NTN®

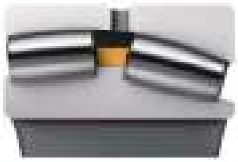
Asymmetrical Spherical Roller Bearings

for Wind Turbine Main Shafts

CAT. No. 3038／E

Asymmetric design of left and right roller rows

Longer operating life and better wear-resistance characteristics



Asymmetrical Spherical Roller Bearings for Wind Turbine Main Shafts

Next generation bearings delivering innovation to wind power generation

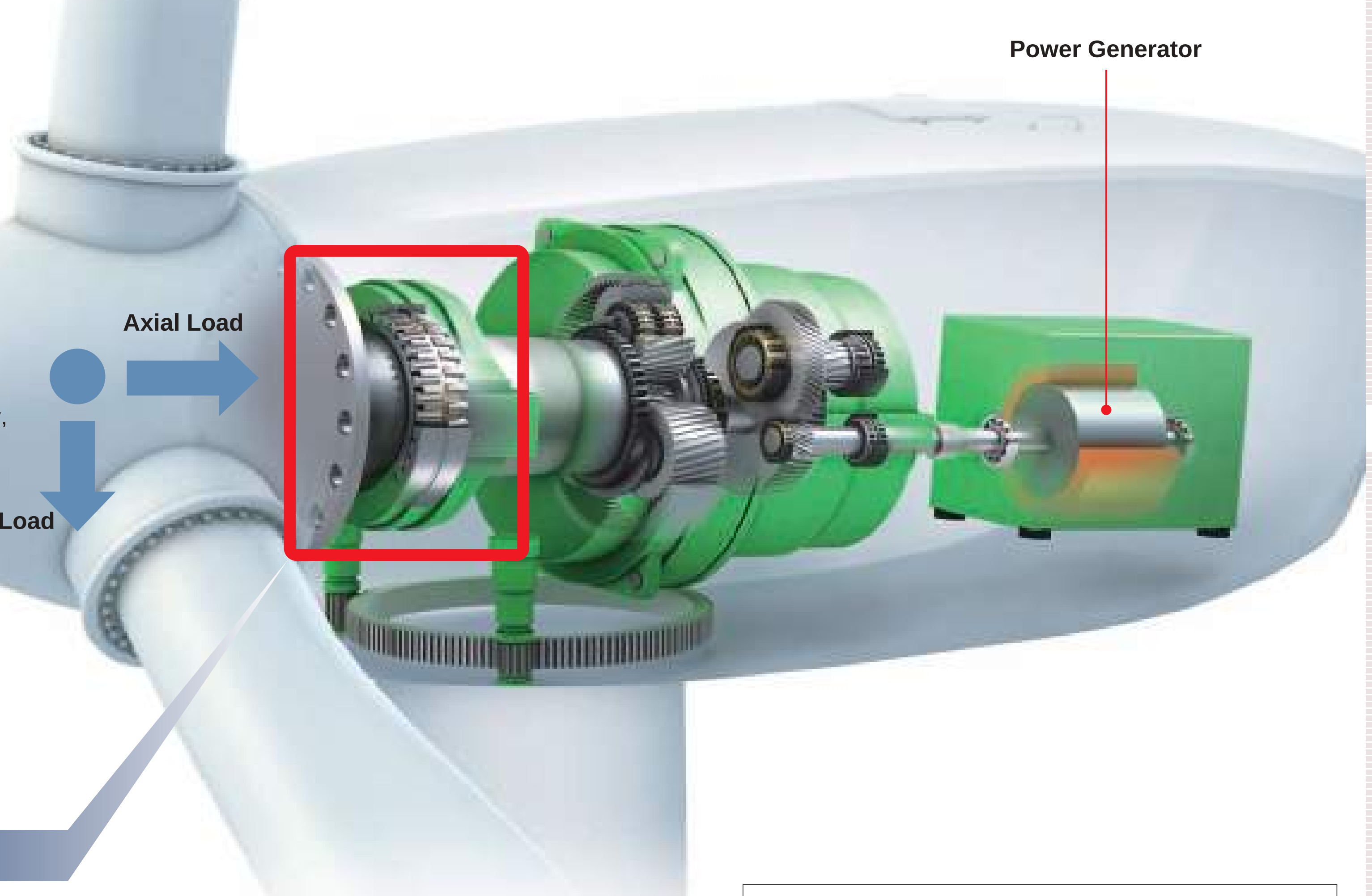
NTN

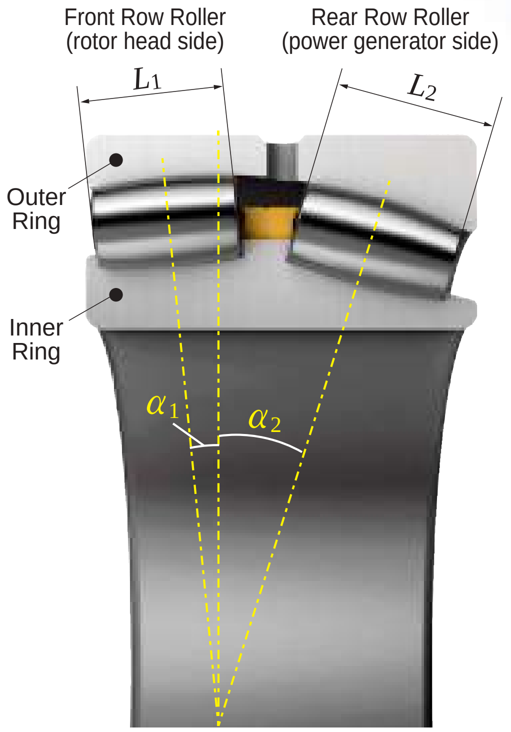
Asymmetric design of left and right roller rows for

longer operating life and better wear-resistance characteristics

Wind turbine main shaft bearings are subjected to axial loading caused by wind loads, in addition to radial loads from the weight of components including the rotors and blades. The use of spherical roller bearings for such applications results in the rear row (power generator side) being subjected to large loads while the front row is more lightly loaded (see **Fig. 1**). Additionally, spherical roller bearings have a characteristic of rolling and sliding due to inherent internal geometry.*1 These conditions, combined with insufficient lubrication at the roller/raceway contact, lead to wear at the raceway surface in areas with a high PV value.*2 As a result, damage might occur, particularly in the outer ring of the rear side.

Asymmetrical spherical roller bearings for wind turbine main shafts have an asymmetrical design of the internal left and right roller rows. This allows the left and right roller rows to distribute loads more evenly, giving the bearings a longer operating life and better wear-resistance characteristics compared to conventional spherical roller bearings.





Design specifications of the developed product

- ▷**Contact angle** : $\alpha_2 > \alpha_1$ (α_1: front row contact angle, α_2: rear row contact angle)
- ▷**Roller length** : $L_2 > L_1$ (L_1: front row roller length, L_2: rear row roller length)
- ▷**Cage design** : separate brass cages for left and right rows
- ▷**Inner ring design** : with inner ring center rib
- ▷**Roller design** : asymmetrical rollers (with maximum roller diameter position towards the bearing center)

*1 Rolling sliding: sliding caused by the difference in speeds between the contact areas of the roller and raceway surface in the direction of rotation
*2 PV value: value combining the contact surface pressure [P] and rolling sliding velocity [V].
*3 Compared with **NTN**'s conventional products (calculated by **NTN** under average fatigue load conditions acting on wind turbine main shaft bearings)
*4 When the rollers in roller bearings tilt away from the correct rotating axis

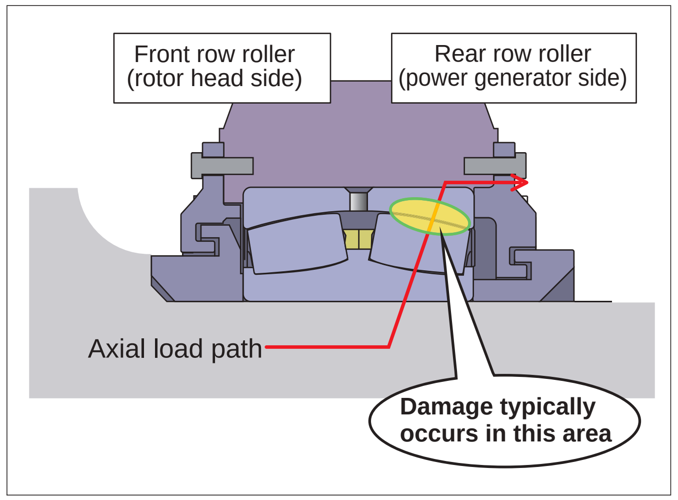


Fig. 1 Axial load acting on wind turbine main shaft bearing

Features

- **Asymmetric design of left/right roller rows:**
  Asymmetric bearing design with different length and contact angles between the rollers in the left and right rows
- **Increased wear-resistance:**
  Better wear-resistance characteristics due to a reduction in PV value*2 of approximately 30%*3
- **Extended operating life:**
  Approximately 2.5-times*3 longer life when compared to theoretical life of the standard product

Compared to conventional products, the contact angle of the developed product is smaller at the front row and larger at the rear row. Additionally, the length of the rear row is longer than the front row, allowing for more efficient support of axial loads from the wind on the rear row and better support of radial loading on the front row.

The asymmetric spherical roller bearing is designed with a central rib on the inner ring. The maximum diameter position of the roller is located towards the center of the inner ring to prevent roller skewing.*4

Solutions from NTN

Solution 1

An asymmetric spherical roller bearing design can be selected with the same boundary dimensions as the conventional product, resulting in longer theoretical operating life and better wear-resistance characteristics.

Solution 2

An asymmetric spherical roller bearing design can be selected with approximately 10% reduction in inner diameter and 30% reduction in weight to achieve a similar theoretical operating life as the conventional product.

For New Technology Network

NTN®

NTN corporation

LARGE BEARINGS

CAT. NO. 2250-Ⅳ/E

CONTENTS

Warranty

NTN warrants, to the original purchaser only, that the delivered product which is the subject of this sale (a) will conform to drawings and specifications mutually established in writing as applicable to the contract, and (b) be free from defects in material or fabrication. The duration of this warranty is one year from date of delivery. If the buyer discovers within this period a failure of the product to conform to drawings or specifications, or a defect in material or fabrication, it must promptly notify **NTN** in writing. In no event shall such notification be received by **NTN** later than 13 months from the date of delivery. Within a reasonable time after such notification, **NTN** will, at its option, (a) correct any failure of the product to conform to drawings, specifications or any defect in material or workmanship, with either replacement or repair of the product, or (b) refund, in part or in whole, the purchase price. Such replacement and repair, excluding charges for labor, is at **NTN**'s expense. All warranty service will be performed at service centers designated by **NTN**. These remedies are the purchaser's exclusive remedies for breach of warranty.

NTN does not warrant (a) any product, components or parts not manufactured by **NTN**, (b) defects caused by failure to provide a suitable installation environment for the product, (c) damage caused by use of the product for purposes other than those for which it was designed, (d) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, or (g) any other abuse or misuse by the purchaser.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

In no case shall **NTN** be liable for any special, incidental, or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory,and in no case shall total liability of **NTN** exceed the purchase price of the part upon which such liability is based. Such damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the product or any associated equipment, cost of capital, cost of any substitute equipment, facilities or services, downtime, the claims of third parties including customers, and injury to property. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, the limits in this paragraph and in paragraph (2) shall apply to the extent allowable under case law and statutes in such states.

Any action for breach of warranty or any other legal theory must be commenced within 15 months following delivery of the goods.

Unless modified in a writing signed by both parties, this agreement is understood to be the complete and exclusive agreement between the parties, superceding all prior agreements, oral or written, and all other communications between the parties relating to the subject matter of this agreement. No employee of **NTN** or any other party is authorized to make any warranty in addition to those made in this agreement.

This agreement allocates the risks of product failure between **NTN** and the purchaser. This allocation is recognized by both parties and is reflected in the price of the goods. The purchaser acknowledges that it has read this agreement, understands it, and is bound by its terms.

NTN

LARGE BEARINGS

TECHNICAL DATA CONTENTS

1. Load Rating and Life

1.1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly being subjected to repeated compressive stresses which cause flaking of these surfaces to occur. This flaking is due to material fatigue and will eventually cause the bearings to fail. The effective life of a bearing is usually defined in terms of the total number of revolutions a bearing can undergo before flaking of either the raceway surface or the rolling element surfaces occurs.

Other causes of bearing failure are often attributed to problems such as seizing, abrasions, cracking, chipping, gnawing, rust, etc. However, these so called "causes" of bearing failure are usually themselves caused by improper installation, insufficient or improper lubrication, faulty sealing or inaccurate bearing selection. Since the above mentioned "causes" of bearing failure can be avoided by taking the proper precautions, and are not simply caused by material fatigue, they are considered separately from the flaking aspect.

1.2 Basic rated life and basic dynamic load rating

A group of seemingly identical bearings when subjected to identical load and operating conditions will exhibit a wide diversity in their durability.

This "life" disparity can be accounted for by the difference in the fatigue of the bearing material itself. This disparity is considered statistically when calculating bearing life, and the basic rated life is defined as follows.

The basic rated life is based on a 90% statistical model which is expressed as the total number of revolutions 90% of the bearings in an identical group of bearings subjected to identical operating conditions will attain or surpass before flaking due to material fatigue occurs. For bearings operating at fixed constant speeds, the basic rated life (90% reliability) is expressed in the total number of hours of operation.

The basic dynamic load rating is an expression of the load capacity of a bearing based on a constant load which the bearing can sustain for one million revolutions (the basic life rating). For radial bearings this rating applies to pure radial loads, and for thrust bearings it refers to pure axial loads. The basic dynamic load ratings given in the bearing tables of this catalog are for bearings constructed of **NTN** standard bearing materials, using standard manufacturing techniques. Please consult **NTN** Engineering for basic load ratings of bearings constructed of special materials or using special manufacturing techniques.

The relationship between the basic rated life, the basic dynamic load rating and the bearing load is given in formula (1.1).

$$L_{10} = \left(\frac{C}{P}\right)^{p} \cdots\cdots\cdots\cdots (1.1)$$

where,

p= 3......................For ball bearings

p= 10/3.................For roller bearings

L_{10} : Basic rated life 10^6 revolutions

C : Basic dynamic rated load, N
(C_r: radial bearings, C_a: thrust bearings)

P : Equivalent dynamic load, N
(P_r: radial bearings, P_a: thrust bearings)

The basic rated life can also be expressed in terms of hours of operation (revolution), and is calculated as shown in formula (1.2).

$$L_{10h} = 500 f_h^{\,p} \cdots\cdots\cdots\cdots (1.2)$$

$$f_h = f_n \frac{C}{P} \cdots\cdots\cdots\cdots (1.3)$$

$$f_n = \left(\frac{33.3}{n}\right)^{1/p} \cdots\cdots\cdots (1.4)$$

where,

L_{10h} : Basic rated life, h

f_h : Life factor

f_n : Speed factor

n : Shaft speed, $\min^{-1}$

Formula (1.2) can also be expressed as shown in formula (1.5).

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^{p} \cdots (1.5)$$

The relationship between Rotational speed n and speed factor f_n as well as the relation between the basic rated life L_{10h} and the life factor f_h is shown in **Fig. 1.1**.

When several bearings are incorporated in machines or equipment as complete units, all the bearings in the unit are considered as a whole when computing bearing life (see formula 1.6). The total bearing life of the unit is a life rating based on the viable lifetime of the unit before even one of the bearings fails due to rolling contact fatigue.

$$L = \frac{1}{\left(\frac{1}{L_1^{\,e}} + \frac{1}{L_2^{\,e}} + \cdots \frac{1}{L_n^{\,e}}\right)^{1/e}} \cdots\cdots\cdots (1.6)$$

where,

e = 10/9...................For ball bearings

e = 9/8.....................For roller bearings

L : Total basic rated life of entire unit, h

$L_1 . L_2 \cdots L_n$: Basic rated life of individual bearings, 1, 2, ⋯n, h

When the load conditions vary at regular intervals, the life can be given by formula (1.7).

$$L_m = \left(\Sigma \Phi_j / L_j\right)^{-1} \cdots\cdots\cdots\cdots\cdots\cdots\cdots (1.7)$$

where,

Φ_j : Frequency of individual load conditions

L_j : Life under individual conditions

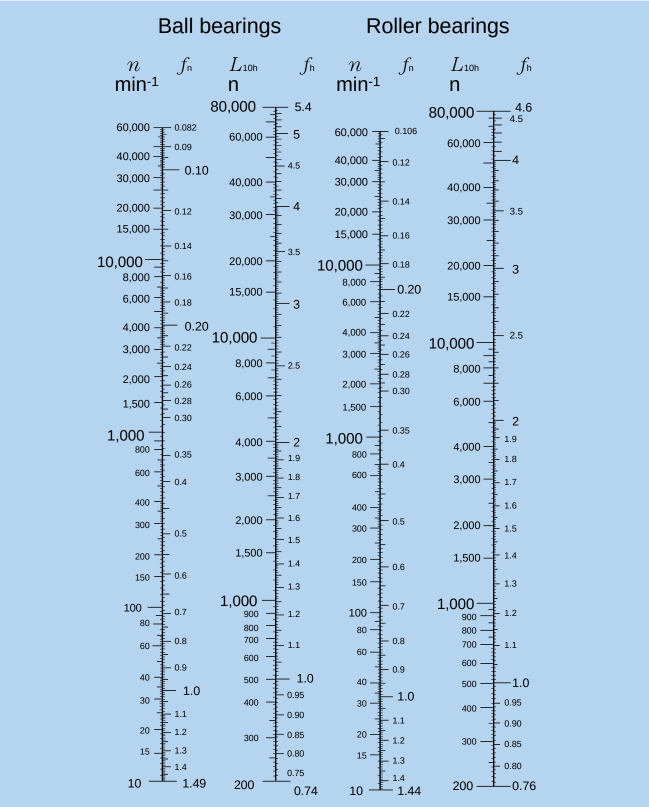


Fig. 1.1 Bearing life rating scale

1.3 Adjusted life rating factor

The basic bearing life rating (90% reliability factor) can be calculated through the formulas mentioned earlier in Section 1.2. However, in some applications a bearing life factor of over 90% reliability may be required. To meet these requirements, bearing life can be lengthened by the use of specially improved bearing materials or special construction techniques. Moreover, according to elastohydrodynamic lubrication theory, it is clear that the bearing operating conditions (lubrication, temperature, shaft speed, etc.) all exert an effect on bearing life. All these adjustment factors are taken into consideration when calculating bearing life, and using the life adjustment factor as prescribed in ISO 281, the adjusted bearing life can be determined.

$$L_{na} = a_1 \cdot a_2 \cdot a_3 \cdot (C/P)^p \quad \cdots \quad (1.8)$$

where,

L_{na} : Adjusted life rating in millions of revolutions (10^6)(adjusted for reliability, material and operating conditions)

a_1 : Reliability adjustment factor

a_2 : Material adjustment factor

a_3 :Operating condition adjustment factor

1.3.1 Life adjustment factor for reliability a_1

The values for the reliability adjustment factor a_1 (for a reliability factor higher than 90%) can be found in **Table 1.1**.

Table 1.1 Reliability adjustment factor values a_1

Reliability %	L_n	Reliability factor a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

1.3.2 Life adjustment factor for material a_2

The life of a bearing is affected by the material type and quality as well as the manufacturing process. In this regard, the life is adjusted by the use of an a_2 factor.

The basic dynamic load ratings listed in the catalog are based on **NTN**'s standard material and manufacturing processes, therefore, the adjustment factor a_2=1. When special materials or processes are used the adjustment factor can be larger than 1.

NTN bearings can generally be used up to 120°C. If bearings are operated at a higher temperature, the bearing must be specially heat treated (stabilized) so that inadmissible dimensional change does not occur due to changes in the micro-structure. This special heat treatment might cause the reduction of bearing life because of a hardness change.

1.3.3 Life adjustment factor a_3 for operating conditions

The operating conditions life adjustment factor a_3 is used to adjust for such conditions as lubrication, operating temperature, and other operation factors which have an effect on bearing life.

Generally speaking, when lubricating conditions are satisfactory, the a_3 factor has a value of one; and when lubricating conditions are exceptionally favorable, and all other operating conditions are normal, a_3 can have a value greater than one.

However, when lubricating conditions are particularly unfavorable and the oil film formation on the contact surfaces of the raceway and rolling elements is insufficient, the value of a_3 becomes less than one. This insufficient oil film formation can be caused, for example, by the lubricating oil viscosity being too low for the operating temperature (below 13 mm^2/s for ball bearings; below 20 mm^2/s for roller bearings); or by exceptionally low rotational speed ($n$min^{-1} x $d_p$mm less than 10,000). For bearings used under special operating conditions, please consult **NTN** Engineering.

As the operating temperature of the bearing increases, the hardness of the bearing material decreases. Thus, the bearing life correspondingly decreases. The operating temperature adjustment values are shown in **Fig. 1.2**.

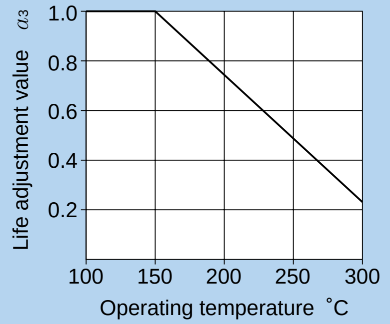


Fig. 1.2 Life adjustment value for operating temperature

1.4 Basic static load rating

When stationary rolling bearings are subjected to static loads, they suffer from partial permanent deformation of the contact surfaces at the contact point between the rolling elements and the raceway. The amount of deformity increases as the load increases, and if this increase in load exceeds certain limits, the subsequent smooth operation of the bearings is impaired.

It has been found through experience that a permanent deformity of 0.0001 times the diameter of the rolling element, occurring at the most heavily stressed contact point between the raceway and the rolling elements, can be tolerated without any impairment in running efficiency.

The basic rated static load refers to a fixed static load limit at which a specified amount of permanent deformation occurs. It applies to pure radial loads for radial bearings and to pure axial loads for thrust bearings. The maximum applied load values for contact stress occurring at the rolling element and raceway contact points are given below.

For ball bearings (except self-aligning ball bearings)	4,200 Mpa
For self-aligning ball bearings	4,600 Mpa
For roller bearings	4,000 Mpa

1.5 Allowable static equivalent load

Generally the static equivalent load which can be permitted (See Section 2.3.2 page A-9) is limited by the basic static rated load as stated in **Section 1.4**. However, depending on requirements regarding friction and smooth operation, these limits may be greater or lesser than the basic static rated load.

In the following formula (1.9) and **Table 1.2** the safety factor S_o can be determined considering the maximum static equivalent load.

$$S_o = C_o / P_o \cdots \quad (1.9)$$

where,

S_o : Safety factor
C_o : Basic static rated load, N
(radial bearings: C_{or}, thrust bearings: C_{oa})
$P_{o\,max}$: Maximum static equivalent load, N
(radial: P_{or} max, thrust: C_{oa} max)

Table 1.2 Minimum safety factor values S_0

Operating conditions	Ball bearings	Roller bearings
High rotational accuracy demand	2	3
Normal rotating accuracy demand (Universal application)	1	1.5
Slight rotational accuracy deterioration permitted (Low speed, heavy loading, etc.)	0.5	1

Notes: 1. For spherical thrust roller bearings, min. S_0 value=4.
2. For shell needle roller bearings, min. S_0 value=3.
3. When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_0 max value.
4. If a large axial load is applied to deep groove ball bearings or angular ball bearings, the contact oval may exceed the raceway surface. For more information, please contact **NTN** Engineering.

2. Bearing Load Calculation

To compute bearing loads, the forces which act on the shaft being supported by the bearing must be determined. These forces include the inherent dead weight of the rotating body (the weight of the shafts and components themselves), loads generated by the working forces of the machine, and loads arising from transmitted power.

It is possible to calculate theoretical values for these loads; however, there are many instances where the load acting on the bearing is usually determined by the nature of the load acting on the main power transmission shaft.

2.1 Load acting on shafts

2.1.1 Load factor

There are many instances where the actual operational shaft load is much greater than the theoretically calculated load, due to machine vibration and/or shock. This actual shaft load can be found by using formula (2.1)

$$K = f_w \cdot K_c \cdots \quad (2.1)$$

where:

K : Actual shaft load N {kgf}
f_w : Load factor (**Table 2.1**)
K_c : Theoretically calculated value N {kgf}

Table 2.1 Load factor f_w

Amount of shock	f_w	Application
Very little or no shock	1.0～1.2	Electrical machines, machine tools, measuring instruments.
Light shock	1.2～1.5	Railway vehicles, automobiles, rolling mills, metal working machines, paper making machines, rubber mixing machines, printing machines, aircraft, textile machines, electrical units, office machines.
Heavy shock	1.5～3.0	Crushers, agricultural equipment, construction equipment, cranes.

2.2 Mean load

The load on bearings used in machines under normal circumstances will, in many cases, fluctuate according to a fixed time period or planned operation schedule. The load on bearings operating under such conditions can be converted to a mean load (F_m), this is a load which gives bearings the same life they would have under constant operating conditions.

(1) Fluctuating stepped load

The mean bearing load, F_m, for stepped loads is calculated from formula (2.2). F_1 , F_2 .... F_n are the loads acting on the bearing; n_1, n_2.......n_n and t_1, t_2....... t_n are the bearing speeds and operating times respectively.

$$F_m = \left[\frac{\Sigma (F_i{}^p \, n_i \, t_i)}{(n_i \, t_i)} \right]^{1/p} \cdots\cdots\cdots\cdots\cdots\cdots \quad (2.2)$$

where:

$p=3$ For ball bearings
$p=10/3$ For roller bearings

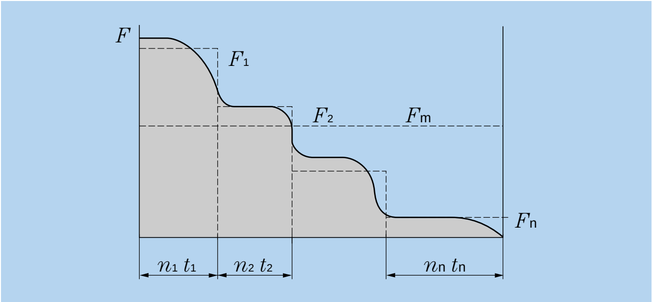


Fig. 2.1 Stepped load

(2) Consecutive series load

Where it is possible to express the function $F(t)$ in terms of load cycle to and time t, the mean load is found by using formula (2.3).

$$F_m = \left[\frac{1}{t_o} \int_o^{t_o} F(t)^p \, d_t \right]^{1/p} \cdots\cdots\cdots\cdots\cdots\cdots \quad (2.3)$$

where:

$p=3$ For ball bearings
$p=10/3$ For roller bearings

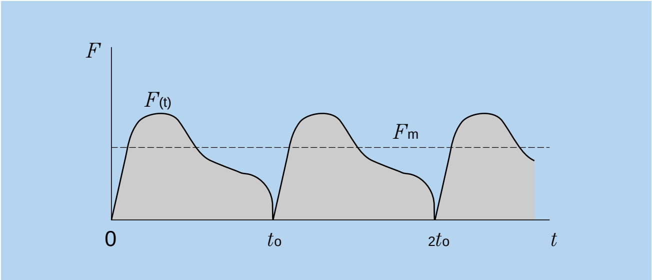


Fig. 2.2 Linear fluctuating load

(3) Linear fluctuating load

The mean load, F_m, can be approximated by formula (2.4).

$$F_m = \frac{F_{min} + 2F_{max}}{3} \cdots \quad (2.4)$$

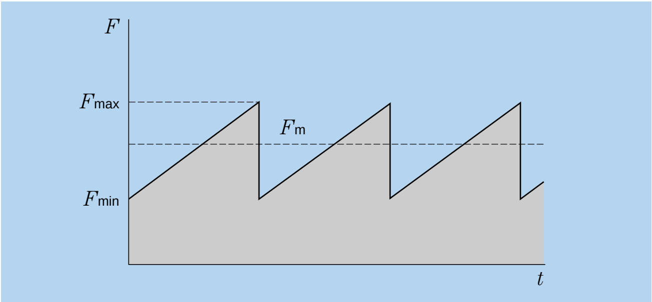


Fig. 2.3 Time function series load

(4) Sinusoidal fluctuating load

The mean load, F_m, can be approximated by formulas (2.5) and (2.6).

case (a) $F_m = 0.75 F_{max}$ ········ (2.5)

case (b) $F_m = 0.65 F_{max}$ ········ (2.6)

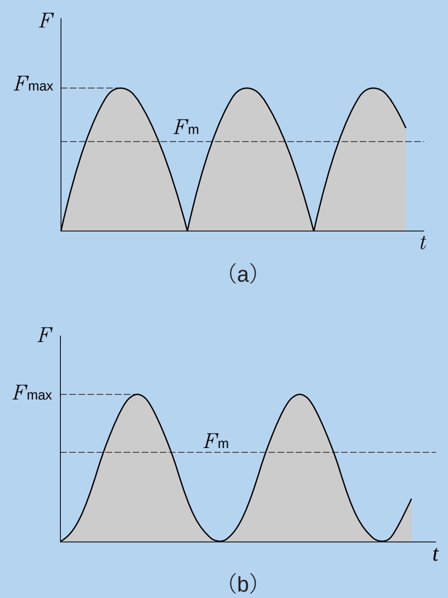


Fig. 2.4 Sinusoidal variable load

2.3 Equivalent load

2.3.1 Dynamic equivalent load

When both dynamic radial loads and dynamic axial loads act on a bearing at the same time, the hypothetical load acting on the center of the bearing giving the bearings the same life as if they had only a radial load or only an axial load, is called the dynamic equivalent load.

For radial bearings, this load is expressed as pure radial load and is called the dynamic equivalent radial load. For thrust bearings, it is expressed as pure axial load and is called the dynamic equivalent axial load.

(1) Dynamic equivalent radial load

The dynamic equivalent radial load is expressed by formula (2.7).

$$P_r = XF_r + YF_a \cdots\cdots\cdots\cdots\cdots\cdots \quad (2.7)$$

where,

P_r : Dynamic equivalent radial load, N
F_r : Actual radial load, N
F_a : Actual axial load, N
X : Radial load factor
Y : Axial load factor

The values for X and Y are listed in the bearing tables.

(2) Dynamic equivalent axial load

As a rule, standard thrust bearings with a contact angle of 90˚ cannot carry radial loads. However, self-aligning thrust roller bearings can accept some radial load. The dynamic equivalent axial load for these bearings is given in formula (2.8).

$$P_a = F_a + 1.2F_r \cdots\cdots\cdots\cdots\cdots\cdots \quad (2.8)$$

where,

P_a : Dynamic equivalent axial load, N
F_a : Actual axial load, N
F_r : Actual radial load, N

Provided that $F_r / F_a \leqq 0.55$ only.

2.3.2 Static equivalent load

The static equivalent load is a hypothetical load which would cause the same total permanent deformation at the most heavily stressed contact point between the rolling elements and the raceway as under actual load conditions; that is when both static radial loads and static axial loads are simultaneously applied to the bearing.

For radial bearings this hypothetical load refers to pure radial loads, and for thrust bearings it refers to pure centric axial loads. These loads are designated static equivalent radial loads and static equivalent axial loads respectively.

(1) Static equivalent radial load

For radial bearings the static equivalent radial load can be found by using formula (2.9) or (2.10). The greater of the two resultant values is always taken for P_{or}.

$$P_{or} = X_o F_r + Y_o F_a \cdots \quad (2.9)$$

$$P_{or} = F_r \cdots\cdots\cdots\cdots\cdots \quad (2.10)$$

where,

P_{or} : Static equivalent radial load, N
F_r : Actual radial load, N
F_a : Actual axial load, N
X_o : Static radial load factor
Y_o : Static axial load factor

The values for X_o and Y_o are given in the respective bearing tables.

(2) Static equivalent axial load

For spherical thrust roller bearings the static equivalent axial load is expressed by formula (2.11).

$$P_{oa} = F_a + 2.7F_r \cdots \quad (2.11)$$

where,

P_{oa} : Static equivalent axial load, N
F_a : Actual axial load, N
F_r : Actual radial load, N

Provided that $F_r / F_a \leqq 0.55$ only.

3. Bearing Tolerances

3.1 Dimensional accuracy and running accuracy

Bearing “tolerances” or dimensional accuracy and running accuracy, are regulated by ISO and JIS B 1514 standards (rolling bearing tolerances). For **dimensional accuracy**, these standards prescribe the tolerances necessary when installing bearings on shafts or in housings. **Running accuracy** is defined as the allowable limits for bearing runout during operation.

Dimensional accuracy

Dimensional accuracy constitutes the acceptable values for bore diameter, outer diameter, assembled bearing width, and bore diameter uniformity as seen in chamfer dimensions, allowable inner ring tapered bore deviation and shape error. Also included are, average bore diameter variation average, outer diameter variation, average outer diameter unevenness, as well as raceway width and height variation (for thrust bearings).

Running accuracy

Running accuracy constitutes the acceptable values for inner and outer ring radial runout and axial runout, inner ring side runout, and outer ring outer diameter runout.

Allowable rolling bearing tolerances have been established according to precision classes. JIS Class 0 corresponds to normal precision class bearings, and precision becomes progressively higher as the class number becomes smaller; i.e., Class 6 is less precise than Class 5, which is less precise than Class 4, and so on.

Table 3.1 indicates which standards and precision classes are applicable to the major bearing types. **Table 3.2** shows a relative comparison between JIS B 1514 precision class standards and other standards. For greater detail on allowable error limitations and values, refer to **Tables 3.3** - **3.8**. Allowable values for chamfer dimensions are shown in **Table 3.9**, and allowable error limitations and values for radial bearing inner ring tapered bores are shown in **Table 3.10**.

Table 3.1 Bearing types and applicable tolerance

Bearing type		Applicable standard	Applicable tolerance					Tolerance table
Deep groove ball bearing		ISO492	class 0	class 6	class 5	class 4	class 2	Table 3.3
Angular contact ball bearings			class 0	class 6	class 5	class 4	class 2	
Cylindrical roller bearigns			class 0	class 6	class 5	class 4	class 2	
Spherical roller bearings			class 0	—	—	—	—	
Tapered roller bearings	metric	ISO492	class 0,6X	class 6	class 5	class 5	—	**Table 3.4**
	Inch	ABMA Std.19	class 4	class 2	class 3	class 0	class 00	**Table 3.5**
Thrust ball bearings		ISO199	class 0	class 6	class 5	class 4	—	**Table 3.6**
Spherical roller thrust bearings			class 0	—	—	—	—	**Table 3.7**
Thrust tapered roller bearings	metric	**NTN** standard	class 0	—	—	—	—	**Table 3.8**
	Inch	ANSI/ABMA Std. 23	class 2	—	—	—	—	**Table 3.8**

Table 3.2 Comparison of tolerance classifications of national standards

Standard		Tolerance Class					Bearing Types
Japanese industrial standard (JIS)	JIS B 1514	class 0,6X	class 6	class 5	class 4	class 2	All type
International Organization for Standardization (ISO)	ISO 492	Normal class Class 6X	Class 6	Class 5	Class 4	Class 2	Radial bearings
	ISO 199	Normal class	Class 6	Class 5	Class 4	—	Thrust ball bearings
	ISO 578	Class 4	—	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)
Deutsches Institut fur Normung(ISO)	DIN 620	P0	P6	P5	P4	P2	All type
American National Standards Institute (ANSI) Anti-Friction Bearing Manufacturers (ABMA)	ANSI/ABMA Std.20 ❶	ABEC-1 RBEC-1	ABEC-3 RBEC-3	ABEC-5 RBEC-5	ABEC-7	ABEC-9	Radial bearings (Except tapered roller bearings)
	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)

❶ "ABEC" is applied for ball bearings and "RBEC" for roller bearings.
Notes: 1. JIS B 1514, ISO 492 and 199, and DIN 620 have the same specification level.
2. The tolerance and allowance of JIS B 1514 are a little different from those of ABMA standards.

Table 3.3 Tolerance for radial bearings (Except tapered roller bearings)
Table 3.3 (1) Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}										Single radial plane bore diameter variation V_{dp}														
		class 0		class 6		class 5		class 4 ❶		class 2 ❶		diameter series 9					max diameter series 0,1					max diameter series 2,3,4				
												class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2
over	incl.	high	low	high	low	high	low	high	low	high	low	max					max					max				
80	120	0	-20	0	-15	0	-10	0	-8	0	-5	25	19	10	8	5	25	19	8	6	5	15	11	8	6	5
120	150	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-22	0	-15	0	-12	0	-8	38	28	15	12	8	38	28	12	9	8	23	17	12	9	8
250	315	0	-35	0	-25	0	-18	—	—	—	—	44	31	18	—	—	44	31	14	—	—	26	19	14	—	—
315	400	0	-40	0	-30	0	-23	—	—	—	—	50	38	23	—	—	50	38	18	—	—	30	23	18	—	—
400	500	0	-45	0	-35	—	—	—	—	—	—	56	44	—	—	—	56	44	—	—	—	34	26	—	—	—
500	630	0	-50	0	-40	—	—	—	—	—	—	63	50	—	—	—	63	50	—	—	—	38	30	—	—	—
630	800	0	-75	—	—	—	—	—	—	—	—	94	—	—	—	—	94	—	—	—	—	55	—	—	—	—
800	1,000	0	-100	—	—	—	—	—	—	—	—	125	—	—	—	—	125	—	—	—	—	75	—	—	—	—
1,000	1,250	0	-125	—	—	—	—	—	—	—	—	155	—	—	—	—	155	—	—	—	—	94	—	—	—	—
1,250	1,600	0	-160	—	—	—	—	—	—	—	—	200	—	—	—	—	200	—	—	—	—	120	—	—	—	—
1,600	2,000	0	-200	—	—	—	—	—	—	—	—	250	—	—	—	—	250	—	—	—	—	150	—	—	—	—

❶ The dimensional difference Δ_{ds} of bore diameter to applied for class 4 and 2 is the same as the tolerance of dimensional difference Δ_{dmp} of average bore diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and to all the diameter series against Class 2.

Table 3.3 (2) Outer rings

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}										Single radial plane outside diameter variation V_{Dp} open type														
		class 0		class 6		class 5		class 4 ❹		class 2 ❹		diameter series 9					max diameter series 0,1					max diameter series 2,3,4				
												class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2
over	incl.	high	low	high	low	high	low	high	low	high	low	max					max					max				
80	120	0	-15	0	-13	0	-10	0	-8	0	-5	19	16	10	8	5	19	16	8	6	5	11	10	8	6	5
120	150	0	-18	0	-15	0	-11	0	-9	0	-5	23	19	11	9	5	23	19	8	7	5	14	11	8	7	5
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-20	0	-15	0	-11	0	-8	38	25	15	11	8	38	25	11	8	8	23	15	11	8	8
250	315	0	-35	0	-25	0	-18	0	-13	0	-8	44	31	18	13	8	44	31	14	10	8	26	19	14	10	8
315	400	0	-40	0	-28	0	-20	0	-15	0	-10	50	35	20	15	10	50	35	15	11	10	30	21	15	11	10
400	500	0	-45	0	-33	0	-23	—	—	—	—	56	41	23	—	—	56	41	17	—	—	34	25	17	—	—
500	630	0	-50	0	-38	0	-28	—	—	—	—	63	48	28	—	—	63	48	21	—	—	38	29	21	—	—
630	800	0	-75	0	-45	0	-35	—	—	—	—	94	56	35	—	—	94	56	26	—	—	55	34	26	—	—
800	1,000	0	-100	0	-60	—	—	—	—	—	—	125	75	—	—	—	125	75	—	—	—	75	45	—	—	—
1,000	1,250	0	-125	—	—	—	—	—	—	—	—	155	—	—	—	—	155	—	—	—	—	94	—	—	—	—
1,250	1,600	0	-160	—	—	—	—	—	—	—	—	200	—	—	—	—	200	—	—	—	—	120	—	—	—	—
1,600	2,000	0	-200	—	—	—	—	—	—	—	—	250	—	—	—	—	250	—	—	—	—	150	—	—	—	—
2,000	2,500	0	-250	—	—	—	—	—	—	—	—	310	—	—	—	—	310	—	—	—	—	190	—	—	—	—

❹ The dimensional difference Δ_{Ds} of outer diameter to be applied for classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{Dmp} of average outer diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and also to all the diameter series against Class 2.

Unit μm

Mean single plane bore diameter variation V_{dmp}					Inner ring radial runout K_{ia}					Face runout with bore S_d			Inner ring axial runout (with side) S_{ia} ❷			Inner ring width deviation Δ_{Bs}										Inner ring width variation V_{Bs}				
																normal						modified ❸								
class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 5	class 4	class 2	class 5	class 4	class 2	class 0,6		class 5,4		class 2		class 0,6		class 5,4		class 0	class 6	class 5	class 4	class 2
max					max					max			max			high	low	high	low	high	low	high	low	high	low	max				
15	11	5	4	2.5	25	13	6	5	2.5	9	5	2.5	9	5	2.5	0	-200	0	-200	0	-200	0	-380	0	-380	25	25	7	4	2.5
19	14	7	5	3.5	30	18	8	6	2.5	10	6	2.5	10	7	2.5	0	-250	0	-250	0	-250	0	-500	0	-380	30	30	8	5	2.5
19	14	7	5	3.5	30	18	8	6	5	10	6	4	10	7	5	0	-250	0	-250	0	-300	0	-500	0	-380	30	30	8	5	4
23	17	8	6	4	40	20	10	8	5	11	7	5	13	8	5	0	-300	0	-300	0	-350	0	-500	0	-500	30	30	10	6	5
26	19	9	—	—	50	25	13	—	—	13	—	—	15	—	—	0	-350	0	-350	—	—	0	-500	0	-500	35	35	13	—	—
30	23	12	—	—	60	30	15	—	—	15	—	—	20	—	—	0	-400	0	-400	—	—	0	-630	0	-630	40	40	15	—	—
34	26	—	—	—	65	35	—	—	—	—	—	—	—	—	—	0	-450	—	—	—	—	—	—	—	—	50	45	—	—	—
38	30	—	—	—	70	40	—	—	—	—	—	—	—	—	—	0	-500	—	—	—	—	—	—	—	—	60	50	—	—	—
55	—	—	—	—	80	—	—	—	—	—	—	—	—	—	—	0	-750	—	—	—	—	—	—	—	—	70	—	—	—	—
75	—	—	—	—	90	—	—	—	—	—	—	—	—	—	—	0	-1,000	—	—	—	—	—	—	—	—	80	—	—	—	—
94	—	—	—	—	100	—	—	—	—	—	—	—	—	—	—	0	-1,250	—	—	—	—	—	—	—	—	100	—	—	—	—
120	—	—	—	—	120	—	—	—	—	—	—	—	—	—	—	0	-1,600	—	—	—	—	—	—	—	—	120	—	—	—	—
150	—	—	—	—	140	—	—	—	—	—	—	—	—	—	—	0	-2,000	—	—	—	—	—	—	—	—	140	—	—	—	—

❷ To be applied to deep groove ball bearing and angular contact ball bearings.
❸ To be applied to individual raceway rings manufactured for combined bearing use.

Unit μm

Mean single plane outside diameter variation V_{Dmp}					Outer ring radial runout K_{ea}					Outside surface inclination S_D			Outside ring axial runout S_{ea} ❺			Outer ring width variation V_{Cs}		
class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 5	class 4	class 2	class 5	class 4	class 2	class 5	class 4	class 2
max					max					max			max			max		
11	10	5	4	2.5	35	18	10	6	5	9	5	2.5	11	6	5	8	4	2.5
14	11	6	5	2.5	40	20	11	7	5	10	5	2.5	13	7	5	8	5	2.5
19	14	7	5	3.5	45	23	13	8	5	10	5	2.5	14	8	5	8	5	2.5
23	15	8	6	4	50	25	15	10	7	11	7	4	15	10	7	10	7	4
26	19	9	7	4	60	30	18	11	7	13	8	5	18	10	7	11	7	5
30	21	10	8	5	70	35	20	13	8	13	10	7	20	13	8	13	8	7
34	25	12	—	—	80	40	23	—	—	15	—	—	23	—	—	15	—	—
38	29	14	—	—	100	50	25	—	—	18	—	—	25	—	—	18	—	—
55	34	18	—	—	120	60	30	—	—	20	—	—	30	—	—	20	—	—
75	45	—	—	—	140	75	—	—	—	—	—	—	—	—	—	—	—	—
94	—	—	—	—	160	—	—	—	—	—	—	—	—	—	—	—	—	—
120	—	—	—	—	190	—	—	—	—	—	—	—	—	—	—	—	—	—
150	—	—	—	—	220	—	—	—	—	—	—	—	—	—	—	—	—	—
190	—	—	—	—	250	—	—	—	—	—	—	—	—	—	—	—	—	—

❺ To be applied to deep groove ball bearings and angular contact ball bearings.

Table 3.4 Tolerance of tapered roller bearings (Metric system)

Table 3.4 (1) Inner rings

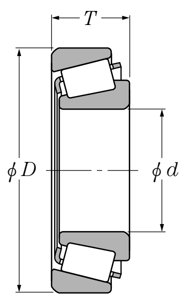
Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}						Single radial plane bore diameter variation V_{dp}				Mean single plane bore diameter variation V_{dmp}				Inner ring radial runout K_{ia}				Face runout with bore S_d	
		class 0,6X		class 5,6		class 4 ❶		class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 5	class 4
over	incl.	high	low	high	low	high	low	max				max				max				max	
80	120	0	-20	0	-15	0	-10	20	15	11	8	15	11	8	5	30	13	8	5	9	5
120	180	0	-25	0	-18	0	-13	25	18	14	10	19	14	9	7	35	18	11	6	10	6
180	250	0	-30	0	-22	0	-15	30	22	17	11	23	16	11	8	50	20	13	8	11	7
250	315	0	-35	—	—	—	—	35	—	—	—	26	—	—	—	60	—	—	—	—	—
315	400	0	-40	—	—	—	—	40	—	—	—	30	—	—	—	70	—	—	—	—	—
400	500	0	-45	—	—	—	—	45	—	—	—	34	—	—	—	80	—	—	—	—	—
500	630	0	-50	—	—	—	—	50	—	—	—	38	—	—	—	90	—	—	—	—	—
630	800	0	-75	—	—	—	—	75	—	—	—	56	—	—	—	105	—	—	—	—	—
800	1,000	0	-100	—	—	—	—	100	—	—	—	75	—	—	—	120	—	—	—	—	—
1,000	1,250	0	-125	—	—	—	—	125	—	—	—	94	—	—	—	140	—	—	—	—	—
1,250	1,600	0	-160	—	—	—	—	160	—	—	—	120	—	—	—	160	—	—	—	—	—

❶ The dimensional difference Δ_{ds} of bore diameter to be applied for class 4 is the same as the tolerance of dimensional difference Δ_{dmp} of average bore diameter.

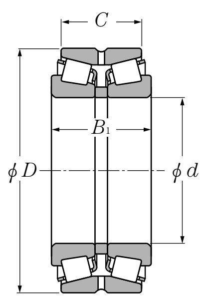
Table 3.4 (2) Outer rings

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}						Single radial plane outside diameter variation V_{Dp}				Mean single plane outside diameter variation V_{Dmp}				Outer ring radial runout K_{ea}				Outside surface inclination S_D ❷	
		class 0,6X		class 5,6		class 4 ❸		class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 5	class 4
over	incl.	high	low	high	low	high	low	max				max				max				max	
80	120	0	-18	0	-13	0	-10	18	13	10	8	14	10	7	5	35	18	10	6	9	5
120	150	0	-20	0	-15	0	-11	20	15	11	8	15	11	8	6	40	20	11	7	10	5
150	180	0	-25	0	-18	0	-13	25	18	14	10	19	14	9	7	45	23	13	8	10	5
180	250	0	-30	0	-20	0	-15	30	20	15	11	23	15	10	8	50	25	15	10	11	7
250	315	0	-35	0	-25	0	-18	35	25	19	14	26	19	13	9	60	30	18	11	13	8
315	400	0	-40	0	-28	0	-20	40	28	22	15	30	21	14	10	70	35	20	13	13	10
400	500	0	-45	—	—	—	—	45	—	—	—	34	—	—	—	80	—	—	—	—	—
500	630	0	-50	—	—	—	—	50	—	—	—	38	—	—	—	100	—	—	—	—	—
630	800	0	-75	—	—	—	—	75	—	—	—	56	—	—	—	120	—	—	—	—	—
800	1,000	0	-100	—	—	—	—	100	—	—	—	75	—	—	—	140	—	—	—	—	—
1,000	1,250	0	-125	—	—	—	—	125	—	—	—	84	—	—	—	165	—	—	—	—	—
1,250	1,600	0	-160	—	—	—	—	160	—	—	—	120	—	—	—	190	—	—	—	—	—
1,600	2,000	0	-200	—	—	—	—	200	—	—	—	150	—	—	—	230	—	—	—	—	—

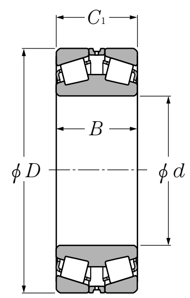
❷ The dimensional difference Δ_{Ds} of outside diameter to be applied for class 4 is the same as the tolerance of dimensional difference Δ_{Dmp} of average outside diameter.
❸ Δ_{Ds} as the same as Δ_{Dmp} in the case of class 4.



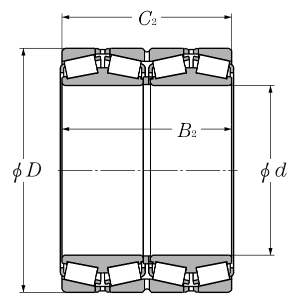
Single



Double Row (outside direction)



Double Row (inside direction)



Four Row

Unit μm

Inner ring axial runout (with side) S_{ia} class 4 max	Inner ring width deviation Δ_{Bs} class 0,6 high	low	class 6X high	low	class 4,5 high	low	Overall width deviation of assembled single row tapered roller bearing, or height deviation Δ_{Ts} class 0,6 high	low	class 6X high	low	class 4,5 high	low	Overall width deviation of assembled double rows tapered roller bearing or height deviation Δ_{B1s}, Δ_{C1s} class 0,6,5 high	low	Overall width deviation of assembled four rows tapered roller bearing or height deviation Δ_{B2s}, Δ_{C2s} class 0,6,5 high	low
5	0	-200	0	-50	0	-400	+200	-200	+100	0	+200	-200	+400	-400	+500	-500
7	0	-250	0	-50	0	-500	+350	-250	+150	0	+350	-250	+500	-500	+600	-600
8	0	-300	0	-50	0	-600	+350	-250	+150	0	+350	-250	+600	-600	+750	-750
—	0	-350	0	-50	—	—	+350	-250	+200	0	—	—	+700	-700	+900	-900
—	0	-400	0	-50	—	—	+400	-400	+200	0	—	—	+800	-800	+1,000	-1,000
—	0	-450	—	—	—	—	—	—	—	—	—	—	+900	-900	+1,200	-1,200
—	0	-500	—	—	—	—	—	—	—	—	—	—	+1,000	-1,000	+1,200	-1,200
—	0	-750	—	—	—	—	—	—	—	—	—	—	+1,500	-1,500	+1,500	-1,500
—	0	-1,000	—	—	—	—	—	—	—	—	—	—	+1,500	-1,500	+1,500	-1,500
—	0	-1,200	—	—	—	—	—	—	—	—	—	—	+1,500	-1,500	+1,500	-1,500
—	0	-1,500	—	—	—	—	—	—	—	—	—	—	+1,500	-1,500	+1,500	-1,500

Unit μm

Outer ring axial runout S_{ea} class 4 max	Outer ring width deviation Δ_{Cs} class 0,6,5,4 sup.	inf.	class 6X ❹ sup.	inf.
6	Identical to Δ_{Bs} inner ring of same bearing		0	-100
7			0	-100
8			0	-100
10			0	-100
10			0	-100
13			0	-100
—			0	-100
—			0	-100
—			—	—
—			—	—
—			—	—
—			—	—
—			—	—

❹ To be applied for nominal bore diameters of 406.400mm (16 inch) or lass.

Table 3.4 (3) Effective width of outer and inner rings with roller

Unit μm

Nominal bore diameter d mm over	incl.	Effective width deviation of roller and inner ring assembly of tapered roller bearing Δ_{T1s} class 0 high	low	class 6X high	low	Tapered roller bearing outer ring effective width deviation Δ_{T2s} class 0 high	low	class 6X high	low
80	120	+100	-100	+50	0	+100	-100	+50	0
120	180	+150	-150	+50	0	+200	-100	+100	0
180	250	+150	-150	+50	0	+200	-100	+100	0
250	315	+150	-150	+100	0	+200	-100	+100	0
315	400	+200	-200	+100	0	+200	-200	+100	0

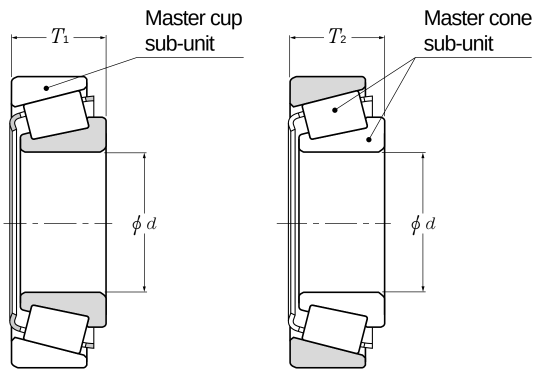


Table 3.5 Tolerance for tapered roller bearings of inch system

Table 3.5 (1) Inner rings

Unit μm

Nominal bore diameter d mm		Single bore diameter deviation Δ_{ds}									
		Class 4		Class 2		Class 3		Class 0		Class 00	
over	incl.	high	low	high	low	high	low	high	low	high	low
76.2	266.7	+25	0	+25	0	+13	0	+13	0	+8	0
266.7	304.8	+25	0	+25	0	+13	0	+13	0	–	–
304.8	609.6	+51	0	+51	0	+25	0	–	–	–	–
609.6	914.4	+76	0	–	–	+38	0	–	–	–	–
914.4	1,219.2	+102	0	–	–	+51	0	–	–	–	–
1,219.2	–	+127	0	–	–	+76	0	–	–	–	–

Table 3.5 (2) Outer rings

Unit μm

Nominal outside diameter D mm		Single outside diameter deviation Δ_{Ds}									
		Class 4		Class 2		Class 3		Class 0		Class 00	
over	incl.	high	low	high	low	high	low	high	low	high	low
–	266.7	+25	0	+25	0	+13	0	+13	0	+8	0
266.7	304.8	+25	0	+25	0	+13	0	+13	0	–	–
304.8	609.6	+51	0	+51	0	+25	0	–	–	–	–
609.6	914.4	+76	0	+76	0	+38	0	–	–	–	–
914.4	1,219.2	+102	0	–	–	+51	0	–	–	–	–
1,219.2	–	+127	0	–	–	+76	0	–	–	–	–

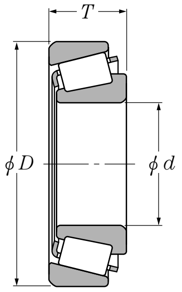
Table 3.5 (3) Effective width of inner rings with roller and outer rings

Nominal bore diameter d mm		Nominal outside diameter D mm		Overall width deviation of assembled single row tapered roller bearing Δ_{Ts}								Overall width deviation of assembled 4-row tapered roller bearings Δ_{B2s}, Δ_{C2s}	
				Class 4		Class 2		Class 3		Class 0,00		Class 4,2,3,0	
over	incl.	over	incl.	high	low	high	low	high	low	high	low	high	low
–	101.6			+203	0	+203	0	+203	-203	+203	-203	+1,520	-1,520
101.6	304.8			+356	-254	+203	0	+203	-203	+203	-203	+1,520	-1,520
304.8	609.6	–	508.0	+381	-381	+381	-381	+203	-203	–	–	+1,520	-1,520
304.8	609.6	508.0	–	+381	-381	+381	-381	+381	-381	–	–	+1,520	-1,520
609.6	–			+381	-381	–	–	+381	-381	–	–	+1,520	-1,520

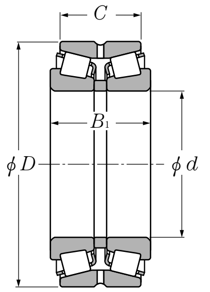
Table 3.5 (4) Radial deflection of inner and outer rings

Unit μm

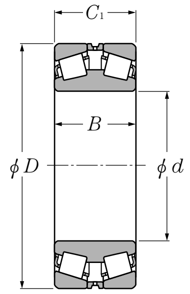
Nominal outside diameter D mm		Inner ring radial runout K_{ia} Outer ring radial runout K_{ea}				
		Class 4	Class 2	Class 3	Class 0	Class 00
over	incl.	max				
–	304.8	51	38	8	4	2
304.8	609.6	51	38	18	–	–
609.6	914.4	76	51	51	–	–
914.4	–	76	–	76	–	–



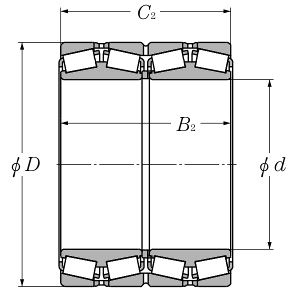
Single



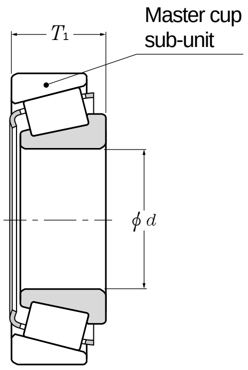
Double Row
(outside direction)

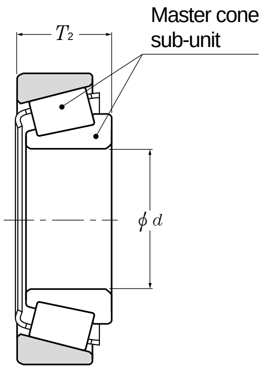


Double Row
(inside direction)



Four Row





Unit μm

Effective width deviation of roller and inner ring assembly of tapered roller bearing Δ_{T1s}						Tapered roller bearing outer ring effective width deviation Δ_{T2s}					
Class 4		Class 2		Class 3		Class 4		Class 2		Class 3	
high	low	high	low	high	low	high	low	high	low	high	low
+102	0	+102	0	+102	-102	+102	0	+102	0	+102	-102
+152	-152	+102	0	+102	-102	+203	-102	+102	0	+102	-102
–	–	+178	-178❶	+102	-102❶	–	–	+203	-203❶	+102	-102❶
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–

❶ To be applied for nominal bore diameters of 406.400 mm (16 inch) or less.

Table 3.6 Tolerance of thrust ball bearings

Table 3.6 (1) Shaft washer

Unit μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}				Single radial plane bore diameter variation V_{dp}		Thrust bearing shaft washer raceway (or center washer raceway) thickness variation S_i			
		Class 0,6,5		Class 4		Class 0,6,5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	max		max			
80	120	0	-20	0	-15	15	11	15	8	4	3
120	180	0	-25	0	-18	19	14	15	9	5	4
180	250	0	-30	0	-22	23	17	20	10	5	4
250	315	0	-35	0	-25	26	19	25	13	7	5
315	400	0	-40	0	-30	30	23	30	15	7	5
400	500	0	-45	0	-35	34	26	30	18	9	6
500	630	0	-50	0	-40	38	30	35	21	11	7
630	800	0	-75	0	-50	55	–	40	25	13	8
800	1,000	0	-100	–	–	75	–	45	30	15	–

Table 3.6 (2) Housing washer

Unit μm

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}				Single radial plane outside diameter variation V_{Dp}		Thrust bearing housing washer raceway thickness variation S_e			
		Class 0,6,5		Class 4		Class 0,6,5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	max		max			
80	120	0	-22	0	-13	17	10	According to the tolerance of S_1 against "d" or "d_2" of the same bearings			
120	180	0	-25	0	-15	19	11				
180	250	0	-30	0	-20	23	15				
250	315	0	-35	0	-25	26	19				
315	400	0	-40	0	-28	30	21				
400	500	0	-45	0	-33	34	25				
500	630	0	-50	0	-38	38	29				
630	800	0	-75	0	-45	55	34				
800	1,000	0	-100	0	-60	75	45				
1,000	1,250	0	-125	–	–	95	–				

Table 3.6 (3) Height of bearings center washer

Unit μm

Nominal bore diameter d mm		Single direction type ❶ Δ_{Ts}	
over	incl.	high	low
80	120	0	-150
120	180	0	-175
180	250	0	-200
250	315	0	-225
315	400	0	-300
400	500	0	-350
500	630	0	-400
630	800	0	-500
800	1,000	0	-600

❶ This standard is applied to flat back face bearing of class 0.

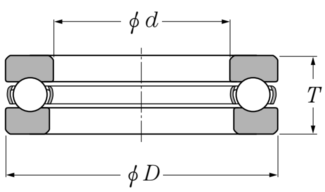


Table 3.7 Tolerance of spherical thrust roller bearing

Table 3.7 (1) Shaft washer

Unit μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}		Single radial plane bore diameter variation V_{dp}	Face runout with bore S_d	Height deviation of single direction thrust bearing Δ_{Ts}	
over	incl.	high	low	max	max	high	low
80	120	0	-20	15	25	+200	-200
120	180	0	-25	19	30	+250	-250
180	250	0	-30	23	30	+300	-300
250	315	0	-35	26	35	+350	-350
315	400	0	-40	30	40	+400	-400
400	500	0	-45	34	45	+450	-450
500	630	0	-50	38	50	+500	-500
630	800	0	-75	55	60	+750	-750

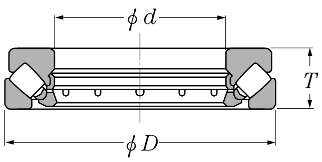


Table 3.7 (2) Housing washer

Unit μm

Nominal outside diameter d mm		Single plane mean outside diameter deviation Δ_{Dmp}	
over	incl.	high	low
120	180	0	-25
180	250	0	-30
250	315	0	-35
315	400	0	-40
400	500	0	-45
500	630	0	-50
630	800	0	-75
800	1,000	0	-100
1,000	1,250	0	-125
1,250	1,600	0	-160

Table 3.8 Tolerance of thrust tapered roller bearings

Table 3.8 (1) Shaft washer (metric series)

Unit μm

Nominal outside diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}		Bearing hight deviation Δ_{Ts}	
over	incl.	high	low	high	low
80	120	0	-20	0	-150
120	180	0	-25	0	-175
180	250	0	-30	0	-200
250	315	0	-35	0	-225
315	400	0	-40	0	-300
400	500	0	-45	0	-350
500	630	0	-50	0	-400
630	800	0	-75	0	-500
800	1,000	0	-100	0	-600

Table 3.8 (2) Housing washer (metric series)

Unit μm

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}	
over	incl.	high	low
180	250	0	-30
250	315	0	-35
315	400	0	-40
400	500	0	-45
500	630	0	-60
630	800	0	-75
800	1,000	0	-100
1,000	1,250	0	-125

Table 3.8 (3) Shaft washer (inch series)

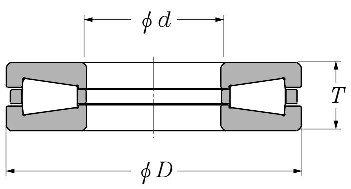
Unit μm

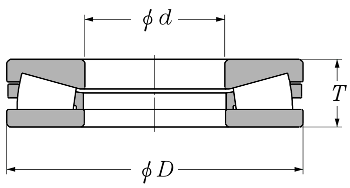
Nominal bore diameter d		Single plane mean bore diameter deviation Δ_{dmp}		Bearing hight deviation Δ_{Ts}	
over mm	incl. mm	high	low	high	low
–	304.800	+25	0	+381	-381
304.800	609.600	+51	0	+381	-381
609.600	914.400	+76	0	+381	-381
914.400	1,219.200	+102	0	+381	-381

Table 3.8 (4) Housing washer (inch series)

Unit μm

Nominal outside diameter D		Single plane mean outside diameter deviation Δ_{Dmp}	
over mm	incl. mm	high	low
–	304.800	+25	0
304.800	609.600	+51	0
609.600	914.400	+76	0
914.400	1,219.200	+102	0
1,219.200	–	+127	0





3.2 Limits and tolerances for chamfer and tapered bore

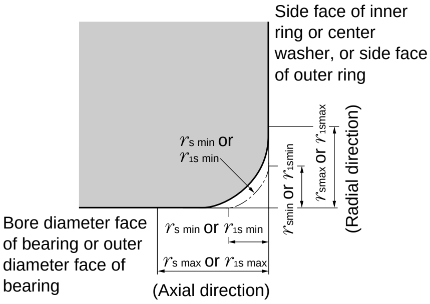


Table 3.9 Allowable critical-value of bearing chamfer

Table 3.9 (1) Radial bearing (except tapered roller bearing)

Unit mm

$r_{s\ min}$ ❶ or $r_{1s\ min}$	Nominal bore diameter d over	incl.	$r_{s\ max}$ or $r_{1s\ max}$ Radial direction	Axial direction
0.6	–	40	1	2
	40	–	1.3	2
1	–	50	1.5	3
	50	–	1.9	3
1.1	–	120	2	3.5
	120	–	2.5	4
1.5	–	120	2.3	4
	120	–	3	5
2	–	80	3	4.5
	80	220	3.5	5
	220	–	3.8	6
2.1	–	280	4	6.5
	280	–	4.5	7
2.5	–	100	3.8	6
	100	280	4.5	6
	280	–	5	7
3	–	280	5	8
	280	–	5.5	8
4	–	–	6.5	9
5	–	–	8	10
6	–	–	10	13
7.5	–	–	12.5	17
9.5	–	–	15	19
12	–	–	18	24
15	–	–	21	30
19	–	–	25	38

❶ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Table 3.9 (2) Tapered roller bearings of metric system

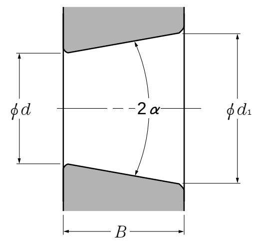
Unit mm

$r_{s\ min}$ ❷ or $r_{1s\ min}$	Nominal bore❸ diameter of bearing "d" or nominal outside diameter "D" over	incl.	$r_{s\ max}$ or $r_{1s\ max}$ Radial direction	Axial direction
0.3	–	40	0.7	1.4
	40	–	0.9	1.6
0.6	–	40	1.1	1.7
	40	–	1.3	2
1	–	50	1.6	2.5
	50	–	1.9	3
1.5	–	120	2.3	3
	120	250	2.8	3.5
	250	–	3.5	4
2	–	120	2.8	4
	120	250	3.5	4.5
	250	–	4	5
2.5	–	120	3.5	5
	120	250	4	5.5
	250	–	4.5	6
3	–	120	4	5.5
	120	250	4.5	6.5
	250	400	5	7
	400	–	5.5	7.5
4	–	120	5	7
	120	250	5.5	7.5
	250	400	6	8
	400	–	6.5	8.5
5	–	180	6.5	8
	180	–	7.5	9
6	–	180	7.5	10
	180	–	9	11

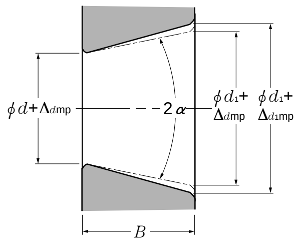
❷ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

❸ Inner rings shall be in accordance with the division of "d" and outer rings with that of "D".

Note: This standard will be applied to the bearings whose dimensional series (refer to the dimensional table) are specified in the standard of ISO 355 or JIS B 1512. Please consult **NTN** Engineering on non-standard bearings.



Theoretical tapered hole



Tapered hole having dimensional difference of the average bore diameter within the flat surface

Table 3.9 (3) Thrust bearings

Unit mm

$r_{s\,min}$ or $r_{1\,min}$ ❹	$r_{s\,max}$ or $r_{1s\,max}$ Radial and axial direcition
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5
4	6.5
5	8
6	10
7.5	12.5
9.5	15
12	18
15	21
19	25

❹ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Table 3.10 (1) Tolerance and allowable values (Class 0) of tapered bore of radial bearings

Unit μm

d mm		Δ_{dmp}		$\Delta_{d1mp}-\Delta_{dmp}$		V_{dp} ❶❷
over	incl.	high	low	high	low	max
80	120	+ 54	0	+ 35	0	22
120	180	+ 63	0	+ 40	0	40
180	250	+ 72	0	+ 46	0	46
250	315	+ 81	0	+ 52	0	52
315	400	+ 89	0	+ 57	0	57
400	500	+ 97	0	+ 63	0	63
500	630	+110	0	+ 70	0	70
630	800	+125	0	+ 80	0	–
800	1,000	+140	0	+ 90	0	–
1,000	1,250	+165	0	+105	0	–
1,250	1,600	+195	0	+125	0	–

Table 3.10 (2) Allowable variations for radial bearing inner ring tapered bores standard taper ratio 1:30 (Class 0)

Units μm

d mm		Δ_{dmp}		$\Delta_{d1mp}-\Delta_{dmp}$		V_{dp} ❶❷
over	incl.	high	low	high	low	max
80	120	+20	0	+35	0	22
120	180	+25	0	+40	0	40
180	250	+30	0	+46	0	46
250	315	+35	0	+52	0	52
315	400	+40	0	+57	0	57
400	500	+45	0	+63	0	63
500	630	+50	0	+70	0	70

❶ Applies to all radial flat planes of inner ring tapered bore.
❷ Does not apply to diameter series 7 and 8.

Note: Quantifiers

For a standard taper ratio of 1:12 $d1=d+\frac{1}{12}B$

For a standard taper ratio of 1:30 $d1=d+\frac{1}{30}B$

Δ_{dmp} : Dimensional difference of the average bore diameter within the flat surface at the theoretical small end of the tapered bore.

Δ_{d1mp} : Dimensional difference of the average bore diameter within the flat surface at the theoretical large end of the tapered bore.

V_{dp} : Unevenness of the bore diameter with the flat surface

B : Nominal width of inner ring

α : Half of the tapered bore's nominal taper angle
For a standard taper ratio of 1:12 $\alpha = 2°23'9.4''$
For a standard taper ratio of 1:30 $\alpha = 0°57'7.4''$

4. Bearing Fits

4.1 Interference

For rolling bearings, inner and outer rings are fixed on the shaft or in the housing so that relative movement does not occur between fitted surfaces during operation or under load. This relative movement (referred to as "creep") between the fitted surfaces of the bearing and the shaft or housing can occur in a radial direction, an axial direction, or in the direction of rotation. To help prevent this creeping movement, bearing rings and the shaft or housing are installed with one of three interference fits, a **"tight fit"** (also called shrink fit), **"transition fit,"** or **"loose fit"** (also called clearance fit), and the degree of interference between their fitted surfaces varies.

The most effective way to fix the fitted surfaces between a bearing's raceway and shaft or housing is to apply a **"tight fit."** The advantage of this tight fit for thin walled bearings is that it provides uniform load support over the entire ring circumference without any loss of load carrying capacity. However, with a tight fit, ease of installation and disassembly is lost; and when using a non-separable bearing as the floating-side bearing, axial displacement is not possible. For this reason, a tight fit cannot be recommended in all cases.

4.2 The necessity of a proper fit

In some cases, improper fit may lead to damage and shorten bearing life, therefore it is necessary to make a careful analysis in selecting a proper fit. Some of the negative conditions caused by improper fit are listed below.

- Raceway cracking, early peeling and displacement of raceway
- Raceway and shaft or housing abrasion caused by creeping and fretting corrosion
- Seizing caused by loss of internal clearances
- Increased noise and lowered rotational accuracy due to raceway groove deformation

4.3 Fit selection

Selection of a proper fit is dependent upon thorough analysis of bearing operating conditions, including consideration of:

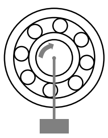
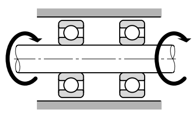
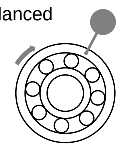
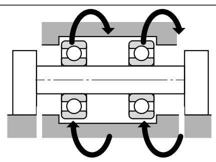
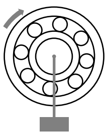
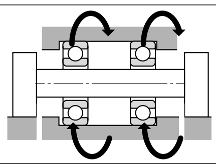
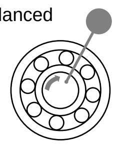
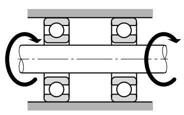
- Shaft and housing material, wall thickness, finished surface accuracy, etc.
- Machinery operating conditions (nature and magnitude of load, rotational speed, temperature, etc.)

4.3.1 "Tight fit," "transition fit," or "loose fit"

(1) For raceways under rotating loads, a tight fit is necessary. (refer to **Table 4.1**) **"**Raceways under rotating loads**"** refers to raceways receiving loads rotating relative to their radial direction. For raceways under static loads, on the other hand, a loose fit is sufficient.
(Example) Rotating inner ring load = the direction of the radial load on the inner ring is rotating relatively

(2) For non-separable bearings, such as deep groove ball bearings, it is generally recommended that either the inner ring or outer ring be given a loose fit.

Table 4.1 Radial load and bearing fit

Illustration	Bearing rotation		Ring load	Fit
Static load 		Inner ring: Rotatring Outer ring: Stationary	Rotating inner ring load Static outer ring load	Inner ring : Tight fit Outer ring : Loose fit
Unbalanced load 		Inner ring: Stationary Outer ring: Rotating		
Static load 		Inner ring: Stationary Outer ring: Rotating	Static inner ring load Rotating outer ring load	Inner ring : Loose fit Outer ring : Tight fit
Unbalanced load 		Inner ring: Rotating Outer ring: Stationary		

4.3.2 Recommended Fits

Bearing fit is governed by the selection tolerances for bearing shaft diameters and housing bore diameters.

Widely used fits for 0 Class tolerance bearings and various shaft and housing bore diameter tolerances are shown in **Fig. 4.1**.

Generally-used, standard fits for most types of bearings and operating conditions are shown in **Tables 4.2** - **4.6**.

Table 4.2: Fits for radial bearings
Table 4.3: Fits for thrust bearings
Table 4.4: Fits for electric motor bearings
Table 4.5: Fits for inch series tapered roller bearings (ANSI Class 4)
Table 4.6: Fits for inch series tapered roller bearings (ANSI Class 3 and 0)
Table 4.5. shows fits and their numerical values.

For special fits or applications, please consult **NTN** Engineering.

4.3.3 Interference minimum and maximum values

The following points should be considered when it is necessary to calculate the interference for an application:

- In calculating the minimum required amount of interference keep in mind that:
  1) interference is reduced by radial loads
  2) interference is reduced by differences between bearing temperature and ambient temperature
  3) interference is reduced by variation of fitted surfaces
- Maximum interference should be no more than 1:1000 of the shaft diameter or outer diameter.

Required interference calculations are shown below.

(1) Radial loads and required interference

Interference between inner rings mounted on solid shafts is reduced when acted upon by radial loads. Calculation of the minimum required amount of interference in such cases is shown in formulae (4.1) and (4.2).

$F_r \leqq 0.3\, C_{or}$

$$\left.\begin{aligned}\Delta_{dF} &= 0.08\,(d \cdot F_r / B)^{1/2} \quad \text{N} \\ &= 0.25\,(d \cdot F_r / B)^{1/2} \quad \{\text{kgf}\}\end{aligned}\right\} \cdots\cdots\cdots (4.1)$$

$F_r > 0.3\, C_{or}$

$$\left.\begin{aligned}\Delta_{dF} &= 0.02\,(F_r / B) \quad \text{N} \\ &= 0.2\,(F_r / B) \quad \{\text{kgf}\}\end{aligned}\right\} \cdots\cdots\cdots (4.2)$$

Where,

Δ_{dF} : Required effective interference for load μm
d : Nominal bore diameter mm
B : Inner ring width mm
F_r : Radial load N {kgf}
C_{or} : Basic static rated load N {kgf}

(2) Temperature difference and required interference

Interference between inner rings and steel shafts is reduced as a result of temperature increases (difference between bearing temperature and ambient temperature, ΔT) caused by bearing rotation. Calculation of the minimum required amount of interference in such cases is shown in formulae (4.3).

$$\Delta_{dT} = 0.0015\, d\, \Delta T \cdots\cdots\cdots (4.3)$$

Δ_{dT} : Required effective interference for temperature difference μm
ΔT : Difference between bearing temperature and ambient temperature °C
d : Bearing bore diameter mm

(3) Fitted surface variation and required interference

Interference between fitted surfaces is reduced by roughness and other slight variations of these surfaces which are flattened in the fitting process. The degree of reduced interference depends upon the finish treatment of these surfaces, but in general it is necessary to assume the following interference reductions.

For ground shafts: 1.0～2.5 μm
For lathed shafts: 5.0～7.0 μm

(4) Maximum interference

When bearing rings are installed with an interference fit, tension or compression stress may occur along their raceways. If interference is too great, this may cause damage to the rings and reduce bearing life. For these reasons, maximum interference should not exceed the previously mentioned ratio of 1:1,000 of shaft or outside diameter.

4.3.4 Other details

(1) Tight interference fits are recommended for,
- Operating conditions with large vibration or shock loads
- Applications using hollow shafts or housings with thin walls
- Applications using housings made of light alloys or plastic

(2) Loose interference fits are preferable for,
- Applications requiring high running accuracy
- Applications using small sized bearings or thin walled bearings

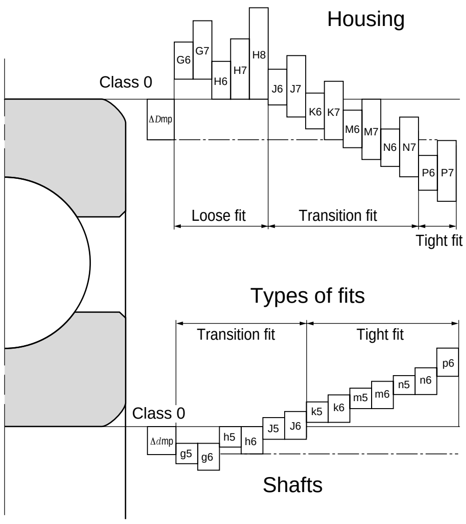


Fig. 4.1

(3) Consideration must also be given to the fact that fit selection will affect internal bearing clearance selection. (refer to page insert A-29)

(4) A particular type of fit is recommended for SL type cylindrical roller bearings.

Table 4.2 General standards for radial bearing fits (JIS Class 0, 6, 6X)

Table 4.2 (1) Tolerance class of shafts commonly used for radial bearings (classes 0, 6X and 6)

Nature of load	Fit	Load conditions, magnitude	Load conditions, magnitude Ball bearing		Cylindrical roller bearing Tapered roller bearing		Self-aligning roller bearings		Remarks
			Shaft diameter mm over incl	Tolerance class	Shaft diameter mm over incl	Tolerance class	Shaft diameter mm over incl	Tolerance class	
Rotating inner ring load Indeterminate direction load	Tight fit / Transition fit	Light or fluctuating variable load ❶	18 ～100 100 ～200	js6 k6	40 ～140 140 ～200	k6 m6			When greater accuracy is required js5, k5, and m5 may be substituted for js6, k6, and m6.
		Normal load ❶	18 ～100 100 ～140 140 ～200 200 ～280	k5 m5 m6 n6	40 ～100 100 ～140 140 ～200 200 ～400	m5 m6 n6 p6	40 ～ 65 65 ～100 100 ～140 140 ～280 280 ～500	m5 m6 n6 p6 r6	Alteration of inner clearances to accommodate fit is not a consideration with single-row angular contact bearings and tapered roller bearings. Therefore, k5 and m5 may be substituted for k6 and m6.
		Heavy load or shock load ❶			50 ～140 140 ～200 200 ～	n6 p6 r6	50 ～100 100 ～140 140 ～200	n6 p6 r6	Use bearings with larger internal clearances than CN clearance bearings.
Static inner ring load	Transition fit	Inner ring axial displacement possible	All shaft diameters	g6	All shaft diameters	g6	All shaft diameters	g6	When greater accuracy is required use g5. For large bearings, f6 may be used.
		Inner ring axial displacement unnecessary		h6		h6		h6	When greater accuracy is required use h5.
Centric axial load only	Transition fit	All loads	All shaft diameters	js6	All shaft diameters	js6	All shaft diameters	js6	General; depending on the fit, shaft and inner rings are not fixed.

Table 4.2 (2) Fit with shaft (fits for tapered bore bearings (Class 0) with adapter assembly/withdrawal sleeve)

All loads	All bearing types	All shaft diameters	Tolerance class	h9 / IT5 ❷	General applications
				h10/ IT7 ❷	Transmission shafts, etc.

❶ Standards for light loads, normal loads, and heavy loads
- Light loads: equivalent radial load ≦ 0.06 C_r
- Normal loads: 0.06 C_r ＜equivalent radial load ≦ 0.12 C_r
- Heavy loads: 0.12 C_r ＜equivalent radial load

❷ IT5 and IT7 show shaft roundness tolerances, cylindricity tolerances, and related values.

Note: All values and fits listed in the above tables are for solid steel shafts.

Table 4.2 (3) Housing fits

Nature of load	Housing	Fit	Load conditions, magnitude	Tolerance class	Outer ring axial displacement❷	Remarks
Rotating outer ring load or static outer ring load	Solid or split housing	Loose fit	All loads	H7	Displacement possible	G7 also acceptable for large type bearings as well as outer rings and housings with large temperature differences.
				G7	Easy displacement	
			Light❶ to normal load	H8	Displacement possible	—
			Shaft and inner rings reach high temperature	G7	Easy displacement	F7 also acceptable for large type bearings as well as outer rings and housings with large temperature differences.
				F7	Easy displacement	
	Solid housing	Transition or loose fit	Requires silent operation	H6	Displacement possible	—
			High rotation accuracy required with light to normal loads	Js6	Displacement not possible (in principle)	Applies primarily to ball bearings
				K6	Displacement not possible (in principle)	Applies primarily to roller bearings
Direction indeterminate load		Tight to transition fit	Light to normal load	Js7	Displacement possible	When greater accuracy is required substitute Js6 for Js7 and K6 for K7.
			Normal to heavy load	K7	Displacement not possible (in principle)	
			Heavy shock load	M7	Displacement not possible	—
Inner ring static load or outer ring rotating load		Tight fit	Light or variable load	M7	Displacement not possible	—
			Normal to heavy load	N7	Displacement not possible	Applies primarily to ball bearings
			Heavy load (thin wall housing) or heavy shock load	P7	Displacement not possible	Applies primarily to roller bearings
Centered axial load only - Loose fit		Loose fit	—	Select a tolerance class that will provide clearance between outer ring and housing.		—

❶ Standards for light loads, normal loads, and heavy loads
- Light loads: equivalent radial load ≦ 0.06 C_r
- Normal loads: 0.06 C_r < equivalent radial load ≦ 0.12 C_r
- Heavy loads: 0.12 C_r < equivalent radial load

❷ Indicates whether or not outer ring axial displacement is possible with non-separable type bearings.

Notes: 1. All values and fits listed in the above tables are for cast iron or steel housings.
2. In cases where only a centered axial load acts on the bearing, select a tolerance class that will provide clearance in the axial direction for the outer ring.

Table 4.3 Standard fits for thrust bearings (JIS Class 0 and 6)

Table 4.3 (1) Shaft fits

Bearing type	Load conditions		Fit	Shaft diameter mm over incl	Tolerance class
All thrust bearings	Centered axial load only		Transition fit	All sizes	js6 or h6
Self-aligning roller thrust bearings	Combined load	Inner ring static load	Transition fit	All sizes	js6
		Inner ring rotating load or direction indeterminate load	Transition fit Tight fit	— ～ 200 200 ～ 400 400 ～	k6 or js6 m6 or k6 n6 or m6

Table 4.3 (2) Housing fits

Bearing type	Load conditions		Fit	Tolerance class	Remarks
All thrust bearings	Centered axial load only		Loose fit	Select a tolerance class that will provide clearance between outer ring and housing.	
				H8	Greater accuracy required with thrust ball bearings
Self-aligning roller thrust bearings	Combined load	Outer ring static load		H7	——
		Direction Indeterminate load or outer ring rotating load	Transition fit	K7	Normal operating conditions
				M7	For relatively large radial loads

Note: All values and fits listed in the above tables are for cast iron or steel housings.

Table 4.4 Fits for electric motor bearings

Bearing type	Shaft fits		Housing bore diameter	
	Shaft diameter mm over incl.	Tolerance class	Housing fits	Tolerance class
Deep groove ball bearings	18 ～100 100 ～160	k5 m5	All sizes	H6 or J6
Cylindrical roller bearings	40 ～160 160 ～200	m5 n6	All sizes	H6 or J6

Table 4.5 Fits for inch series tapered roller bearing (ANSI class 4)

Table 4.5 (1) Fit with shaft

Unit μm

Load conditions		Shaft diameter d mm over	incl.	Cone bore tolerance Δ_{ds} high	low	Shaft tolerance high	low	Extreme fits[1] max	min	Remark
Rotating cone load	Normal loads, no shock	76.2	304.8	+25	0	+ 64	+ 38	64T	13T	Applicable when slight impact load is applied as well.
		304.8	609.6	+51	0	+127	+ 76	127T	25T	
		609.6	914.4	+76	0	+190	+114	190T	38T	
	Heavy loads or shock loads	76.2	304.8	+25	0	Use average tight cone fit of 0.5 μm/mm, (0.0005 inch/inch) of cone bore, use a minimum fit of 25 μm, 0.0010 inch tight.				
		304.8	609.6	+51	0					
		609.6	914.4	+76	0					
Stationary cone load	Cone axial displacement on shaft necessary	76.2	304.8	+25	0	+ 25	0	25T	25L	Not applicable when impact load is applied.
		304.8	609.6	+51	0	+ 51	0	51T	51L	
		609.6	914.4	+76	0	+ 76	0	76T	76L	
	Cone axial displacement on shaft unnecessary	76.2	304.8	+25	0	0	- 25	0	50L	
		304.8	609.6	+51	0	0	- 51	0	102L	
		609.6	914.4	+76	0	0	- 76	0	152L	

Table 4.5 (2) Fit with housing

Unit μm

Load conditions		Housing bore diameter D mm over	incl.	Cup O.D. tolerance Δ_{Ds} high	low	Housing bore tolerance high	low	Extreme fits❶ max	min	Types of fit
Stationary cup load	Light and normal loads: cup easily axially displaceable	76.2	127.0	+25	0	+ 76	+ 51	26L	76L	loose fit
		127.0	304.8	+25	0	+ 76	+ 51	26L	76L	
		304.8	609.6	+51	0	+152	+102	51L	152L	
		609.6	914.4	+76	0	+229	+152	76L	229L	
	Light and normal loads: cup axially adjustable	76.2	127.0	+25	0	+ 25	0	25T	25L	tight interference fit
		127.0	304.8	+25	0	+ 51	0	25T	51L	
		304.8	609.6	+51	0	+ 76	+ 26	25T	76L	
		609.6	914.4	+76	0	+127	+ 51	25T	127L	
	Heavy loads: cup not axially displaceable	76.2	127.0	+25	0	- 25	- 51	76T	25T	tight fit
		127.0	304.8	+25	0	- 25	- 51	76T	25T	
		304.8	609.6	+51	0	- 25	- 76	127T	25T	
		609.6	914.4	+76	0	- 25	-102	178T	25T	
Rotating cup load	Cup not axially displaceable	76.2	127.0	+25	0	- 25	- 51	76T	25T	
		127.0	304.8	+25	0	- 25	- 51	76T	25T	
		304.8	609.6	+51	0	- 25	- 76	127T	25T	
		609.6	914.4	+76	0	- 25	-102	178T	25T	

❶ T= tight, L= loose

Table 4.6 Fits for inch series tapered roller bearing (ANSI class 3 and 0)

Table 4.6. (1) Fit with shaft

Unit μm

Load conditions		Shaft diameter d mm over	incl.	Cone bore tolerance Δ_{ds} high	low	Shaft tolerance high	low	Extreme fits[1] max	min
Rotating cone load	Precision machine tool spindles		~ 304.8	+13	0	+ 30	+ 18	30T ~	5T
		304.8	~ 609.6	+25	0	+ 64	+ 38	64T ~	13T
		609.6	~ 914.4	+38	0	+102	+ 64	102T ~	26T
	Heavy loads, or high speed or shock	76.2	~ 304.8	+13	0	Use minimum tight cone fit of 0.25 μm/mm 0.00025 inch/inch of cone bore.			
		304.8	~ 609.6	+25	0				
		609.6	~ 914.4	+38	0				
Stationary cone load	Precision machine tool spindles		~ 304.8	+13	0	+ 13	0	30T ~	5T
		304.8	~ 609.6	+25	0	+ 25	0	64T ~	13T
		609.6	~ 914.4	+38	0	+102	0	102T ~	26T

Note: Must be applied for maximum bore dia. 241.300mm (9.500 inch) in case of class 0 product.

Table 4.6 (2) Fit with housing

Unit μm

Load conditions		Housing bore diameter D mm over	incl.	Cup O.D. tolerance Δ_{Ds} high	low	Housing bore tolerance high	low	Extreme fits❶ max	min	Type of fit
Stationary cup load	Floating		~ 152.4	+13	0	+ 38	+ 25	12L ~	38L	loose fit
		152.4	~ 304.8	+13	0	+ 38	+ 25	12L ~	38L	
		304.8	~ 609.6	+25	0	+ 64	+ 38	13L ~	64L	
		609.6	~ 914.4	+38	0	+ 89	+ 51	13L ~	89L	
	Clamped		~ 152.4	+13	0	+ 25	+ 13	0 ~	25L	
		152.4	~ 304.8	+13	0	+ 25	+ 13	0 ~	25L	
		304.8	~ 609.6	+25	0	+ 51	+ 25	0 ~	51L	
		609.6	~ 914.4	+38	0	+ 76	+ 38	0 ~	76L	
	Adjustable		~ 152.4	+13	0	+ 13	0	13T ~	13L	tight interference fit
		152.4	~ 304.8	+13	0	+ 13	0	13T ~	13L	
		304.8	~ 609.6	+13	0	+ 25	0	25T ~	25L	
		609.6	~ 914.4	+38	0	+ 38	0	38T ~	38L	
	Nonadjustable or in carriers		~ 152.4	+13	0	0	- 13	26T ~	0	tight fit
		152.4	~ 304.8	+13	0	0	- 25	38T ~	0	
		304.8	~ 609.6	+25	0	0	- 25	50T ~	0	
		609.6	~ 914.4	+38	0	0	- 38	76T ~	0	
Rotating cup load	Nonadjustable or in carriers		~ 152.4	+13	0	- 13	- 25	38T ~	13T	
		152.4	~ 304.8	+13	0	- 13	- 38	51T ~	13T	
		304.8	~ 609.6	+25	0	- 13	- 38	63T ~	13T	
		609.6	~ 914.4	+38	0	- 13	- 51	89T ~	13T	

❶ T= tight, L= loose

Note: Must be applied for maximum cup OD 304.800mm (12.000 inch) in case of class 0 product.

5. Bearing Internal Clearance

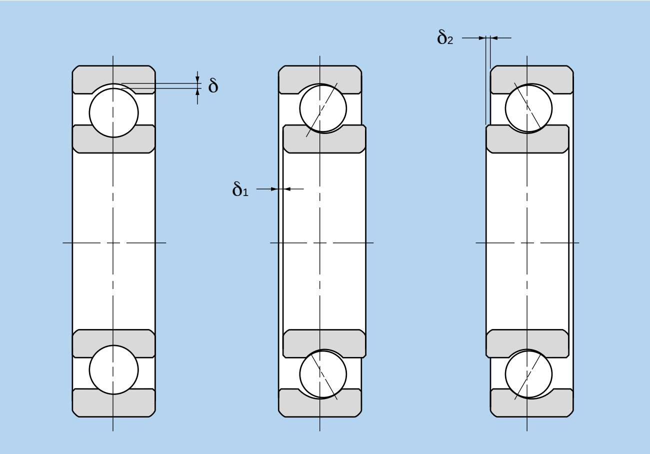
5.1 Bearing internal clearance

Bearing internal clearance (initial clearance) is the amount of internal clearance a bearing has before being installed on a shaft or in a housing.

As shown in **Fig. 5.1**, when either the inner ring or the outer ring is fixed and the other ring is free to move, displacement can take place in either an axial or radial direction. This amount of displacement (radially or axially) is termed the internal clearance and, depending on the direction, is called the radial internal clearance or the axial internal clearance.

When the internal clearance of a bearing is measured, a slight measurement load is applied to the raceway so the internal clearance may be measured accurately. However, at this time, a slight amount of elastic deformation of the bearing occurs under the measurement load, and the clearance measurement value (measured clearance) is slightly larger than the true clearance. This discrepancy between the true bearing clearance and the increased amount due to the elastic deformation must be compensated for. These compensation values are given in **Table 5.1**. For roller bearings the amount of elastic deformation can be ignored.

The internal clearance values for each bearing class are shown in **Tables 5.2** through **5.9**.



Radial clearance = δ Axial clearance = $\delta_1 + \delta_2$

Fig. 5.1 Internal clearance

5.2 Internal clearance selection

The internal clearance of a bearing under operating conditions (effective clearance) is usually smaller than the same bearing's initial clearance before being installed and operated. This is due to several factors including bearing fit, the difference in temperature between the inner and outer rings, etc. As a bearing's operating clearance has an effect on bearing life, heat generation, vibration, noise, etc.; care must be taken in selecting the most suitable operating clearance.

Effective internal clearance:

The internal clearance differential between the initial clearance and the operating (effective) clearance (the amount of clearance reduction caused by interference fits, or clearance variation due to the temperature difference between the inner and outer rings) can be calculated by the following formula:

$$\delta_{eff} = \delta_o - (\delta_f + \delta_t) \quad \cdots\cdots\cdots\cdots (5.1)$$

where,

δ_{eff} : Effective internal clearance, mm

δ_o : Bearing internal clearance, mm

δ_f : Reduced amount of clearance due to interference, mm

δ_t : Reduced amount of clearance due to temperature differential of inner and outer r, mm

Table 5.1 Examples of applications where bearing clearances other than normal clearance are used

Operating conditions	Applications	Selected clearance
With heavy or shock load, clearance is great.	Railway vehicle axles	C3
	Vibration screens	C3, C4
With direction indeterminate load, both inner and outer rings are tight-fitted.	Railway vehicle traction motors	C4
	Tractors and final speed regulators	C4
Shaft or inner ring is heated.	Paper making machines and driers	C3, C4
	Rolling mill table rollers	C3
To reduce shaft runout, clearance is adjusted.	Main spindles of lathes (Double-row cylindrical roller bearings)	C9NA, C0NA

(1) Reduced clearance due to interference

When bearings are installed with interference fits on shafts and in housings, the inner ring will expand and the outer ring will contract; thus reducing the bearings' internal clearance. The amount of expansion or contraction varies depending on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. The differential can range from approximately 70% to 90% of the effective interference.

$$\delta_f = (0.70 \sim 0.90)\,\Delta_{deff} \cdots\cdots\cdots\cdots (5.2)$$

where,

δ_f : Reduced amount of clearance due to interference, mm

Δ_{deff} : Effective interference, mm

(2) Reduced internal clearance due to inner/outer ring temperature difference.

During operation, normally the outer ring will range from 5 to 10℃ cooler than the inner ring or rotating parts. However, if the cooling effect of the housing is large, the shaft is connected to a heat source, or a heated substance is conducted through the hollow shaft; the temperature difference between the two rings can be even greater. The amount of internal clearance is thus further reduced by the differential expansion of the two rings.

$$\delta_t = \alpha \cdot \Delta T \cdot D_o \cdots\cdots\cdots\cdots (5.3)$$

where,

δ_t : Amount of reduced clearance due to heat differential, mm

α : Bearing steel linear expansion coefficient 12.5×10^{-6}/°C

ΔT : Inner/outer ring temperature differential, ℃

D_o : Outer ring raceway diameter, mm

Outer ring raceway diameter, D_o, values can be approximated by using formula (5.4) or (5.5).

For ball bearings and self-aligning roller bearings,

$$D_o = 0.20\,(d + 4.0D) \cdots\cdots\cdots\cdots (5.4)$$

For roller bearings (except self-aligning),

$$D_o = 0.25\,(d + 3.0D) \cdots\cdots\cdots\cdots (5.5)$$

where,

d : Bearing bore diameter, mm

D : Bearing outside diameter, mm

Table 5.2 Radial internal clearance of deep groove ball bearings

Unit μm

Nominal bore diameter *d* mm		C2		Normal		C3		C4		C5	
over	incl.	min	max	min	max	min	max	min	max	min	max
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690
630	710	20	130	110	260	240	400	380	570	540	760
710	800	20	140	120	290	270	450	430	630	600	840
800	900	20	160	140	320	300	500	480	700	670	940
900	1,000	20	170	150	350	330	550	530	770	740	1,040
1,000	1,120	20	180	160	380	360	600	580	850	820	1,150
1,120	1,250	20	190	170	410	390	650	630	920	890	1,260

Table 5.3 Radial internal clearance of double row and duplex angular contact ball bearings

Unit μm

Nominal bore diameter d mm		C1		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max	min	max
80	100	3	13	13	22	22	40	40	60	95	120
100	120	3	15	15	30	30	50	50	75	110	140
120	150	3	16	16	33	35	55	55	80	130	170
150	180	3	18	18	35	35	60	60	90	150	200
180	200	3	20	20	40	40	65	65	100	180	240
200	225	3	25	25	50	50	75	75	115	210	270
225	250	3	25	25	50	50	75	80	130	230	300
250	280	3	30	30	55	55	85	90	150	260	340
280	315	3	30	30	55	55	85	100	170	300	380
315	400	-	-	40	65	60	85	110	180	-	-
400	500	-	-	40	65	60	85	110	180	-	-

Notes: 1. The clearance group in the table is applied only to contact angles in the table below.
2. This table shows **NTN** standard clearances.

Contact angle symbol	Nominal contact angle	Applicable clearance group❷
C	15°	C1, C2
A❶	30°	C2, Normal, C3
B	40°	Normal, C3, C4

❶ Usually not to be indicated
❷ For information concerning clearance other than applicable clearance, please contact **NTN** Engineering.

Table 5.4 Radial internal clearance of bearings for electric motor

Unit μm

Nominal bore diameter d mm		Radial internal clearance CM			
		Deep groove ball bearings		Cylindrical roller bearings	
over	incl.	min	max	min	max
80 (incl.)	100	18	30	35	55
100	120	18	30	35	60
120	140	24	38	40	65
140	160	24	38	50	80
160	180	—	—	60	90
180	200	—	—	65	100

Notes: 1. Suffix CM is added to bearing numbers. Ex. 6220CM
2. Cylindrical roller bearings are non-interchangeable clearance.

Table 5.5 Radial internal clearance of cylindrical roller bearings, needle roller bearings (Interchangeable, cylindrical bore bearings)

Unit μm

Nominal bore diameter d mm		C2		Normal		C3		C4		C5	
over	incl.	min	max	min	max	min	max	min	max	min	max
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735
500	560	120	240	240	360	360	480	480	600	-	-
560	630	140	260	260	380	380	500	500	620	-	-
630	710	145	285	285	425	425	565	565	705	-	-
710	800	150	310	310	470	470	630	630	790	-	-
800	900	180	350	350	520	520	690	690	860	-	-
900	1,000	200	390	390	580	580	770	770	960	-	-
1,000	1,120	220	430	430	640	640	850	850	1,060	-	-
1,120	1,250	230	470	470	710	710	950	950	1,190	-	-

Note: This table shows **NTN** standard clearances where "d>500mm".

Table 5.6 Radial internal clearance of cylindrical roller bearings, needle roller bearings (non-interchangeable)

Nominal bore diameter *d* mm		Bearing with cylindrical bore											
		C1NA		C2NA		NA❶		C3NA		C4NA		C5NA	
over	incl.	min	max	min	max	min	max	min	max	min	max	min	max
80	100	10	25	25	45	45	70	80	105	105	125	155	180
100	120	10	25	25	50	50	80	95	120	120	145	180	205
120	140	15	30	30	60	60	90	105	135	135	160	200	230
140	160	15	35	35	65	65	100	115	150	150	180	225	260
160	180	15	35	35	75	75	110	125	165	165	200	250	285
180	200	20	40	40	80	80	120	140	180	180	220	275	315
200	225	20	45	45	90	90	135	155	200	200	240	305	350
225	250	25	50	50	100	100	150	170	215	215	265	330	380
250	280	25	55	55	110	110	165	185	240	240	295	370	420
280	315	30	60	60	120	120	180	205	265	265	325	410	470
315	355	30	65	65	135	135	200	225	295	295	360	455	520
355	400	35	75	75	150	150	225	255	330	330	405	510	585
400	450	45	85	85	170	170	255	285	370	370	455	565	650
450	500	50	95	95	190	190	285	315	410	410	505	625	720
500	560	-	-	100	210	210	320	350	450	450	550	720	815
560	630	-	-	110	230	230	350	380	500	500	615	800	910
630	710	-	-	130	260	260	400	435	570	570	695	900	1,030
710	800	-	-	140	290	290	450	485	635	635	780	1,000	1,140
800	900	-	-	160	330	330	500	540	700	700	860	1,130	1,290
900	1,000	-	-	180	360	360	560	600	780	780	970	1,270	1,440
1,000	1,120	-	-	200	400	400	620	670	900	900	1,100	1,410	1,620
1,120	1,250	-	-	220	440	440	690	750	1,000	1,000	1,220	1,580	1,820

❶ For bearings with normal clearance, only NA is added to bearing numbers. Ex. NU310NA

Table 5.7 Axial internal clearance of metric double row and duplex tapered roller bearings (except series 329X, 322C, 323C)

Nominal bore diameter *d* mm		Contact angle $\alpha \leqq 27^{\circ}$ ($e \leqq 0.76$)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
80	100	45	150	150	260	280	390	390	500
100	120	45	175	175	305	350	480	455	585
120	140	45	175	175	305	390	520	500	630
140	160	60	200	200	340	400	540	520	660
160	180	80	220	240	380	440	580	600	740
180	200	100	260	260	420	500	660	660	820
200	225	120	300	300	480	560	740	720	900
225	250	160	360	360	560	620	820	820	1,020
250	280	180	400	400	620	700	920	920	1,140
280	315	200	440	440	680	780	1,020	1,020	1,260
315	355	220	480	500	760	860	1,120	1,120	1,380
355	400	260	560	560	860	980	1,280	1,280	1,580
400	500	300	600	620	920	1,100	1,400	1,440	1,740
500	560	350	650	750	1,050	1,250	1,550	1,650	1,950
560	630	400	700	850	1,150	1,400	1,700	1,850	2,150
630	710	500	850	1,000	1,350	1,650	2,000	2,100	2,450
710	800	550	950	1,100	1,500	1,800	2,200	2,300	2,700
800	900	650	1,050	1,250	1,650	2,000	2,400	2,550	2,950
900	1,000	700	1,100	1,400	1,800	2,200	2,600	2,900	3,300
1,000	1,120	750	1,250	1,500	2,000	2,500	3,000	3,250	3,750
1,120	1,250	850	1,350	1,700	2,200	2,850	3,350	3,700	4,200
1,250	1,400	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500

Notes: 1. This table applies to bearings contained in the catalog. For information concerning other bearings or bearings using US customary unit, please contact **NTN** Engineering.
2. The correlation of axial internal clearance (Δ_a) and radial internal clearance (Δ_r) is expressed as $\Delta_r = 0.667 \cdot e \cdot \Delta_a$.
e: Constant (see dimensions table)
3. Bearing series 329X, 330, 322C and 323Cdo not apply to the table.
4. This table shows **NTN** standard clearances.

Unit μm

Bearing with tapered bore												Nominal bore diameter	
C9NA❷		C0NA❷		C1NA		C2NA		NA❶		C3NA		d mm	
min	max	min	max	min	max	min	max	min	max	min	max	over	incl.
10	25	20	35	25	45	45	70	80	105	105	125	80	100
10	25	20	35	25	50	50	80	95	120	120	145	100	120
15	30	25	40	30	60	60	90	105	135	135	160	120	140
15	35	30	45	35	65	65	100	115	150	150	180	140	160
15	35	30	45	35	75	75	110	125	165	165	200	160	180
20	40	30	50	40	80	80	120	140	180	180	220	180	200
20	45	35	55	45	90	90	135	155	200	200	240	200	225
25	50	40	65	50	100	100	150	170	215	215	265	225	250
25	55	40	65	55	110	110	165	185	240	240	295	250	280
30	60	45	75	60	120	120	180	205	265	265	325	280	315
30	65	45	75	65	135	135	200	225	295	295	360	315	355
35	75	50	90	75	150	150	225	255	330	330	405	355	400
45	85	60	100	85	170	170	255	285	370	370	455	400	450
50	95	70	115	95	190	190	285	315	410	410	505	450	500
-	-	-	-	100	210	210	320	350	450	450	550	500	560
-	-	-	-	110	230	230	350	380	500	500	615	560	630
-	-	-	-	130	260	260	400	435	570	570	695	630	710
-	-	-	-	140	290	290	450	485	635	635	780	710	800
-	-	-	-	160	330	330	500	540	700	700	860	800	900
-	-	-	-	180	360	360	560	600	780	780	970	900	1,000
-	-	-	-	200	400	400	620	670	900	900	1,100	1,000	1,120
-	-	-	-	220	440	440	690	750	1,000	1,000	1,220	1,120	1,250

❷ C9NA, C0NA and C1NA are applied only to precision bearings of Class 5 and higher.

Unit μm

Contact angle $\alpha > 27^\circ$ ($e > 0.76$)								Nominal bore diameter	
C2		Normal		C3		C4		d mm	
min	max	min	max	min	max	min	max	over	incl.
20	70	70	120	130	180	180	230	80	100
20	70	70	120	150	200	210	260	100	120
20	70	70	120	160	210	210	260	120	140
30	100	100	160	180	240	240	300	140	160
40	110	110	180	200	270	280	340	160	180
50	120	120	190	230	300	310	380	180	200
60	140	140	200	260	340	340	420	200	225
80	160	170	260	290	380	380	470	225	250
90	190	190	280	320	420	430	520	250	280
90	200	200	310	360	470	470	580	280	315
100	220	230	350	400	510	520	630	315	355
120	260	260	400	450	590	590	730	355	400
140	280	280	420	510	640	650	780	400	500
160	310	310	460	530	650	680	820	500	630
180	350	350	520	590	760	760	930	630	800

Table 5.8 Axial internal clearance of double row and duplex tapered roller bearings (inch series)
Table 5.8 (1) contact angle $\alpha < 12^\circ$

Unit μm

Nominal bore❶ diameter d mm		Contact angle $\alpha < 12^\circ$ ($e < 0.32$)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
63.5	127	55	165	290	400	400	510	510	620
127	203.2	85	230	320	470	470	620	620	770
203.2	304.8	140	320	370	550	550	730	730	910
304.8	406.4	200	420	660	880	880	1,100	1,100	1,320
406.4	508	260	520	710	970	970	1,230	1,230	1,490
508	609.6	340	640	790	1,090	1,090	1,390	1,390	1,690
609.6	711.2	430	780	1,120	1,470	1,470	1,820	1,820	2,170
711.2	762	-	-	-	-	-	-	-	-
762	914.4	-	-	-	-	-	-	-	-

❶ Nominal bore diameter is the minimum size among the same series.
Note: This table shows **NTN** standard clearances.

Table 5.8 (2) $12^\circ \leqq$ contact angle $\alpha < 15^\circ$

Unit μm

Nominal bore❶ diameter d mm		$12^\circ \leqq$ Contact angle $\alpha < 15^\circ$ ($0.32 \leqq e < 0.40$)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
63.5	127	45	135	240	330	330	420	420	510
127	203.2	70	190	270	390	390	510	510	630
203.2	304.8	120	270	310	460	460	610	610	760
304.8	406.4	160	340	550	730	730	910	910	1,090
406.4	508	210	420	590	800	800	1,010	1,010	1,220
508	609.6	280	530	650	900	900	1,150	1,150	1,400
609.6	711.2	350	640	930	1,220	1,220	1,510	1,510	1,800
711.2	762	420	750	990	1,320	1,320	1,650	1,650	1,980
762	914.4	520	890	1,070	1,440	1,440	1,810	1,810	2,180

❶ Nominal bore diameter is the minimum size among the same series.
Note: This table shows **NTN** standard clearances.

Table 5.8 (3) $15^\circ \leqq$ contact angle $\alpha < 20^\circ$

Unit μm

Nominal bore❶ diameter d mm		$15^\circ \leqq$ Contact angle $\alpha < 20^\circ$ ($0.40 \leqq e < 0.55$)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
63.5	127	35	105	190	260	260	330	330	400
127	203.2	55	155	210	310	310	410	410	510
203.2	304.8	90	210	240	360	360	480	480	600
304.8	406.4	130	270	440	580	580	720	720	860
406.4	508	170	340	470	640	640	810	810	980
508	609.6	220	420	520	720	720	920	920	1,120
609.6	711.2	280	510	740	970	970	1,200	1,200	1,430
711.2	762	340	600	780	1,040	1,040	1,300	1,300	1,560
762	914.4	410	700	850	1,140	1,140	1,430	1,430	1,720

❶ Nominal bore diameter is the minimum size among the same series.
Note: This table shows **NTN** standard clearances.

Table 5.8 (4) 20°≦ contact angle *α* <30°

Unit μm

Nominal bore diameter[1] *d* mm		20° ≦ Contact angle *α* <30° (0.55≦ *e* <0.87)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
63.5	127	30	80	140	190	190	240	240	290
127	203.2	40	110	160	230	230	300	300	370
203.2	304.8	70	160	180	270	270	360	360	450
304.8	406.4	95	195	320	420	420	520	520	620
406.4	508	120	240	350	470	470	590	590	710
508	609.6	160	310	380	530	530	680	680	830
609.6	711.2	210	380	540	710	710	880	880	1,050
711.2	762	250	440	580	770	770	960	960	1,150
762	914.4	300	520	630	850	850	1,070	1,070	1,290

[1] Nominal bore diameter is the minimum size among the same series.
Note: This table shows **NTN** standard clearances.

Table 5.8 (5) 30°≦ contact angle *α*

Unit μm

Nominal bore diameter[1] *d* mm		30° ≦ Contact angle *α* (0.87≦ *e*)							
		C2		Normal		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
63.5	127	15	50	90	125	125	160	160	200
127	203.2	25	70	100	145	145	190	190	240
203.2	304.8	45	100	110	170	170	230	230	290
304.8	406.4	60	130	200	270	270	340	340	410
406.4	508	80	160	220	300	300	380	380	460
508	609.6	100	200	-	-	-	-	-	-
609.6	711.2	130	250	-	-	-	-	-	-
711.2	762	160	290	-	-	-	-	-	-
762	914.4	190	330	-	-	-	-	-	-

[1] Nominal bore diameter is the minimum size among the same series.
Note: This table shows **NTN** standard clearances.

Table 5.9 Radial internal clearance of spherical roller bearings

Nominal bore diameter d mm		Bearing with cylindrical bore									
		C2		Normal		C3		C4		C5	
over	incl.	min	max	min	max	min	max	min	max	min	max
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	500	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1,000
560	630	170	310	310	480	480	650	650	850	850	1,100
630	710	190	350	350	530	530	700	700	920	920	1,190
710	800	210	390	390	580	580	770	770	1,010	1,010	1,300
800	900	230	430	430	650	650	860	860	1,120	1,120	1,440
900	1,000	260	480	480	710	710	930	930	1,220	1,220	1,570
1,000	1,120	290	530	530	780	780	1,020	1,020	1,330	1,330	1,720
1,120	1,250	320	580	580	860	860	1,120	1,120	1,460	1,460	1,870
1,250	1,400	350	640	640	950	950	1,240	1,240	1,620	1,620	2,080
1,400	1,600	400	720	720	1,060	1,060	1,380	1,380	1,800	-	-
1,600	1,800	450	810	810	1,180	1,180	1,550	1,550	2,000	-	-

Note: This table shows **NTN** standard clearances where "d>1,000mm".

Unit μm

Bearing with tapered bore										Nominal bore diameter d mm	
C2		Normal		C3		C4		C5			
min	max	min	max	min	max	min	max	min	max	over	incl.
55	80	80	110	110	140	140	180	180	230	80	100
65	100	100	135	135	170	170	220	220	280	100	120
80	120	120	160	160	200	200	260	260	330	120	140
90	130	130	180	180	230	230	300	300	380	140	160
100	140	140	200	200	260	260	340	340	430	160	180
110	160	160	220	220	290	290	370	370	470	180	200
120	180	180	250	250	320	320	410	410	520	200	225
140	200	200	270	270	350	350	450	450	570	225	250
150	220	220	300	300	390	390	490	490	620	250	280
170	240	240	330	330	430	430	540	540	680	280	315
190	270	270	360	360	470	470	590	590	740	315	355
210	300	300	400	400	520	520	650	650	820	355	400
230	330	330	440	440	570	570	720	720	910	400	450
260	370	370	490	490	630	630	790	790	1,000	450	500
290	410	410	540	540	680	680	870	870	1,100	500	560
320	460	460	600	600	760	760	980	980	1,230	560	630
350	510	510	670	670	850	850	1,090	1,090	1,360	630	710
390	570	570	750	750	960	960	1,220	1,220	1,500	710	800
440	640	640	840	840	1,070	1,070	1,370	1,370	1,690	800	900
490	710	710	930	930	1,190	1,190	1,520	1,520	1,860	900	1,000
530	770	770	1,030	1,030	1,300	1,300	1,670	1,670	2,050	1,000	1,120
570	830	830	1,120	1,120	1,420	1,420	1,830	1,830	2,250	1,120	1,250
620	910	910	1,230	1,230	1,560	1,560	2,000	2,000	2,470	1,250	1,400
680	1,000	1,000	1,350	1,350	1,720	1,720	2,200	-	-	1,400	1,600
750	1,110	1,110	1,500	1,500	1,920	1,920	2,400	-	-	1,600	1,800

6. Lubrication

6.1 Lubrication of rolling bearings

The purpose of bearing lubrication is to prevent direct metallic contact between the various rolling and sliding elements. This is accomplished through the formation of a thin oil (or grease) film on the contact surfaces. For rolling bearings, lubrication also has the following advantages:

(1) Friction and wear reduction
(2) Friction heat dissipation
(3) Prolonged bearing life
(4) Prevention of rust
(5) Protection against harmful elements

In order to achieve the above effects, the most effective lubrication method for the operating conditions must be selected. Also, a good quality, reliable lubricant must be selected. In addition, an effectively designed sealing system that prevents the intrusion of damaging elements (dust, water, etc.) into the bearing interior, removes dust and other impurities from the lubricant, and prevents the lubricant from leaking to the outside, is also a requirement.

Almost all rolling bearings use either grease or oil lubrication methods, but in some special applications, a solid lubricant such as molybdenum disulfide or graphite may be used.

Fig. 6.1 shows the relationship between oil volume, friction loss, and bearing temperature. **Table 6.1** details the characteristics of this relationship.

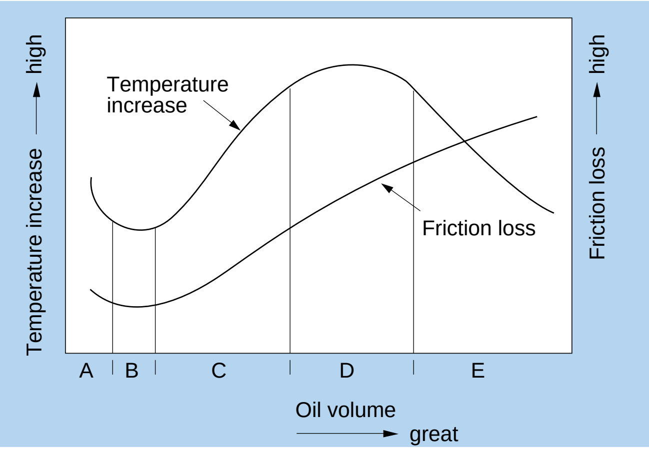


Fig. 6.1

Table 6.1 Oil volume, friction loss, bearing temperature (See Fig. 6.1)

Range	Characteristics	Lubrication method
A	When oil volume is extremely low, direct metallic contact occurs in places between the rolling elements and raceway surfaces. Bearing abrasion and seizing occur.	—
B	A thin oil film develops over all surfaces, friction is minimal and bearing temperature is low.	Grease lubrication, oil mist, air-oil lubrication
C	As oil volume increases, heat buildup is balanced by cooling.	Circulating lubrication
D	Regardless of oil volume, temperature increases at a fixed rate.	Circulating lubrication
E	As oil volume increases, cooling predominates and bearing temperature decreases.	Forced circulation lubrication, Oil jet lubrication

6.2 Characteristics of grease and oil lubricants

Grease and oil are the two general choices for lubrication: it is important to select lubricant with care. Please contact **NTN** Engineering when selecting a lubricant.
The characteristics are show in **table 6.2**.

Table 6.2 Comparison of grease lubrication and oil lubrication characteristics

Concern \ Method	Grease lubrication	Oil lubrication
Handling	◎	△
Reliability	○	◎
Cooling effect	×	○ (Circulation necessary)
Seal structure	○	△
Power loss	○	○
Environment contamination	○	△
High speed rotation	×	○

◎ : Very good ○ : Good △ : Fair × : Poor

6.3 Grease lubrication

Grease type lubricants are relatively easy to handle and require only the simplest sealing devices–for these reasons, grease is the most widely used lubricant for rolling bearings.

6.3.1 Types and characteristics of grease

Lubricating greases are composed of either a mineral oil base or a synthetic oil base. To this base a thickener and other additives are added. The properties of all greases are mainly determined by the kind of base oil used and by the combination of thickening agent and various additives.

Standard greases and their characteristics are listed in **Table 6.3**. As performance characteristics of even the same type of grease will vary widely from brand to brand, it is best to check the manufacturers' data when selecting a grease.

Table 6.3 Grease varieties and characteristics

Grease name	Lithium grease			Sodium grease (fiber grease)	Calcium compound base grease
Thickener	Li soap			Na soap	Ca+Na soap Ca+Li soap
Base oil	Mineral oil	Diester oil	Silicone oil	Mineral oil	Mineral oil
Dropping point ˚C	170 ～ 190	170 ～ 190	200 ～ 250	150 ～ 180	150 ～ 180
Operating temperature range ˚C	-30 ～ +130	-50 ～ +130	-50 ～ +160	-20 ～ +130	-20 ～ +120
Mechanical stability	Excellent	Good	Good	Excellent ～ Good	Excellent ～ Good
Pressure resistance	Good	Good	poor	Good	Excellent ～ Good
Water resistance	Good	Good	Good	Good ～ poor	Good ～ poor
Applications	Widest range of applications. Grease used in all types of rolling bearings.	Excellent low temperature and wear characteristics. Suitable for small sized and miniature bearings.	Suitable for high and low temperatures. Unsuitable for heavy load applications due to low oil film strength.	Some emulsification when water is introduced. Excellent characteristics at relatively high temperatures.	Excellent pressure resistance and mechanical stability. Suitable for bearings receiving shock loads.

Grease name	Aluminum grease	Non-soap base grease Thickener	
Thickener	Al soap	Bentone, silica gel, urea, carbon black, fluorine compounds, etc.	
Base oil	Mineral oil	Mineral oil	Synthetic oil
Dropping point ˚C	70 ～ 90	250 or above	250 or above
Operating temperature range ˚C	-10 ～ +80	-10 ～ +130	-50 ～ +200
Mechanical stability	Good ～ poor	Good	Good
Pressure resistance	Good	Good	Good
Water resistance	Good	Good	Good
Applications	Excellent viscosity characteristics. Suitable for bearings subjected to vibrations.	Can be used in a wide range of low to high temperatures. Shows excellent heat resistance, cold resistance, chemical resistance, and other characteristics when matched with a suitable base oil and thickener. Grease used in all types of rolling bearings.	

6.3.2 Base oil

Natural mineral oil or synthetic oils such as diester oil, silicone oil and fluorocarbon oil are used as grease base oils.

Mainly, the properties of any grease are determined by the properties of the base oil. Generally, greases with a low viscosity base oil are best suited for low temperatures and high speeds; while greases made from high viscosity base oils are best suited for heavy loads.

6.3.3 Thickening agents

Thickening agents are compounded with base oils to maintain the semi-solid state of the grease. Thickening agents consist of two types of bases, metallic soaps and non-soaps. Metallic soap thickeners include: lithium, sodium, calcium, etc.

Non-soap base thickeners are divided into two groups; inorganic (silica gel, bentonite, etc.) and organic (poly-urea, fluorocarbon, etc.).

The various special characteristics of a grease, such as limiting temperature range, mechanical stability, water resistance, etc. depend largely on the type of thickening agent used. For example, a sodium based grease is generally poor in water resistance properties, while greases with bentone, poly-urea and other non-metallic soaps as the thickening agent are generally superior in high temperature properties.

6.3.4 Additives

Various additives are added to greases to improve various properties and efficiency. For example, there are anti-oxidants, high-pressure additives (EP additives), rust preventives, and anti-corrosives.

For bearings subject to heavy loads and/or shock loads, a grease containing high-pressure additives should be used. For comparatively high operating temperatures or in applications where the grease cannot be replenished for long periods, a grease with an oxidation stabilizer is best to use.

6.3.5 Consistency

The consistency of a grease, i.e. the stiffness and liquidity, is expressed by a numerical index.

The NLGI values for this index indicate the relative softness of the grease; the larger the number, the stiffer the grease. The consistency of a grease is determined by the amount of thickening agent used and the viscosity of the base oil. For the lubrication of rolling bearings, greases with the NLGI consistency numbers of 1, 2, and 3 are used.

General relationships between consistency and application of grease are shown in **Table 6.4**.

Table 6.4 Consistency of grease

NLGI Consis-tency No.	JIS (ASTM) Worked penetration	Applications
0	355～385	For centralized greasing use
1	310～340	For centralized greasing use
2	265～295	For general use and sealed bearing use
3	220～250	For general and high temperature use
4	175～205	For special use

6.3.6 Mixing of greases

When greases of different kinds are mixed together, the consistency of the greases will change (usually softer), the operating temperature range will be lowered, and other changes in characteristics will occur. As a general rule, greases with different bases oil, and greases with different thickener agents should never be mixed.

Also, greases of different brands should not be mixed because of the different additives they contain.

However, if different greases must be mixed, at least greases with the same base oil and thickening agent should be selected. But even when greases of the same base oil and thickening agent are mixed, the quality of the grease may still change due to the difference in additives. For this reason, changes in consistency and other qualities should be checked before being applied.

6.3.7 Amount of grease

The amount of grease used in any given situation will depend on many factors relating to the size and shape of the housing, space limitations, bearing's rotating speed and type of grease used.

As a general rule, housings and bearings should be only filled from 30% to 60% of their capacities.

Table 6.5 Bearings space ratio K

Bearing type	Retainer type	K
Ball bearings ❶	Pressed retainer	61
NU-type cylindrical roller bearings ❷	Pressed retainer Machined retainer	50 36
N-type cylindrical roller bearings ❸	Pressed retainer Machined retainer	55 37
Tapered roller bearings	Pressed retainer	46
Spherical roller bearings	Pressed retainer Machined retainer	35 28

❶ Remove 160 series
❷ Remove NU4 series
❸ Remove N4 series

Where speeds are high and temperature rises need to be kept to a minimum, a reduced amount of grease should be used. Excessive amount of grease cause temperature rise which in turn causes the grease to soften and may allow leakage. With excessive grease fills oxidation and deterioration may cause lubricating efficiency to be lowered.

6.4 Solid grease (for bearings with solid grease)

"Solid grease" is a lubricant composed mainly of lubricating grease and ultra-high polymer polyethylene. Solid grease has the same viscosity as grease at normal temperature, but by applying a special heat treatment process, this special grease solidifies retaining a large proportion of the lubricant within the bearing. The result of this solidification is that the grease does not easily leak from the bearing, even when the bearing is subjected to strong vibrations or centrifugal force.

Bearings with solid grease are available in two types: the spot-pack type in which solid grease is injected into the retainer, and the full-pack type in which all empty space around the rolling elements is filled with solid grease.

Spot-pack solid grease is standard for deep groove ball bearings, small diameter ball bearings, and bearing units. Full-pack solid grease is standard for self-aligning ball bearings, self-aligning roller bearings, and needle roller bearings.

Primary advantages:

(1) Clean working environment with minimal grease leakage

(2) Low bearing torque with spot-pack type solid grease

For more details, please refer to the **NTN** special catalog for **Solid grease bearings**.

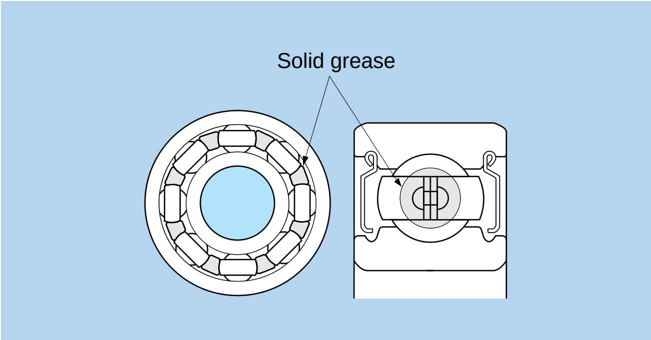


Fig. 6.3 Deep groove ball bearing with spot-pack solid grease (Z shield) (Standard for deep groove ball bearings)

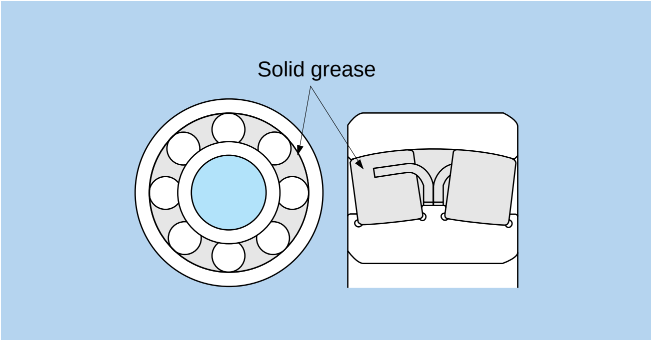
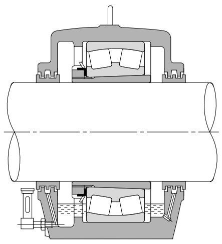
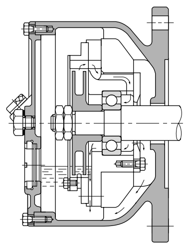
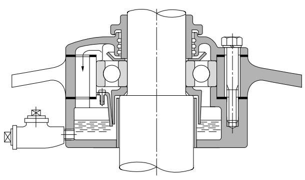
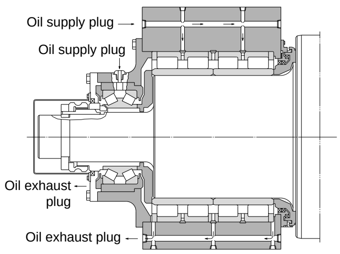
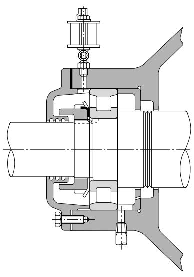
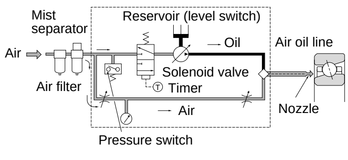
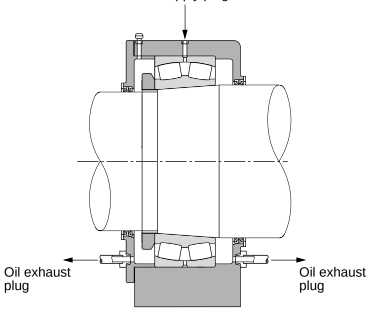
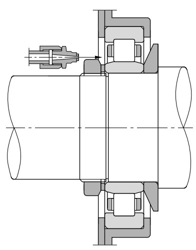


Fig. 6.4 Self-aligning roller bearing with full-pack solid grease (Standard for self-aligning roller bearings)

6.5 Oil lubrication

Oil lubrication is suitable for applications that require bearing-generated heat or heat applied to the bearing from other sources be carried away from the bearing and dissipated to the outside. **Table 6.6** shows the main methods of oil lubrication.

Table 6.6 Oil lubrication methods

Lubrication method	Example	Lubrication method	Example
(Oil bath lubrication) ● Oil bath lubrication is the most generally used method of lubrication and is widely used for low to moderate rotation speed applications. ● For horizontal shaft applications, oil level should be maintained at approximately the center of the lowest rolling element, according to the oil gauge, when the bearing is at rest. For vertical shafts at low speeds, oil level should be maintained at 50 - 80% submergence of the rolling elements.		**(Disc lubrication)** ● In this method, a partially submerged disc rotates and pulls oil up into a reservoir from which it then drains down through the bearing, lubricating it.	
(Oil spray lubrication) ● In this method, an impeller or similar device mounted on the shaft draws up oil and sprays it onto the bearing. This method can be used at considerably high speeds.		**(Oil mist lubrication)** ● Using pressurized air, lubricating oil is atomized before passing through the bearing. ● Due to the low lubricant resistance, this method is well suited to high speed applications.	
(Drip lubrication) ● In this method, oil is collected above the bearing and allowed to drip down into the housing where it becomes a lubricating mist as it strikes the rolling elements. Another version allows only slight amounts of oil to pass through the bearing. ● Used at relatively high speeds for light to moderate load applications. ● In most cases, oil volume is a few drops per minute.		**(Air-oil lubrication)** ● In this method, the required minimum amount of lubricating oil is measured and fed to each bearing at ideal intervals using compressed air. ● With fresh lubricating oil constantly being fed to the bearing, and with the cooling effect of the compressed air, bearing temperature rise can be minimized. ● Because the required oil quantity is infinitesimal, the working environment can be kept clean. Air-oil lubrication units are available from **NTN**.	
(Circulating lubrication) ● Used for bearing cooling applications or for automatic oil supply systems in which the oil supply is centrally located. ● One of the advantages of this method is that oil cooling devices and filters to maintain oil purity can be installed within the system. ● In order for oil to thoroughly lubricate the bearing, oil inlets and outlets must be provided on opposite sides of the bearing.		**(Oil jet lubrication)** ● This method lubricates by injecting oil under high pressure directly into the side of the bearing. This is a reliable system for high speed, high temperature or otherwise severe conditions. ● Used for lubricating the bearings in jet engines, gas turbines, and other high speed equipment. ● Under-race lubrication for machine tools is one example of this type of lubrication.	

6.5.1 Selection of lubricating oil

Under normal operating conditions, **spindle oil**, **machine oil**, **turbine oil**, and other mineral oils are widely used for the lubrication of rolling bearings. However, for temperatures **above 150˚C or below -30˚C**, synthetic oils such as **diester oil**, **silicone oil**, and **fluorocarbon oil** are used.

For lubricating oils, viscosity is one of the most important properties and it determines an oil's lubricating efficiency. If viscosity is too low, formation of the oil film will be insufficient, and damage will occur to the load carrying surfaces of the bearing. If viscosity is too high, viscous resistance will also be great and result in temperature increases and friction loss. In general, for higher speed applications a lower viscosity oil should be used; for heavier load applications, a higher viscosity oil should be used.

In regard to operating temperature and lubrication, **Table 6.7** lists the required oil viscosity for different types of rolling bearings. **Fig. 6.3** is an oil viscosity–operating temperature comparison chart for the purpose of selecting a lubrication oil with viscosity characteristics appropriate to an application.

Table 6.8 lists the selection standards for lubricating oil viscosity with reference to bearing operating conditions.

Table 6.7 Required lubricating oil viscosity for bearings

Bearing type	Dynamic viscosity mm^2/s
Ball bearings, Cylindrical roller bearings, Needle roller bearings	13
Self-aligning roller bearings, Tapered roller bearings, Needle roller thrust bearings	20
Self-aligning roller thrust bearings	30

6.5.2 Oil quantity

In forced oil lubrication systems, the heat radiated away by the housing and surrounding parts plus the heat carried away by the lubricating oil is approximately equal to the amount of heat generated by the bearing and other sources.

For standard housing applications, the quantity of oil required can be found by formula (6.2).

$$Q = K \cdot q \quad \cdots\cdots (6.2)$$

where,

Q: Quantity of oil for one bearing cm^3/min.
K: Allowable oil temperature rise factor (**Table 6.9**)
q: Minimum oil quantity cm^3/min. (**Fig. 6.4**)

Because the amount of heat radiated will vary according to the type of housing, for actual operation it is advisable that the quantity of oil calculated by formula (6.2) be multiplied by a factor or 1.5 or 2.0. Then, the amount of oil can be adjusted to correspond to actual operating conditions.

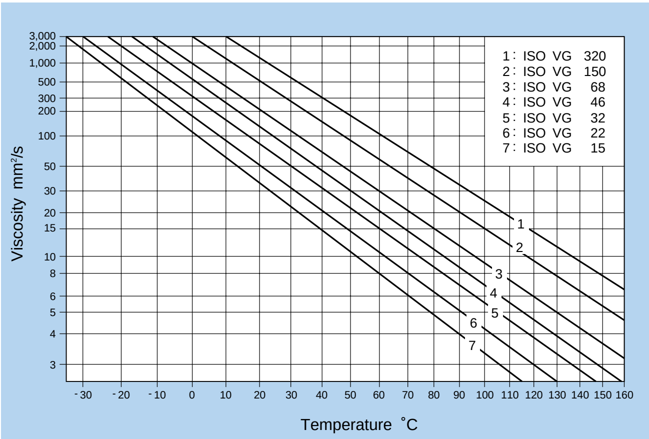


Fig. 6.3 Relation between lubricating oil viscosity and temperature

Table 6.8 Selection standards for lubricating oils (reference)

Bearing operating temperature ˚C	dn-value	Lubricating oil ISO viscosity grade (VG)		Suitable bearing
		Normal load	Heavy load or shock load	
−30〜 0	Up to allowable speed limiting	22, 32	46	All types
0〜 60	15,000 Up to	46, 68	100	All types
	15,000 〜80,000	32, 46	68	All types
	80,000 〜150,000	22, 32	32	All types but thrust ball bearings
	150,000〜500,000	10	22, 32	Single row radial ball bearings, cylindrical roller bearings
60〜100	15,000 Up to	150	220	All types
	15,000 〜80,000	100	150	All types
	80,000 〜150,000	68	100, 150	All types but thrust ball bearings
	150,000〜500,000	32	68	Single row radial ball bearings, cylindrical roller bearings
100 〜150	Up to allowable speed limiting	320		All types
0〜 60	Up to allowable speed limiting	46, 68		Self-aligning roller bearings
60〜100	Up to allowable speed limiting	150		

Notes: 1. Applied when lubrication method is either oil bath or circulating lubrication.
2. Please consult **NTN** Engineering in cases where operating conditions fall outside the range covered by this table.

Table 6.9 Factor K

Expelled oil temp minus supplied oil temp ˚C	K
10	1.5
15	1
20	0.75
25	0.6

Furthermore, if it is assumed for calculation purposes that no heat is radiated by the housing, and that all bearing heat is removed by the oil, then the value in **Fig. 6.3** for shaft diameter, d = 0, regardless of actual shaft diameter.

(Example) For tapered roller bearing **30220U** mounted on a flywheel shaft with a radial load of 9.5 kN (969 kgf), operating at 1,800 min^{-1}, what is the amount of lubricating oil required to keep the bearing temperature rise below 15˚C.

d = 100 mm,
dn = 100×1,800=18×10^4
From **Fig. 6.4** q = 180cm^3 / min
Assume the bearing temperature is approximately equal to the expelled oil temperature,
from **Table 6.9**, since K = 1
Q=1×180=180cm^3 / min

6.5.3 Relubrication intervals

The intervals at which lubricating oil should be changed varies depending upon operating conditions, oil quantity, and type of oil used. In general, for oil bath lubrication where the operating temperature is 50˚C or less, oil should be replaced once a year. When the operating temperature is between 80˚C – 100˚C, oil should be replaced at least every three months. For important equipment, it is advisable that lubricating efficiency and oil purity deterioration be checked regularly to determine when oil replacement is necessary.

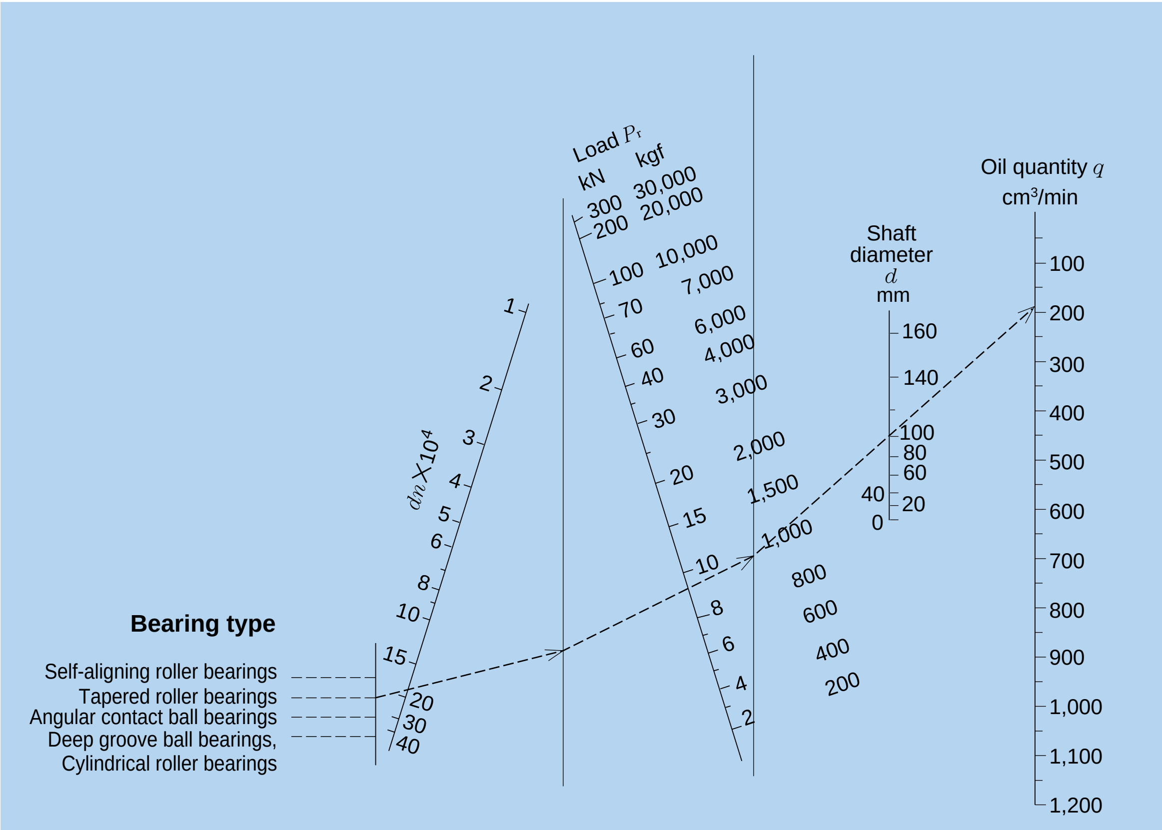


Fig. 6.4 Oil quantity guidelines

7. Bearing Materials

7.1 Raceway and rolling element materials

While the contact surfaces of a bearing's raceways and rolling elements are subjected to repeated heavy stress, they still must maintain high precision and rotational accuracy. To accomplish this, the raceways and rolling elements must be made of a material that has high hardness, is resistant to rolling fatigue, is wear resistant, and has good dimensional stability. The most common cause of fatigue cracking in bearings is the inclusion of non-metallic impurities in the steel. By using pure materials low in these non-metallic impurities, the rolling fatigue life of the bearing is lengthened.

For all **NTN** bearings, steel low in oxygen content and non-metallic impurities, then refined by a vacuum degassing process as well as outside hearth smelting, is used. For bearings requiring especially high reliability and long life, steels of even higher in purity, such as vacuum smelted steel (VIM, VAR, CEVM) and electro-slag melted steel (ESR), are used.

1) High/mid carbon alloy steel

In general, steel varieties which can be hardened not just on the surface but also deep hardened by the so-called "through hardening method" are used for the raceways and rolling elements of bearings. Foremost among these is high carbon chromium bearing steel, which is widely used. For large type bearings and bearings with large cross sectional dimensions, induction hardened bearing steel incorporating manganese or molybdenum is used. Also in use is mid-carbon chromium steel incorporating silicone and manganese, which gives it hardening properties comparable to high carbon chromium steel.

2) Case hardened (carburized) steel

Because of its combination of a hard surface layer which has been carburized and hardened to an appropriate depth, and a relatively pliable inner core, case hardened steel has excellent efficiency against shock loads. **NTN** uses case hardened steel for almost all of its tapered roller bearings. In terms of case hardened steel for **NTN**'s other bearings, chromium steel and chrome molybdenum steel are used for small to medium sized bearings, and nickel chrome molybdenum steel is used for large sized bearings.

3) Heat resistant bearing steel

When bearings made of ordinary high carbon chromium steel which have undergone standard heat treatment are used at temperatures above 120˚C for long durations, unacceptably large dimensional changes can occur. For this reason, a dimension stabilizing treatment (TS treatment) has been devised for very high temperature applications. Through application of this dimension stabilizing treatment, shortening of rolling fatigue life due to decreases in bearing hardness at high temperatures can be avoided. (refer to page insert A-6 1.3.2)

For standard high temperature bearings used at temperatures from 150˚C – 200˚C, the addition of silicone to the steel improves heat resistance and results in a bearing with excellent rolling fatigue life with minimal dimensional change or softening at high temperatures.

A variety of heat resistant steels are also incorporated in bearings to minimize softening and dimensional changes when used at high temperatures. Two of these are high speed molybdenum steel and high speed tungsten steel. For bearings requiring heat resistance in high speed applications, there is also heat resistant case hardening molybdenum steel.

4) Corrosion resistant bearing steel

For applications requiring high corrosion resistance, stainless steel is used. To achieve this corrosion resistance a large proportion of the alloying element chrome is added to martensite stainless steel.

5) Induction hardened steel

Besides the use of surface hardening steel, induction hardening is also utilized for bearing raceway surfaces, and for this purpose mid-carbon steel is used for its lower carbon content instead of through hardened steel. For induction hardening of the deep layers required for larger bearings and bearings with large surface dimensions, mid-carbon steel is fortified with chrome and molybdenum.

6) Other bearing materials

For ultra high speed applications and applications requiring very high level corrosion resistance, ceramic bearing materials such as Si_3N_4 are also available.

7.2 Cage materials

Bearing cage materials must have the strength to withstand rotational vibrations and shock loads. These materials must also have a low friction coefficient, be light weight, and be able to withstand bearing operation temperatures.

For small and medium sized bearings, pressed cages of cold or hot rolled steel with a low carbon content of approx. 0.1% are used. However, depending on the application, austenitic stainless steel is also used.

For large bearings, machined cages of machine structural carbon steel or high tensile cast brass are widely used, although aluminum alloy and other material cages are also available.

For aircraft engine bearings, high tensile brass, mid-carbon nickel, chrome, or molybdenum steel is used after undergoing various heat treatments and high temperature tempering. The sliding properties of these materials may also be enhanced when silver plated.

Injection molded plastic cages are now widely used: most are made from fiberglass reinforced heat resistant polyamide resin. Plastic cages are light weight, corrosion resistant and have excellent damping and sliding properties. Heat resistant polyamide resins now enable the production of cages that perform well in applications ranging between -40˚C – 120˚C. However, they are not recommended for use at temperatures exceeding 120˚C.

MEMO

General Bearings

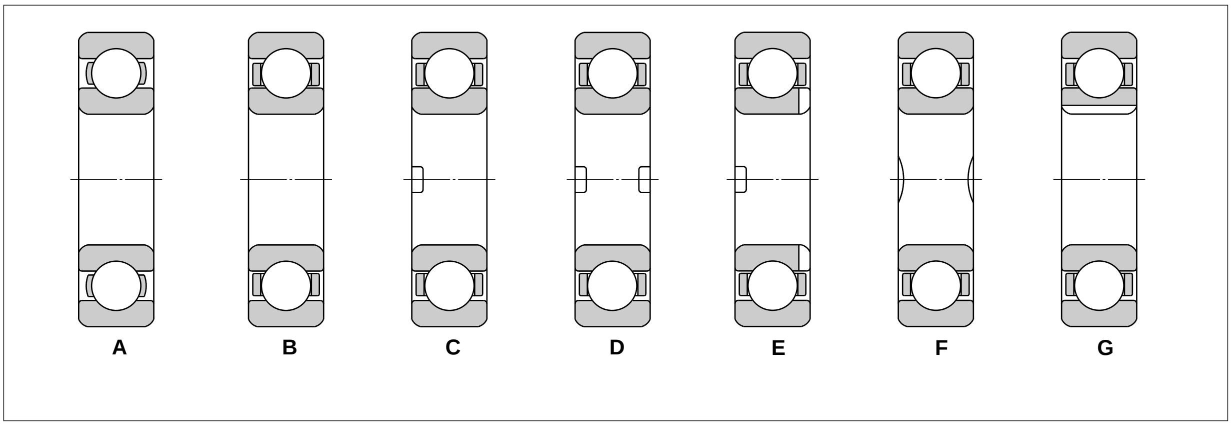
INDEX OF BEARING TABLES

Deep Groove Ball Bearings

1. Structure and Characteristics

A widely used bearing, the deep groove ball bearing takes its name from the track formed on both the inner and outer rings of the bearing. The bearings can sustain radial and axial loads and the resultant forces of these loads and they are suitable for high speed operation.

The dimensional table below represents the various cage models and special shapes. **Drawing A** is the pressed cage; **drawing B** shows the machined cage; **drawings C** through **F** show the position and shape of the notch on the inner ring; and **drawing G** shows a bearing with the key groove on the inner ring. Pressed cages are generally used, though machined cages are used for larger sized bearings, or bearings for high speed rotation.



Deep groove ball bearings drawing

2. Dimensional Accuracy/Rotation Accuracy

Refer to Table 3.3 (Page A-12)

3. Recommended Fitting

Refer to Table 4.2 (Page A-24)

4. Bearing Internal Clearance

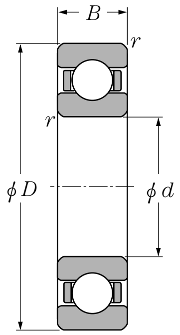
Refer to Table 5.2 (Page A-30)

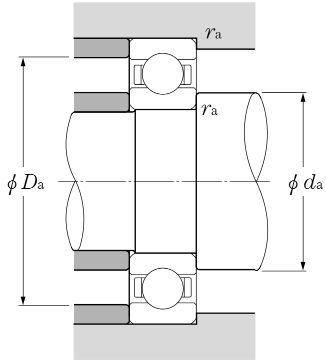
5. Permissible slant angle

0.0006-0.003 radian

6. General Operating Cautions

Slippage between the balls and raceways may occur when bearings are operated under small loads (about $F_r \leqq 0.01C_{or}$) and may cause smearing. This is most apparent when using large size deep groove ball bearings due to the large cage mass. Please consult **NTN** Engineering for further details.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

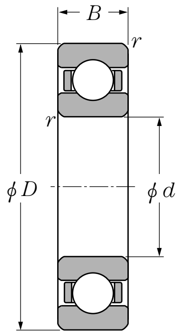
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18				2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29	1	0	0.56	1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

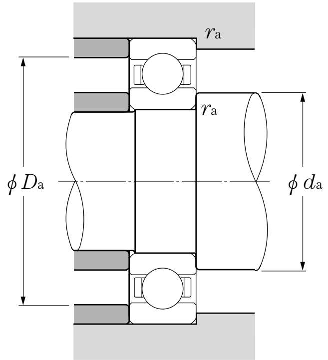
static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 100～140mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ [2]	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing No. [1]	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
100	125	13	1	19.6	21.2	2,000	2,160	**6820**	A	105	120	1	0.31
	140	20	1.1	41	39.5	4,200	4,050	**6920**	A	106.5	133.5	1	0.78
	150	16	1	35	36.5	3,600	3,750	**16020**	A	105	145	1	0.91
	150	24	1.5	60	54	6,150	5,500	**6020**	A	108	142	1.5	1.15
	180	34	2.1	122	93	12,500	9,450	**6220**	A	111	169	2	3.14
	215	47	3	173	141	17,600	14,400	**6320**	A	113	202	2.5	7
105	130	13	1	19.8	22	2,020	2,240	**6821**	A	110	125	1	0.33
	145	20	1.1	42.5	42	4,300	4,300	**6921**	A	111.5	138.5	1	0.81
	160	18	1	52	50.5	5,300	5,150	**16021**	A	110	155	1	1.2
	160	26	2	72.5	65.5	7,400	6,700	**6021**	A	114	151	2	1.59
	190	36	2.1	133	105	13,600	10,700	**6221**	A	116	179	2	3.7
	225	49	3	184	153	18,700	15,700	**6321**	A	118	212	2.5	8.05
110	140	16	1	24.9	28.2	2,540	2,880	**6822**	A	115	135	1	0.51
	150	20	1.1	43.5	44.5	4,450	4,550	**6922**	A	116.5	143.5	1	0.85
	170	19	1	57.5	56.5	5,850	5,800	**16022**	A	115	165	1	1.46
	170	28	2	82	73	8,350	7,450	**6022**	A	119	161	2	1.96
	200	38	2.1	144	117	14,700	11,900	**6222**	A	121	189	2	4.36
	240	50	3	205	179	20,900	18,300	**6322**	A	123	227	2.5	9.54
120	150	16	1	28.9	33	2,950	3,350	**6824**	A	125	145	1	0.55
	165	22	1.1	53	54	5,400	5,500	**6924**	A	126.5	158.5	1	1.15
	180	19	1	63	63.5	6,450	6,450	**16024**	A	125	175	1	1.56
	180	28	2	85	79.5	8,650	8,100	**6024**	A	129	171	2	2.07
	215	40	2.1	155	131	15,900	13,400	**6224**	A	131	204	2	5.15
	260	55	3	207	185	21,100	18,800	**6324**	A	133	247	2.5	12.4
130	165	18	1.1	37	41	3,750	4,200	**6826**	A	136.5	158.5	1	0.8
	180	24	1.5	65	67.5	6,650	6,850	**6926**	A	138	172	1.5	1.52
	200	22	1.1	80	79.5	8,150	8,100	**16026**	A	136.5	193.5	1	2.31
	200	33	2	106	101	10,800	10,300	**6026**	A	139	191	2	3.16
	230	40	3	167	146	17,000	14,900	**6226**	A	143	217	2.5	5.82
	280	58	4	229	214	23,400	21,800	**6326**	A	146	264	3	15.3
140	175	18	1.1	38.5	44.5	3,900	4,550	**6828**	A	146.5	168.5	1	0.85
	190	24	1.5	66.5	71.5	6,800	7,300	**6928**	A	148	182	1.5	1.62
	210	22	1.1	82	85	8,350	8,650	**16028**	A	146.5	203.5	1	2.45
	210	33	2	110	109	11,200	11,100	**6028**	A	149	201	2	3.35

[1] Drawing details are shown in Page B-5.
[2] Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

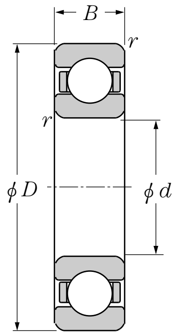
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

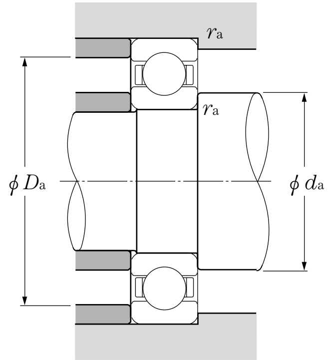
static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 140～180mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ ❷	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing❶ No.	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
140	250	42	3	166	150	17,000	15,300	6228	A	153	237	2.5	7.57
	300	62	4	253	246	25,800	25,100	6328	A	156	284	3	18.5
145	220	38	2.5	126	115	12,800	11,800	SC2951	B	157	208	2	5.07
150	190	20	1.1	47.5	55	4,850	5,600	6830	A	156.5	183.5	1	1.16
	210	28	2	85	90.5	8,650	9,200	6930	A	159	201	2	2.47
	225	24	1.1	96.5	101	9,850	10,300	16030	A	156.5	218.5	1	3.07
	225	35	2.1	126	126	12,800	12,800	6030	A	161	214	2	4.08
	230	35	2.5	120	118	12,300	12,100	SC3002	C	162	218	2	5.18
	230	35	2.5	120	118	12,300	12,100	SC3007	G	162	218	2	5.18
	270	45	3	176	168	18,000	17,100	6230	A	163	257	2.5	9.41
	320	65	4	274	284	28,000	28,900	6330	A	166	304	3	22
160	200	20	1.1	48.5	57	4,950	5,800	6832	A	166.5	193.5	1	1.23
	220	28	2	87	96	8,850	9,800	6932	A	169	211	2	2.61
	229.5	33	2.5	108	111	11,000	11,300	SC3209	B	172	218	2	4.35
	229.5	36	2.5	120	119	12,200	12,100	SC3207	B	172	218	2	4.75
	230	33	2.5	108	111	11,000	11,300	SC3210	B	172	218	2	4.39
	240	25	1.5	99	108	10,100	11,000	16032	A	168	232	1.5	3.64
	240	38	2.1	143	144	14,500	14,700	6032	A	171	229	2	5.05
	290	48	3	185	186	18,900	19,000	6232	A	173	277	2.5	11.7
	340	68	4	278	286	28,300	29,200	6332	A	176	324	3	26
170	215	22	1.1	60	70.5	6,100	7,200	6834	A	176.5	208.5	1	1.63
	230	28	2	86	95.5	8,750	9,750	6934	A	179	221	2	2.74
	260	28	1.5	119	128	12,100	13,100	16034	A	178	252	1.5	4.93
	260	42	2.1	168	172	17,200	17,600	6034	A	181	249	2	6.76
	310	52	4	212	223	21,700	22,800	6234	A	186	294	3	14.5
	360	72	4	325	355	33,500	36,000	6334	A	186	344	3	30.7
180	225	22	1.1	60.5	73	6,200	7,450	6836	B	186.5	218.5	1	2.03
	250	33	2	110	119	11,200	12,200	6936	B	189	241	2	4.76
	265	33	2.5	113	127	11,500	13,000	SC3605	B	192	253	2	6.08
	280	31	2	117	134	11,900	13,600	16036	A	189	271	2	6.49
	280	46	2.1	189	199	19,300	20,300	6036	A	191	269	2	8.8
	320	52	4	227	241	23,200	24,600	6236	A	196	304	3	15.1
	380	75	4	355	405	36,000	41,500	6336	A	196	364	3	35.6

❶ Drawing details are shown in Page B-5.
❷ Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

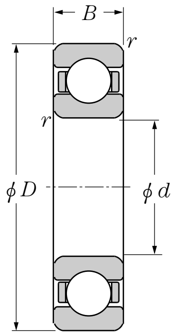
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

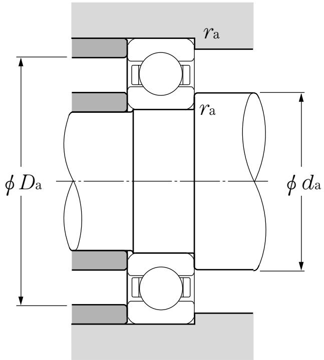
static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 190～260mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing[1] No.	Abutment and fillet dimensions (mm)			Mass kg
d	D	B	$r_{s\,min}$[2]	C_r	C_{or}	C_r	C_{or}			d_a min	D_a max	r_{as} max	(approx.)
190	240	24	1.5	73	88	7,450	9,000	**6838**	B	198	232	1.5	2.62
	260	33	2	113	127	11,500	13,000	**6938**	B	199	251	2	4.98
	269.5	33	2.5	117	134	11,900	13,600	**SC3805**	G	202	258	2	5.87
	290	31	2	134	156	13,700	15,900	**16038**	A	199	281	2	6.77
	290	46	2.1	197	215	20,100	21,900	**6038**	A	201	279	2	9.18
	340	55	4	255	281	26,000	28,700	**6238**	A	206	324	3	18.2
	400	78	5	355	415	36,000	42,500	**6338**	A	210	380	4	41
195	270	35	2.5	130	147	13,300	15,000	**SC3904**	B	207	258	2	5.94
200	250	24	1.5	74	91.5	7,550	9,300	**6840**	B	208	242	1.5	2.73
	280	38	2.1	157	168	16,000	17,100	**6940**	B	211	269	2	7.1
	310	34	2	142	160	14,400	16,300	**16040**	A	209	301	2	8.68
	310	51	2.1	218	243	22,200	24,800	**6040**	A	211	299	2	11.9
	360	58	4	269	310	27,400	31,500	**6240**	A	216	344	3	21.6
	420	80	5	410	500	42,000	51,000	**6340**	A	220	400	4	46.3
220	270	24	1.5	76.5	98	7,800	10,000	**6844**	B	228	262	1.5	3
	300	38	2.1	160	180	16,400	18,400	**6944**	B	231	289	2	7.69
	309.5	38	2.5	176	202	18,000	20,600	**SC4401**	B	232	298	2	8.77
	319.5	46	2.5	193	220	19,700	22,400	**SC4405**	B	232	308	2	12
	340	37	2.1	181	216	18,500	22,000	**16044**	A	231	329	2	11.3
	340	56	3	241	289	24,600	29,400	**6044**	A	233	327	2.5	15.7
	400	65	4	297	365	30,500	37,000	**6244**	A	236	384	3	30.2
	460	88	5	410	520	42,000	53,000	**6344**	A	240	440	4	60.8
230	329.5	40	2.5	191	227	19,500	23,100	**SC4605**	B	242	318	2	10.8
	339.5	45	3	224	266	22,800	27,200	**SC4609**	G	244	326	2.5	13.7
240	300	28	2	85	112	8,650	11,400	**6848**	B	249	291	2	4.6
	320	38	2.1	170	203	17,300	20,700	**6948**	B	251	309	2	8.28
	360	37	2.1	178	217	18,200	22,100	**16048**	A	251	349	2	12.1
	360	56	3	249	310	25,400	32,000	**6048**	A	253	347	2.5	16.8
	440	72	4	360	470	36,500	48,000	**6248**	B	258	422	3	51.7
	500	95	5	440	590	45,000	60,000	**6348**	B	262	478	4	93.6
250	349.5	46	2.5	214	262	21,800	26,700	**SC5003**	B	262	338	2	13.4
260	320	28	2	87	120	8,900	12,200	**6852**	B	269	311	2	5

❶ Drawing details are shown in Page B-5.
❷ Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

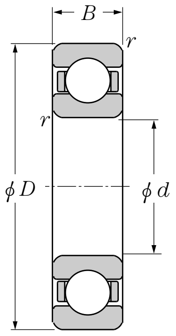
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

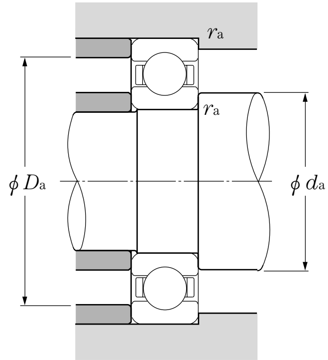
static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 260～340mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ [2]	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing[1] No.	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
260	360	46	2.1	222	280	22,600	28,500	**6952**	B	271	349	2	13.9
	379.5	56	4	253	320	25,800	32,500	**SC5206**	G	278	362	3	20.8
	400	44	3	227	299	23,200	30,500	**16052**	A	273	387	2.5	18.5
	400	65	4	291	375	29,700	38,500	**6052**	A	276	384	3	25
	480	80	5	400	540	41,000	55,000	**6252**	B	282	458	4	65.7
	540	102	6	505	710	51,500	72,500	**6352**	B	288	512	5	116
280	350	33	2	137	177	13,900	18,100	**6856**	B	289	341	2	7.4
	360	38	2.5	147	191	14,900	19,500	**SC5605**	B	292	348	2	9.47
	380	46	2.1	227	299	23,200	30,500	**6956**	B	291	369	2	14.8
	420	44	3	232	315	23,700	32,500	**16056**	B	293	407	2.5	23
	420	65	4	325	420	33,000	43,000	**6056**	B	296	404	3	31
	500	80	5	440	600	44,500	61,000	**6256**	B	302	478	4	70.9
	580	108	6	530	760	54,000	77,500	**6356**	B	308	552	5	142
290	419.5	60	5	277	375	28,300	38,500	**SC5803**	G	312	398	4	26.8
300	380	38	2.1	162	210	16,500	21,500	**6860**	B	311	369	2	10.5
	420	56	3	276	375	28,200	38,500	**6960**	B	313	407	2.5	23.5
	460	50	4	292	410	29,800	42,000	**16060**	B	316	444	3	32.5
	460	74	4	355	480	36,000	49,000	**6060**	B	316	444	3	43.8
	540	85	5	465	670	47,500	68,500	**6260**	B	322	518	4	88.9
310	429.5	60	4	275	380	28,000	38,500	**SC6201**	B	328	412	3	25.8
	450	50	4	286	420	29,200	42,500	**SC6203**	B	328	432	3	25.9
320	400	38	2.1	168	228	17,200	23,200	**6864**	B	331	389	2	10.9
	440	56	3	285	405	29,000	41,000	**6964**	B	333	427	2.5	24.8
	449.5	56	3	276	395	28,200	40,500	**SC6406**	B	334	436	2.5	27.6
	470	70	4	330	475	34,000	48,500	**SC6403**	B	338	452	3	40.4
	480	50	4	300	440	30,500	45,000	**16064**	B	336	464	3	34.2
	480	74	4	370	530	38,000	54,000	**6064**	B	336	464	3	46.1
	580	92	5	530	805	54,500	82,500	**6264**	B	342	558	4	110
340	420	38	2.1	170	236	17,400	24,000	**6868**	2	351	409	2	11.5
	460	56	3	293	430	29,800	44,000	**6968**	B	353	447	2.5	26.2
	489.5	60	5	290	435	29,600	44,000	**SC6802**	B	362	468	4	36.2
	520	57	4	340	515	35,000	52,500	**16068**	B	356	504	3	47.1
	520	82	5	420	610	42,500	62,500	**6068**	B	360	500	4	61.8

[1] Drawing details are shown in Page B-5.
[2] Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

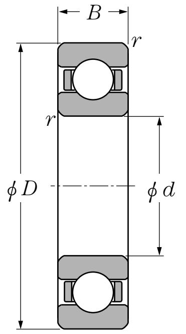
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

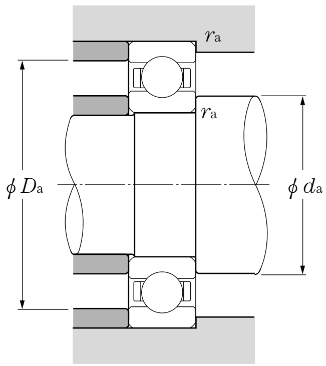
static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 340～480mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ ❷	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing❶ No.	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
340	620	92	6	530	820	54,000	83,500	**6268**	B	368	592	5	129
355.6	469.9	57.15	5	233	340	23,800	34,500	**SC7101**	B	377.5	448	4	26.3
360	440	38	2.1	187	258	19,100	26,300	**6872**	B	371	429	2	12.3
	480	56	3	300	455	30,500	46,500	**6972**	B	373	467	2.5	27.5
	509.5	70	5	340	515	34,500	52,500	**SC7205**	B	382	488	4	45
	540	57	4	350	550	36,000	56,000	**16072**	B	376	524	3	49.3
	540	82	5	440	670	44,500	68,000	**6072**	B	380	520	4	64.7
	650	95	6	555	905	57,000	92,000	**6272**	B	388	622	5	145
380	480	46	2.1	231	340	23,600	34,500	**6876**	B	391	469	2	19.7
	520	65	4	325	510	33,000	52,000	**6976**	B	396	504	3	39.8
	560	57	4	360	590	37,000	60,000	**16076**	B	398	542	3	50.1
	560	82	5	455	725	46,500	74,000	**6076**	B	400	540	4	67.5
400	500	46	2.1	226	340	23,100	34,500	**6880**	B	411	489	2	20.6
	540	65	4	335	535	34,000	54,500	**6980**	B	416	524	3	41.6
	600	63	5	370	620	38,000	63,000	**16080**	B	422	578	4	65.8
	600	90	5	510	825	52,000	84,000	**6080**	B	420	580	4	87.6
	720	130	6	610	1,080	62,000	110,000	**SC8002**	D	428	692	5	226
420	520	46	2.1	260	405	26,500	41,500	**6884**	B	431	509	2	21.6
	560	65	4	340	560	35,000	57,000	**6984**	B	436	544	3	43.4
	620	90	5	530	895	54,000	91,000	**6084**	B	440	600	4	91.1
440	540	46	2.1	264	420	26,900	43,000	**6888**	B	451	529	2	22.5
	599	80	4	425	720	43,000	73,500	**SC8803**	B	458	581	3	64
	600	74	4	365	615	37,500	63,000	**6988**	B	456	584	3	60
	650	94	6	525	900	53,500	92,000	**6088**	B	468	622	5	104
450	629	80	4	435	770	44,500	78,500	**SC9001**	F	468	611	3	76
460	580	56	3	315	515	32,000	52,500	**6892**	B	473	567	2.5	34.8
	620	74	4	375	645	38,500	66,000	**6992**	B	476	604	3	62.2
	680	100	6	605	1,080	62,000	110,000	**6092**	B	488	652	5	122
480	600	56	3	320	540	32,500	55,000	**6896**	B	493	587	2.5	36.2
	650	78	5	430	770	44,000	78,500	**6996**	B	500	630	4	73

❶ Drawing details are shown in Page B-5.
❷ Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

static

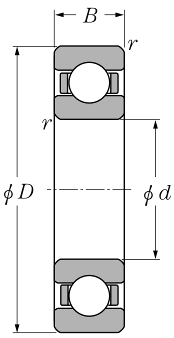
$P_{or} = 0.6F_r + 0.5F_a$

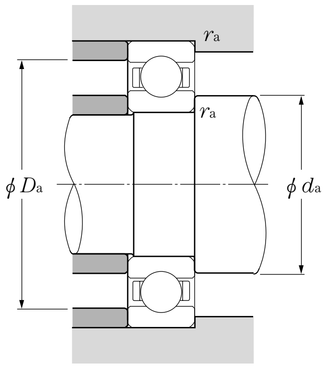
When $P_{or} < F_r$ use $P_{or} = F_r$

d 480～710mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ [2]	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing [1] No.	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
480	700	100	6	605	1,090	61,500	111,000	**6096**	B	508	672	5	126
500	620	56	3	325	560	33,500	57,000	**68/500**	B	513	607	2.5	37.5
	670	78	5	445	805	45,500	82,500	**69/500**	B	520	650	4	75.5
	689	100	5	545	980	55,500	100,000	**SC10006**	B	522	667	4	103
	720	100	6	630	1,170	64,000	120,000	**60/500**	B	528	692	5	130
520	719	100	5	560	1,050	57,000	107,000	**SC10403**	B	542	697	4	118
530	650	56	3	330	580	34,000	59,500	**68/530**	B	543	637	2.5	39.5
	710	82	5	455	845	46,500	86,000	**69/530**	B	552	688	4	89.1
	780	112	6	645	1,270	66,000	129,000	**60/530**	B	558	752	5	178
560	680	56	3	335	600	34,000	61,500	**68/560**	B	573	667	2.5	41.5
	750	85	5	525	1,020	53,500	104,000	**69/560**	B	582	728	4	103
	820	115	6	705	1,410	72,000	143,000	**60/560**	B	588	792	5	200
570	790	115	6	705	1,400	72,000	143,000	**SC11401**	B	598	762	5	166
600	730	60	3	375	705	38,500	72,000	**68/600**	B	613	717	2.5	51.7
	800	90	5	590	1,200	60,500	122,000	**69/600**	B	622	778	4	122
	870	118	6	725	1,510	74,000	154,000	**60/600**	B	628	842	5	228
610	869	120	5	725	1,510	74,000	154,000	**SC12203**	E	632	847	4	223
630	710	69	4	210	395	21,400	40,000	**SC12601**	B	648	692	3	36
	780	69	4	420	820	43,000	84,000	**68/630**	B	648	762	3	71.6
	850	100	6	680	1,450	69,500	148,000	**69/630**	B	658	822	5	158
	920	128	7.5	840	1,770	85,500	181,000	**60/630**	B	666	884	6	280
650	919	118	6	840	1,780	85,500	181,000	**SC13007**	B	678	891	5	246
670	820	69	4	425	850	43,000	86,500	**68/670**	B	688	802	3	75.1
	900	103	6	700	1,530	71,000	156,000	**69/670**	B	698	872	5	181
	980	136	7.5	975	2,120	99,500	216,000	**60/670**	B	706	944	6	336
710	870	74	4	440	910	44,500	92,500	**68/710**	B	728	852	3	91.1
	950	106	6	715	1,600	72,500	163,000	**69/710**	B	738	922	5	205
	1,030	140	7.5	1,020	2,310	104,000	235,000	**60/710**	B	746	994	6	379

[1] Drawing details are shown in Page B-5.
[2] Smallest allowable dimension for chamfer dimension r.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

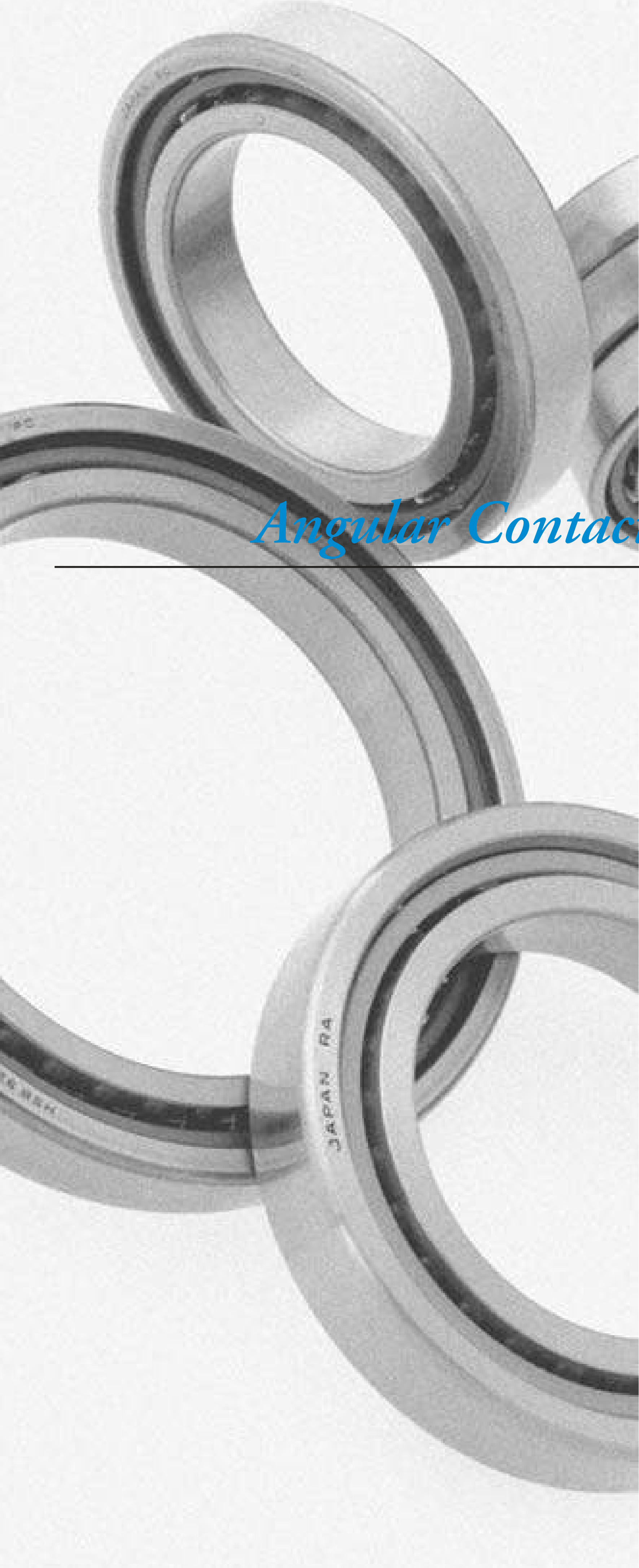
$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.010	0.18	1	0	0.56	2.46
0.020	0.20				2.14
0.040	0.24				1.83
0.070	0.27				1.61
0.10	0.29				1.48
0.15	0.32				1.35
0.20	0.35				1.25
0.30	0.38				1.13
0.40	0.41				1.05
0.50	0.44				1.00

static
$P_{or} = 0.6F_r + 0.5F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$

d 750～1,320mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ [2]	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers	Drawing [1] No.	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max	Mass kg (approx.)
750	920	78	5	485	1,040	49,500	106,000	**68/750**	B	772	898	4	107
	1,000	112	6	725	1,670	74,000	171,000	**69/750**	B	778	972	5	238
	1,070	140	7.5	925	2,210	94,500	225,000	**SC15002**	C	765	1,055	6	403
	1,090	150	7.5	1,050	2,500	107,000	255,000	**60/750**	B	765	1,075	6	457
800	980	82	5	485	1,070	49,500	110,000	**68/800**	B	822	958	4	127
	1,060	115	6	800	1,900	81,500	194,000	**69/800**	B	828	1,032	5	270
	1,150	155	7.5	1,090	2,690	111,000	274,000	**60/800**	B	836	1,114	6	515
820	1,160	160	7.5	1,020	2,540	104,000	259,000	**SC16401**	C	856	1,124	6	524
850	1,030	82	5	500	1,140	51,000	116,000	**68/850**	B	872	1,008	4	135
	1,120	118	6	900	2,240	92,000	228,000	**69/850**	B	878	1,092	5	305
	1,220	165	7.5	1,120	2,880	114,000	294,000	**60/850**	B	886	1,184	6	615
900	1,090	85	5	610	1,450	62,500	148,000	**68/900**	B	922	1,068	4	156
	1,180	122	6	920	2,340	93,500	238,000	**69/900**	B	928	1,152	5	346
	1,280	170	7.5	1,150	3,100	117,000	315,000	**60/900**	B	936	1,244	6	685
950	1,150	90	5	630	1,550	64,500	158,000	**68/950**	B	972	1,128	4	184
	1,250	132	7.5	935	2,430	95,000	248,000	**69/950**	B	986	1,214	6	424
	1,360	180	7.5	1,130	3,050	116,000	310,000	**60/950**	B	986	1,324	6	855
1,000	1,220	100	6	710	1,790	72,000	183,000	**68/1000**	B	1,028	1,192	5	237
	1,320	140	7.5	1,010	2,700	103,000	275,000	**69/1000**	B	1,036	1,284	6	506
	1,420	185	7.5	1,160	3,200	119,000	330,000	**60/1000**	B	1,036	1,384	6	945
1,060	1,280	100	6	730	1,910	74,500	195,000	**68/1060**	B	1,088	1,252	5	250
	1,400	150	7.5	1,200	3,400	122,000	345,000	**69/1060**	B	1,096	1,364	6	610
	1,500	195	9.5	1,190	3,350	121,000	345,000	**60/1060**	B	1,104	1,456	8	1,126
1,120	1,360	106	6	885	2,410	90,500	246,000	**68/1120**	B	1,148	1,332	5	307
	1,460	150	7.5	1,230	3,550	125,000	360,000	**69/1120**	B	1,156	1,424	6	640
	1,580	200	9.5	1,170	3,350	120,000	340,000	**60/1120**	B	1,164	1,536	8	1,258
1,180	1,420	106	6	920	2,580	94,000	264,000	**68/1180**	B	1,208	1,392	5	322
	1,540	160	7.5	1,250	3,700	127,000	375,000	**69/1180**	B	1,216	1,504	6	762
1,250	1,500	112	6	925	2,670	94,500	272,000	**68/1250**	B	1,278	1,472	5	376
1,320	1,600	122	6	1,100	3,300	112,000	335,000	**68/1320**	B	1,348	1,572	5	495

❶ Drawing details are shown in Page B-5.
❷ Smallest allowable dimension for chamfer dimension r.



Angular Contact Ball Bearings

1. Structure and Characteristics

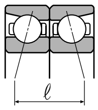
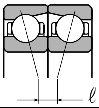
1. 1 Single row angular contact ball bearings / duplex angular contact ball bearings

A line connecting the contact points of both the ball and inner ring and ball and outer ring forms an angle to a line drawn radially: that angle is called the contact angle.

An angular contact ball bearing, while designed for radial loads, can accommodate single direction axial loads. Under radial loads and the resulting axial force component, the bearings are generally used in a duplex arrangement. More information on types and characteristics of duplexed angular contact ball bearings is shown in **Table 1**.

Cage types and special features of single and multi–row angular contact ball bearings are show in **Fig.1**. **Drawings A** through **F** feature the inner ring guide cage. **Drawings B** and **C** illustrate cages with lubrication ports. **Drawings D** and **E** feature a rolling element guide cage: **E** also shows the cage with a lubrication port. Note that the inner ring width in **drawing F** is larger than that of the outer ring.

Table 1 Duplex angular contact ball bearings

Arrangement type		Characteristics	
Back-to-back duplex arrangement (Code: DB)		These bearings support the radial loads and both direction of axial loads.	● Since the distance "l" between the cone pressure apexes of bearing is large, the load capacity of the moment load is high. ● Permissible slant angle is small.
Face-to-face duplex arrangement (Code: DF)			● The distance "l" between the cone pressure apexes of bearing is small in comparison with the back-to-back duplex arrangement, the load capacity of the moment load is low. ● Permissible slant angle is larger than the back-to-back duplex arrangement type.

Notes: 1. Since the bearings are manufactured in a set to adjust for the internal clearance or pre-loading, **parts with same serial number must be used for assembly**.
2. Combination of more than 3 bearings may occur. Please consult **NTN Engineering** for details.

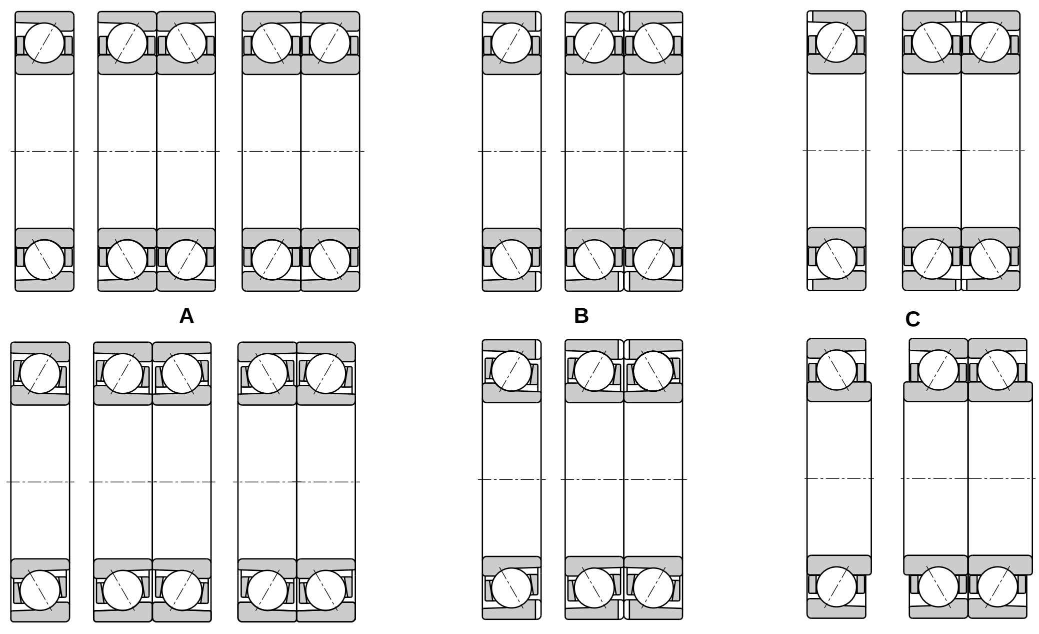


Fig.1 Single row/duplex angular contact ball bearings

1. 2 Double row angular contact ball bearings

Two single row angular contact ball bearings when duplexed back-to-back (DB) so that the inner ring forms one piece are used to create double row angular contact ball bearings. Alternatively, the bearings may be duplexed face-to-face (DF) with the outer ring as one piece.

These bearings support radial and axial loads in either direction: back-to-back duplexed bearings also support moment loads.

The cage type and special shape of the double row angular contact ball bearings are shown in **Fig.2** with the list of drawing numbers in the dimensions table.

The **drawings A** and **B** are the front-to-front duplex arrangement; drawing 2 is a bearing with a lubricating port; **drawings** from **C** to **G** show the back-to-back duplex arrangement and the different position of the lubricating ports whether or not there are lubricating grooves. **Drawing C** shows the inner ring width larger than that of outer ring.

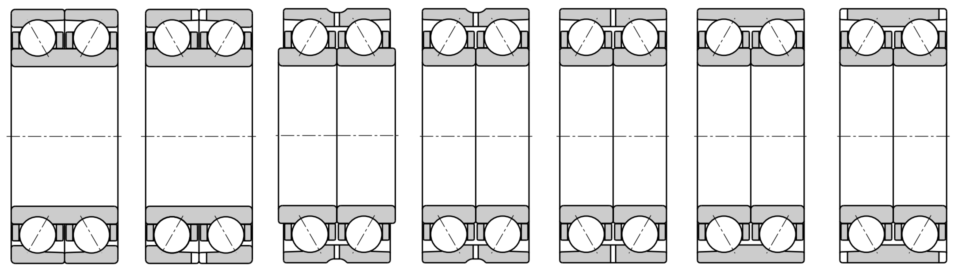


Fig.2 Double row angular contact ball bearings drawing

2. Dimensional Accuracy/Rotation Accuracy

Refer to Table 3.3 (Page A-12)

Single row/Duplex angular contact ball bearings
Double row angular contact ball bearings

3. Recommended Fitting

Refer to Table 4.2 (Page A-24)

Single row/Duplex angular contact ball bearings
Double row angular contact ball bearings

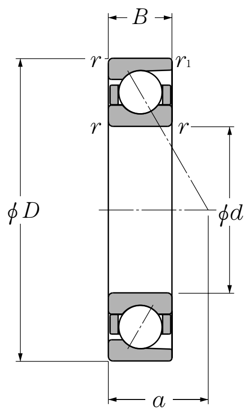
4. Bearing Internal Clearance

Refer to Table 5.3 (Page A-31)

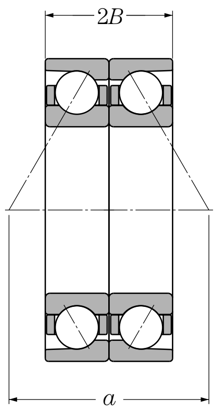
Duplex angular contact ball bearings
Double row angular contact ball bearings

5. Cautions for Operation

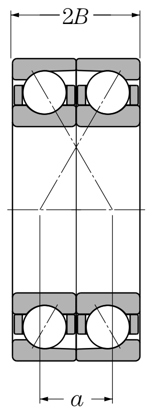
When the bearing loads are small(about $F_r \leqq 0.02C_{or}$) or the ratio between the axial and radial loads of the duplex bearing exceeds the value "e", slippage may occur between the balls and the raceways. This slippage may cause smearing. Particularly with large size angular contact ball bearings, this tendency is significant since the ball and cage mass is large. Please consult with **NTN** Engineering for further details.



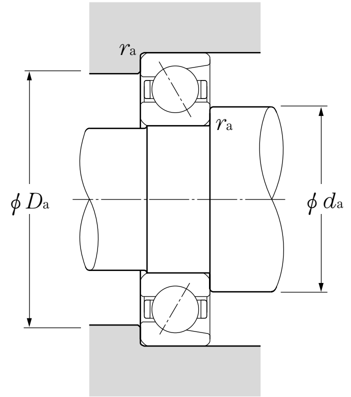
single



back-to-back arrangement (DB)



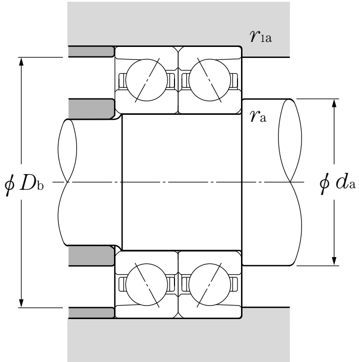
face-to-face arrangement (DF)

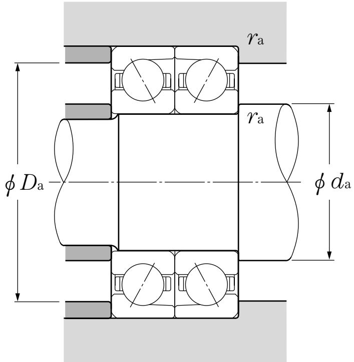


d 100～130mm

Boundary dimensions (mm)						contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing[1] No.	Load center (mm)	Mass (kg)
							single				single			single
d	D	B	C	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	α	C_r	C_{or}	C_r	C_{or}			a	(approx.)
100	125	13	—	1	0.6	30	21.2	25.2	2,160	2,570	7820	A	39	0.36
	140	20	—	1.1	0.6	30	48.0	52.5	4,900	5,350	7920	A	44.5	0.93
	150	24	—	1.5	1	30	68.5	70.5	6,950	7,200	7020	A	48	1.47
	150	24	—	1.5	1	40	61.0	63.5	6,250	6,500	7020B	A	64.5	1.49
	180	34	—	2.1	1.1	30	144	126	14,700	12,800	7220	A	57.5	3.2
	180	34	—	2.1	1.1	40	130	114	13,300	11,700	7220B	A	76	3.26
	215	47	—	3	1.1	30	207	193	21,100	19,700	7320	A	69	7.18
	215	47	—	3	1.1	40	190	178	19,400	18,100	7320B	A	89.5	7.32
105	130	13	—	1	0.6	30	21.7	26.5	2,210	2,700	7821	A	40.5	0.37
	145	20	—	1.1	0.6	30	48.5	54.5	4,950	5,550	7921	A	46	0.97
	160	26	—	2	1	30	80.0	81.5	8,150	8,350	7021	A	51.5	1.86
	160	26	—	2	1	40	71.5	73.5	7,300	7,500	7021B	A	68.6	1.88
	190	36	—	2.1	1.1	30	157	142	16,000	14,400	7221	A	60.5	3.79
	190	36	—	2.1	1.1	40	142	129	14,500	13,100	7221B	A	80	3.87
	225	49	—	3	1.1	30	220	210	22,400	21,500	7321	A	72	8.2
	225	49	—	3	1.1	40	202	194	20,600	19,700	7321B	A	93.5	8.36
110	140	16	—	1	0.6	30	31.0	38.0	3,200	3,850	7822	A	44	0.58
	150	20	—	1.1	0.6	30	49.5	56.0	5,050	5,700	7922	A	47.5	1.01
	170	28	—	2	1	30	92.0	93.0	9,350	9,450	7022	A	54.5	2.3
	170	28	—	2	1	40	82.5	83.5	8,400	8,550	7022B	A	72.8	2.34
	200	38	—	2.1	1.1	30	170	158	17,300	16,100	7222	A	64	4.45
	200	38	—	2.1	1.1	40	154	144	15,700	14,700	7222B	A	84	4.54
	240	50	—	3	1.1	30	246	246	25,100	25,100	7322	A	76	9.6
	240	50	—	3	1.1	40	226	226	23,000	23,100	7322B	A	99	9.8
120	150	16	—	1	0.6	30	31.5	40.0	3,250	4,050	7824	A	47	0.63
	165	22	—	1.1	0.6	30	61.0	69.5	6,200	7,100	7924	A	52	1.66
	180	28	—	2	1	30	93.5	98.5	9,550	10,000	7024	A	57.5	2.47
	180	28	—	2	1	40	84.0	89.0	8,550	9,050	7024B	A	77	2.51
	215	40	—	2.1	1.1	40	165	162	16,900	16,500	7224B	A	90.5	6.26
	215	40	—	2.1	1.1	30	183	177	18,600	18,100	7224	A	68.5	6.26
	260	55	—	3	1.1	30	246	252	25,100	25,700	7324	A	82.5	14.7
	260	55	—	3	1.1	40	225	231	23,000	23,600	7324B	A	107	14.7
130	165	18	—	1.1	0.6	30	42.0	53.0	4,300	5,400	7826	A	51.5	0.91
	180	24	—	1.5	1	30	75.0	87.5	7,650	8,900	7926	A	56.5	1.82
	199.5	33	—	2.5	1	30	117	125	12,000	12,900	SF2652	A	64	3.74

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

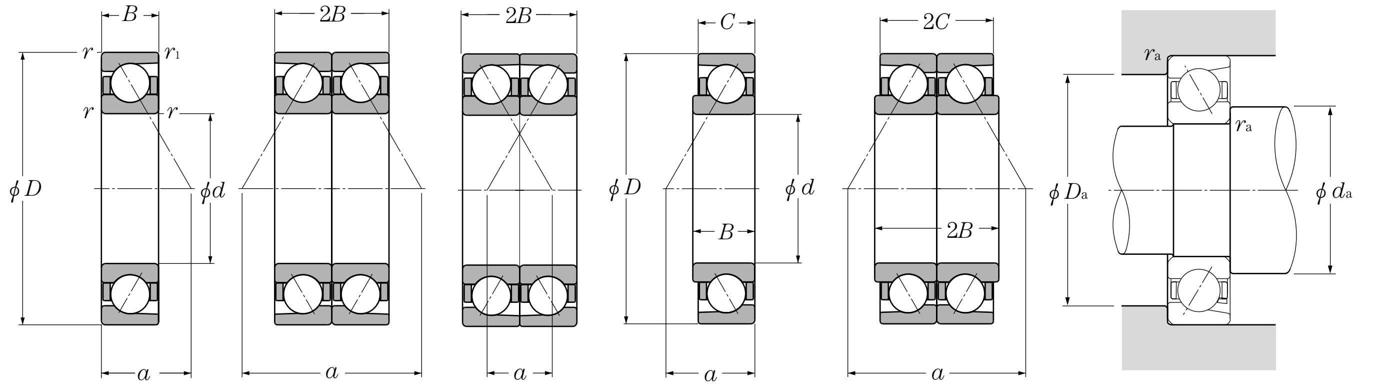
Contact angle	e	Single $F_a/F_r \leqq e$		Single $F_a/F_r > e$		DB, DF $F_a/F_r \leqq e$		DB, DF $F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static
$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single X_o	Single Y_o	DB, DF X_o	DB, DF Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings dynamic (KN) C_r	static (KN) C_{or}	dynamic (duplex) (kgf) C_r	static (kgf) C_{or}	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
34.0	50.5	3,500	5,150	DB	DF	78	52	105.5	119.5	1	0.6
78.0	105	7,950	10,700	DB	DF	109	69	107	133	1	0.6
111	141	11,300	14,400	DB	DF	120	72	108.5	141.5	1.5	1
76.5	127	10,100	13,000	DB	DF	129	81	108.5	141.5	1.5	1
233	251	23,800	25,600	DB	DF	149	81	112	168	2	1
212	229	21,600	23,300	DB	DF	186	118	112	168	2	1
335	385	34,500	39,500	DB	DF	185	91	114	201	2.5	1
310	355	31,500	36,000	DB	DF	226	132	114	201	2.5	1
35.0	53.0	3,600	5,400	DB	DF	81	55	110.5	124.5	1	0.6
79.0	109	8,050	11,100	DB	DF	112	72	112	138	1	0.6
130	163	13,300	16,700	DB	DF	129	77	115	150	2	1
116	147	11,900	15,000	DB	DF	137	85	115	150	2	1
254	283	25,900	28,900	DB	DF	157	85	117	178	2	1
231	258	23,500	26,300	DB	DF	196	124	117	178	2	1
355	420	36,500	43,000	DB	DF	193	95	119	211	2.5	1
330	385	33,500	39,500	DB	DF	236	138	119	211	2.5	1
50.5	76.0	5,150	7,750	DB	DF	88	56	115.5	134.5	1	0.6
80.0	112	8,150	11,400	DB	DF	115	75	117	143	1	0.6
149	186	15,200	18,900	DB	DF	137	81	120	160	2	1
134	167	13,600	17,100	DB	DF	145.5	89.5	120	160	2	1
276	315	28,100	32,500	DB	DF	166	90	122	188	2	1
250	289	25,500	29,400	DB	DF	206	130	122	188	2	1
400	490	41,000	50,000	DB	DF	202	102	124	226	2.5	1
365	455	37,500	46,000	DB	DF	248	148	124	226	2.5	1
51.5	79.5	5,250	8,100	DB	DF	94	62	125.5	144.5	1	0.6
99.0	139	10,100	14,200	DB	DF	126	82	127	158	1	0.6
152	197	15,500	20,100	DB	DF	143	87	130	170	2	1
136	178	13,900	18,100	DB	DF	154	98	130	170	2	1
269	325	27,400	33,000	DB	DF	221	141	132	203	2	1
297	355	30,500	36,000	DB	DF	177	97	132	203	2	1
400	505	41,000	51,500	DB	DF	220	110	134	246	2.5	1
365	460	37,500	47,000	DB	DF	269	159	134	246	2.5	1
68.5	106	6,950	10,800	DB	DF	103	67	137	158	1	0.6
121	175	12,400	17,800	DB	DF	137	89	138.5	171.5	1.5	1
191	251	19,400	25,600	DB	DF	128.5	62.5	142	187.5	2	1

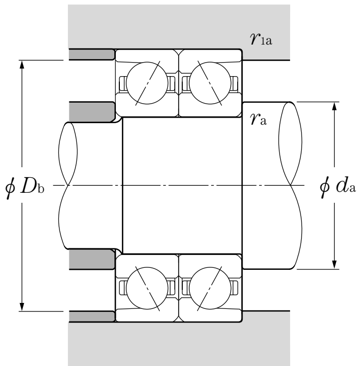


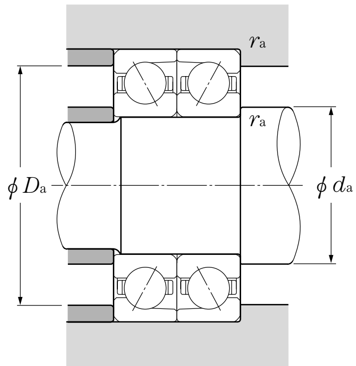
single | back-to-back arrangement (DB) | face-to-face arrangement (DF) | single | back-to-back arrangement (DB)

d 130～160mm

Boundary dimensions (mm)						contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing❶ No.	Load center (mm)	Mass (kg)
							single				single			single
d	D	B	C	$r_{s\,min}$ ❷	$r_{1s\,min}$ ❷	α	C_r	C_{or}	C_r	C_{or}			a	(approx.)
130	200	33	–	2	1	30	117	125	12,000	12,800	7026	A	64	3.73
	200	33	–	2	1	40	105	113	10,700	11,500	7026B	A	86	3.78
	205	24	–	2.5	1	30	75.0	90.0	7,650	9,150	SF2608	A	60.5	2.98
	230	40	–	3	1.1	30	196	198	20,000	20,200	7226	A	72	7.15
	230	40	–	3	1.1	40	177	180	18,100	18,300	7226B	A	95.5	7.15
	280	58	–	4	1.5	30	273	293	27,900	29,800	7326	A	88	17.6
	280	58	–	4	1.5	40	250	268	25,500	27,400	7326B	A	115	17.6
140	175	18	–	1.1	0.6	30	43.0	55.5	4,350	5,650	7828	A	54.5	0.97
	190	24	–	1.5	1	30	75.5	90.0	7,700	9,150	7928	A	59.5	1.94
	210	33	–	2	1	30	120	133	12,200	13,500	7028	A	67	3.96
	210	33	–	2	1	40	107	119	10,900	12,100	7028B	A	90	4.01
	250	42	–	3	1.1	30	203	215	20,700	21,900	7228	A	77.5	8.78
	250	42	–	3	1.1	40	183	195	18,700	19,900	7228B	A	103	8.78
	300	62	–	4	1.5	30	300	335	30,500	34,500	7328	A	94.5	21.5
	300	62	–	4	1.5	40	275	310	28,100	31,500	7328B	A	123	21.5
145	220	38	–	2.5	1.5	30	148	158	15,100	16,100	SF2951	A	71.7	5.15
150	190	20	–	1.1	0.6	30	54.5	70.5	5,550	7,200	7830	A	59	1.35
	210	28	–	2	1	30	97.5	117	9,900	11,900	7930	A	66	2.96
	225	35	–	2.1	1.1	30	137	154	14,000	15,700	7030	A	71.5	4.82
	225	35	–	2.1	1.1	40	122	138	12,500	14,000	7030B	A	96	4.88
	270	45	–	3	1.1	30	232	259	23,700	26,400	7230	A	83	11
	270	45	–	3	1.1	40	210	235	21,400	24,000	7230B	A	111	11
	320	65	–	4	1.5	30	330	380	33,500	39,000	7330	A	100	25.1
	320	65	–	4	1.5	40	300	350	30,500	36,000	7330B	A	131	25.1
160	200	20	–	1.1	0.6	30	55.5	74.0	5,650	7,550	7832	A	62	1.42
	215	28	25	2.5	1.1	40	75.5	93.0	7,700	9,450	SF3208	F	91	2.74
	220	28	–	2	1	30	98.5	121	10,000	12,300	7932	A	69	3.13
	229.5	33	–	2.5	1	40	111	128	11,300	13,100	SF3209	A	98.5	4.52
	229.5	33	–	2.5	1	40	111	128	11,300	13,100	SF3214	C	98.5	4.52
	230	33	–	2.5	1	30	124	147	12,600	15,000	SF3210	A	73	4.15
	240	38	–	2.1	1.1	30	155	176	15,800	18,000	7032	A	77	5.96
	240	38	–	2.1	1.1	40	139	158	14,100	16,100	7032B	A	103	5.98
	290	48	–	3	1.1	30	263	305	26,800	31,500	7232	A	89	13.7
	290	48	–	3	1.1	40	238	279	24,200	28,400	7232B	A	118	13.7
	340	68	–	4	1.5	30	345	420	35,500	43,000	7332	A	106	29.8

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

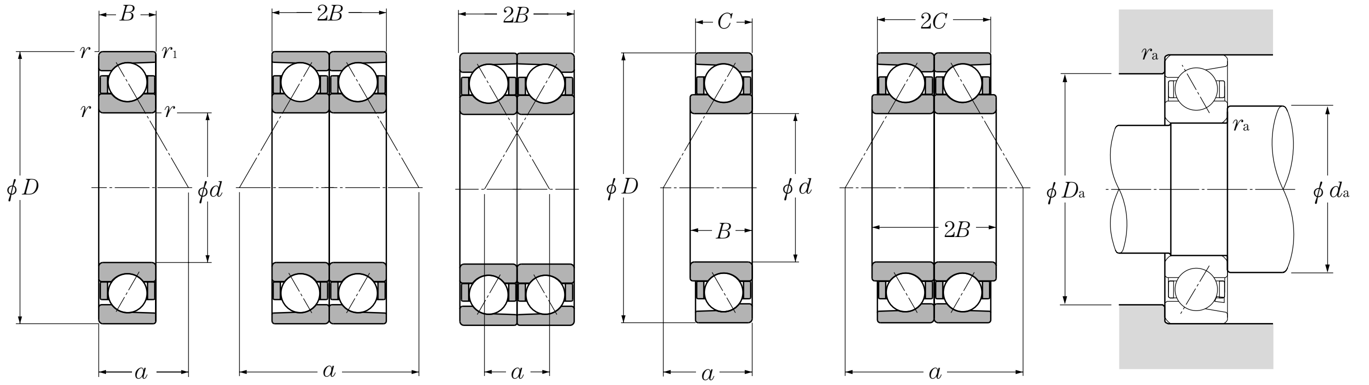
Contact angle	e	Single				DB, DF			
		$F_a/F_r \leq e$		$F_a/F_r > e$		$F_a/F_r \leq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static
$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings dynamic (KN) C_r	static (KN) C_{or}	dynamic (duplex) (kgf) C_r	static (kgf) C_{or}	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
191	251	19,400	25,600	DB	DF	161	95	140	190	2	1
171	226	17,400	23,100	DB	DF	171.5	105.5	140	190	2	1
122	180	12,500	18,300	DB	DF	120.5	72.5	142	193	2	1
320	395	32,500	40,500	DB	DF	184	104	144	216	2.5	1
288	360	29,400	36,500	DB	DF	231	151	144	216	2.5	1
445	585	45,500	59,500	DB	DF	234	118	148	262	3	1.5
405	535	41,500	54,500	DB	DF	288	172	148	262	3	1.5
69.5	111	7,100	11,300	DB	DF	109	73	147	168	1	0.6
123	180	12,500	18,300	DB	DF	143	95	148.5	181.5	1.5	1
194	265	19,800	27,000	DB	DF	167	101	150	200	2	1
174	237	17,700	24,200	DB	DF	180	114	150	200	2	1
330	430	33,500	44,000	DB	DF	197	113	154	236	2.5	1
297	390	30,500	40,000	DB	DF	248	164	154	236	2.5	1
490	670	50,000	68,500	DB	DF	251	127	158	282	3	1.5
445	615	45,500	63,000	DB	DF	308	184	158	282	3	1.5
241	315	24,500	32,000	DB	DF	143.5	67.5	157	208	2	1.5
88.5	141	9,000	14,400	DB	DF	118	78	157	183	1	0.6
158	234	16,100	23,900	DB	DF	160	104	160	200	2	1
222	305	22,700	31,500	DB	DF	178	108	162	213	2	1
199	275	20,300	28,100	DB	DF	192.5	122.5	162	213	2	1
375	515	38,500	53,000	DB	DF	211	121	164	256	2.5	1
340	470	34,500	48,000	DB	DF	267	177	164	256	2.5	1
535	765	54,500	78,000	DB	DF	265	135	168	302	3	1.5
490	700	50,000	71,500	DB	DF	327	197	168	302	3	1.5
90.5	148	9,200	15,100	DB	DF	124	84	167	193	1	0.6
123	186	12,500	18,900	DB	—	182.5	132.5	172	203	2	1
160	241	16,300	24,600	DB	DF	166	110	170	210	2	1
180	256	18,300	26,100	DB	DF	196.5	130.5	172	217.5	2	1
180	256	18,300	26,100	—	DF	196.5	130.5	172	217.5	2	1
201	293	20,500	29,900	DB	DF	145.5	79.5	172	218	2	1
252	355	25,700	36,000	DB	DF	192	116	172	228	2	1
225	315	23,000	32,500	DB	DF	206	130	172	228	2	1
425	615	43,500	62,500	DB	DF	226	130	174	276	2.5	1
385	555	39,500	57,000	DB	DF	284	188	174	276	2.5	1
565	845	57,500	86,000	DB	DF	280	144	178	322	3	1.5

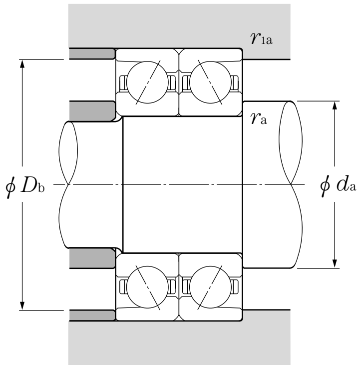


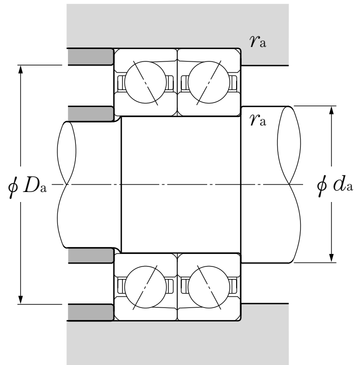
single | back-to-back arrangement (DB) | face-to-face arrangement (DF) | single | back-to-back arrangement (DB)

d 160～195mm

Boundary dimensions (mm)						contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing[1] No.	Load center (mm)	Mass (kg)
							single				single			single
d	D	B	C	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	α	C_r	C_{or}	C_r	C_{or}			a	(approx.)
160	340	68	—	4	1.5	40	315	385	32,000	39,500	**7332B**	A	139	29.8
170	215	22	—	1.1	0.6	30	68.5	90.5	6,950	9,250	**7834**	A	66.5	1.88
	230	28	—	2	1	30	102	129	10,400	13,100	**7934**	A	71.5	3.29
	260	42	—	2.1	1.1	30	186	214	18,900	21,900	**7034**	A	83	7.96
	260	42	—	2.1	1.1	40	166	193	17,000	19,700	**7034B**	A	111.5	8.02
	310	52	—	4	1.5	30	295	360	30,000	36,500	**7234**	A	95.5	17
	310	52	—	4	1.5	40	266	325	27,200	33,000	**7234B**	A	127	17
	360	72	—	4	1.5	30	390	485	39,500	49,500	**7334**	A	113	35.3
	360	72	—	4	1.5	40	355	445	36,000	45,500	**7334B**	A	147	35.3
180	225	22	—	1.1	0.6	30	70.0	95.0	7,100	9,700	**7836**	A	69.5	1.98
	250	33	—	2	1	30	131	163	13,400	16,600	**7936**	A	78.5	4.87
	259.5	33	—	2.5	1	40	138	166	14,100	16,900	**SF3618**	B	109	5.7
	259.5	33	—	2.5	1	30	178	211	18,200	21,500	**SF3629**	C	80	5.8
	259.5	33	—	2.5	1	30	178	211	18,200	21,500	**SF3639**	B	80	5.75
	259.5	33	—	2.5	1	30	155	190	15,800	19,400	**SF3641**	C	80	5.65
	280	46	—	2.1	1.1	30	219	266	22,300	27,100	**7036**	A	89.5	10.4
	280	46	—	2.1	1.1	40	196	240	20,000	24,400	**7036B**	A	119.5	10.5
	320	52	—	4	1.5	30	305	385	31,000	39,000	**7236**	A	98	17.7
	320	52	—	4	1.5	40	276	350	28,100	35,500	**7236B**	A	131	17.7
	380	75	—	4	1.5	30	410	535	41,500	54,500	**7336**	A	118	40.9
	380	75	—	4	1.5	40	375	490	38,000	50,000	**7336B**	A	155	40.9
190	240	24	—	1.5	1	30	85.0	116	8,650	11,800	**7838**	A	74	2.55
	255	33	29	2.5	1.5	40	108	138	11,000	14,100	**SF3806**	F	108	4.16
	259.5	33	—	2	1	30	133	169	13,500	17,200	**SF3816**	C	81.5	5.1
	260	33	—	2	1	30	133	169	13,500	17,200	**7938**	A	81.5	5.1
	269.5	33	—	2.5	1.5	30	132	168	13,500	17,100	**SF3802**	A	83	5.95
	269.5	33	—	2.5	2.5	40	134	166	13,600	16,900	**SF3807**	B	113	6.05
	290	46	—	2.1	1.1	30	224	280	22,800	28,600	**7038**	A	92.5	10.8
	290	46	—	2.1	1.1	40	201	253	20,400	25,800	**7038B**	A	124	10.9
	340	55	—	4	1.5	30	305	390	31,000	39,500	**7238**	A	104	21.3
	340	55	—	4	1.5	40	273	355	27,800	36,000	**7238B**	A	139	21.3
	400	78	—	5	2	30	430	585	44,000	59,500	**7338**	A	124	47
	400	78	—	5	2	40	390	535	40,000	54,500	**7338B**	A	163	47
195	270	35	—	2.5	1.5	30	153	196	15,600	20,000	**SF3901**	C	84.5	6.2

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

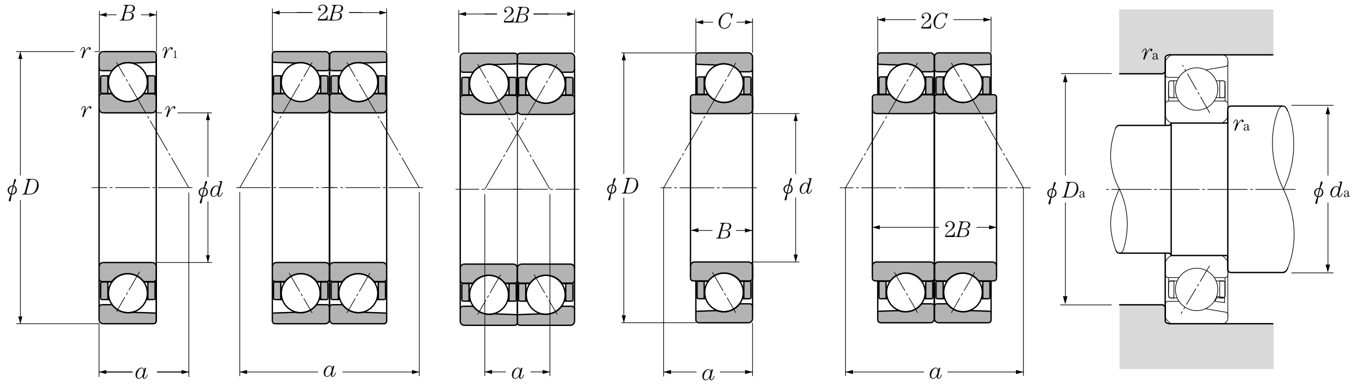
Contact angle	e	Single				DB, DF			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static
$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings (duplex) dynamic KN C_r	static KN C_{or}	dynamic kgf C_r	static kgf C_{or}	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
515	770	52,500	79,000	DB	DF	346	210	178	322	3	1.5
111	181	11,300	18,500	DB	DF	133	89	177	208	1	0.6
165	257	16,900	26,200	DB	DF	171	115	180	220	2	1
300	430	31,000	43,500	DB	DF	208	124	182	248	2	1
270	385	27,600	39,500	DB	DF	222.5	138.5	182	248	2	1
480	715	49,000	73,000	DB	DF	243	139	188	292	3	1.5
435	650	44,000	66,500	DB	DF	306	202	188	292	3	1.5
630	970	64,500	99,000	DB	DF	298	154	188	342	3	1.5
575	890	59,000	90,500	DB	DF	366	222	188	342	3	1.5
113	190	11,600	19,400	DB	DF	139	95	187	218	1	0.6
213	325	21,700	33,500	DB	DF	190	124	190	240	2	1
224	330	22,800	34,000	DB	—	217.5	151.5	192	247.5	2	1
290	420	29,600	43,000	—	DF	160	94	192	247.5	2	1
290	420	29,600	43,000	DB	DF	160	80	192	247.5	2	1
251	380	25,600	38,500	—	DF	160	94	192	247.5	2	1
355	530	36,500	54,000	DB	DF	225	133	192	268	2	1
320	480	32,500	49,000	DB	DF	239	147	192	268	2	1
495	770	50,500	78,500	DB	DF	248	144	198	302	3	1.5
450	700	45,500	71,000	DB	DF	314	210	198	302	3	1.5
665	1,070	68,000	109,000	DB	DF	311	161	198	362	3	1.5
605	975	62,000	99,500	DB	DF	385	235	198	362	3	1.5
138	232	14,100	23,700	DB	DF	148	100	198.5	231.5	1.5	1
175	276	17,800	28,200	DB	—	215.5	157.5	202	243	2	1.5
216	335	22,000	34,500	—	DF	163	97	200	249.5	2	1
216	335	22,000	34,500	DB	DF	196	130	200	250	2	1
215	335	21,900	34,500	DB	DF	166	83	202	257.5	2	1.5
217	330	22,100	34,000	DB	—	226	160	202	257.5	2	2
365	560	37,000	57,000	DB	DF	231	139	202	278	2	1
325	505	33,000	51,500	DB	DF	247.5	155.5	202	278	2	1
495	780	50,000	79,500	DB	DF	263	153	208	322	3	1.5
445	705	45,000	72,000	DB	DF	333	223	208	322	3	1.5
695	1,170	71,000	119,000	DB	DF	326	170	212	378	4	2
635	1,070	64,500	109,000	DB	DF	404	248	212	378	4	2
249	390	25,400	40,000	—	DF	169	99	207	258	2	1.5

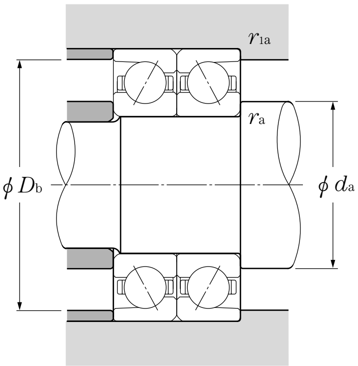


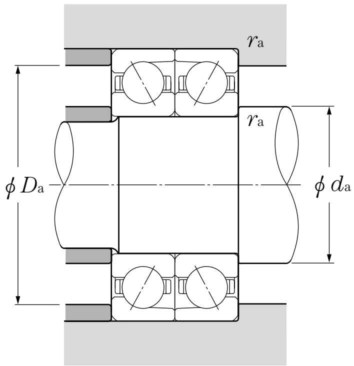
single | back-to-back arrangement (DB) | face-to-face arrangement (DF) | single | back-to-back arrangement (DB)

d 200～250mm

Boundary dimensions (mm) d	D	B	C	$r_{s\,min}$ ❷	$r_{ls\,min}$ ❷	contact angle α	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers single	Drawing❶ No.	Load center (mm) a	Mass single kg (approx.)
200	250	24	–	1.5	1	30	87.0	122	8,850	12,400	**7840**	A	77	2.68
	279.5	38	–	2.5	1.5	40	165	202	16,800	20,600	**SF4006**	A	119.5	7.15
	280	38	–	2.1	1.1	30	185	231	18,900	23,600	**7940**	A	88.5	7.15
	289.5	38	–	2.5	1.5	40	188	238	19,200	24,200	**SF4017**	C	122	8.25
	310	51	–	2.1	1.1	30	252	325	25,700	33,000	**7040**	A	99	14
	310	51	–	2.1	1.1	40	226	293	23,000	29,900	**7040B**	A	132.5	14.1
	360	58	–	4	1.5	30	335	450	34,500	46,000	**7240**	A	110	25.3
	360	58	–	4	1.5	40	305	410	31,000	41,500	**7240B**	A	146	25.3
	420	80	–	5	2	30	450	605	46,000	62,000	**7340**	A	130	53.1
	420	80	–	5	2	40	410	555	42,000	56,500	**7340B**	A	170	53.1
203.2	330.2	88.9	–	3	1.5	30	219	285	22,400	29,100	**SF4104**	A	99	14.7
220	270	24	–	1.5	1	30	89.0	131	9,100	13,300	**7844**	A	82.5	2.91
	300	38	–	2.1	1.1	30	187	239	19,000	24,300	**7944**	A	94	7.74
	300	38	35	2.5	1.5	40	149	189	15,200	19,300	**SF4407**	F	126.5	7.25
	309.5	38	–	2.1	1.1	40	190	246	19,400	25,100	**SF4421**	B	130	8.9
	309.5	38	–	2.1	1.1	40	190	246	19,400	25,100	**SF4433**	C	130	8.9
	319.5	46	–	2.1	1.1	35	226	299	23,000	30,500	**SF4438**	C	117.5	12.2
	340	56	–	3	1.1	30	286	390	29,100	39,500	**7044**	A	109	18.2
	340	56	–	3	1.1	40	238	325	24,300	33,000	**7044B**	A	145.5	18.4
	400	65	–	4	1.5	30	345	485	35,000	49,500	**7244**	A	122	37.1
	460	88	–	5	2	30	495	725	50,500	74,000	**7344**	A	142	72.4
230	329.5	40	–	2.5	1.5	40	154	202	15,700	20,600	**SF4614**	E	135.5	11
240	300	28	–	2	1	30	101	155	10,300	15,800	**7848**	A	92	4.49
	320	38	–	2.1	1.1	30	193	255	19,600	26,000	**7948**	A	100	8.34
	329.5	40	–	2.1	1.1	30	221	305	22,600	31,000	**SF4839**	C	102.5	10
	329.5	40	–	2.5	1.5	40	197	265	20,100	27,000	**SF4814**	A	139.5	10.1
	329.5	40	–	2.5	1.5	40	197	265	20,100	27,000	**SF4818**	B	139.5	10.1
	340	40	–	2.5	1.5	30	211	289	21,500	29,400	**SF4802**	A	160.5	11.5
	360	56	–	3	1.1	30	279	400	28,500	40,500	**7048**	A	114.5	19.5
	360	56	–	3	1.1	40	249	355	25,400	36,000	**7048B**	A	154	19.8
	440	72	–	4	1.5	30	420	630	42,500	64,500	**7248**	A	135.5	49.8
	500	95	–	5	2	30	515	795	52,500	81,000	**7348**	A	154.5	92.2
250	340	38	–	2.5	1	40	169	222	17,200	22,600	**SF5005**	F	141.5	9.55
	349.5	46	–	3	1.5	30	233	325	23,700	33,000	**SF5004**	A	109.5	13.6

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

Contact angle	e	Single $F_a/F_r \leqq e$		Single $F_a/F_r > e$		DB, DF $F_a/F_r \leqq e$		DB, DF $F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

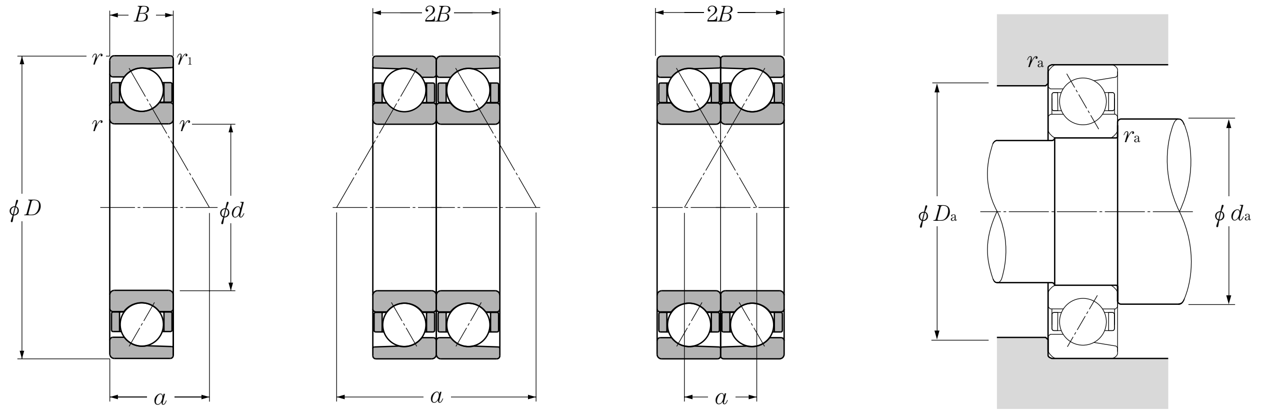
static

$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single X_o	Single Y_o	DB, DF X_o	DB, DF Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings (duplex) dynamic KN C_r	static KN C_{or}	dynamic kgf C_r	static kgf C_{or}	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
141	244	14,400	24,900	DB	DF	154	106	208.5	241.5	1.5	1
268	405	27,400	41,000	DB	DF	239	163	212	267.5	2	1.5
300	465	30,500	47,000	DB	DF	215	139	212	268	2	1
305	475	31,000	48,500	—	DF	243.5	167.5	212	277.5	2	1.5
410	650	41,500	66,000	DB	DF	249	147	212	298	2	1
365	585	37,500	60,000	DB	DF	265	163	212	298	2	1
550	900	56,000	92,000	DB	DF	278	162	218	342	3	1.5
495	815	50,500	83,000	DB	DF	350	234	218	342	3	1.5
730	1,210	74,500	124,000	DB	DF	340	180	222	398	4	2
665	1,110	68,000	113,000	DB	DF	420	260	222	398	4	2
355	570	36,500	58,000	DB	DF	198.5	109.5	217.2	316.2	2.5	1.5
145	261	14,800	26,600	DB	DF	165.5	117.5	228.5	261.5	1.5	1
305	475	31,000	48,500	DB	DF	226	150	232	288	2	1
243	380	24,700	38,500	DB	—	253	183	232	288	2	1.5
310	490	31,500	50,000	DB	—	260.5	184.5	232	297.5	2	1
310	490	31,500	50,000	—	DF	260.5	184.5	232	297.5	2	1
365	600	37,500	61,000	—	DF	235	143	232	307.5	2	1
465	780	47,500	79,500	DB	DF	217.5	105.5	234	326	2.5	1
385	650	39,500	66,000	DB	DF	291	179	234	326	2.5	1
560	975	57,000	99,000	DB	DF	244	114	238	382	3	1.5
805	1,450	82,000	148,000	DB	DF	284.5	108.5	242	438	4	2
251	405	25,600	41,000	DB	—	270.8	191	242	317.5	2	1.5
164	310	16,800	31,500	DB	DF	184	128	250	290	2	1
315	510	32,000	52,000	DB	DF	238	162	252	308	2	1
360	605	36,500	62,000	—	DF	204.5	124.5	252	317.5	2	1
320	530	32,500	54,000	DB	DF	279	199	252	317.5	2	1.5
320	530	32,500	54,000	DB	—	279	199	252	317.5	2	1.5
345	575	35,000	59,000	DB	DF	207.5	127.5	252	328	2	1.5
455	795	46,000	81,000	DB	DF	229.5	117.5	254	346	2.5	1
405	710	41,500	72,500	DB	DF	308	196	254	346	2.5	1
680	1,260	69,000	129,000	DB	DF	271	127	258	422	3	1.5
840	1,590	85,500	162,000	DB	DF	309	119	262	478	4	2
275	445	28,000	45,500	DB	—	282.5	212.5	262	328	2	1
380	650	38,500	66,000	DB	DF	219	127	264	335.5	2.5	1.5



single

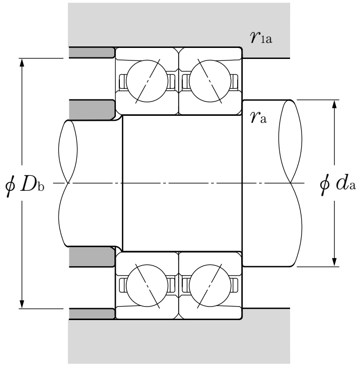
back-to-back arrangement (DB)

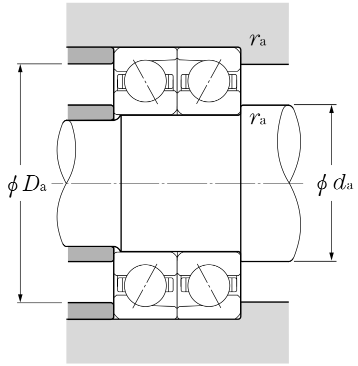
face-to-face arrangement (DF)

d 260～340mm

Boundary dimensions (mm)						contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing❶ No.	Load center (mm)	Mass (kg)
							single				single			single
d	D	B	C	$r_{s\,min}$❷	$r_{ls\,min}$❷	α	C_r	C_{or}	C_r	C_{or}			a	(approx.)
260	320	28	—	2	1	30	127	192	12,900	19,600	**7852**	A	97.5	4.83
	360	46	—	2.1	1.1	30	258	375	26,300	38,000	**7952**	A	112	14
	369.5	46	—	2.5	1.5	40	235	340	23,900	34,500	**SF5206**	C	155	16.1
	369.5	46	—	2.5	1.5	40	235	340	23,900	34,500	**SF5225**	B	155	15.7
	369.5	46	—	2.5	1.5	40	235	340	23,900	34,500	**SF5224**	A	155	15.7
	369.5	46	—	2.5	1.5	30	242	350	24,700	35,500	**SF5210**	D	114	15.7
	379.5	56	—	4	2	40	264	385	26,900	39,500	**SF5218**	A	162.5	19.1
	400	65	—	4	1.5	30	315	455	32,000	46,500	**7052**	A	128	28.7
	400	65	—	4	1.5	40	282	410	28,700	41,500	**7052B**	A	171	29
	480	80	—	5	2	30	480	750	48,500	76,500	**7252**	A	147	66
	540	102	—	6	3	30	590	960	60,000	98,000	**7352**	A	166.5	115
280	350	33	—	2	1	30	164	247	16,700	25,200	**7856**	A	107.5	7.17
	380	46	—	2.1	1.1	30	261	385	26,600	39,500	**7956**	A	118	14.8
	389.5	46	—	2.1	1.1	40	223	325	22,700	33,000	**SF5606**	A	163.5	16
	389.5	46	—	2.5	1.5	30	250	370	25,500	38,000	**SF5608**	D	119.5	16
	420	65	—	4	1.5	30	390	595	40,000	60,500	**7056**	A	133.5	30.7
	420	65	—	4	1.5	40	350	540	35,500	55,000	**7056B**	A	179.5	30.9
	500	80	—	5	2	30	535	860	54,500	87,500	**7256**	A	152.5	69.7
	580	108	—	6	3	30	670	1,140	68,000	116,000	**7356**	A	178	140
285	380	46	—	2.5	2	40	206	305	21,000	31,000	**SF5702**	A	162.5	14.7
290	419.5	60	—	5	2.5	40	292	455	29,800	46,500	**SF5803**	B	179	26.9
300	380	38	—	2.1	1.1	30	193	290	19,700	29,500	**7860**	A	117	10.1
	420	56	—	3	1.1	30	325	520	33,500	53,000	**7960**	A	132	23.7
	460	74	—	4	1.5	30	440	715	45,000	73,000	**7060**	A	146.5	43.4
	460	74	—	4	1.5	40	395	645	40,500	66,000	**7060B**	A	196.5	43.7
	540	85	—	5	2	30	550	930	56,500	94,500	**7260**	A	164	87.2
310	429.5	60	—	4	2	40	297	470	30,500	48,000	**SF6203**	A	185.5	26.7
320	400	38	—	2.1	1.1	30	197	305	20,100	31,000	**7864**	A	123	10.7
	440	56	—	3	1.1	30	330	540	34,000	55,000	**7964**	A	137.5	24.7
	480	74	—	4	1.5	30	450	760	46,000	77,500	**7064**	A	152.5	45.7
	580	92	—	5	2	30	635	1,120	64,500	114,000	**7264**	A	176	109
340	420	38	—	2.1	1.1	30	204	325	20,800	33,500	**7868**	A	128.5	11.3

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

Contact angle	e	Single				DB, DF			
		$F_a/F_r \leq e$		$F_a/F_r > e$		$F_a/F_r \leq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

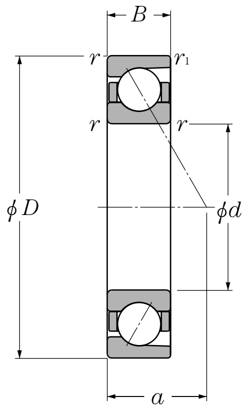
static
$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

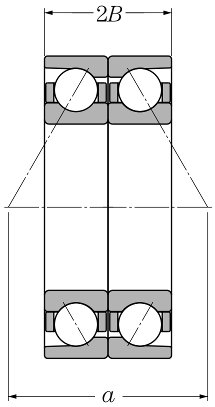
For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings dynamic (duplex) static				Bearing numbers (duplex)		Load center mm		Abutment and fillet dimensions mm			
dynamic kN	static kN	dynamic kgf	static kgf			a		d_a	D_a	r_{as}	r_{1as}
C_r	C_{or}	C_r	C_{or}	DB	DF	DB	DF	min	max	max	max
206	385	21,000	39,000	DB	DF	195.5	139.5	270	310	2	1
420	750	42,500	76,500	DB	DF	270	178	272	348	2	1
380	680	39,000	69,000	—	DF	310.5	218.5	272	357.5	2	1.5
380	680	39,000	69,000	DB	—	310.5	218.5	272	357.5	2	1.5
380	680	39,000	69,000	DB	DF	310.5	218.5	272	357.5	2	1.5
395	695	40,000	71,000	DB	DF	228	136	272	357.5	2	1.5
430	775	44,000	79,000	DB	DF	324.5	212.5	278	361.5	3	2
510	905	52,000	92,500	DB	DF	255.5	125.5	278	382	3	1.5
458	820	46,500	83,500	DB	DF	342	212	278	382	3	1.5
775	1,500	79,000	153,000	DB	DF	294	134	282	458	4	2
960	1,920	98,000	196,000	DB	DF	333	129	288	512	5	2.5
267	495	27,200	50,500	DB	DF	215	148	290	340	2	1
425	775	43,000	79,000	DB	DF	282	190	292	368	2	1
360	650	37,000	66,500	DB	DF	327	235	292	377.5	2	1
405	745	41,500	76,000	DB	DF	239.5	147.5	292	377.5	2	1.5
635	1,190	64,500	121,000	DB	DF	267	137	298	402	3	1.5
570	1,080	58,000	110,000	DB	DF	359	229	298	402	3	1.5
870	1,720	88,500	175,000	DB	DF	305	145	258	478	4	2
1,080	2,270	111,000	232,000	DB	DF	356.5	140.5	308	552	5	2.5
335	605	34,000	62,000	DB	DF	325	233	297	368	2	2
475	910	48,500	93,000	DB	—	357.5	237.5	312	397.5	4	2
315	580	32,000	59,000	DB	DF	234.5	158.5	312	368	2	1
530	1,040	54,000	106,000	DB	DF	320	208	314	406	2.5	1
715	1,430	73,000	146,000	DB	DF	293.5	145.5	318	442	3	1.5
640	1,290	65,500	132,000	DB	DF	393	245	318	442	3	1.5
895	1,860	91,500	189,000	DB	DF	327.5	157.5	322	518	4	2
480	945	49,000	96,000	DB	—	370.5	250.5	328	411.5	3	2
320	610	32,500	62,000	DB	DF	246	170	332	388	2	1
540	1,080	55,000	110,000	DB	DF	275.5	163.5	334	426	2.5	1
735	1,520	75,000	155,000	DB	DF	305	152.5	338	462	3	1.5
1,030	2,230	105,000	228,000	DB	DF	352	168	342	558	4	2
330	650	34,000	66,500	DB	DF	257.5	181.5	352	408	2	1

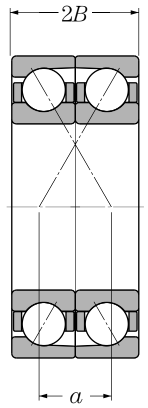
Angular Contact Ball Bearings (Single, Duplex)



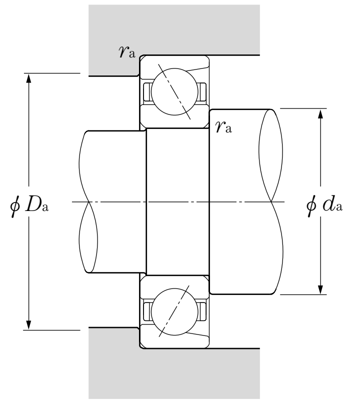
single



back-to-back arrangement (DB)



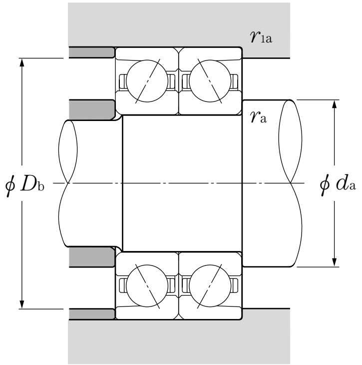
face-to-face arrangement (DF)

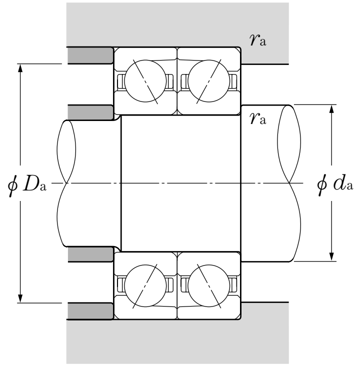


d 340～480mm

Boundary dimensions (mm) d	D	B	C	$r_{s\,min}$ ❷	$r_{ls\,min}$ ❷	contact angle α	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers single	Drawing❶ No.	Load center (mm) a	Mass single kg (approx.)
340	460	56	—	3	1.1	30	345	575	35,000	59,000	7968	A	143.5	26.0
	479.5	65	—	4	2	30	395	680	40,500	69,500	SF6807	A	151	36.7
	520	82	—	5	2	30	520	905	53,000	92,500	7068	A	165	61.1
	620	92	—	5	2	30	650	1,200	66,500	122,000	7268	A	184.5	127
360	440	38	—	2.1	1.1	30	226	365	23,100	37,000	7872	A	134.5	11.9
	480	56	—	3	1.1	30	350	595	35,500	60,500	7972	A	149.5	27.3
	509.5	70	—	5	2	40	390	685	40,000	69,500	SF7203	A	217.5	45
	540	82	—	5	2	30	530	960	54,500	98,000	7072	A	171	63.4
	650	95	—	6	3	30	670	1,280	68,500	130,000	7272	A	193.5	143
380	480	46	—	2.1	1.1	30	281	475	28,700	48,500	7876	A	147	19.5
	519.5	65	—	4	2	40	345	610	35,500	62,500	SF7603	A	221.5	41.3
	520	65	—	4	1.5	30	390	700	40,000	71,000	7976	A	162.5	39.6
	540	164	—	4	2	40	440	810	45,000	83,000	SF7601	A	234	61
	560	82	—	5	2	30	545	1,010	55,500	103,000	7076	A	176.5	66.3
400	500	46	—	2.1	1.1	30	287	500	29,300	51,000	7880	A	153	20.4
	540	65	—	4	1.5	30	395	720	40,000	73,500	7980	A	168	41
	600	90	—	5	2	30	615	1,180	63,000	121,000	7080	A	189.5	86.1
420	520	46	—	2.1	1.1	30	310	555	31,500	56,500	7884	A	158.5	21.1
	560	65	—	4	1.5	30	410	765	41,500	78,000	7984	A	174	42.8
	620	90	—	5	2	30	630	1,250	64,500	127,000	7084	A	195	89.7
440	540	46	—	2.1	1.1	30	310	565	31,500	58,000	7888	A	164.5	22
	600	74	—	4	1.5	30	445	860	45,500	87,500	7988	A	187	59.3
	650	94	—	6	3	30	645	1,310	65,500	134,000	7088	A	204.5	103
460	540	40	—	2.1	1.1	30	249	455	25,400	46,000	SF9211	A	164.5	15.8
	580	56	—	3	1.1	30	380	725	39,000	74,000	7892	A	178	33.5
	620	74	—	4	1.5	30	450	885	46,000	90,000	7992	A	193	61.6
	680	100	—	6	3	30	720	1,510	73,500	154,000	7092	A	214.5	119
470	570	50	—	2.1	1.1	30	320	605	32,500	62,000	SF9404	A	175	25.7
480	600	56	—	3	1.1	30	390	760	40,000	77,500	7896	A	184	34.9
	650	78	—	5	2	30	530	1,090	54,000	111,000	7996	A	202	71.8
	700	100	—	6	3	30	715	1,520	73,000	155,000	7096	A	220.5	123

❶ Drawing details are shown in Page B-15.
❷ Smallest allowable dimension for chamfer dimension r or r_l.





Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

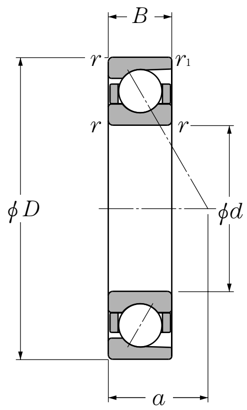
Contact angle	e	Single $F_a/F_r \leqq e$ X	Single $F_a/F_r \leqq e$ Y	Single $F_a/F_r > e$ X	Single $F_a/F_r > e$ Y	DB, DF $F_a/F_r \leqq e$ X	DB, DF $F_a/F_r \leqq e$ Y	DB, DF $F_a/F_r > e$ X	DB, DF $F_a/F_r > e$ Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static
$P_{or} = X_o F_r + Y_o F_a$

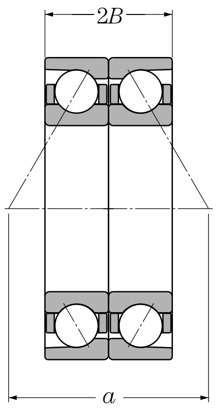
Contact angle	Single X_o	Single Y_o	DB, DF X_o	DB, DF Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

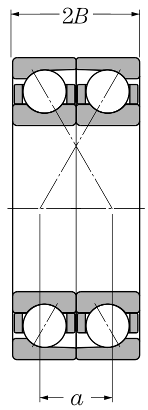
Basic load ratings (duplex) dynamic C_r (KN)	static C_{or} (KN)	dynamic C_r (kgf)	static C_{or} (kgf)	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
560	1,150	57,000	118,000	DB	DF	287	175	354	446	2.5	1
645	1,360	65,500	139,000	—	DF	301.5	171.5	358	461.5	3	2
845	1,810	86,000	185,000	DB	DF	330.5	166.5	362	498	4	2
1,060	2,400	108,000	244,000	DB	DF	369	185	362	598	4	2
370	725	37,500	74,000	DB	DF	269	193	372	428	2	1
565	1,190	57,500	121,000	DB	DF	298.5	186.5	374	466	2.5	1
635	1,370	64,500	140,000	DB	—	435	295	382	487.5	4	2
865	1,920	88,000	196,000	DB	DF	342	178	382	518	4	2
1,090	2,550	111,000	260,000	DB	DF	386.5	196.5	388	622	5	2.5
455	955	46,500	97,500	DB	DF	294.5	202.5	392	468	2	1
565	1,220	57,500	125,000	DB	—	442.5	312.5	398	501.5	3	2
635	1,400	64,500	142,000	DB	DF	325	195	398	502	3	1.5
715	1,620	73,000	166,000	—	DF	468	304	398	522	3	2
865	1,920	88,000	196,000	DB	DF	342	178	402	538	4	2
465	1,000	47,500	102,000	DB	DF	306	214	412	488	2	1
640	1,440	65,500	147,000	DB	DF	336.5	206.5	418	522	3	1.5
1,000	2,370	102,000	241,000	DB	DF	379	199	422	578	4	2
505	1,110	51,500	113,000	DB	DF	317.5	225.5	432	508	2	1
660	1,530	67,500	156,000	DB	DF	348	218	438	542	3	1.5
1,030	2,500	105,000	255,000	DB	DF	390.5	210.5	442	598	4	2
505	1,130	51,500	116,000	DB	DF	329	237	452	528	2	1
720	1,720	73,500	175,000	DB	DF	374.5	226.5	458	582	3	1.5
1,050	2,630	107,000	268,000	DB	DF	409	221	468	622	5	2.5
405	905	41,500	92,500	DB	—	328.5	248.5	472	528	2	1
620	1,450	63,000	148,000	DB	DF	356.5	244.5	474	566	2.5	1
730	1,770	74,500	180,000	DB	DF	386	238	478	602	3	1.5
117	300	12,000	31,000	DB	DF	429	229	488	652	5	2.5
520	1,210	53,000	124,000	DB	—	350	250	482	558	2	1
635	1,520	64,500	155,000	DB	DF	368	256	494	586	2.5	1
860	2,180	88,000	223,000	DB	DF	404.5	248.5	502	628	4	2
1,170	3,050	119,000	310,000	DB	DF	441	241	508	672	5	2.5



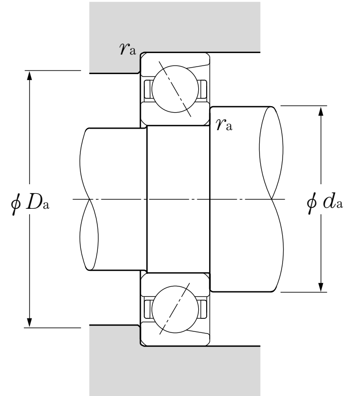
single



back-to-back arrangement (DB)



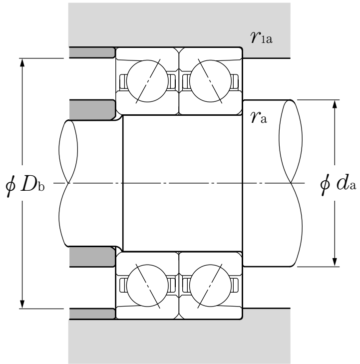
face-to-face arrangement (DF)

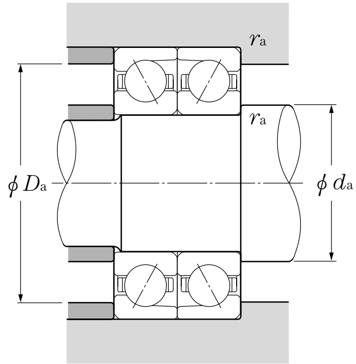


d 500～1,060mm

Boundary dimensions (mm)						contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing No.[1]	Load center (mm)	Mass (kg)
							single				single			single
d	D	B	C	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	α	C_r	C_{or}	C_r	C_{or}			a	(approx.)
500	620	56	—	3	1.1	30	395	780	40,000	79,500	**78/500**	A	189.5	36.5
	670	78	—	5	2	30	540	1,120	55,000	115,000	**79/500**	A	208	74.9
	720	100	—	6	3	30	735	1,590	75,000	163,000	**70/500**	A	226	129
560	700	100	—	5	2.5	30	670	1,450	68,000	147,000	**SF10013**	A	223	87.3
	750	85	—	5	2	30	620	1,380	63,500	141,000	**79/560**	A	231.5	105
630	780	69	—	4	1.5	30	500	1,140	51,000	116,000	**78/630A**	A	238	72.2
670	820	69	—	4	1.5	30	475	1,080	48,000	110,000	**78/670**	A	249.5	76.3
	820	69	—	4	1.5	40	420	945	43,000	96,500	**78/670B**	A	347	76.3
700	900	74	—	4	1.5	30	530	1,290	54,000	131,000	**SF14001**	A	268	117
1,000	1,420	130	—	7.5	4	30	1,440	4,650	147,000	470,000	**SF20001**	A	414.5	654
1,060	1,280	100	—	6	3	30	880	2,680	895,000	273,000	**78/1060**	A	387.5	255

[1] Drawing details are shown in Page B-15.
[2] Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic
$P_r=XF_r+YF_a$

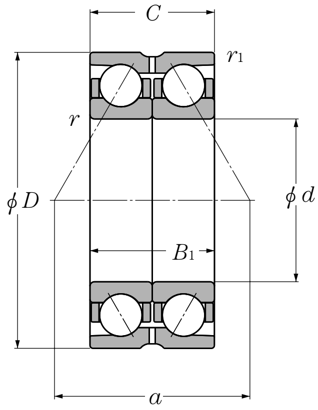
Contact angle	e	Single				DB, DF			
		$F_a/F_r\leqq e$		$F_a/F_r>e$		$F_a/F_r\leqq e$		$F_a/F_r>e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

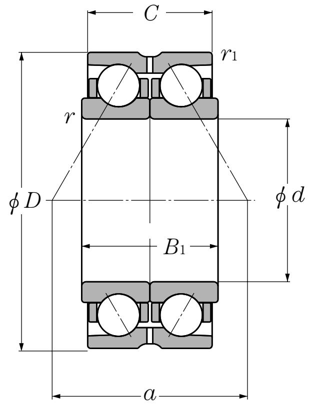
static
$P_{or}=X_oF_r+Y_oF_a$

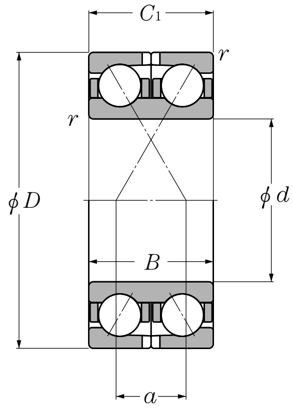
Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or}<F_r$ use $P_{or}=F_r$

Basic load ratings dynamic (duplex) KN C_r	static KN C_{or}	dynamic (duplex) kgf C_r	static kgf C_{or}	Bearing numbers (duplex) DB	DF	Load center mm a DB	DF	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max
640	1,560	65,000	159,000	DB	DF	379.5	267.5	514	606	2.5	1
875	2,250	89,000	229,000	DB	DF	416	260	522	648	4	2
1,190	3,200	122,000	325,000	DB	DF	452.5	252.5	528	692	5	2.5
1,080	2,890	111,000	295,000	DB	DF	446.5	246.5	522	678	4	2
1,010	2,760	103,000	281,000	DB	DF	463.5	293.5	582	728	4	2
815	2,270	83,000	232,000	DB	DF	476	338	648	762	3	1.5
770	2,150	78,500	219,000	DB	DF	499	361	688	802	3	1.5
680	1,890	69,500	193,000	DB	DF	694	556	688	802	3	1.5
860	2,580	88,000	263,000	DB	DF	536	388	718	882	3	1.5
2,340	9,250	238,000	945,000	DB	DF	828.5	568.5	1,036	1,384	6	3
1,430	5,350	146,000	545,000	DB	DF	775.5	575.5	1,088	1,252	5	2.5



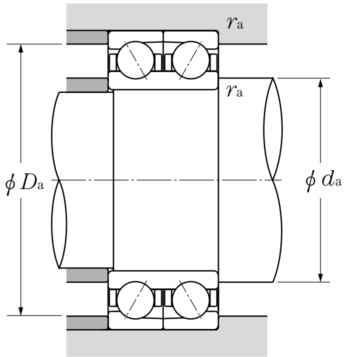


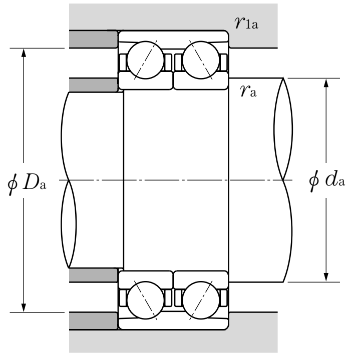


d 100～190mm

Boundary dimensions (mm)						Contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing[1] No.
d	D	B or B_1	C or C_1	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	α	C_r	C_{or}	C_r	C_{or}		
100	170	60.3	60.3	2.5	2.5	40	160	179	16,300	18,200	DE2010	D
110	169.5	56	56	2.5	—	30	149	186	15,200	18,900	DE2208	B
120	190	66	66	2.5	1	30	187	236	19,000	24,100	DE2405	F
	190	66	66	2.5	1	30	187	236	19,000	24,100	DE2409	D
130	200	66	66	2.5	—	30	191	251	19,400	25,600	DE2601	B
140	210	66	66	2	—	40	203	266	20,700	27,100	DE2812	A
	210	66	66	1	—	40	179	248	18,300	25,300	DE2806	B
	210	66	66	2.5	—	30	194	265	19,800	27,000	DE2807	B
150	225	70	70	2.5	—	30	222	305	22,700	31,500	DE3010	A
	225	70	70	2.5	—	30	222	305	22,700	31,500	DE3011	B
	225	73	73	2.5	—	30	216	293	22,000	29,900	DE3009	A
	230	70	70	2.5	1.5	30	222	305	22,700	31,500	DE3007	F
	230	70	70	2	2	40	198	275	20,200	28,100	DE3019	D
160	215	56	50	2	1.1	40	123	186	12,500	18,900	DE3207	C
	240	76	76	2.5	—	30	252	355	25,700	36,000	DE3201	A
170	260	84	84	2.5	—	30	300	430	31,000	43,500	DE3402	A
175	280	92	92	2.5	—	40	320	480	32,500	49,000	DE3502	A
	280	92	92	2.5	—	40	320	480	32,500	49,000	DE3501	A
180	250	66	66	2.5	—	40	185	275	18,900	28,000	DE3606	A
	250	70	70	2.5	1	40	190	285	19,300	29,100	DE3609	F
	259.5	66	66	2.5	1	30	212	325	21,600	33,000	DE3610	D
	259.5	66	66	2.5	1	30	212	325	21,600	33,000	DE3601	F
	259.5	66	66	2.5	—	40	224	330	22,800	34,000	DE3608	B
	259.5	66	66	2	—	40	224	330	22,800	34,000	DE3615	A
	259.5	66	66	2.5	—	30	251	380	25,600	38,500	DE3603	A
	259.5	66	66	2.5	2.5	30	212	325	21,600	33,000	DE3612	D
	280	92	92	2.5	—	30	345	505	35,000	51,500	DE3605	A
190	269.5	66	66	2.5	1	30	215	335	21,900	34,500	DE3807	D
	269.5	66	66	2.5	1	30	215	335	21,900	34,500	DE3801	F

1. Drawing details are shown in Page B-16.
2. Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load
dynamic

$P_r = XF_r + YF_a$

Contact angle	e	Single $F_a/F_r \leqq e$		Single $F_a/F_r > e$		DB, DF $F_a/F_r \leqq e$		DB, DF $F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static

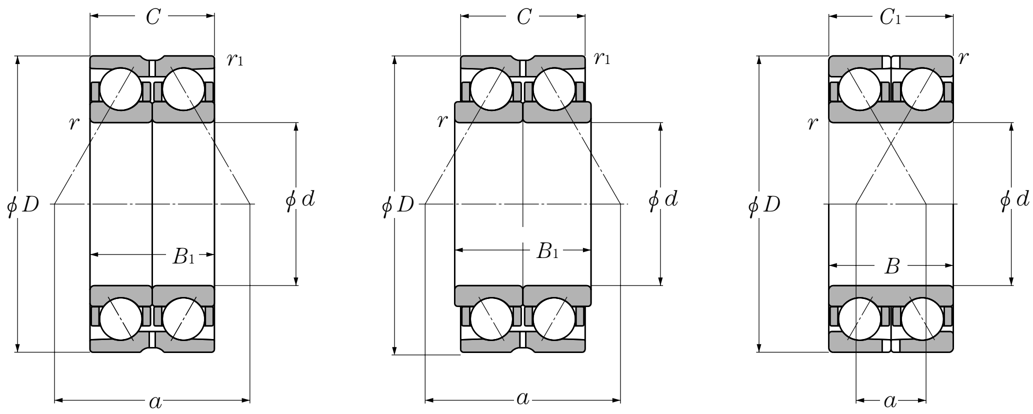
$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max	Load center mm a	Mass kg (approx.)
158	112	2	2	143	5.64
157.5	112	2	—	54.5	4.61
184.5	132	2	1	122	7.09
184.5	132	2	1	122	7.09
188	142	2	—	64	7.54
198	150	2	—	90	8
204.5	152	2	—	90	7.76
198	152	2	—	67	7.72
213	162	2	—	71.5	9.74
213	162	2	—	71.5	9.74
213	162	2	—	72.5	9.69
221.5	162	2	1.5	143	9.74
221.5	158.5	2	2	194	9.74
208	170	2	1	182	5.71
228	172	2	—	76.5	12
248	182	2	—	111	16.1
268	187	2	—	119	21.7
268	187	2	—	88.5	21.7
238	192	2	—	106	9.83
244.5	192	2	1	215	10.4
254	192	2	1	160	10.4
254	192	2	1	160	10.4
247.5	192	2	—	109	10.7
249.5	190	2	—	109	10.7
247.5	192	2	—	80	10.7
247.5	192	2	2	160	10.4
268	192	2	—	89.5	20.9
264	202	2	1	166	11.9
264	202	2	1	166	11.9

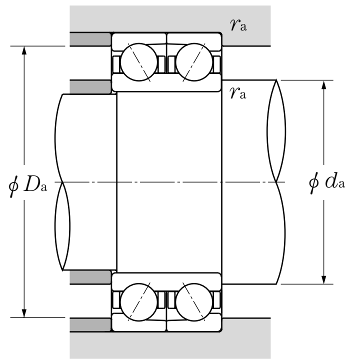
Double Row Angular Contact Ball Bearings

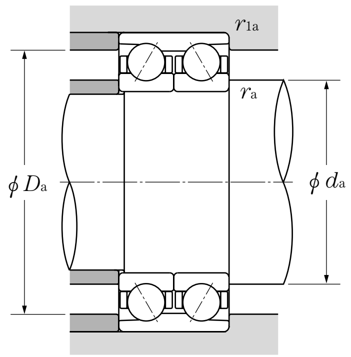


d 200～360mm

Boundary dimensions (mm)						Contact angle	Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing No.[1]
d	D	B or B_1	C or C_1	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	α	C_r	C_{or}	C_r	C_{or}		
200	279.5	76	76	2.5	1.5	30	253	405	25,800	41,500	DE4004	F
	279.5	76	76	2.5	—	30	253	405	25,800	41,500	DE4008	B
	289.5	76	76	2.5	1.5	40	260	385	26,500	39,500	DE4010	G
	289.5	76	76	2.5	2.1	30	269	420	27,500	42,500	DE4019	D
	289.5	76	76	2.5	1.5	30	269	420	27,500	42,500	DE4009	F
	289.5	76	76	2.5	1.5	30	269	420	27,500	42,500	DE4002	F
	289.5	76	76	2.5	1.5	30	269	420	27,500	42,500	DE4012	D
	310	102	102	2.5	—	30	410	650	41,500	66,000	DE4007	A
220	309.5	76	76	2.5	—	30	325	520	33,000	53,000	DE4403	A
	309.5	76	76	2.5	—	30	325	520	33,000	53,000	DE4404	A
	309.5	76	76	2.1	1.1	30	325	520	33,000	53,000	DE4408	D
	319.5	92	92	2.5	—	30	375	625	38,500	63,500	DE4409	A
	319.5	92	92	2.5	—	40	335	550	34,500	56,000	DE4406	A
230	329.5	80	80	2.5	1.5	30	350	585	36,000	59,500	DE4602	F
	329.5	80	80	2.5	1.5	30	350	585	36,000	59,500	DE4603	D
	329.5	80	80	2.5	1.5	30	350	585	36,000	59,500	DE4605	E
240	359.5	112	112	3	1.5	40	440	770	45,000	78,500	DE4803	F
250	340	76	70	2	2	30	272	480	27,800	49,000	DE5004	C
260	369.5	92	92	2.5	—	40	380	680	39,000	69,000	DE5213	A
	369.5	92	92	2.5	—	30	430	775	43,500	79,000	DE5211	A
	369.5	92	92	2.5	2.5	30	395	695	40,000	71,000	DE5212	F
280	389.5	92	92	2.1	1.1	30	405	745	41,500	76,000	DE5605	D
300	429.5	112	112	3	—	30	530	1,040	54,000	106,000	DE6001	A
360	540	164	164	5	—	30	725	1,630	74,000	166,000	DE7201	A

1. Drawing details are shown in Page B-16.
2. Smallest allowable dimension for chamfer dimension r or r_1.





Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

Contact angle	e	Single				DB, DF			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

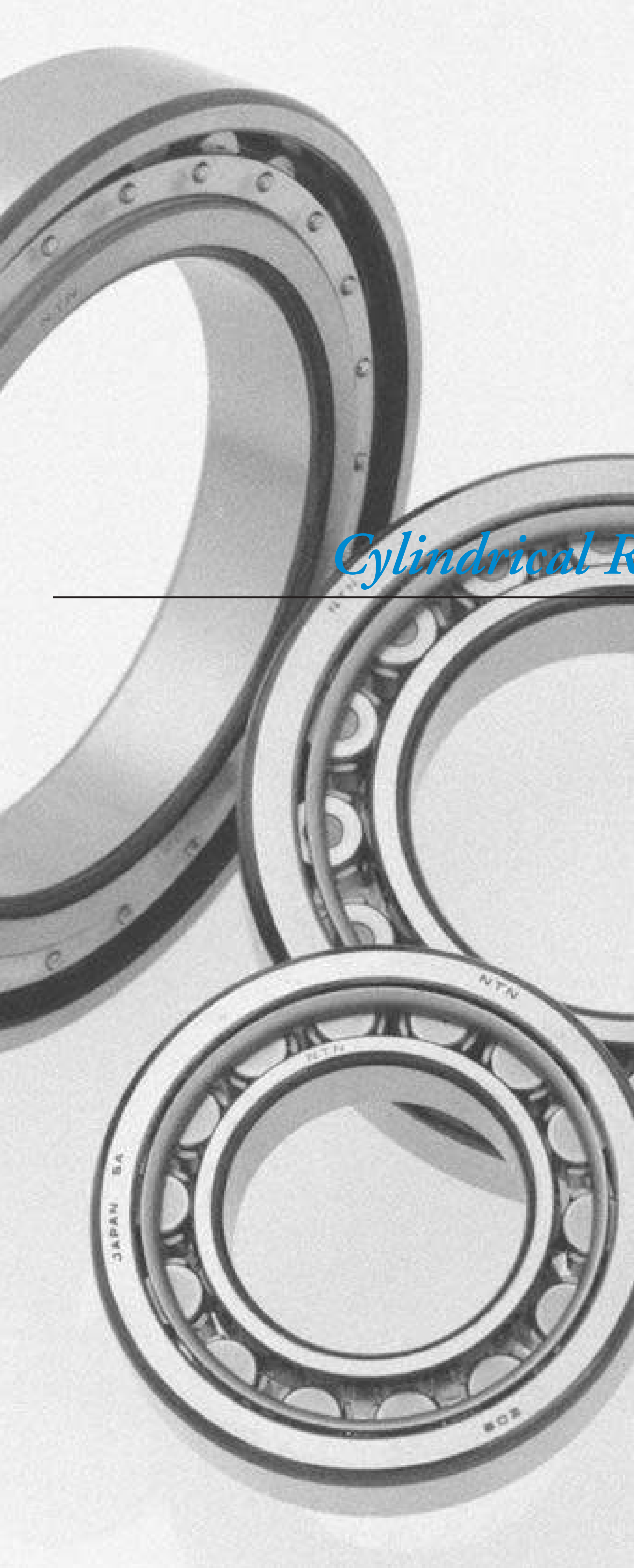
static

$P_{or} = X_o F_r + Y_o F_a$

Contact angle	Single		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single, When $P_{or} < F_r$ use $P_{or} = F_r$

Abutment and fillet dimensions mm				Load center mm	Mass kg
d_a min	D_a max	r_{as} max	r_{las} max	a	(approx.)
271	212	2	1.5	177	14.3
267.5	212	2	—	88.5	14.3
281	212	2	1.5	244	16.5
277.5	212	2	2	179	16.4
281	212	2	1.5	180	16.4
281	212	2	1.5	179	16.4
281	212	2	1.5	179	16.4
298	212	2	—	99	28.3
297.5	232	2	—	95.5	17.8
297.5	232	2	—	95.5	17.8
302.5	232	2	1	191	17.8
307.5	232	2	—	101	24.4
307.5	232	2	—	136	24.4
321	242	2	1.5	202	22
321	242	2	1.5	202	22
321	242	2	1.5	202	22
351	254	2.5	1.5	308	39.7
328	262	2	2	208	18.4
357.5	272	2	—	155	31.3
357.5	272	2	—	114	31.3
357.5	272	2	2	228	30.9
382.5	292	2	1	239	33.4
417.5	312	2.5	—	132	52.4
518	382	4	—	171	131



Cylindrical Roller Bearings

●Cylindrical Roller Bearings

1. Structure and Characteristics

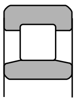
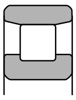
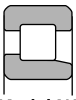
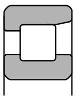
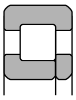
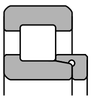
Since the rollers of the cylindrical roller bearings make line contact with the raceways, these bearings can support heavy radial loads and are suitable for high speed operation.

Assembly and disassembly are comparatively easy even if the inner or outer ring requires a shrink fit, as the bearing is a separation type.

Cylindrical roller bearings are classified as single row, double row and four row type, according to how many rollers are used, and there are models as shown in **Table 1** to **3**.

Although designed as a thin wall type, the SL Model double row cylindrical roller bearing can support enormous radial and impact loads. **Table 4** lists the configurations available.

Table 1 Model and characteristics of the single row cylindrical roller bearings

Model code	Drawing	Characteristics
Model NU Model N	 Model NU  Model N	● Model NU has ribs on the outer ring and the inner ring can be separated from "the arranged set of outer ring, rollers and cage". Model N has ribs on the inner ring and the outer ring can be separated from "the arranged set of inner ring, rollers and cage". ● This bearing cannot support axial loads. ● The most suitable model widely used as the free end bearing.
Model NJ Model NF	 Model NJ  Model NF	● Model NJ has ribs on the outer ring and a rib on the inner ring. Model NF has a rib on the outer ring and ribs on the inner ring. ● These bearings support axial loads in one direction only. ● There may be a case to use two bearings adjacent when they are used regardless of the fixed end or free end.
Model NUP Model NH (NJ+HJ)	 Model NUP  Model NH	● Model NUP has a rib ring added on the side of the inner ring where it did not have a rib. Model NJ with the added ring rib of Model L is Model NH. The inner ring should be fixed along the axial direction since each ring rib will be separated. ● These bearings support axial loads in either direction. ● There may be a case to use as the fixed end bearing.

Note: Model E provides higher load capacity designed with increased diameter,length and numbers of rollers but the boundary dimensions are same as the standard type bearings.

Table 2 Model and characteristics of the double row cylindrical roller bearings

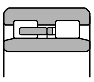
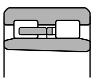
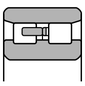
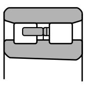
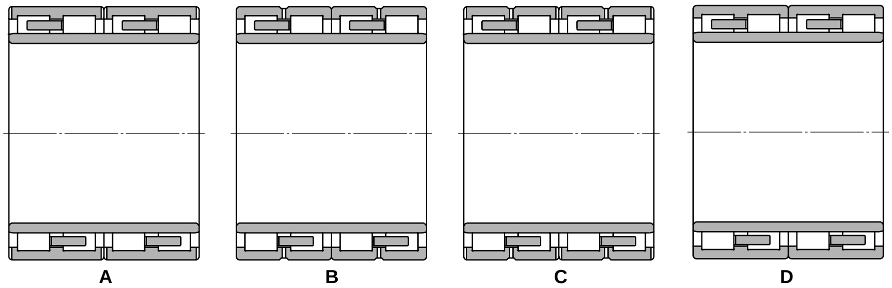
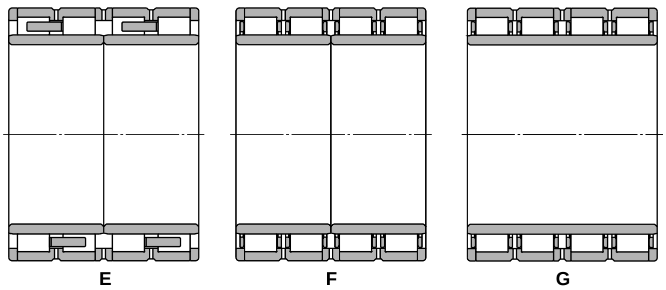
Model code	Drawing	Characteristics
Model NNU Model NN	  Model NNU Cylindrical hole Tapered hole   Model NN Cylindrical hole Tapered hole	● These bearings are used in the main shaft of machine tools, rolling mill rolls and printing machine plate cylinders where thin walled bearings are needed. ● To use the bearing in the main shaft of machine tools, adjust the radial internal clearance by inserting a tapered inner ring to the tapered shaft.

Table 3 Models and characters of four row cylindrical roller bearings

Drawing	Characteristics
Refer to the drawings. **Drawing numbers are listed in the dimensions table.**	● The bearing is mainly used for the roll neck of a rolling mill, and is designed so as to handle the maximum rating load for the allowable space in the roll neck part. Carbonized steel may be used to provide better resistance to cracking or impact to the inner ring. ● Consult **NTN** Engineering about the fitting and bearing internal clearance when the bearing is used for the preparing roll of a rolling mill. ● **NTN** provides bearings with special configurations: with tapered shaft holes; for high speed use; designed to prevent creeping; and, with dust and waterproof seals.





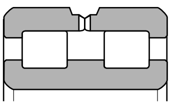
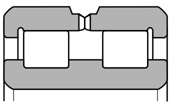
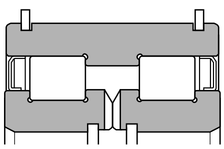
Remarks
Drawings from **A** to **E** show the long cylindrical rollers and the machined cage. **Drawings** from **F** to **G** show the hollow rollers and the pin type cage.

Suffix to the drawing number
M: Bearings which outer ring lubrication port is equipped with a fitting nozzle for oil mist.
R: Inner ring has a helical groove on its inner surface.
S: Special specifications.

Note 1) The bearing has lubricant grooves on both sides of the inner rings.
2) The bearing has lubricant grooves on one of the inner rings.
3) The bearing has lubricant grooves on one of the outer rings.
4) No lubricant groove and hole is designed on the outer ring spacer.

Drawings

Table 4 Model and Characteristics of the Model SL cylindrical roller bearings

Model		Characteristics
Open type	 Model SL01  Model SL02	● Fixed end is Model SL01, free end is Model SL02. ● Since the outer ring is split in the circumference direction using a special method and fixed as a unit after mounting rollers, **the bearing side face should be securely fixed using the shaft or housing shoulder in the axial direction.** ● Outer ring has an oil groove and port. ● Model SL01 can support axial loads from both directions via rollers. ● Shoulder dimensions of shaft and bearings generally applies D_a and d_a dimensions in the dimensions table, but J and K dimensions are used when the moment or large axial loads are applied.
Enclosed type	 Model SL04	● Model SL04 only with the fixed side. ● Since the inner ring is split in the circumference direction using a special method and fixed as a unit after mounting rollers, the bearing side face should be securely fixed by using the shaft or housing shoulder in the axial direction. ● Inner ring has an oil groove and port. ● Model SL04 can support radial and axial loads in either directions. ● A sealed bearing prelubricated with grease, the outer ring is fitted with a locating snap ring, making it easy to handle and appropriate for sheaves and other applications. ● Surface coating is added for rust prevention.

Note: We also provide 3-row, 4-row and 5-row bearings for the Model SL cylindrical roller bearing. Consult **NTN** Engineering for further details.

2. Dimensional Accuracy/Rotation Accuracy

Refer to Table 3.3 (Page A-12,13)

3. Recommended Fitting

Refer to Table 4.2 (Page A-24)

4. Bearing Internal Clearance

Refer to Table 5.5 and 5.6 (Page A-31, 32, 33)

5. Permissible slant angle

It varies according to the bearing type and internal specifications, the values in the table below are widely used to avoid edge loads under general load conditions.

When the width series is 0 or 1 ······0.001 rad (3.5')
When the width series is 2 ············0.0005 rad (1.5')
Double row cylindrical roller bearing ❶ ···0.0005 rad (1.5')

❶ This is no applied to high accuracy bearings which are used as the main shaft of machine tools.

Table 5 Tolerance of inscribed circle diameter F_w of rollers and circumscribed circle diameter E_w of rollers for compatible bearings.

Unit μm

d mm		ΔF_w		ΔE_w	
over	Incl	high	low	low	high
50	120	+ 20	0	0	- 20
120	200	+ 25	0	0	- 25
200	250	+ 30	0	0	- 30
250	315	+ 35	0	0	- 35
315	400	+ 40	0	0	- 40
400	500	+ 45	0	0	- 45
500	630	+ 70	0	0	- 70
630	800	+ 80	0	0	- 80
800	1,000	+ 90	0	0	- 90
1,000	1,250	+105	0	0	-105
1,250	1,400	+125	0	0	-125

ΔF_w : Dimensional difference of inscribed circle diameter of rollers.❷
ΔE_w : Dimensional difference of circumscribed circle diameter of rollers.❷
❷ Regulation range of JIS is $d \leqq$ 500mm for ΔF_w, and $d \leqq$ 400mm for ΔE_w.

Table 6 Radial internal clearance of Model SL cylindrical roller bearing.

Unit μm

Nominal bore diameter d mm		CN (Normal)		C 3		C 4	
over	Incl	min	max	min	max	min	max
30	50	20	75	40	95	55	110
50	80	30	90	55	115	75	135
80	120	35	105	80	150	105	175
120	180	60	150	110	200	150	240
180	250	90	190	155	255	205	305
250	315	110	225	195	310	255	370
315	400	140	265	245	370	320	445
400	500	180	320	300	440	395	535

6. Radial internal clearance of the Model SL cylindrical roller bearings.

Table 6 lists the radial internal clearance values of the Model SL cylindrical roller bearings.

7. Recommended fit of the Model SL cylindrical roller bearings, and selection of the radial internal clearance.

Table 7 lists the recommended fit for outer ring rotation such as sheaves and wheels, **Table 8** lists the relation between the fitting and the radial internal clearance.

For assembling and disassembling the bearing, it is necessary to evenly load around the circumference of the raceway end on the fitting side.

8. General Operating Cautions

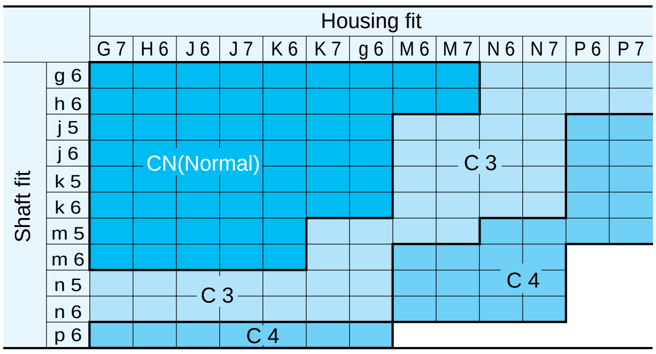
Slippage between the rollers and raceways may occur when bearings are operated under small loads (about $F_r \leqq 0.04C_{or}$) and may cause smearing. This is most apparent when using large size cylindrical roller bearings due to the large cage mass. Please consult **NTN** Engineering for further details.

Table 7 Recommended fit

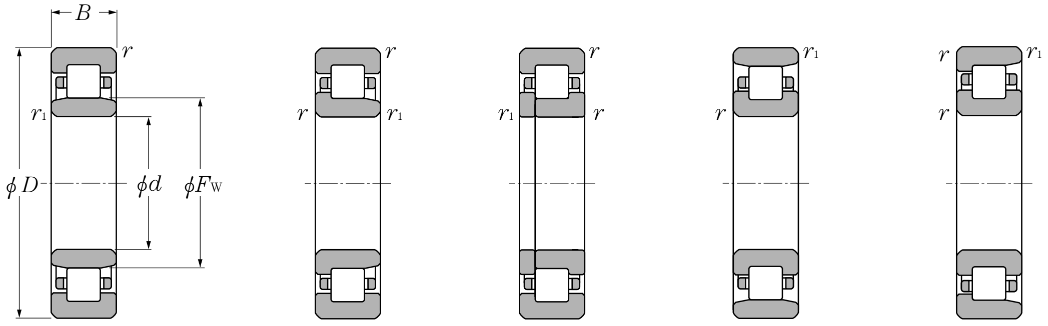
Conditions		Tolerance range class of shaft	Tolerance range class of housing
Outer ring rotating load	Heavy load with a thin walled housing.	g6 or h6	P7
	Normal load, heavy load		N7 ❸
	Light load, changing load		M7

❸ Be sure to use N7 for sheaves.

Table 8 Relation between fit and radial internal clearance.



Note: When the shaft fit is g6, housing fit is N7(N6) and used at low speed (for sheaves), apply CN(normal) clearance.

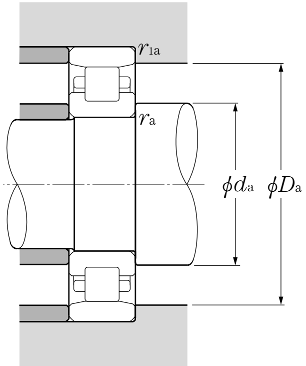


Type NU Type NJ Type NUP Type N Type NF

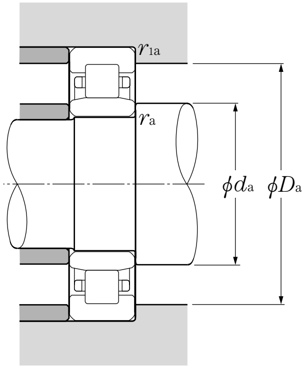
d 100～120mm

	Boundary dimensions				Basic load ratings				Bearing numbers	Dimensions
					dynamic	static	dynamic	static		
	mm				kN		kgf			mm
d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	type NU	F_w
100	140	20	1.1	1	70.0	98.0	7,100	10,000	NU1920	110
	150	24	1.5	1.1	93.0	126	9,500	12,800	NU1020	113
	180	34	2.1	2.1	183	217	18,600	22,200	NU220	120
	180	34	2.1	2.1	249	305	25,400	31,000	NU220E	119
	180	46	2.1	2.1	258	340	26,300	34,500	NU2220	120
	180	46	2.1	2.1	335	445	34,000	45,500	NU2220E	119
	215	47	3	3	299	335	30,500	34,500	NU320	129.5
	215	47	3	3	380	425	38,500	43,500	NU320E	127.5
	215	73	3	3	410	505	42,000	51,500	NU2320	129.5
	215	73	3	3	570	715	58,000	73,000	NU2320E	127.5
105	160	26	2	1.1	105	142	10,700	14,500	NU1021	119.5
	190	36	2.1	2.1	201	241	20,500	24,600	NU221	126.8
	190	65.1	2.1	2.1	360	505	36,500	51,500	NU3221	126.8
	225	49	3	3	320	360	32,500	36,500	NU321	135
110	150	20	1.1	1	72.5	106	7,400	10,800	NU1922	120
	170	28	2	1.1	131	174	13,400	17,700	NU1022	125
	200	38	2.1	2.1	240	290	24,500	29,500	NU222	132.5
	200	38	2.1	2.1	293	365	29,800	37,000	NU222E	132.5
	200	53	2.1	2.1	320	415	32,500	42,000	NU2222	132.5
	200	53	2.1	2.1	385	515	39,000	52,500	NU2222E	132.5
	200	69.8	2.1	2.1	425	605	43,500	62,000	NU3222	132.5
	240	50	3	3	360	400	36,500	41,000	NU322	143
	240	50	3	3	450	525	46,000	53,500	NU322E	143
	240	80	3	3	605	790	61,500	80,500	NU2322	143
	240	80	3	3	675	880	69,000	89,500	NU2322E	143
	240	92.1	3	3	715	985	73,000	100,000	NU3322A	143
120	165	22	1.1	1	89.5	134	9,150	13,700	NU1924	132
	165	27	1.1	1	116	188	11,900	19,100	NU2924	132
	180	28	2	1.1	139	191	14,100	19,500	NU1024	135
	215	40	2.1	2.1	260	320	26,500	32,500	NU224	143.5
	215	40	2.1	2.1	335	420	34,000	43,000	NU224E	143.5
	215	58	2.1	2.1	350	460	35,500	47,000	NU2224	143.5
	215	58	2.1	2.1	450	620	46,000	63,000	NU2224E	143.5
	215	76	2.1	2.1	540	815	55,000	83,000	NU3224	143.5
	260	55	3	3	450	510	46,000	52,000	NU324	154
	260	55	3	3	530	610	54,000	62,000	NU324E	154

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

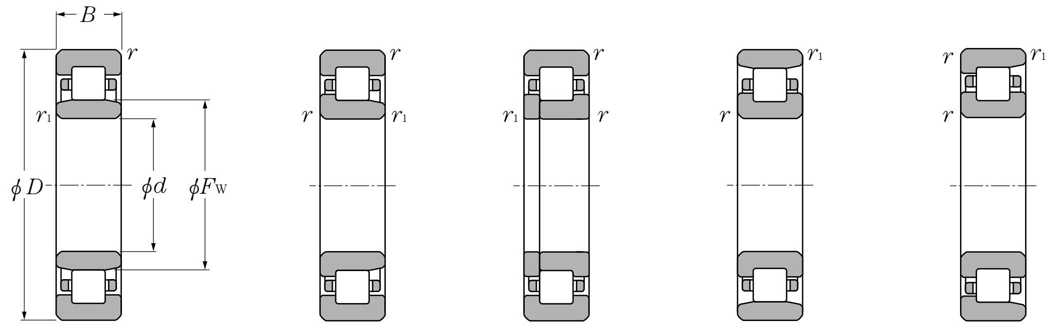


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
105	133.5	1	1	1.01
106.5	142	1.5	1	1.45
111	169	2	2	3.33
111	169	2	2	3.66
111	169	2	2	4.57
111	169	2	2	5.01
113	202	2.5	2.5	7.49
113	202	2.5	2.5	8.57
113	202	2.5	2.5	11.7
113	202	2.5	2.5	12.8
111.5	151	2	1	1.84
116	179	2	2	3.95
116	179	2	2	8.25
118	212	2.5	2.5	8.53
115	143.5	1	1	1.09
116.5	161	2	1	2.33
121	189	2	2	4.63
121	189	2	2	4.27
121	189	2	2	6.56
121	189	2	2	7.4
121	189	2	2	9.85
123	227	2.5	2.5	10
123	227	2.5	2.5	11.1
123	227	2.5	2.5	17.1
123	227	2.5	2.5	19.4
123	227	2.5	2.5	20.2
125	158.5	1	1	1.48
125	158.5	1	1	1.81
126.5	171	2	1	2.44
131	204	2	2	5.57
131	204	2	2	5.97
131	204	2	2	8.19
131	204	2	2	9.18
131	204	2	2	12.2
133	247	2.5	2.5	12.8
133	247	2.5	2.5	13.9



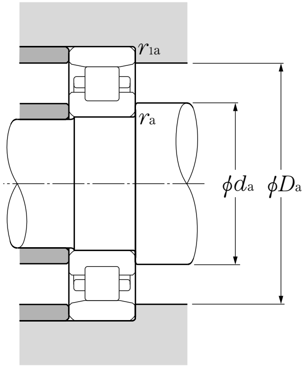
Type NU Type NJ Type NUP Type N Type NF

d 120～150mm

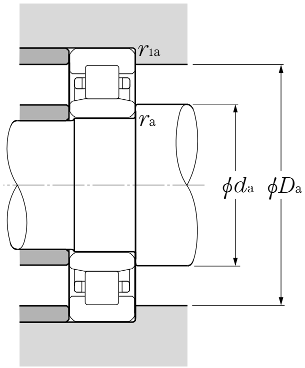
d	D	B	$r_{s\,min}$ ❶	$r_{ls\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	NU	F_w
	Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers type	Dimensions (mm)
120	260	86	3	3	710	920	72,500	93,500	NU2324	154
	260	86	3	3	795	1,030	81,000	105,000	NU2324E	154
	260	106	3	3	845	1,150	86,000	117,000	NU3324	154
130	180	24	1.5	1.1	106	161	10,800	16,400	NU1926	143
	180	30	1.5	1.1	149	248	15,200	25,300	NU2926	143
	200	33	2	1.1	172	238	17,500	24,200	NU1026	148
	230	40	3	3	270	340	27,600	35,000	NU226	156
	230	40	3	3	365	455	37,000	46,000	NU226E	153.5
	230	64	3	3	380	530	38,500	54,000	NU2226	156
	230	64	3	3	530	735	54,000	75,000	NU2226E	153.5
	230	80	3	3	600	955	61,000	97,500	NU3226	156
	280	58	4	4	560	665	57,000	68,000	NU326	167
	280	58	4	4	615	735	63,000	75,000	NU326E	167
	280	93	4	4	840	1,130	85,500	115,000	NU2326	167
	280	93	4	4	920	1,230	94,000	126,000	NU2326E	167
	280	112	4	4	975	1,360	99,500	139,000	NU3326	167
140	190	30	1.5	1.1	151	258	15,400	26,300	NU2928	153
	210	33	2	1.1	176	250	17,900	25,500	NU1028	158
	210	53	2	2	350	585	36,000	60,000	NU3028	158
	250	42	3	3	310	400	31,500	40,500	NU228	169
	250	42	3	3	395	515	40,000	52,500	NU228E	169
	250	68	3	3	445	635	45,500	64,500	NU2228	169
	250	68	3	3	575	835	58,500	85,000	NU2228E	169
	250	88	3	3	695	1,120	70,500	114,000	NU3228	169
	300	62	4	4	615	745	63,000	76,000	NU328	180
	300	62	4	4	665	795	67,500	81,500	NU328E	180
	300	102	4	4	920	1,250	94,000	127,000	NU2328	180
	300	102	4	4	1,020	1,380	104,000	141,000	NU2328E	180
150	210	28	2	1.1	147	219	15,000	22,300	NU1930	165
	210	36	2	1.1	204	335	20,800	34,000	NU2930	165
	225	35	2.1	1.5	202	294	20,600	29,900	NU1030	169.5
	270	45	3	3	345	435	35,000	44,500	NU230	182
	270	45	3	3	450	595	45,500	60,500	NU230E	182
	270	73	3	3	500	710	51,000	72,500	NU2230	182
	270	73	3	3	660	980	67,500	100,000	NU2230E	182
	270	96	3	3	800	1,300	81,500	132,000	NU3230	182

❶ Minimal allowable dimension for chamfer dimension r or r_1.

NTN



Type N

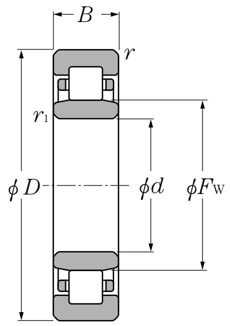


Type NU

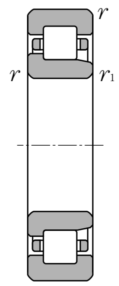
Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

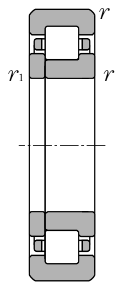
Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
133	247	2.5	2.5	21.5
133	247	2.5	2.5	26.1
133	247	2.5	2.5	27.1
136.5	172	1.5	1	1.95
136.5	172	1.5	1	2.44
136.5	191	2	1	3.69
143	217	2.5	2.5	6.3
143	217	2.5	2.5	6.9
143	217	2.5	2.5	10.2
143	217	2.5	2.5	11.8
143	217	2.5	2.5	14.6
146	264	3	3	17.4
146	264	3	3	19.4
146	264	3	3	26.9
146	264	3	3	30.9
146	264	3	3	33.1
146.5	182	1.5	1	2.59
146.5	201	2	1	4.05
149	201	2	2	6.8
153	237	2.5	2.5	7.88
153	237	2.5	2.5	8.73
153	237	2.5	2.5	12.9
153	237	2.5	2.5	15.8
153	237	2.5	2.5	19.1
156	284	3	3	21.2
156	284	3	3	23.2
156	284	3	3	33.8
156	284	3	3	38.7
156.5	201	2	1	3.17
156.5	201	2	1	4.08
158	214	2	1.5	4.77
163	257	2.5	2.5	9.92
163	257	2.5	2.5	11
163	257	2.5	2.5	16.3
163	257	2.5	2.5	19.7
163	257	2.5	2.5	24.5



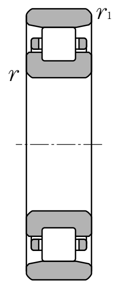
Type NU



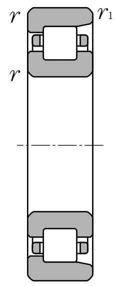
Type NJ



Type NUP



Type N

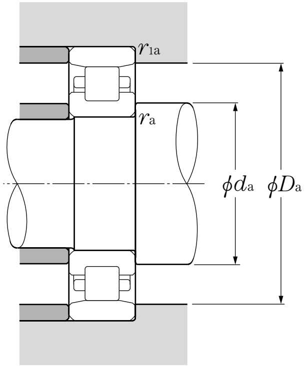


Type NF

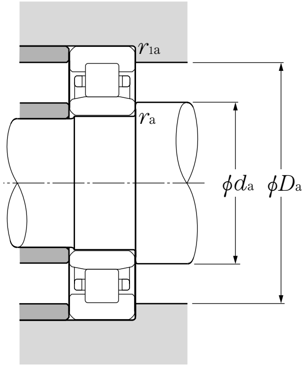
d 150～180mm

Boundary dimensions					Basic load ratings				Bearing numbers	Dimensions
					dynamic	static	dynamic	static		
mm					kN		kgf			mm
									type	
d	D	B	$r_{s\,min}$ ❶	$r_{ls\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	NU	F_w
150	320	65	4	4	665	805	67,500	82,500	**NU330**	193
	320	65	4	4	760	920	77,500	94,000	**NU330E**	193
	320	108	4	4	1,020	1,400	104,000	143,000	**NU2330**	193
	320	108	4	4	1,160	1,600	118,000	163,000	**NU2330E**	193
160	220	28	2	1.1	154	236	15,700	24,100	**NU1932**	175
	220	36	2	1.1	213	360	21,700	36,500	**NU2932**	175
	240	38	2.1	1.5	238	340	24,200	35,000	**NU1032**	180
	270	86	2.1	2.1	400	565	40,500	57,500	**NU3132**	189
	290	48	3	3	430	570	43,500	58,000	**NU232**	195
	290	48	3	3	500	665	51,000	68,000	**NU232E**	195
	290	80	3	3	630	940	64,500	96,000	**NU2232**	195
	290	80	3	3	810	1,190	82,500	121,000	**NU2232E**	193
	340	68	4	4	700	875	71,000	89,500	**NU332**	208
	340	68	4	4	860	1,050	87,500	107,000	**NU332E**	204
	340	114	4	4	1,070	1,520	109,000	155,000	**NU2332**	208
	340	114	4	4	1,310	1,820	134,000	186,000	**NU2332E**	204
170	230	28	2	1.1	160	254	16,300	25,900	**NU1934**	185
	230	36	2	1.1	222	385	22,600	39,500	**NU2934**	185
	260	42	2.1	2.1	278	400	28,300	41,000	**NU1034**	193
	310	52	4	4	475	635	48,500	65,000	**NU234**	208
	310	52	4	4	605	800	61,500	81,500	**NU234E**	207
	310	86	4	4	715	1,080	73,000	110,000	**NU2234**	208
	310	86	4	4	965	1,410	98,500	144,000	**NU2234E**	205
	310	110	4	4	1,020	1,690	104,000	172,000	**NU3234**	208
	360	72	4	4	795	1,010	81,500	103,000	**NU334**	220
	360	120	4	4	1,220	1,750	125,000	179,000	**NU2334**	220
180	250	33	2	1.1	215	335	21,900	34,000	**NU1936**	197
	250	42	2	1.1	293	495	29,900	50,500	**NU2936**	197
	280	46	2.1	2.1	340	485	35,000	49,500	**NU1036**	205
	280	74	2.1	2.1	610	1,030	62,000	105,000	**NU3036**	205
	320	52	4	4	495	675	50,500	69,000	**NU236**	218
	320	52	4	4	625	850	64,000	87,000	**NU236E**	217
	320	86	4	4	745	1,140	76,000	117,000	**NU2236**	218
	320	86	4	4	1,010	1,510	103,000	154,000	**NU2236E**	215
	320	112	4	4	1,010	1,700	103,000	174,000	**NU3236**	218
	380	75	4	4	905	1,150	92,000	118,000	**NU336**	232

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

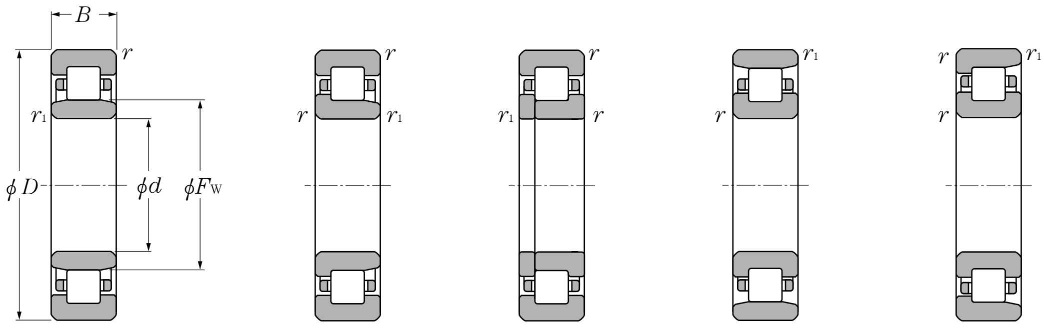


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
166	304	3	3	25.3
166	304	3	3	28.4
166	304	3	3	40.6
166	304	3	3	47.2
166.5	211	2	1	3.35
166.5	211	2	1	4.3
168	229	2	1.5	5.9
171	259	2	2	20.6
173	277	2.5	2.5	13.7
173	277	2.5	2.5	15.6
173	277	2.5	2.5	22
173	277	2.5	2.5	25.1
176	324	3	3	31.3
176	324	3	3	34
176	324	3	3	50.5
176	324	3	3	56
176.5	221	2	1	3.52
176.5	221	2	1	4.53
181	249	2	2	7.88
186	294	3	3	17
186	294	3	3	19.6
186	294	3	3	27.2
186	294	3	3	31
186	294	3	3	37.4
186	344	3	3	37
186	344	3	3	59.5
186.5	241	2	1	5.21
186.5	241	2	1	6.63
191	269	2	2	10.3
191	269	2	2	17.8
196	304	3	3	17.7
196	304	3	3	20.4
196	304	3	3	28.4
196	304	3	3	31.9
196	304	3	3	39.6
196	364	3	3	44.2

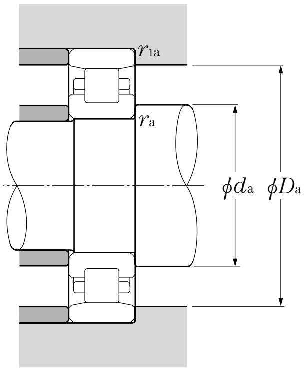


Type NU Type NJ Type NUP Type N Type NF

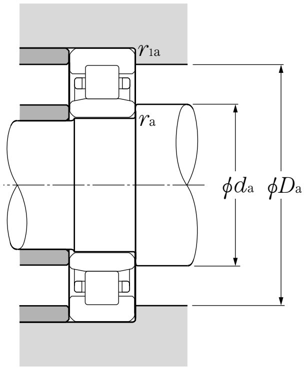
d 180～240mm

Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)
d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	type NU	F_w
180	380	126	4	4	1,380	1,990	141,000	203,000	NU2336	232
	380	150	4	4	1,600	2,410	163,000	246,000	NU3336	232
190	260	42	2	1.1	299	515	30,500	52,500	NU2938	207
	290	46	2.1	2.1	350	510	36,000	52,000	NU1038	215
	340	55	4	4	555	770	56,500	78,500	NU238	231
	340	55	4	4	695	955	71,000	97,500	NU238E	230
	340	92	4	4	830	1,290	84,500	131,000	NU2238	231
	340	92	4	4	1,100	1,670	113,000	170,000	NU2238E	228
	340	120	4	4	1,240	2,160	126,000	220,000	NU3238	231
	400	78	5	5	975	1,260	99,500	129,000	NU338	245
	400	132	5	5	1,520	2,220	155,000	226,000	NU2338	245
	400	155	5	5	1,550	2,280	158,000	233,000	NU3338	245
200	280	38	2.1	2.1	259	405	26,400	41,500	NU1940	220
	280	48	2.1	1.5	365	630	37,000	64,500	NU2940	220
	310	51	2.1	2.1	390	580	40,000	59,500	NU1040	229
	310	82	2.1	2.1	735	1,240	75,000	127,000	NU3040	227
	340	112	3	3	1,130	1,820	115,000	186,000	NU3140A	235
	360	58	4	4	620	865	63,500	88,500	NU240	244
	360	58	4	4	765	1,060	78,000	108,000	NU240E	243
	360	98	4	4	925	1,440	94,000	147,000	NU2240	244
	360	98	4	4	1,220	1,870	125,000	191,000	NU2240E	241
	360	128	4	4	1,260	2,150	128,000	219,000	NU3240	244
	420	80	5	5	975	1,270	99,500	130,000	NU340	260
	420	138	5	5	1,510	2,240	154,000	229,000	NU2340	260
	420	165	5	5	1,870	2,930	190,000	299,000	NU3340	260
220	300	48	2.1	1.5	390	705	39,500	72,000	NU2944	240
	340	56	3	3	500	750	51,000	76,500	NU1044	250
	340	90	3	3	860	1,490	87,500	152,000	NU3044	250
	370	120	4	4	1,180	2,090	120,000	213,000	NU3144	262
	400	65	4	4	760	1,080	77,500	110,000	NU244	270
	400	108	4	4	1,140	1,810	116,000	184,000	NU2244	270
	400	144	4	4	1,540	2,680	157,000	273,000	NU3244	270
	460	88	5	5	1,190	1,570	122,000	161,000	NU344	284
	460	145	5	5	1,780	2,620	181,000	268,000	NU2344	284
240	320	48	2.1	1.5	400	755	41,000	77,000	NU2948	260

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

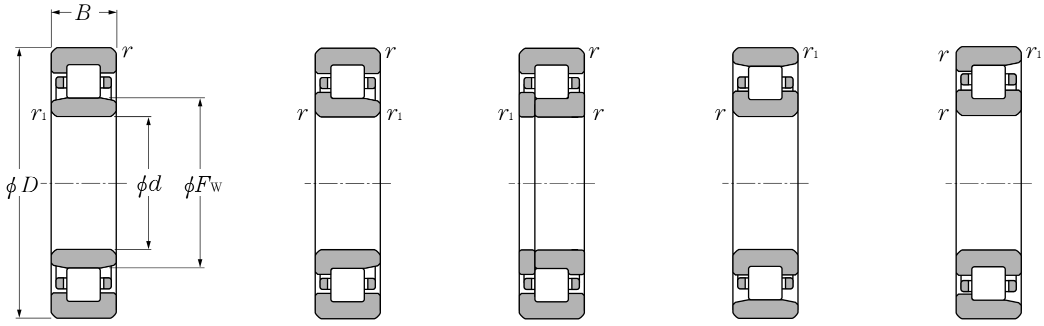


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
196	364	3	3	69.5
196	364	3	3	88
196.5	251	2	1	6.93
201	279	2	2	10.7
206	324	3	3	21.3
206	324	3	3	24.2
206	324	3	3	34.4
206	324	3	3	39.5
206	324	3	3	48.2
210	380	4	4	49.4
210	380	4	4	80.5
210	380	4	4	101
211	269	2	2	7.65
208	269	2	1.5	9.66
211	299	2	2	13.9
211	299	2	2	24.1
213	327	2.5	2.5	42.8
216	344	3	3	25.3
216	344	3	3	28.1
216	344	3	3	41.3
216	344	3	3	47.8
216	344	3	3	58
220	400	4	4	55.8
220	400	4	4	92.6
220	400	4	4	118
231	289	2	1.5	10.5
233	327	2.5	2.5	18.2
233	327	2.5	2.5	31.7
236	354	3	3	55.7
236	384	3	3	37.7
236	384	3	3	59
236	384	3	3	84.2
240	440	4	4	73.4
240	440	4	4	116
248	309	2	1.5	11.3

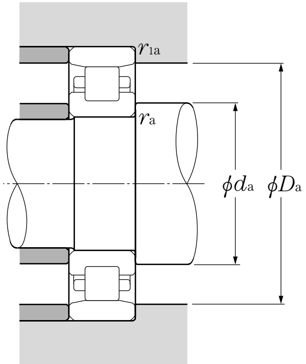


Type NU　　Type NJ　　Type NUP　　Type N　　Type NF

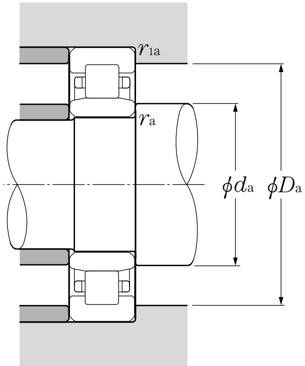
d 240～320mm

Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)
d	D	B	$r_{s\,min}$ ❶	$r_{ls\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	type NU	F_w
240	360	56	3	3	530	820	54,000	83,500	NU1048	270
	360	92	3	3	940	1,710	95,500	174,000	NU3048	270
	440	72	4	4	935	1,340	95,500	136,000	NU248	295
	440	120	4	4	1,440	2,320	146,000	236,000	NU2248	295
	500	95	5	5	1,430	1,950	146,000	198,000	NU348	310
	500	155	5	5	2,100	3,200	214,000	325,000	NU2348	310
260	360	46	2.1	2.1	400	665	41,000	67,500	NU1952	285
	360	60	2.1	2.1	545	985	55,500	100,000	NU2952	285
	400	65	4	4	645	1,000	65,500	102,000	NU1052	296
	400	104	4	4	1,150	2,020	117,000	206,000	NU3052	294
	440	144	4	4	1,810	3,150	185,000	320,000	NU3152	305
	480	80	5	5	1,150	1,660	117,000	170,000	NU252	320
	480	130	5	5	1,780	2,930	182,000	299,000	NU2252	320
	540	102	6	6	1,620	2,230	165,000	228,000	NU352	336
	540	165	6	6	2,340	3,600	239,000	365,000	NU2352	336
	540	206	6	6	2,930	4,800	299,000	490,000	NU3352	336
280	380	46	2.1	2.1	415	710	42,500	72,500	NU1956	305
	380	60	2.1	2.1	565	1,060	58,000	108,000	NU2956	305
	420	65	4	4	660	1,050	67,000	107,000	NU1056	316
	420	106	4	4	1,240	2,260	126,000	230,000	NU3056	314
	500	80	5	5	1,190	1,760	121,000	180,000	NU256	340
	500	130	5	5	1,840	3,100	188,000	315,000	NU2256	340
	580	108	6	6	1,820	2,540	185,000	259,000	NU356	362
	580	175	6	6	2,700	4,250	275,000	430,000	NU2356	362
300	380	60	2.1	2.1	505	1,230	51,500	125,000	NU3860	324
	420	56	3	3	560	935	57,000	95,500	NU1960	330
	420	72	3	3	780	1,440	79,500	147,000	NU2960	330
	460	74	4	4	855	1,340	87,000	137,000	NU1060	340
	460	118	4	4	1,610	3,000	164,000	305,000	NU3060	340
	540	85	5	5	1,400	2,070	143,000	211,000	NU260	364
	540	140	5	5	2,180	3,650	223,000	370,000	NU2260	364
	620	185	7.5	7.5	3,250	5,150	330,000	525,000	NU2360	385
320	400	60	2.1	2.1	525	1,310	53,500	134,000	NU3864	344
	440	56	3	3	580	1,010	59,500	103,000	NU1964	350
	480	74	4	4	875	1,410	89,500	143,000	NU1064	360

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N



Type NU

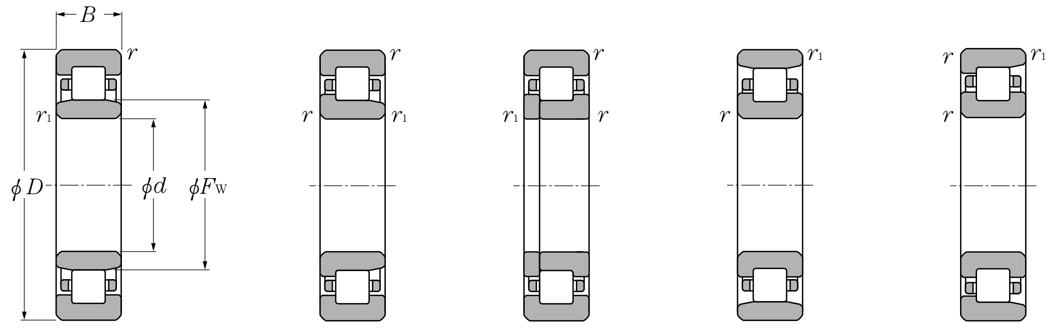
Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions (mm)				Mass (kg)
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
253	347	2.5	2.5	19.6
253	347	2.5	2.5	34.7
256	424	3	3	50.2
256	424	3	3	80
260	480	4	4	93.4
260	480	4	4	147
271	349	2	2	14.9
271	349	2	2	19.5
276	384	3	3	29.1
276	384	3	3	50.4
276	424	3	3	95.1
280	460	4	4	66.9
280	460	4	4	104
284	516	5	5	117
284	516	5	5	182
284	516	5	5	242
291	369	2	2	15.9
291	369	2	2	20.8
296	404	3	3	30.9
296	404	3	3	54.4
300	480	4	4	70.8
300	480	4	4	109
304	556	5	5	142
304	556	5	5	222
311	369	2	2	17.1
313	407	2.5	2.5	25.4
313	407	2.5	2.5	32.6
316	444	3	3	43.6
316	444	3	3	75.2
320	520	4	4	88.2
320	520	4	4	138
332	588	6	6	316
331	389	2	2	18.1
333	427	2.5	2.5	26.8
336	464	3	3	46

Single Row Cylindrical Roller Bearings

NTN

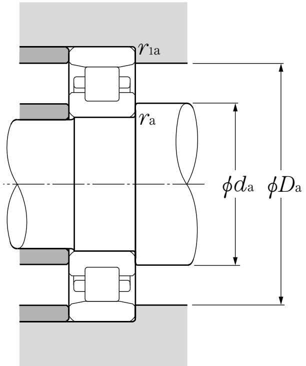


Type NU Type NJ Type NUP Type N Type NF

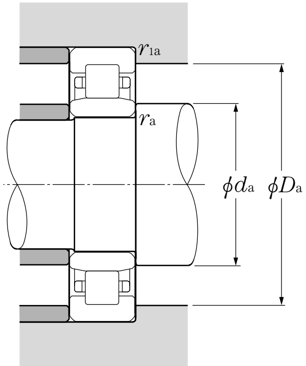
d 320～420mm

d	Boundary dimensions (mm) D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers type NU	Dimensions (mm) F_w
320	480	121	4	4	1,580	2,890	161,000	295,000	NU3064	358
	540	176	5	5	2,530	4,550	258,000	465,000	NU3164	376
	580	92	5	5	1,600	2,390	164,000	244,000	NU264	390
	580	150	5	5	2,550	4,350	260,000	445,000	NU2264	390
	670	200	7.5	7.5	3,750	5,800	385,000	595,000	NU2364	410
340	460	56	3	3	590	1,040	60,500	107,000	NU1968	370
	460	72	3	3	830	1,610	84,500	164,000	NU2968	370
	520	82	5	5	1,050	1,670	107,000	170,000	NU1068	385
	520	133	5	5	2,030	3,900	207,000	400,000	NU3068	385
	580	190	5	5	3,050	5,450	310,000	555,000	NU3168	400
	620	165	6	6	2,880	4,650	294,000	475,000	NU2268	410
	620	224	6	6	4,000	7,100	410,000	725,000	NU3268	410
	710	118	7.5	7.5	2,250	3,300	230,000	340,000	NU368	450
	710	212	7.5	7.5	4,250	6,600	430,000	675,000	NU2368	435
360	440	60	2.1	2.1	460	1,090	47,000	111,000	NU3872	382
	480	56	3	3	615	1,120	62,500	114,000	NU1972	390
	480	72	3	3	860	1,720	87,500	176,000	NU2972	390
	540	82	5	5	1,080	1,750	110,000	179,000	NU1072	405
	540	134	5	5	1,990	4,200	202,000	430,000	NU3072	413
	600	192	5	5	3,150	5,500	320,000	560,000	NU3172A	416
	650	232	6	6	4,150	7,600	425,000	775,000	NU3272	435
	750	224	7.5	7.5	4,500	7,000	460,000	710,000	NU2372	460
380	520	65	4	4	740	1,330	75,500	136,000	NU1976	416
	520	82	4	4	1,110	2,230	113,000	227,000	NU2976	416
	560	82	5	5	1,100	1,840	112,000	187,000	NU1076	425
	560	135	5	5	2,200	4,450	224,000	455,000	NU3076	426
	680	175	6	6	3,350	5,800	340,000	590,000	NU2276	460
	680	240	6	6	4,300	7,650	440,000	780,000	NU3276	460
400	500	75	2.1	2.1	870	2,250	88,500	229,000	NU3880	430
	600	90	5	5	1,320	2,190	134,000	223,000	NU1080	450
	600	148	5	5	2,520	5,050	257,000	515,000	NU3080	450
420	560	65	4	4	800	1,510	81,500	154,000	NU1984	456
	560	82	4	4	1,190	2,530	122,000	258,000	NU2984	456
	620	90	5	5	1,350	2,290	138,000	233,000	NU1084	470

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

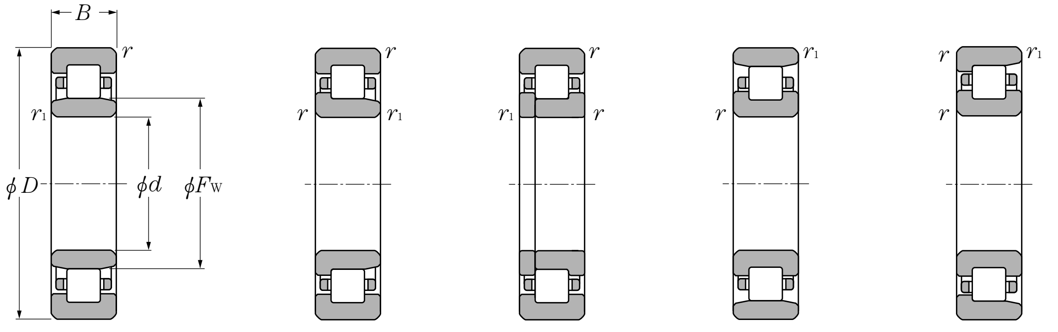


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
336	464	3	3	81.2
340	520	4	4	175
340	560	4	4	111
340	560	4	4	172
352	638	6	6	402
353	447	2.5	2.5	28.2
353	447	2.5	2.5	36.2
360	500	4	4	61.8
360	500	4	4	108
360	560	4	4	220
364	596	5	5	260
364	596	5	5	316
372	678	6	6	246
372	678	6	6	477
371	429	2	2	20.1
373	467	2.5	2.5	29.6
373	467	2.5	2.5	38
380	520	4	4	64.7
380	520	4	4	114
380	580	4	4	232
384	626	5	5	356
392	718	6	6	562
396	504	3	3	42.9
396	504	3	3	54.1
400	540	4	4	67.5
400	540	4	4	120
404	656	5	5	326
404	656	5	5	400
411	489	2	2	35.4
420	580	4	4	87.6
420	580	4	4	155
436	544	3	3	46.7
436	544	3	3	59
440	600	4	4	91

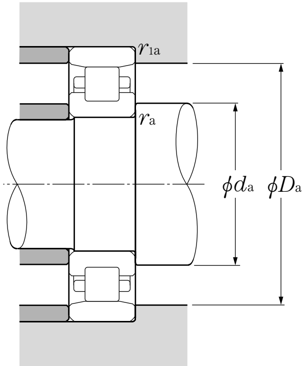


Type NU Type NJ Type NUP Type N Type NF

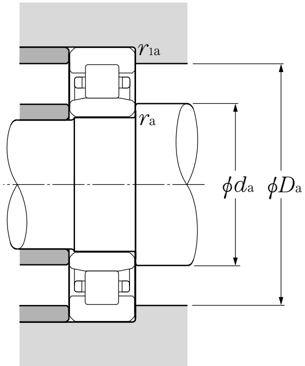
d 440～670mm

Boundary dimensions (mm)					Basic load ratings: dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)
d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	type NU	F_w
440	600	95	4	4	1,520	3,100	155,000	320,000	NU2988	480
	650	94	6	6	1,430	2,430	146,000	248,000	NU1088	493
	650	157	6	6	2,770	5,700	283,000	580,000	NU3088	493
460	580	72	3	3	990	2,230	101,000	227,000	NU2892	490
	680	100	6	6	1,540	2,630	157,000	269,000	NU1092	516
480	650	78	5	5	1,140	2,150	116,000	219,000	NU1996	523
	650	100	5	5	1,640	3,450	168,000	350,000	NU2996	523
	700	100	6	6	1,580	2,750	161,000	280,000	NU1096	536
500	620	72	3	3	1,030	2,390	105,000	244,000	NU28/500	530
	670	78	5	5	1,160	2,220	118,000	226,000	NU19/500	543
	720	100	6	6	1,610	2,870	164,000	292,000	NU10/500	556
530	710	82	5	5	1,290	2,480	132,000	253,000	NU19/530	576
	710	106	5	5	1,870	4,000	191,000	410,000	NU29/530	576
	780	112	6	6	1,930	3,450	197,000	350,000	NU10/530	595
	780	185	6	6	3,650	7,400	375,000	755,000	NU30/530	590
560	680	72	3	3	1,090	2,680	111,000	273,000	NU28/560	590
	680	90	3	3	1,250	3,200	127,000	325,000	NU38/560	590
	750	85	5	5	1,470	2,840	150,000	290,000	NU19/560	607
	750	112	5	5	2,010	4,250	205,000	435,000	NU29/560	607
	820	115	6	6	2,190	3,900	223,000	400,000	NU10/560	626
600	730	78	3	3	1,210	3,000	124,000	310,000	NU28/600	633
	800	90	5	5	1,620	3,200	165,000	325,000	NU19/600	650
	800	118	5	5	2,270	4,950	231,000	505,000	NU29/600	650
	870	200	6	6	4,450	9,350	455,000	955,000	NU30/600	670
630	780	88	4	4	1,520	3,650	155,000	370,000	NU28/630	667
	850	100	6	6	1,910	3,700	195,000	380,000	NU19/630	684
	850	128	6	6	2,710	5,850	277,000	595,000	NU29/630	684
	920	128	7.5	7.5	2,560	4,650	261,000	475,000	NU10/630	705
670	820	88	4	4	1,580	3,900	161,000	395,000	NU28/670	707
	820	112	4	4	2,010	5,500	205,000	560,000	NU38/670	709
	900	103	6	6	1,980	3,950	202,000	405,000	NU19/670	729

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

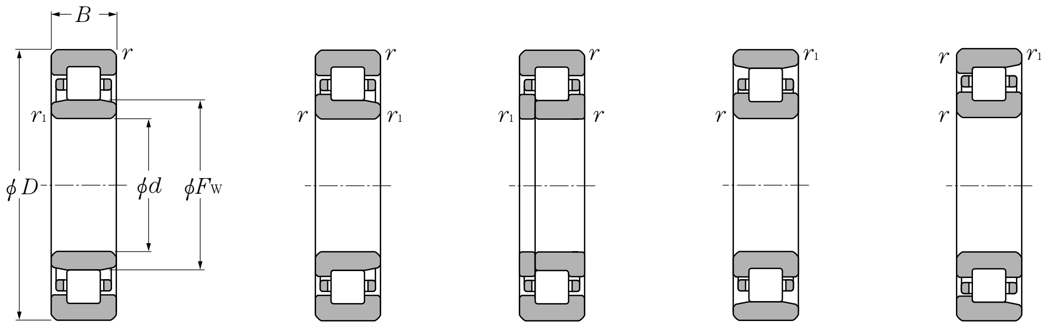


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Abutment and fillet dimensions mm				Mass kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
456	584	3	3	82.8
464	626	5	5	105
464	626	5	5	188
473	567	2.5	2.5	47.1
484	656	5	5	122
500	630	4	4	78.5
560	630	4	4	101
504	676	5	5	126
513	607	2.5	2.5	50.7
520	650	4	4	81.3
524	696	5	5	130
550	690	4	4	95.9
550	690	4	4	124
554	756	5	5	192
554	756	5	5	318
573	667	2.5	2.5	56.1
573	667	2.5	2.5	72.7
580	730	4	4	111
580	730	4	4	146
584	796	5	5	216
613	717	2.5	2.5	70.7
620	780	4	4	132
620	780	4	4	173
624	846	5	5	416
646	764	3	3	97.5
654	826	5	5	171
654	826	5	5	218
662	888	6	6	302
686	804	3	3	103
686	804	3	3	136
694	876	5	5	195

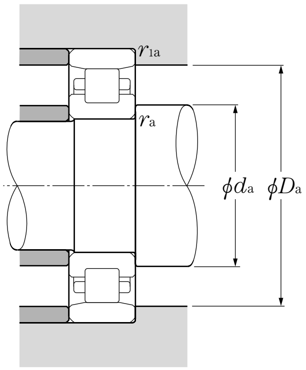


Type NU Type NJ Type NUP Type N Type NF

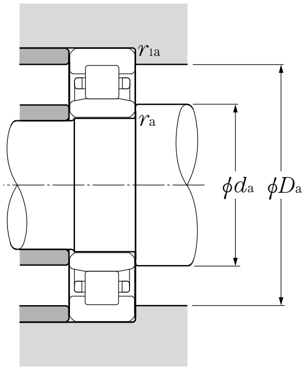
d 670～1,250mm

Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)
d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	type NU	F_w
670	900	136	6	6	2,940	6,600	300,000	675,000	**NU29/670**	729
710	950	106	6	6	2,260	4,600	231,000	465,000	**NU19/710**	770
	950	140	6	6	3,300	7,500	340,000	765,000	**NU29/710**	770
750	1,000	112	6	6	2,340	4,850	239,000	495,000	**NU19/750**	815
	1,000	145	6	6	3,600	8,400	365,000	860,000	**NU29/750**	815
800	980	106	5	5	2,310	5,950	236,000	605,000	**NU28/800**	845
	1,060	150	6	6	3,850	8,850	390,000	900,000	**NU29/800**	865
	1,150	155	7.5	7.5	4,100	7,800	415,000	795,000	**NU10/800**	887
850	1,030	106	5	5	2,390	6,350	244,000	645,000	**NU28/850**	895
	1,120	118	6	6	2,920	6,150	297,000	625,000	**NU19/850**	917
	1,120	155	6	6	4,000	9,250	410,000	945,000	**NU29/850**	917
1,060	1,400	195	7.5	7.5	6,100	14,500	620,000	1,480,000	**NU29/1060**	1,145
1,180	1,540	206	7.5	7.5	6,900	17,000	705,000	1,730,000	**NU29/1180**	1,270
1,250	1,630	170	7.5	7.5	5,550	12,500	565,000	1,280,000	**NU19/1250**	1,345

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Type N

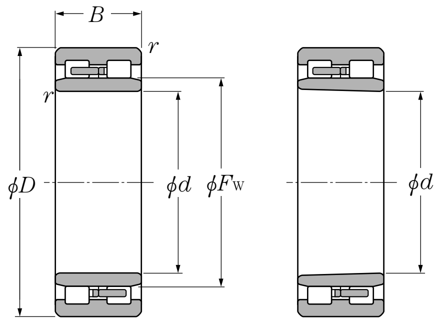


Type NU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

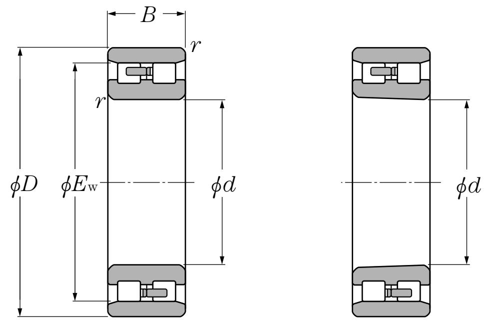
Abutment and fillet dimensions				Mass
mm				kg
d_a min	D_a max	r_{as} max	r_{1as} max	type **NU** (approx.)
694	876	5	5	257
734	926	5	5	221
734	926	5	5	292
774	976	5	5	257
774	976	5	5	332
820	960	4	4	178
824	1,036	5	5	380
832	1,118	6	6	554
870	1,010	4	4	188
874	1,096	5	5	329
874	1,096	5	5	432
1,092	1,368	6	6	855
1,212	1,508	6	6	1,060
1,282	1,598	6	6	975



Type NNU

Cylindrical bore

Tapered bore
taper 1:12



Type NN

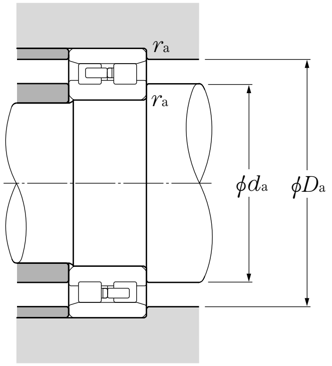
Cylindrical bore

Tapered bore
taper 1:12

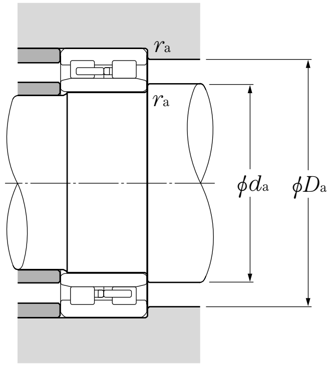
d 100～180mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers type NNU Cylindrical bore	type NNU tapered bore❶	type NN Cylindrical bore	type NN tapered bore❶
d	D	B	$r_{s\,min}$❷	C_r	C_{or}	C_r	C_{or}				
100	140	40	1.1	131	260	13,300	26,500	**NNU4920**	**NNU4920K**	**NN4920**	**NN4920K**
	150	37	1.5	153	256	15,600	26,100	—	—	**NN3020**	**NN3020K**
105	145	40	1.1	133	268	13,500	27,400	**NNU4921**	**NNU4921K**	**NN4921**	**NN4921K**
	160	41	2	198	320	20,200	33,000	—	—	**NN3021**	**NN3021K**
110	150	30	1.1	107	206	10,900	21,000	—	—	**NN3922**	—
	150	40	1.1	137	284	14,000	28,900	**NNU4922**	**NNU4922K**	**NN4922**	**NN4922K**
	170	45	2	229	375	23,300	38,000	**NNU3022**	**NNU3022K**	**NN3022**	**NN3022K**
120	165	45	1.1	183	360	18,700	37,000	**NNU4924**	**NNU4924K**	**NN4924**	**NN4924K**
	180	46	2	233	390	23,700	40,000	**NNU3024**	—	**NN3024**	**NN3024K**
130	180	37	1.5	169	315	17,300	32,000	—	—	**NN3926**	**NN3926K**
	180	50	1.5	220	440	22,400	45,000	**NNU4926**	**NNU4926K**	**NN4926**	**NN4926K**
	200	52	2	284	475	29,000	48,500	**NNU3026**	—	**NN3026**	**NN3026K**
	210	64	2	340	560	35,000	57,000	—	—	**NN3126**	—
140	190	37	1.5	175	335	17,800	34,000	—	—	**NN3928**	—
	190	50	1.5	227	470	23,100	48,000	**NNU4928**	**NNU4928K**	**NN4928**	**NN4928K**
	210	53	2	298	515	30,500	52,500	**NNU3028**	—	**NN3028**	**NN3028K**
150	210	45	2	256	475	26,100	48,500	—	—	**NN3930**	—
	210	60	2	345	690	35,000	70,500	**NNU4930**	**NNU4930K**	**NN4930**	**NN4930K**
	225	56	2.1	335	585	34,000	60,000	**NNU3030**	—	**NN3030**	**NN3030K**
	225	75	2.1	435	825	44,500	84,000	—	—	**NN4030**	—
	250	80	2.1	555	900	56,500	92,000	**NNU3130**	—	—	—
160	220	45	2	265	505	27,000	51,500	—	—	**NN3932**	**NN3932K**
	220	60	2	355	740	36,500	75,500	**NNU4932**	**NNU4932K**	**NN4932**	**NN4932K**
	240	60	2.1	375	660	38,000	67,500	—	—	**NN3032**	**NN3032K**
170	230	45	2	268	520	27,400	53,000	—	—	**NN3934**	**NN3934K**
	230	60	2	360	765	37,000	78,000	**NNU4934**	**NNU4934K**	**NN4934**	**NN4934K**
	260	67	2.1	440	775	45,000	79,000	**NNU3034**	**NNU3034K**	**NN3034**	**NN3034K**
	280	88	2.1	635	1,050	65,000	107,000	**NNU3134**	—	**NN3134**	—
180	250	52	2	340	665	35,000	67,500	—	—	**NN3936**	**NN3936K**
	250	69	2	460	965	46,500	98,500	**NNU4936**	**NNU4936K**	**NN4936**	**NN4936K**

❶ "**K**" indicates bearings have tapered bore with a taper ratio of 1: 12. ❷ Smallest allowable dimension for chamfer dimension *r*.



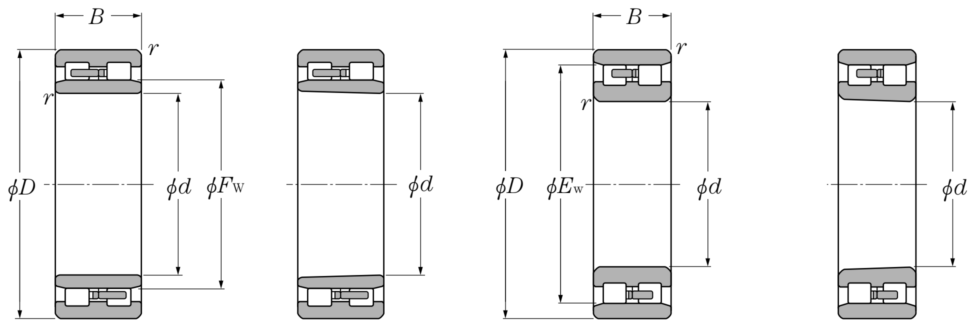
Type NN



Type NNU

Equivalent bearing load
dynamic
$P_r = F_r$
static
$P_{or} = F_r$

Dimensions mm		Abutment and fillet dimensions mm			Mass (approx.) kg	
		d_a	D_a	r_{as}	type NNU	type NN
F_w	E_w	min	max	max	Cylindrical bore	Cylindrical bore
113	129	106.5	133.5	1	1.83	1.75
—	137	108	—	1.5	—	2.26
118	134	111.5	138.5	1	1.91	1.82
—	146	114	—	2	—	2.89
—	139	116.5	—	1	—	1.54
123	139	116.5	143.5	1	1.99	1.9
127	155	119	161	2	3.87	3.69
134.5	154.5	126.5	158.5	1	2.75	2.63
137	165	129	171	2	4.24	3.98
—	168	138	—	1.5	—	—
146	168	138	172	1.5	3.69	3.52
150	182	139	191	2	6.15	5.92
—	189	139	—	2	—	8.59
—	178	148	—	1.5	—	3.01
156	178	148	182	1.5	3.94	3.76
160	192	149	201	2	6.64	6.44
—	196.5	159	—	2	—	4.79
168.5	196.5	159	201	2	6.18	5.9
172	206	161	214	2	8.06	7.81
—	206	161	—	2	—	10.4
177	—	161	239	2	16.4	—
—	206.5	169	—	2	—	5.06
178.5	206.5	169	211	2	6.53	6.24
—	219	171	—	2	—	8.92
—	216.5	179	—	2	—	5.33
188.5	216.5	179	221	2	6.87	6.56
196	236	181	249	2	13.3	12.6
201	253	181	269	2	22.3	21.5
—	234	189	—	2	—	7.72
202	234	189	241	2	9.9	9.45



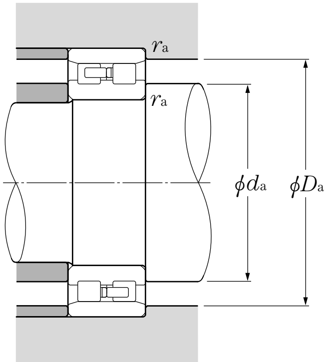
Type NNU — Cylindrical bore; Tapered bore taper 1:12

Type NN — Cylindrical bore; Tapered bore taper 1:12

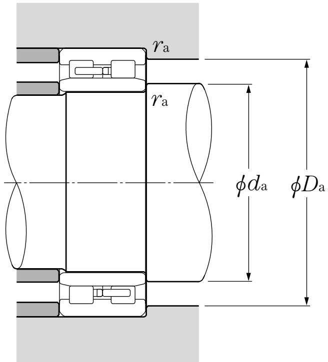
d 180～320mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers type NNU		type NN	
d	D	B	$r_{s\,min}$ [2]	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered bore [1]	Cylindrical bore	tapered bore [1]
180	280	74	2.1	565	995	57,500	102,000	NNU3036	—	NN3036	NN3036K
190	260	52	2	355	705	36,000	72,000	—	—	NN3938	—
	260	69	2	475	1,030	48,500	105,000	NNU4938	NNU4938K	NN4938	NN4938K
	290	75	2.1	580	1,040	59,000	106,000	NNU3038	—	NN3038	NN3038K
200	280	60	2.1	445	890	45,500	91,000	—	—	NN3940	—
	280	80	2.1	555	1,180	56,500	120,000	NNU4940	NNU4940K	NN4940	NN4940K
	310	82	2.1	655	1,170	66,500	119,000	NNU3040	—	NN3040	NN3040K
	310	109	2.1	890	1,730	90,500	177,000	—	—	NN4040	—
	340	112	3	970	1,660	99,000	169,000	—	—	NN3140	—
220	300	60	2.1	470	975	48,000	99,500	—	—	NN3944	NN3944K
	300	80	2.1	585	1,300	59,500	132,000	NNU4944	NNU4944K	NN4944	NN4944K
	340	90	3	815	1,480	83,000	151,000	NNU3044	—	NN3044	NN3044K
	370	120	4	1,080	1,890	111,000	193,000	NNU3144	—	NN3144	—
240	320	60	2.1	490	1,060	50,000	109,000	NNU3948	—	NN3948	NN3948K
	320	80	2.1	610	1,410	62,500	144,000	NNU4948	NNU4948K	NN4948	NN4948K
	360	92	3	855	1,600	87,000	163,000	NNU3048	—	NN3048	NN3048K
	400	128	4	1,250	2,230	127,000	228,000	—	—	NN3148	—
260	360	75	2.1	660	1,390	67,000	141,000	—	—	NN3952	NN3952K
	360	100	2.1	900	2,070	92,000	211,000	NNU4952	NNU4952K	NN4952	NN4952K
	400	104	4	1,060	1,990	108,000	203,000	—	—	NN3052	NN3052K
	400	140	4	1,500	3,100	153,000	315,000	NNU4052	—	NN4052	—
280	350	52	2	320	765	32,500	78,000	NNU3856	—	—	—
	350	69	2	505	1,300	51,000	132,000	NNU4856	NNU4856K	—	—
	380	75	2.1	690	1,510	70,500	154,000	—	—	NN3956	NN3956K
	380	100	2.1	925	2,200	94,500	224,000	NNU4956	NNU4956K	NN4956	NN4956K
	420	106	4	1,080	2,080	110,000	212,000	—	—	NN3056	NN3056K
300	420	90	3	945	2,050	96,000	209,000	—	—	NN3960	NN3960K
	420	118	3	1,200	2,800	122,000	285,000	NNU4960	NNU4960K	NN4960	NN4960K
	460	118	4	1,330	2,560	135,000	261,000	NNU3060	—	NN3060	NN3060K
	460	160	4	1,890	4,050	193,000	410,000	—	—	NN4060	—
320	400	80	2.1	610	1,600	62,500	163,000	NNU4864	—	—	—

❶ "K" indicates bearings have tapered bore with a taper ratio of 1: 12. ❷ Smallest allowable dimension for chamfer dimension r.



Type NN

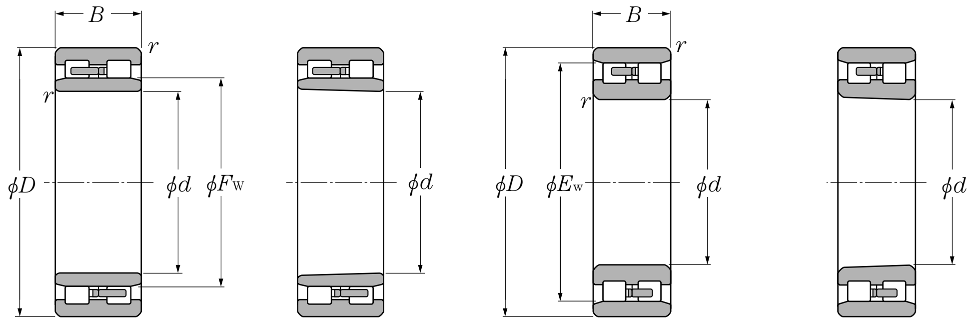


Type NNU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Dimensions mm		Abutment and fillet dimensions mm			Mass (approx.) kg	
		d_a	D_a	r_{as}	type NNU	type NN
F_w	E_w	min	max	max	Cylindrical bore	Cylindrical bore
209	255	191	269	2	17.4	16.6
—	244	199	—	2	—	8.08
212	244	199	251	2	10.4	9.93
219	265	201	279	2	18.4	18
—	261	211	—	2	—	11.4
225	261	211	269	2	14.7	14
232	282	211	299	2	23.5	21.6
—	282	211	—	2	—	30.2
—	304	213	—	2.5	—	41.8
—	281	231	—	2	—	12.3
245	281	231	289	2	15.9	15.2
254	310	233	327	2.5	31.0	29.3
263.5	331.5	236	354	3	54.4	52.4
265	301	251	309	2	13.8	13.3
265	301	251	309	2	17.2	16.4
274	330	253	347	2.5	33.9	32.8
—	361	256	—	3	—	64.7
—	336	271	—	2	—	22.9
292	336	271	349	2	29.6	28.3
—	364	276	—	3	—	47.4
298	362	276	384	3	66.2	63.8
301	—	289	341	2	11.7	—
301	—	289	341	2	15.6	—
—	356	291	—	2	—	24.4
312	356	291	369	2	31.6	30.2
—	384	296	—	3	—	51.1
—	391	313	—	2.5	—	38.4
339	391	313	407	2.5	48.6	46.4
346	418	316	444	3	73.4	70.8
—	418	316	—	3	—	96
344	—	331	389	2	23.6	—



Type NNU

Cylindrical bore | Tapered bore taper 1:12

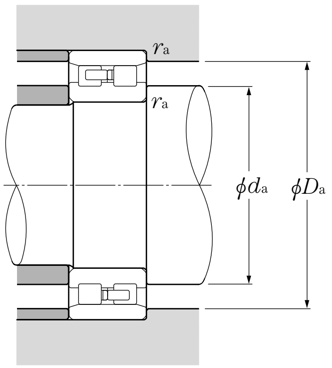
Type NN

Cylindrical bore | Tapered bore taper 1:12

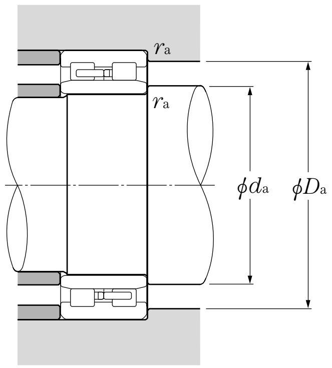
d 320～500mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers type NNU		type NN	
d	D	B	$r_{s\,min}$[2]	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered bore[1]	Cylindrical bore	tapered bore[1]
320	440	90	3	975	2,180	99,000	222,000	—	—	NN3964	NN3964K
	440	118	3	1,240	2,970	126,000	305,000	NNU4964	NNU4964K	NN4964	NN4964K
	480	121	4	1,350	2,670	138,000	272,000	NNU3064	—	NN3064	NN3064K
	540	176	5	2,160	3,950	220,000	400,000	NNU3164	—	—	—
340	460	118	3	1,280	3,150	131,000	320,000	NNU4968	NNU4968K	NN4968	NN4968K
	520	133	5	1,620	3,200	165,000	325,000	NNU3068	—	NN3068	NN3068K
360	480	90	3	1,030	2,430	105,000	248,000	—	—	NN3972	—
	480	118	3	1,290	3,250	131,000	330,000	NNU4972	NNU4972K	—	—
	540	134	5	1,650	3,300	169,000	340,000	NNU3072	—	NN3072	NN3072K
	540	180	5	2,470	5,550	252,000	570,000	NNU4072	—	—	—
380	520	140	4	1,630	4,050	167,000	415,000	NNU4976	NNU4976K	—	—
	560	135	5	1,690	3,450	172,000	355,000	NNU3076	—	NN3076	NN3076K
400	500	100	2.1	1,070	2,950	109,000	300,000	NNU4880	—	—	—
	540	140	4	1,690	4,300	172,000	435,000	NNU4980	NNU4980K	—	—
	600	148	5	2,040	4,150	208,000	420,000	—	—	NN3080	NN3080K
420	560	106	4	1,370	3,350	140,000	340,000	—	—	NN3984	—
	560	140	4	1,740	4,500	177,000	460,000	NNU4984	NNU4984K	—	—
	620	150	5	2,080	4,300	212,000	440,000	—	—	NN3084	NN3084K
	700	224	6	3,400	6,400	345,000	650,000	NNU3184	—	—	—
440	600	160	4	2,150	5,550	219,000	565,000	NNU4988	NNU4988K	—	—
	650	157	6	2,420	5,100	247,000	520,000	NNU3088	—	NN3088	NN3088K
	650	212	6	3,250	7,750	330,000	790,000	NNU4088	—	—	—
460	620	160	4	2,220	5,850	226,000	595,000	NNU4992	NNU4992K	—	—
	680	163	6	2,550	5,350	260,000	545,000	—	—	NN3092	NN3092K
480	600	90	3	1,010	2,570	103,000	262,000	—	—	NN3896	—
	650	170	5	2,280	5,900	233,000	600,000	NNU4996	NNU4996K	—	—
	790	248	7.5	4,100	8,100	420,000	825,000	—	—	NN3196	—
500	620	90	3	1,140	2,880	116,000	293,000	NNU38/500	—	—	—
	670	170	5	2,360	6,200	240,000	635,000	NNU49/500	NNU49/500K	—	—
	720	167	6	2,650	5,750	270,000	590,000	—	—	NN30/500	—

[1] "K" indicates bearings have tapered bore with a taper ratio of 1: 12. [2] Smallest allowable dimension for chamfer dimension r.



Type NN



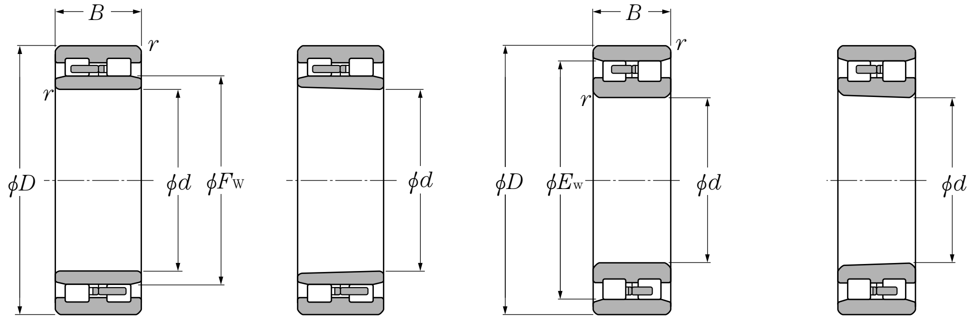
Type NNU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Dimensions mm		Abutment and fillet dimensions mm			Mass (approx.) kg	
		d_a	D_a	r_{as}	type NNU	type NN
F_w	E_w	min	max	max	Cylindrical bore	Cylindrical bore
—	411	333	—	2.5	—	40.5
359	411	333	427	2.5	51.4	49
366	438	336	464	3	79.3	76.2
383	—	340	520	4	170	—
379	431	353	447	2.5	54.2	52.2
393	473	360	500	4	105	102
—	451	373	—	2.5	—	44.8
398	—	373	467	2.5	57	—
413	493	380	520	4	111	107
415	—	380	520	4	136	—
425	—	396	504	3	84.5	—
432	512	400	540	4	117	113
430.5	—	411	489	2	46.1	—
445	—	416	524	3	88.2	—
—	547	420	—	4	—	146
—	522	436	—	3	—	71.7
465	—	436	544	3	92	—
—	567	440	—	4	—	154
500	—	444	676	5	359	—
492	—	456	584	3	127	—
500	596	464	626	5	184	178
505	—	464	626	5	248	—
512	—	476	604	3	132	—
—	622	484	—	5	—	202
—	566	493	—	2.5	—	57.5
534	—	500	630	4	156	—
—	710	512	—	6	—	482
532	—	513	607	2.5	61.9	—
556	—	520	650	4	162	—
—	664	524	—	5	—	221

Multi-Row Cylindrical Roller Bearings



Type NNU

Cylindrical bore | **Tapered bore taper 1:12**

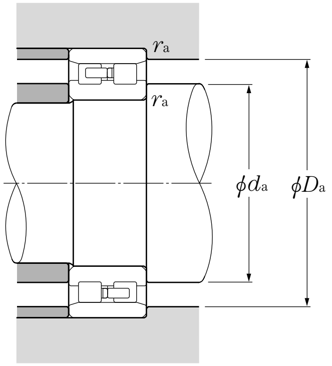
Type NN

Cylindrical bore | **Tapered bore taper 1:12**

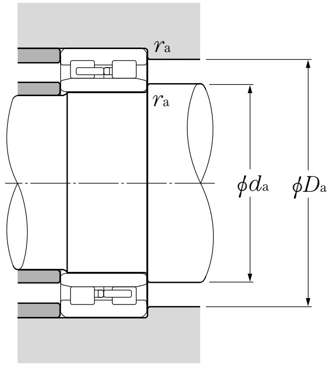
d 530～950mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers type NNU Cylindrical bore	type NNU tapered bore❶	type NN Cylindrical bore	type NN tapered bore❶
d	D	B	$r_{s\,min}$❷	C_r	C_{or}	C_r	C_{or}				
530	650	90	3	1,060	2,840	108,000	289,000	—	—	**NN38/530**	—
	710	180	5	2,740	7,150	279,000	730,000	**NNU49/530**	**NNU49/530K**	—	—
560	680	90	3	1,060	2,960	108,000	300,000	—	—	**NN38/560**	—
	750	190	5	3,150	8,450	325,000	860,000	**NNU49/560**	**NNU49/560K**	**NN49/560**	—
	820	195	6	3,550	7,700	365,000	785,000	**NNU30/560**	—	—	—
600	730	128	3	1,840	5,400	188,000	550,000	**NNU48/600**	—	—	—
	870	200	6	3,700	8,250	375,000	845,000	—	—	**NN30/600**	—
630	780	150	4	2,200	6,200	224,000	630,000	**NNU48/630**	—	—	—
	850	165	6	5,750	5,300	585,000	1,560,000	**NNU39/630**	—	—	—
750	920	128	5	2,340	6,450	238,000	660,000	**NNU38/750**	—	—	—
	1,000	250	6	4,850	3,200	495,000	1,340,000	**NNU49/750**	—	—	—
800	980	136	5	2,430	6,700	248,000	680,000	**NNU38/800**	—	—	—
	1,060	195	6	3,900	10,200	400,000	1,040,000	**NNU39/800**	—	—	—
950	1,250	300	7.5	7,150	1,200	730,000	2,160,000	—	—	**NN49/950**	—

❶ "**K**" indicates bearings have tapered bore with a taper ratio of 1: 12. ❷ Smallest allowable dimension for chamfer dimension r.



Type NN



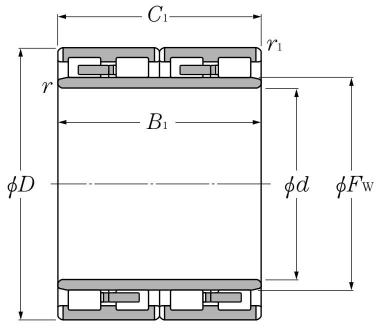
Type NNU

Equivalent bearing load
dynamic
$P_r = F_r$

static
$P_{or} = F_r$

Dimensions mm		Abutment and fillet dimensions mm			Mass (approx.) kg	
		d_a	D_a	r_{as}	type NNU	type NN
F_w	E_w	min	max	max	Cylindrical bore	Cylindrical bore
—	616	543	—	2.5	—	62.9
588	—	550	690	4	206	—
—	647	573	—	2.5	—	66.1
618	702	580	730	4	242	233
634	—	584	796	5	358	—
635	—	613	717	2.5	113	—
—	800	624	—	5	—	392
673	—	646	764	3	162	—
684	—	654	826	5	275	—
798	—	770	900	4	186	—
824	—	774	976	5	560	—
852	—	820	960	4	223	—
878	—	824	1,036	5	483	—
—	1,176	982	—	6	—	977

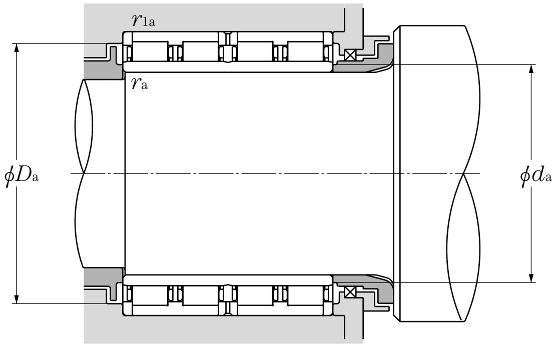
4-Row Cylindrical Roller Bearings



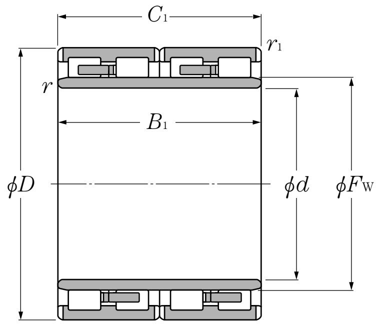
d 100～170mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers[1]	Drawing No.[2]
d	D	B_1	C_1	$r_{s\,min}$[3]	$r_{1s\,min}$[3]	C_r	C_{or}	C_r	C_{or}		
100	150	74	74	2	2	262	510	26,700	52,500	**4R2035**	A
120	180	92	92	2.5	2.5	400	785	40,500	80,000	**4R2437**	A
	180	105	105	2.5	2.5	445	855	45,500	87,000	**4R2438**	A
130	200	104	104	2.5	2.5	490	955	49,500	97,000	**4R2628**	A
140	190	119	119	1.5	1.5	495	1,190	50,500	121,000	**4R2832**	B 2)
	210	116	116	2.5	2.5	510	1,030	52,000	105,000	**4R2823**	A
145	210	155	155	2.5	2.5	705	1,640	71,500	168,000	**4R2906**	A
	225	156	156	2.5	2.5	810	1,750	82,500	178,000	**4R2904**	A
150	220	127	120	2.5	2.5	615	1,280	63,000	130,000	**4R3036**	A
	220	150	150	2.5	2.5	750	1,640	76,500	168,000	**4R3031**	A
	220	150	150	2.5	2.5	750	1,640	76,500	168,000	**4R3056**	A
	230	130	130	2.5	2.5	725	1,520	73,500	155,000	**4R3029**	A
	230	156	156	2.5	2.5	930	2,040	95,000	208,000	**4R3040**	A
	230	168	168	2	2	845	1,950	86,000	199,000	**4R3042**	A
	250	150	150	2	2.5	885	1,640	90,500	167,000	**4R3039**	A
151.5	230	168	168	1.5	2.5	850	2,060	87,000	210,000	**4R3033K**	A
160	220	180	180	2.5	2.5	920	2,490	93,500	254,000	**4R3224**	D 3)
	230	130	130	2.5	2.5	665	1,340	68,000	136,000	**4R3226**	A
	230	168	168	2.5	2.5	915	2,170	93,500	222,000	**4R3232**	A
	230	168	168	2.5	2.5	895	2,200	91,500	225,000	**4R3229**	A
	230	168	168	2.5	2.5	895	2,210	91,000	225,000	**4R3231**	A
	230	180	180	2.5	2.5	920	2,490	93,500	254,000	**4R3228**	D 3)
	240	170	170	2	2.5	980	2,290	100,000	234,000	**4R3225**	A
170	230	120	120	2.5	2.5	620	1,520	63,000	155,000	**4R3426**	A
	230	120	120	2	2	620	1,520	63,000	155,000	**4R3443**	C
	240	156	156	2.5	2.5	905	2,170	92,500	222,000	**4R3429**	A
	240	160	160	2.5	2.5	905	2,180	92,000	222,000	**4R3423**	A
	250	168	168	2.5	2.5	970	2,220	99,000	226,000	**4R3432**	A
	250	168	168	2.5	2.5	1,030	2,390	105,000	243,000	**4R3428**	A
	255	180	180	2.5	2.5	1,100	2,430	112,000	247,000	**4R3425**	A
	260	150	150	2.5	2.5	835	1,750	85,000	179,000	**4R3433**	A

❶ "**K**" indicates bearings have tapered bore with a taper ratio of 1: 12. ❷ Drawing details are shown in Page B-38.
❸ Minimal allowable dimension for chamfer dimension r or r_1.



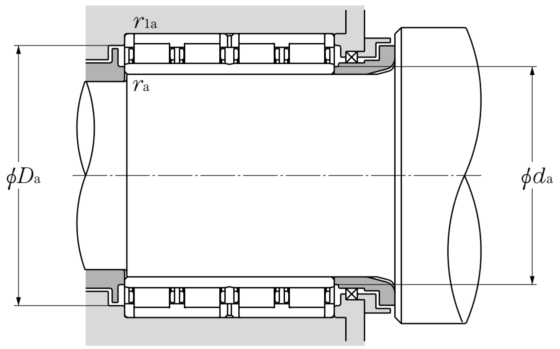
	Abutment and fillet dimensions mm				Mass kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
115	109	141	2.0	2.0	4.68
137	131	169	2	2	8.2
135	131	169	2	2	9.3
150	141	189	2	2	12.1
154	148	182	1.5	1.5	9.93
160	151	199	2	2	13.9
166	156	199	2	2	18
169	156	214	2	2	23.3
168	161	209	2	2	15.7
168	161	209	2	2	19.4
168	161	209	2	2	19.6
174	161	219	2	2	20
174	161	219	2	2	24.5
178	159	221	2	2	25.8
177	161	239	2	2	29.6
179	159.5	219	1.5	2	25.4
177	171	209	2	2	20.2
180	171	219	2	2	16.6
179	171	219	2	2	23.4
180	171	219	2	2	23.2
182	171	219	2	2	23.2
177	171	219	2	2	24.8
183	169	229	2	2	27.8
187	181	219	2	2	14.2
187	179	221	2	2	14.6
189	181	229	2	2	22.2
190	181	229	2	2	22.8
193	181	239	2	2	28.2
193	181	239	2	2	28.5
193	181	244	2	2	19.3
192	181	249	2	2	29.5



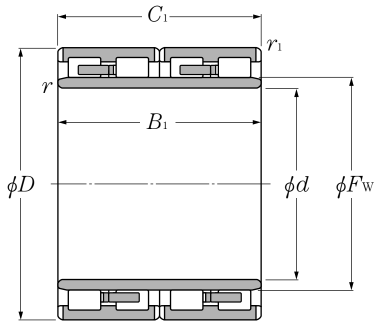
d 170～230mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing❶ numbers	Drawing❷ No.
d	D	B_1	C_1	$r_{s\,min}$❸	$r_{1s\,min}$❸	C_r	C_{or}	C_r	C_{or}		
170	260	225	225	2.5	2.5	1,310	3,150	134,000	320,000	4R3431	A
180	250	156	156	2.5	2.5	895	2,180	91,500	223,000	4R3625	A
	250	168	168	2	2	885	2,470	90,000	252,000	4R3639	A
	260	168	168	2.5	2.5	1,020	2,400	104,000	244,000	4R3628	A
	265	180	180	2.5	2.5	1,090	2,510	111,000	256,000	4R3618	A
190	260	168	168	2.5	2.5	980	2,600	100,000	265,000	4R3820	A
	270	170	170	2.5	2.5	1,090	2,660	111,000	272,000	4R3818	A
	270	200	200	2.5	2.5	1,260	3,100	128,000	315,000	4R3821	A
	270	200	200	2.5	2.5	1,230	3,200	125,000	330,000	4R3817	A
	280	200	200	2.5	2.5	1,240	2,910	126,000	297,000	4R3823	B
	280	200	200	2.5	2.5	1,240	2,910	126,000	297,000	4R3830	C
200	270	170	170	2.5	2.5	970	2,610	99,000	266,000	4R4039	A
	280	152	152	2.1	2.1	1,000	2,320	102,000	237,000	4R4054	B[2)]
	280	170	170	2.5	2.5	1,040	2,430	106,000	248,000	4R4048	A
	280	190	190	2.5	2.5	1,190	3,150	121,000	320,000	4R4026	A
	280	200	200	2.5	2.5	1,310	3,300	134,000	335,000	4R4037	A
	280	200	200	2.5	2.5	1,250	3,350	127,000	340,000	4R4027	A
	290	192	192	2.5	2.5	1,290	3,150	132,000	320,000	4R4041	A
210	290	192	192	2.5	2.5	1,230	3,350	126,000	340,000	4R4206	A
220	290	192	192	2.5	2.5	1,190	3,350	122,000	340,000	4R4413	A
	300	160	160	2.5	2.5	1,000	2,590	102,000	264,000	4R4419	A
	300	160	160	2.1	2.1	1,000	2,590	102,000	264,000	4R4445	C
	310	192	192	2.5	2.5	1,350	3,550	138,000	360,000	4R4410	A
	310	192	192	2.5	2.5	1,390	3,400	141,000	350,000	4R4426	A
	310	204	204	2.5	2.5	1,420	3,750	144,000	385,000	4R4425	A
	310	215	215	2.5	2.5	1,530	3,750	156,000	380,000	4R4420	A
	310	225	225	2.5	2.5	1,480	3,950	151,000	405,000	4R4416	A
	310	225	225	2.5	2.5	1,590	3,950	162,000	400,000	4R4449	A
	320	160	160	3	3	1,190	2,550	121,000	260,000	4R4428	A
	320	210	210	2.5	2.5	1,550	3,650	158,000	370,000	4R4429	A
	320	210	210	2.5	2.5	1,560	3,600	159,000	370,000	4R4444	A
230	330	206	206	2.5	2.5	1,510	3,900	154,000	395,000	4R4610	A
	330	206	206	2.5	2.5	1,520	3,800	155,000	385,000	4R4614	A

❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



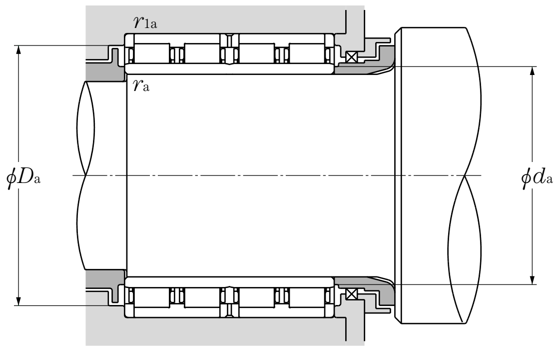
Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{las} max	(approx.)
196	181	249	2	2	44
200	191	239	2	2	23.2
202	189	241	2	2	25.6
202	191	249	2	2	29.4
204	191	254	2	2	34.2
212	201	249	2	2	26.9
213	201	259	2	2	31.7
212	201	259	2	2	37.5
212	201	259	2	2	37.2
214	201	269	2	2	41.5
214	201	269	2	2	42.8
222	211	259	2	2	28.5
222	211	269	2	2	29.5
222	211	269	2	2	33
223	211	269	2	2	36.7
222	211	269	2	2	40.5
224	211	269	2	2	38.8
226	211	279	2	2	42.5
236	221	279	2	2	39.5
239	231	279	2	2	33.8
245	231	289	2	2	32.8
245	231	289	2	2	33.7
247	231	299	2	2	46.3
246	231	299	2	2	46.9
247	231	299	2	2	49.8
242	231	299	2	2	51.5
245	231	299	2	2	54.9
244	231	299	2	2	54.3
245	233	307	2.5	2.5	46.5
248	231	309	2	2	60.5
246	231	309	2	2	57.3
260	241	319	2	2	58.3
258	241	319	2	2	58.6



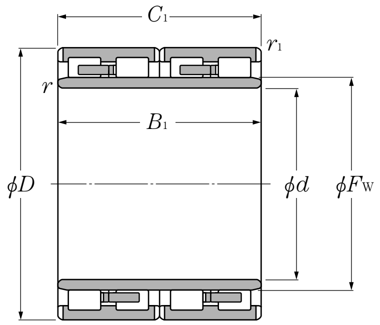
d 230～300mm

	Boundary dimensions					Basic load ratings				Bearing numbers	Drawing[❶] No.
						dynamic	static	dynamic	static		
	mm					kN		kgf			
d	D	B_1	C_1	$r_{s\,min}$[❷]	$r_{ls\,min}$[❷]	C_r	C_{or}	C_r	C_{or}		
230	340	260	260	3	3	2,050	5,100	209,000	520,000	4R4611	A
240	330	220	220	3	3	1,490	4,150	152,000	420,000	4R4811	C
	330	220	220	3	3	1,610	4,250	164,000	435,000	4R4819	A
	330	220	220	3	3	1,490	4,150	152,000	420,000	4R4821	C
	330	220	220	3	3	1,520	4,250	155,000	435,000	4R4804	A
	340	220	220	3	3	1,670	4,200	170,000	425,000	4R4806	A
	360	220	220	2.5	2.5	1,760	4,050	179,000	415,000	4R4807	A
	360	220	220	2.5	2.5	1,760	4,050	179,000	415,000	4R4813	A
250	350	220	220	3	3	1,730	4,300	176,000	440,000	4R5008	A
260	360	220	200	2.5	2.5	1,540	4,150	157,000	426,000	4R5221	D
	360	260	260	2.5	2.1	1,830	4,850	187,000	495,000	4R5231	C[1)]
	370	220	220	3	3	1,760	4,450	179,000	455,000	4R5208	A
	370	220	220	3	3	1,760	4,450	179,000	455,000	4R5217	A[1)]
	380	280	280	3	3	2,420	6,250	247,000	635,000	4R5213	A
	400	290	290	4	2	3,050	7,150	315,000	730,000	4R5218	E[4)]
265	370	234	234	1.5	1.5	2,020	5,000	206,000	510,000	4R5306	A[1)]
270	380	280	280	2.5	2.5	2,260	5,750	231,000	585,000	4R5407	A
	380	280	280	2.5	2.5	2,580	6,850	263,000	700,000	4R5405	F[4)]
280	350	208	208	2.5	2.5	1,290	3,950	132,000	405,000	4R5614	A
	390	220	220	3	3	1,780	4,650	181,000	475,000	4R5611	A
	390	220	220	3	3	1,820	4,800	186,000	490,000	4R5604	A
	390	275	275	2.5	2.5	2,290	6,250	233,000	635,000	4R5612	D[3)]
	420	280	280	4	4	2,430	6,150	248,000	630,000	4R5605	A
290	410	240	240	3	3	2,240	5,550	228,000	565,000	4R5806	A
	420	300	300	3	3	2,830	7,500	288,000	765,000	4R5805	A
300	400	300	300	3	3	2,480	7,500	253,000	765,000	4R6014	A
	420	240	240	3	3	2,020	5,450	206,000	555,000	4R6017	A[1)]
	420	240	240	3	3	2,020	5,450	206,000	555,000	4R6012	A
	420	240	240	3	3	2,010	5,450	205,000	555,000	4R6023	A[1)]
	420	240	240	3	3	2,280	5,750	233,000	585,000	4R6027	A
	420	300	300	3	3	2,990	8,150	305,000	835,000	4R6030	F[1)]

❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



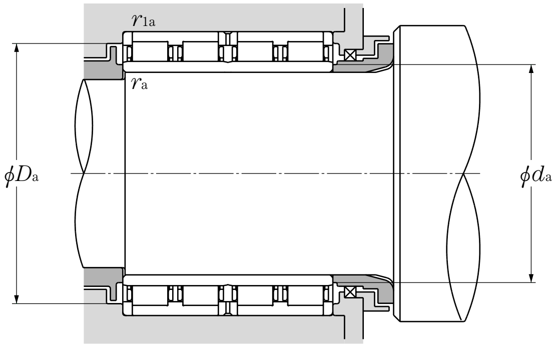
Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
261	243	327	2.5	2.5	82.6
270	253	317	2.5	2.5	56.8
264	253	317	2.5	2.5	57.1
268	253	317	2.5	2.5	57.1
270	253	317	2.5	2.5	57.1
268	253	327	2.5	2.5	63.6
274	251	349	2	2	79.6
274	251	349	2	2	80.1
278	263	337	2.5	2.5	66
292	271	349	2	2	62.7
287	271	349	2	2	81.5
292	273	357	2.5	2.5	77.1
292	273	357	2.5	2.5	76.5
294	273	367	2.5	2.5	109
296	276	391	3	2	135
300	273	362	1.5	1.5	78.9
297	281	369	2	2	101
299.7	281	369	2	2	105
298	291	339	2	2	46.4
312	293	377	2.5	2.5	81.3
312	293	377	2.5	2.5	82
312	291	379	2	2	105
323	296	404	3	3	139
320	303	397	2.5	2.5	103
327	303	407	2.5	2.5	141
328	313	387	2.5	2.5	104
334	313	407	2.5	2.5	106
334	313	407	2.5	2.5	105
336	313	407	2.5	2.5	105
332	313	407	2.5	2.5	105
331	313	407	2.5	2.5	136



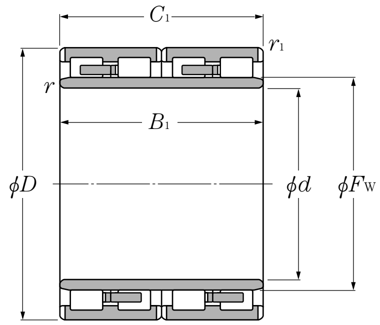
d 300～380mm

d	D	B_1	C_1	$r_{s\,min}$ ❸	$r_{ls\,min}$ ❸	C_r	C_{or}	C_r	C_{or}	Bearing numbers ❶	Drawing No. ❷
Boundary dimensions (mm)						Basic load ratings: dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)		
300	420	300	300	3	3	2,720	7,600	278,000	775,000	4R6015	A
	420	300	300	3	3	2,900	7,850	295,000	800,000	4R6020	F[1)]
	420	320	300	3	3	2,900	7,850	295,000	800,000	4R6018	F[2)]
	430	240	240	3	3	2,160	5,150	220,000	525,000	4R6021	A
	460	270	270	3	3	2,510	5,350	256,000	545,000	4R6019	A
310	430	240	240	3	3	2,240	5,950	228,000	605,000	4R6202	A
320	440	240	230	3	3	2,290	6,050	234,000	615,000	4R6414	A
	450	240	240	3	3	2,370	6,150	242,000	630,000	4R6411	A
	460	340	340	3	3	3,400	9,450	345,000	960,000	4R6412	A
	470	350	350	3	3	4,150	10,900	425,000	1,110,000	4R6406	F[4)]
330	440	200	200	3	3	1,820	4,850	186,000	495,000	4R6603	B
	440	200	200	5	3	1,720	4,550	176,000	465,000	4R6608	B[1)]
	460	340	340	4	4	3,250	8,850	330,000	905,000	4R6605	A
	460	340	340	4	4	3,300	9,550	335,000	975,000	4R6602	A
340	480	350	350	4	4	3,950	10,900	400,000	1,110,000	4R6819	FM[1)]
	480	370	350	5	5	3,450	9,650	350,000	985,000	4R6811	A
	490	300	300	4	4	3,350	8,300	340,000	845,000	4R6804	A
	490	300	300	5	5	3,100	7,950	315,000	810,000	4R6805	A
356.76	550	400	400	4	4	5,100	13,800	520,000	1,410,000	4R7105K	E
360	480	290	290	3	3	2,990	8,150	305,000	830,000	4R7207	A
	510	370	370	4	4	3,550	9,700	365,000	990,000	4R7212	C
	510	400	380	4	2	4,350	11,900	445,000	1,210,000	4R7205	E[1)]
	510	400	400	5	5	4,250	11,500	435,000	1,170,000	4R7203	B
370	480	230	230	5	5	2,100	6,250	214,000	635,000	4R7405	A
	480	250	250	3	3	2,200	6,450	225,000	660,000	4R7408	A
	520	380	380	5	5	3,900	10,800	400,000	1,100,000	4R7411	A
	520	400	400	5	5	4,650	13,500	475,000	1,370,000	4R7404	A
380	520	280	280	4	4	3,400	9,150	350,000	935,000	4R7605	A
	520	290	290	4	4	3,400	9,150	350,000	935,000	4R7617	A
	520	300	300	4	4	3,550	9,600	360,000	980,000	4R7607	G[1)]
	540	400	400	4	4	5,200	15,200	530,000	1,550,000	4R7604	G[2)]

❶ "**K**" indicates bearings have tapered bore with a taper ratio of 1: 12. ❷ Drawing details are shown in Page B-38.
❸ Minimal allowable dimension for chamfer dimension r or r_1.



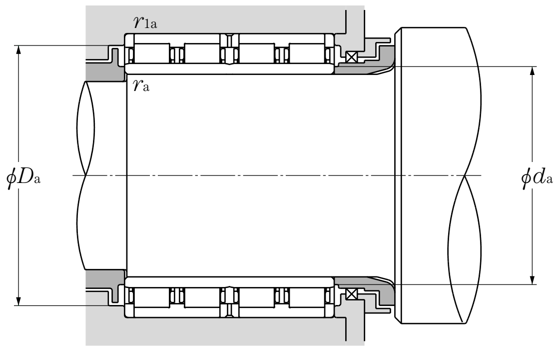
Abutment and fillet dimensions mm					Mass kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
334	313	407	2.5	2.5	125
332	313	407	2.5	2.5	130
332	313	407	2.5	2.5	136
338	313	417	2.5	2.5	115
344	313	447	2.5	2.5	162
344.5	323	417	2.5	2.5	108
351	333	427	2.5	2.5	106
358	333	437	2.5	2.5	125
360	333	447	2.5	2.5	178
361.7	333	457	2.5	2.5	212
360	343	427	2.5	2.5	83.6
360	350	427	4	2.5	85.6
365	346	444	3	3	181
368	346	444	3	3	177
378	356	464	3	3	211
378	360	460	4	4	198
377	356	474	3	3	187
380	360	470	4	4	189
426	372.757	534	3	3	354
388	373	467	2.5	2.5	148
400	376	494	3	3	244
399	376	509	3	2	251
397	380	490	4	4	262
400	390	460	4	4	106
401	383	467	2.5	2.5	118
409	390	500	4	4	256
409	390	500	4	4	273
417	396	504	3	3	174
417	396	504	3	3	185
416	396	504	3	3	210
422	396	524	3	3	325



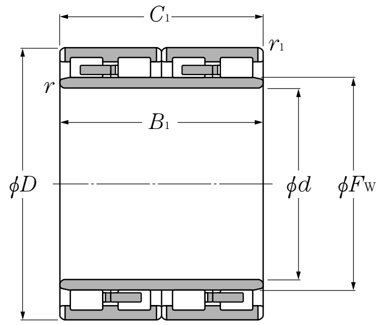
d 380～500mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing❶ No.
d	D	B_1	C_1	$r_{s\,min}$ ❷	$r_{ls\,min}$ ❷	C_r	C_{or}	C_r	C_{or}		
380	540	400	400	4	4	4,950	14,400	505,000	1,470,000	4R7618	FM[1]
	540	400	400	5	5	4,550	12,700	465,000	1,300,000	4R7613	B[1,3]
400	560	400	400	5	5	4,250	11,800	430,000	1,210,000	4R8007	B
	560	410	410	4	4	5,750	17,000	585,000	1,730,000	4R8010	F
	590	420	420	4	4	5,150	13,000	525,000	1,330,000	4R8011	A
420	560	280	280	4	4	3,150	8,750	320,000	895,000	4R8403	A
	580	230	230	4	4	2,430	6,250	248,000	635,000	4R8404	A
	600	440	440	6	2.5	6,350	18,100	650,000	1,850,000	4R8407	F[1]
	620	400	400	5	5	5,000	13,400	510,000	1,360,000	4R8401	D[3]
430	591	420	420	5	5	5,500	17,400	560,000	1,770,000	4R8605	FM[1,4]
440	600	450	450	1.5	5	6,000	17,900	615,000	1,820,000	4R8806	FR[2]
	600	450	450	1.5	5	6,350	19,100	645,000	1,950,000	4R8805	FR[1]
	620	450	450	5	5	6,450	18,700	660,000	1,910,000	4R8803	F[1]
	620	450	450	5	5	6,450	18,700	660,000	1,910,000	4R8801	F
460	620	400	400	4	4	5,350	16,700	545,000	1,700,000	4R9211	GS
	620	400	400	4	4	4,950	15,000	505,000	1,530,000	4R9209	A
	620	460	460	4	4	5,950	19,100	605,000	1,950,000	4R9223	FM[1]
	650	470	470	5	5	7,150	20,600	730,000	2,100,000	4R9216	F[1]
470	660	470	470	5	5	7,300	21,300	745,000	2,170,000	4R9403	FM[1]
480	600	236	236	3	3	2,620	7,850	267,000	805,000	4R9610	A
	650	420	420	5	5	5,700	17,200	585,000	1,750,000	4R9613	G[1]
	650	420	420	5	5	5,950	18,100	605,000	1,840,000	4R9607	G
	680	500	500	6	6	7,950	24,000	810,000	2,450,000	4R9604	F
500	680	420	405	5	5	7,100	22,900	725,000	2,340,000	4R10010	F[2]
	680	420	405	5	5	6,300	18,800	640,000	1,920,000	4R10020	F[2]
	690	470	470	5	5	7,650	22,500	780,000	2,290,000	4R10016	F[1]
	690	510	510	5	5	7,750	24,600	790,000	2,500,000	4R10006	F
	700	515	515	5	5	7,900	24,100	805,000	2,450,000	4R10011	F
	710	480	480	6	6	8,650	24,700	880,000	2,520,000	4R10008	F[1]
	720	530	530	5	5	8,250	25,000	840,000	2,550,000	4R10015	F[1]
	720	530	530	5	5	8,250	25,000	840,000	2,550,000	4R10024	FM[1]

❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



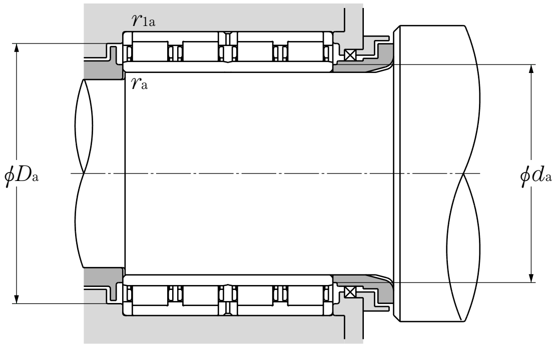
Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
422	396	524	3	3	309
424	400	520	4	4	298
446	420	540	4	4	303
445	416	544	3	3	349
450	416	574	3	3	399
457	436	544	3	3	189
466	436	564	3	3	181
469.6	444	589	5	2	423
478	440	600	4	4	410
476	450	571	4	4	362
480	448	580	1.5	4	392
480	448	580	1.5	4	392
487	460	600	4	4	450
487	460	600	4	4	437
502	476	604	3	3	383
502	476	604	3	3	341
502	476	604	3	3	417
509	480	630	4	4	540
517	490	640	4	4	529
510	493	587	2.5	2.5	155
523	500	630	4	4	423
523	500	630	4	4	369
532	504	656	5	5	640
550	520	660	4	4	495
550	520	660	4	4	451
547	520	670	4	4	590
552	520	670	4	4	640
554	520	680	4	4	680
556	524	686	5	5	675
568	520	700	4	4	780
568	520	700	4	4	745



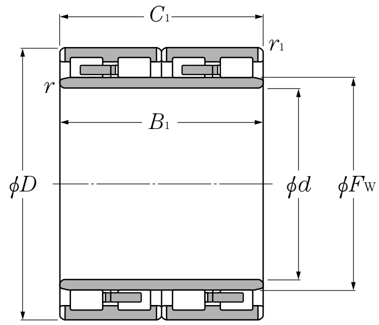
d 510～680mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing No.[1]
d	D	B_1	C_1	$r_{s\,min}$[2]	$r_{1s\,min}$[2]	C_r	C_{or}	C_r	C_{or}		
510	670	320	320	5	5	4,550	13,500	465,000	1,380,000	4R10201	G[1]
	700	540	540	6	6	8,300	25,000	845,000	2,550,000	4R10202	F[1]
520	700	540	540	6	6	8,200	25,500	835,000	2,600,000	4R10403	F[1]
	720	550	550	5	5	9,400	27,700	960,000	2,820,000	4R10406	FR[1]
	735	535	535	5	5	9,000	26,600	915,000	2,710,000	4R10402	F[2]
530	700	540	540	6	6	7,850	25,400	800,000	2,590,000	4R10603	F[1]
	760	520	520	6	6	9,150	26,700	935,000	2,730,000	4R10601	F[1]
	780	570	570	6	6	10,300	29,100	1,050,000	2,970,000	4R10602	F[1]
	780	570	570	7.5	6	10,300	29,100	1,050,000	2,970,000	4R10606	FM[1]
536.18	762.03	558.8	558.8	5	6	10,100	29,200	1,030,000	2,980,000	4R10704	F[2]
550	800	520	520	6	6	9,450	27,000	965,000	2,750,000	4R11001	F[1]
560	680	360	360	3	3	4,650	16,500	475,000	1,680,000	4R11202	A
570	800	514	514	2.5	6	10,200	29,200	1,040,000	2,970,000	4R11404	FR[1]
	815	594	594	6	6	11,800	34,500	1,200,000	3,500,000	4R11402	F
600	820	575	575	7.5	7.5	10,000	31,500	1,020,000	3,200,000	4R12006	FM[1]
	870	540	540	7.5	7.5	10,600	29,600	1,090,000	3,000,000	4R12002	F[1]
	870	640	640	7.5	7.5	13,600	40,500	1,390,000	4,150,000	4R12001	F
610	870	660	660	9.5	7.5	12,600	40,000	1,280,000	4,100,000	4R12202	F[1][4]
628	922	600	600	3	6	13,600	38,500	1,390,000	3,900,000	4R12602	F[1]
640	880	600	600	6	6	11,500	36,000	1,170,000	3,650,000	4R12802	F[2]
650	920	670	670	7.5	4	14,600	46,000	1,490,000	4,700,000	4R13005	F[1]
	920	680	680	7.5	7.5	14,800	47,000	1,520,000	4,800,000	4R13010	FR[1]
	920	690	690	7.5	7.5	14,300	46,500	1,460,000	4,750,000	4R13003	F
660	820	440	440	5	4	7,300	27,800	745,000	2,840,000	4R13201	F
680	1,020	650	650	6	6	15,700	48,000	1,600,000	4,900,000	4R13603	FM[2]
	1,020	680	680	3	5	17,300	49,500	1,760,000	5,050,000	4R13604	F[2]

❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



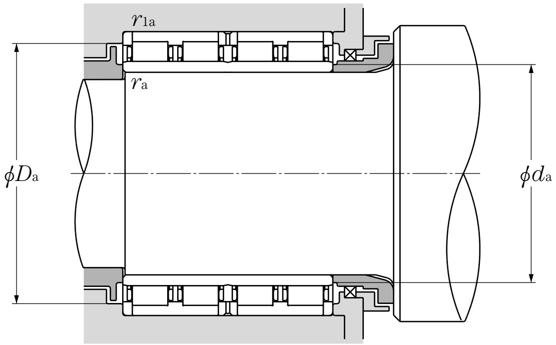
Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
554	530	650	4	4	335
558	534	676	5	5	689
564	544	676	5	5	658
566	540	700	4	4	715
574.5	540	715	4	4	740
574	554	676	5	5	626
590	554	736	5	5	800
601	554	756	5	5	1,010
595	562	756	6	5	978
600	556.176	738.03	4	5	859
622	574	776	5	5	965
590	573	667	2.5	2.5	265
626	581	776	2	5	849
628	594	791	5	5	1,040
660	632	788	6	6	941
672	632	838	6	6	1,150
672	632	838	6	6	1,330
680	650	838	8	6	1,400
702	641	898	2.5	5	1,430
700	664	856	5	5	1,150
723	682	904	6	3	1,500
723	682	888	6	6	1,510
723	682	888	6	6	1,550
702	680	804	4	3	580
803	704	996	5	5	1,970
775	693	1,000	2.5	4	2,060



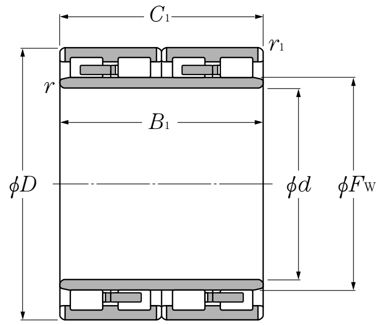
d 690～860mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing❶ No.
d	D	B_1	C_1	$r_{s\,min}$❷	$r_{1s\,min}$❷	C_r	C_{or}	C_r	C_{or}		
690	980	715	715	7.5	7.5	16,800	54,500	1,720,000	5,550,000	4R13802	F2)
	980	750	750	7.5	7.5	16,500	53,000	1,680,000	5,400,000	4R13803	FM2)
710	1,000	715	715	9.5	6	16,800	54,500	1,710,000	5,550,000	4R14205	FS4)
725	1,000	700	700	6	6	15,900	53,500	1,620,000	5,450,000	4R14501	F1)
750	1,050	745	720	7.5	7.5	17,600	58,000	1,790,000	5,900,000	4R15001	FM2)
	1,090	745	720	7.5	7.5	19,100	60,500	1,950,000	6,150,000	4R15002	FM2)
755	1,070	750	750	7.5	7.5	18,700	58,500	1,910,000	5,950,000	4R15101	F1)
760	1,030	750	750	7.5	7.5	17,300	59,500	1,760,000	6,050,000	4R15204	FM1)
	1,080	805	790	6	6	18,700	61,000	1,900,000	6,250,000	4R15207	FM2)
	1,100	745	720	7.5	7.5	19,100	60,500	1,950,000	6,150,000	4R15203	FM2)
761.43	1,079.6	787.4	787.4	9.5	7.5	19,800	63,000	2,020,000	6,400,000	4R15201	F1)
800	1,080	700	700	7.5	7.5	16,500	55,000	1,680,000	5,600,000	4R16004	F1)
	1,080	750	750	6	6	17,300	59,000	1,760,000	6,000,000	4R16005	F1)
820	1,130	800	800	7.5	7.5	19,600	66,500	2,000,000	6,800,000	4R16406	FM1)
	1,130	800	800	7.5	7.5	21,500	72,000	2,200,000	7,300,000	4R16413	FMS2)
	1,130	800	800	7.5	7.5	19,600	66,500	2,000,000	6,800,000	4R16415	F2)
	1,130	825	800	7.5	7.5	19,600	66,500	2,000,000	6,800,000	4R16405	FM1)
	1,160	840	840	7.5	7.5	21,600	71,000	2,200,000	7,250,000	4R16403	F2)
830	1,080	710	710	6	6	16,200	59,500	1,660,000	6,100,000	4R16601	F2)
840	1,160	840	840	5	7.5	21,600	71,000	2,200,000	7,250,000	4R16801	F1)
850	1,150	650	650	9.5	9.5	15,700	51,000	1,610,000	5,200,000	4R17001	F1)
	1,150	800	800	6	6	19,700	71,000	2,010,000	7,250,000	4R17003	F1)
	1,150	840	840	6	6	22,000	77,500	2,240,000	7,900,000	4R17009	F1)
	1,180	650	650	7.5	7.5	16,400	51,500	1,670,000	5,250,000	4R17004	F1)
	1,180	850	850	9.5	9.5	24,100	78,500	2,460,000	8,000,000	4R17002	F
	1,180	850	850	7.5	7.5	21,700	72,000	2,210,000	7,350,000	4R17014	F2)
860	1,140	750	750	7.5	7.5	17,200	61,000	1,750,000	6,200,000	4R17202	F2)

❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



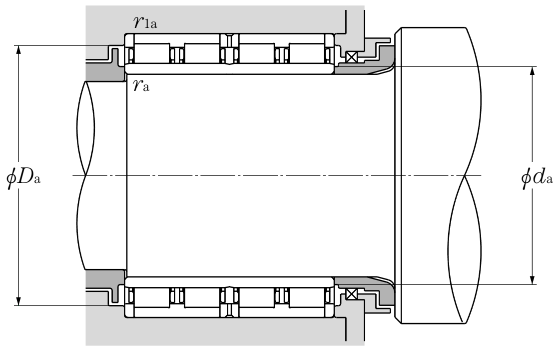
Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
767.5	722	948	6	6	1,850
766	722	948	6	6	1,900
787.5	750	976	8	5	1,900
796	749	976	5	5	1,730
830	782	1,018	6	6	2,180
845	782	1,058	6	6	2,530
837	787	1,038	6	6	2,260
828	792	998	6	6	2,000
845	784	1,056	5	5	2,550
855	792	1,068	6	6	2,560
846	801.425	1,047.6	8	6	2,420
870	832	1,048	6	6	1,950
880	824	1,056	5	5	2,090
903	852	1,098	6	6	2,450
903	852	1,098	6	6	2,530
903	852	1,098	6	6	2,530
903	852	1,098	6	6	2,520
910	852	1,128	6	6	2,930
896	854	1,056	5	5	1,780
920	860	1,128	4	6	2,840
941	890	1,110	8	8	1,980
930	874	1,126	5	5	2,430
928	874	1,126	5	5	2,640
945	882	1,148	6	6	2,270
928	890	1,140	8	8	2,970
940	882	1,148	6	6	2,980
938	892	1,108	6	6	2,200



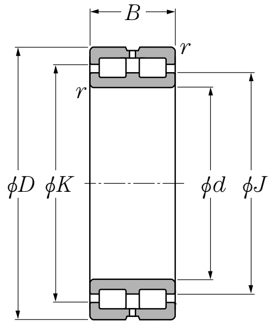
d 860～1,200mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Drawing❶ No.
d	D	B_1	C_1	$r_{s\,min}$❷	$r_{1s\,min}$❷	C_r	C_{or}	C_r	C_{or}		
860	1,160	735	710	6	6	17,800	62,500	1,810,000	6,400,000	4R17201	F1)
900	1,230	895	870	7.5	7.5	24,700	88,000	2,520,000	9,000,000	4R18001	FM2)
920	1,280	865	850	7.5	7.5	26,200	88,500	2,670,000	9,000,000	4R18401	F
1,000	1,310	880	880	9.5	9.5	23,400	88,500	2,380,000	9,000,000	4R20001	F1)
	1,360	800	800	7.5	7.5	25,000	85,000	2,550,000	8,650,000	4R20002	F1)
1,030	1,380	850	850	7.5	7.5	24,400	89,000	2,490,000	9,100,000	4R20601	F1)
1,200	1,590	1,050	1,050	7.5	7.5	36,000	133,000	3,650,000	13,600,000	4R24002	FS

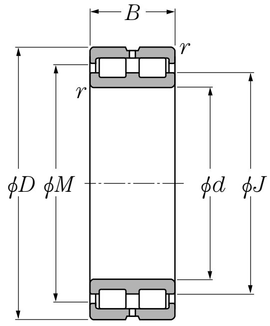
❶ Drawing details are shown in Page B-38.
❷ Minimal allowable dimension for chamfer dimension r or r_1.



Abutment and fillet dimensions					Mass
mm					kg
F_w	d_a min	D_a max	r_{as} max	r_{1as} max	(approx.)
940	884	1,136	5	5	2,310
985	932	1,198	6	6	3,250
1,015	952	1,248	6	6	3,560
1,080	1,040	1,270	8	8	3,260
1,090	1,032	1,328	6	6	3,530
1,124	1,062	1,348	6	6	3,800
1,295	1,232	1,558	6	6	6,220



SL01-48 type SL01-49 type
(Fixed side)

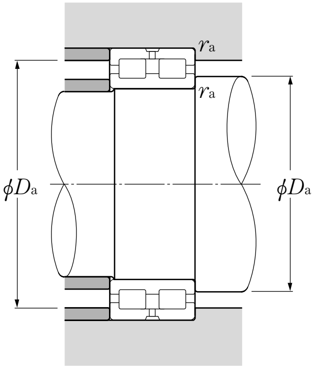


SL02-48 type SL02-49 type
(Free side)

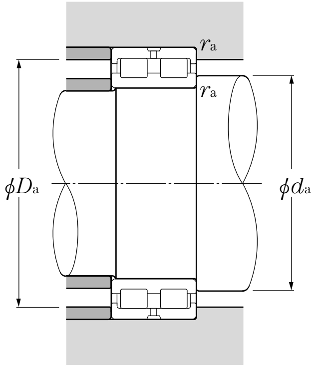
d 100～280mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Dimensions (mm)			
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Fixed side	Free side	J	K	M	e ❷
100	140	40	1.1	194	400	19,800	41,000	**SL01-4920**	**SL02-4920**	116	125	126.5	2
110	150	40	1.1	202	430	20,600	44,000	**SL01-4922**	**SL02-4922**	125	134	135.5	2
120	165	45	1.1	226	480	23,100	49,000	**SL01-4924**	**SL02-4924**	138.5	148.5	150.5	3
130	180	50	1.5	262	555	26,700	56,500	**SL01-4926**	**SL02-4926**	149	160	162	4
140	190	50	1.5	272	595	27,700	60,500	**SL01-4928**	**SL02-4928**	159.5	170	172.5	4
150	190	40	1.1	235	575	23,900	58,500	**SL01-4830**	**SL02-4830**	165.5	173.5	175.5	2
	210	60	2	410	865	41,500	88,000	**SL01-4930**	**SL02-4930**	171.5	186	189.5	4
160	200	40	1.1	241	605	24,600	62,000	**SL01-4832**	**SL02-4832**	173.5	182.5	184	2
	220	60	2	425	935	43,500	95,000	**SL01-4932**	**SL02-4932**	185	199	203	4
170	215	45	1.1	265	650	27,000	66,500	**SL01-4834**	**SL02-4834**	186.5	196.5	198	3
	230	60	2	435	980	44,500	100,000	**SL01-4934**	**SL02-4934**	194	208	211.5	4
180	225	45	1.1	275	695	28,000	71,000	**SL01-4836**	**SL02-4836**	199	209	211	3
	250	69	2	550	1,230	56,000	125,000	**SL01-4936**	**SL02-4936**	206	222	225.5	4
190	240	50	1.5	315	785	32,000	80,000	**SL01-4838**	**SL02-4838**	208.5	219.5	221.5	4
	260	69	2	565	1,290	57,500	131,000	**SL01-4938**	**SL02-4938**	216.5	232.5	235.5	4
200	250	50	1.5	320	825	33,000	84,000	**SL01-4840**	**SL02-4840**	219	230	232	4
	280	80	2.1	665	1,500	68,000	153,000	**SL01-4940**	**SL02-4940**	232	250	253.5	5
220	270	50	1.5	340	905	34,500	92,500	**SL01-4844**	**SL02-4844**	240	251	253	4
	300	80	2.1	695	1,620	70,500	165,000	**SL01-4944**	**SL02-4944**	249.5	267.5	271	5
240	300	60	2	510	1,330	52,000	136,000	**SL01-4848**	**SL02-4848**	261	275	276.5	4
	320	80	2.1	730	1,770	74,000	181,000	**SL01-4948**	**SL02-4948**	272.5	290.5	294	5
260	320	60	2	535	1,450	54,500	148,000	**SL01-4852**	**SL02-4852**	283	297	300	4
	360	100	2.1	1,070	2,520	109,000	257,000	**SL01-4952**	**SL02-4952**	297	320	324.5	6
280	350	69	2	685	1,860	69,500	189,000	**SL01-4856**	**SL02-4856**	308	324	327	4
	380	100	2.1	1,110	2,710	114,000	277,000	**SL01-4956**	**SL02-4956**	319	342	346	6

❶ Maximum allowable dimension for chamfer dimension r. ❷ Allowable axial move.



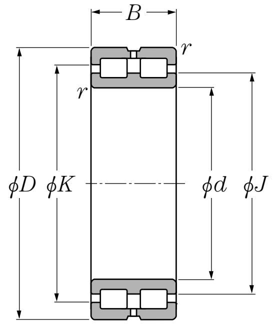
Fixed side



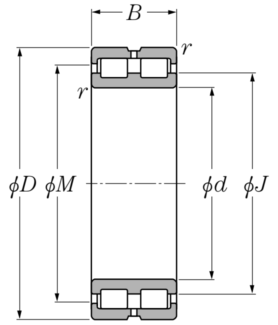
Free side

Abutment and fillet dimensions mm			Mass (approx.) kg	
d_a ❸ min	D_a ❸ max	r_{as} max	Fixed side	Free side
106.5	133.5	1	1.95	1.9
116.5	143.5	1	2.15	2.1
126.5	158.5	1	2.95	2.85
138	172	1.5	3.95	3.8
148	182	1.5	4.2	4.1
156.5	183.5	1	2.9	2.8
159	201	2	6.65	6.45
166.5	193.5	1	3.05	2.9
169	211	2	7	6.8
176.5	208.5	1	4.1	3.95
179	221	2	7.35	7.1
186.5	218.5	1	4.3	4.15
189	241	2	10.7	10.5
198	232	1.5	5.65	5.45
199	251	2	11.2	10.9
208	242	1.5	5.9	5.7
211	269	2	15.7	15.3
228	262	1.5	6.4	6.2
231	289	2	17.1	16.6
249	291	2	10.2	9.9
251	309	2	18.4	17.9
269	311	2	11	10.6
271	349	2	32	31.2
289	341	2	16	15.6
291	369	2	33.9	33.1

❸ Use J and K dimensions for bearings operating at inclined or large axial loads.



SL01-48 type SL01-49 type
(Fixed side)

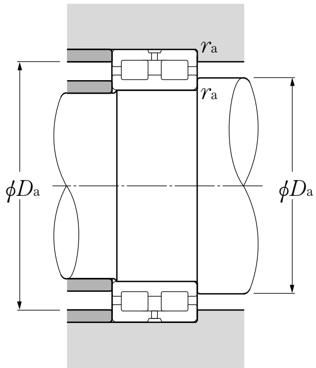


SL02-48 type SL02-49 type
(Free side)

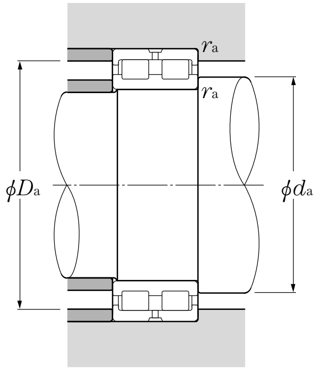
d 300～440mm

Boundary dimensions				Basic load ratings				Bearing numbers		Dimensions			
				dynamic	static	dynamic	static						
mm				kN		kgf				mm			
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Fixed side	Free side	J	K	M	e ❷
300	380	80	2.1	805	2,160	82,000	220,000	**SL01-4860**	**SL02-4860**	330	348	351	6
	420	118	3	1,580	3,800	161,000	385,000	**SL01-4960**	**SL02-4960**	344	371	377	6
320	400	80	2.1	835	2,310	85,000	236,000	**SL01-4864**	**SL02-4864**	353	371	374	6
	440	118	3	1,650	4,100	168,000	415,000	**SL01-4964**	**SL02-4964**	371	398	404	6
340	420	80	2.1	855	2,430	87,500	248,000	**SL01-4868**	**SL02-4868**	370	388	391	6
	460	118	3	1,690	4,300	172,000	440,000	**SL01-4968**	**SL02-4968**	388	416	421	6
360	440	80	2.1	885	2,580	90,000	264,000	**SL01-4872**	**SL02-4872**	393	411	414	6
	480	118	3	1,730	4,500	176,000	460,000	**SL01-4972**	**SL02-4972**	406	434	439	6
380	480	100	2.1	1,290	3,600	132,000	370,000	**SL01-4876**	**SL02-4876**	422	444	449	6
	520	140	4	2,300	5,900	235,000	600,000	**SL01-4976**	**SL02-4976**	437	469	475	7
400	540	140	4	2,410	6,200	246,000	635,000	**SL01-4980**	**SL02-4980**	450	484	490	7
420	560	140	4	2,470	6,500	252,000	665,000	**SL01-4984**	**SL02-4984**	472	505	512	7
440	600	160	4	3,000	7,850	305,000	800,000	**SL01-4988**	**SL02-4988**	503	540	546	7

❶ Maximum allowable dimension for chamfer dimension *r*. ❷ Allowable axial move.



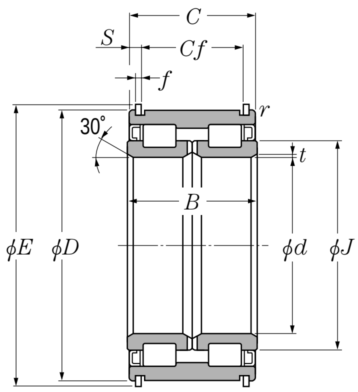
Fixed side



Free side

Abutment and fillet dimensions mm			Mass (approx.) kg	
d_a ❸ min	D_a ❸ max	r_{as} max	Fixed side	Free side
311	369	2	23	22.2
313	407	2.5	53	51.9
331	389	2	24.3	23.5
333	427	2.5	56	54.9
351	409	2	25.6	24.8
353	447	2.5	59	57.8
371	429	2	27	26
373	467	2.5	62	60.8
391	469	2	45.3	44
396	504	3	92.3	90.5
416	524	3	96.4	94.6
436	544	3	101	98.6
456	584	3	139	137

❸ Use J and K dimensions for bearings operating at inclined or large axial loads.

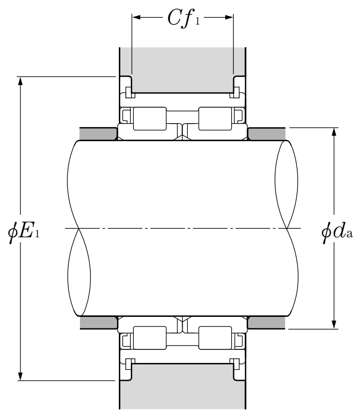


d 100～380mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B	C	t	r	C_r	C_{or}	C_r	C_{or}	
100	150	67	66	1.5	1	330	580	33,500	59,500	**SL04-5020NR**
110	170	80	79	1.8	1.5	385	695	39,000	71,000	**SL04-5022NR**
120	180	80	79	1.8	1.5	400	750	41,000	76,500	**SL04-5024NR**
130	200	95	94	1.8	1.5	535	1,000	55,000	102,000	**SL04-5026NR**
140	210	95	94	1.8	1.5	600	1,120	61,000	115,000	**SL04-5028NR**
150	225	100	99	2	1.5	690	1,290	70,500	131,000	**SL04-5030NR**
160	240	109	108	2	2	720	1,390	73,500	142,000	**SL04-5032NR**
170	260	122	121	2	2	925	1,790	94,500	182,000	**SL04-5034NR**
180	280	136	135	2	2	1,090	2,140	111,000	218,000	**SL04-5036NR**
190	290	136	135	2	2	1,120	2,230	114,000	227,000	**SL04-5038NR**
200	310	150	149	2	2	1,310	2,650	133,000	270,000	**SL04-5040NR**
220	340	160	159	2.5	2	1,640	3,300	167,000	335,000	**SL04-5044NR**
240	360	160	159	2.5	2	1,710	3,550	175,000	365,000	**SL04-5048NR**
260	400	190	189	3	2.5	2,130	4,500	217,000	460,000	**SL04-5052NR**
280	420	190	189	3	2.5	2,170	4,700	221,000	475,000	**SL04-5056NR**
300	460	218	216	3	2.5	2,670	5,850	272,000	600,000	**SL04-5060NR**
320	480	218	216	3	2.5	2,720	6,100	278,000	620,000	**SL04-5064NR**
340	520	243	241	3.5	3	3,650	8,000	370,000	815,000	**SL04-5068NR**
360	540	243	241	3.5	3	3,750	8,300	380,000	845,000	**SL04-5072NR**
380	560	243	241	3.5	3	3,800	8,750	385,000	895,000	**SL04-5076NR**

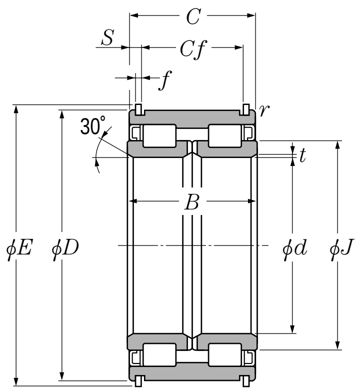
Note 1. The above are greased bearings. 2. The above are treated for rust prevention.
3. The above are non contact shielded bearings. Also, contact sealed can be applied upon request.

NTN



Dimensions mm					Abutment and fillet dimensions mm			Mass kg
J	E (approx.)	f	Cf	S	d_a	E_1	Cf_1 ❶	(approx.)
118.5	156	2.5	54	6	106	180	54	4.03
131.5	176	2.5	65	7	116.5	200	65	7
141.5	188	3	65	7	126.5	210	65	7.5
158	208	3	77	8.5	136.5	230	77	11.4
167	218	3	77	8.5	146.5	245	77	12.1
178	233	3	81	9	157	260	81	14.6
191	248	3	89	9.5	167	275	89	18.2
203	270	4	99	11	177	300	99	24.6
220	290	4	110	12.5	187	320	110	32.3
226	300	4	110	12.5	197	330	110	33.7
245.5	320	4	120	14.5	207	350	120	43.5
260	356	6	130	14.5	228.5	380	130	55.5
280.5	376	6	130	14.5	248.5	400	130	59.5
315.5	416	7	154	17.5	270	445	154	90.7
325	436	7	154	17.5	290	465	154	96.2
363	480	8	176	20	310	510	176	137
376	500	8	176	20	330	530	176	144
406	544	8	194	23.5	352	580	194	194
421	564	10	194	23.5	372	600	194	203
442	584	10	194	23.5	392	620	194	212

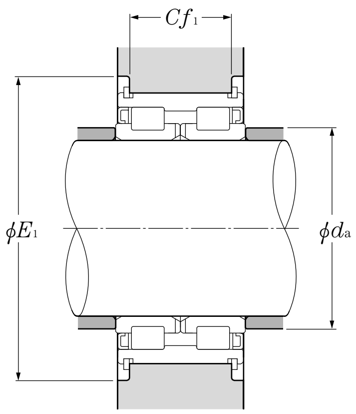
❶ Cf_1 deviation **SL04-5020NR～SL04-5034NR**：-0.1～ -0.5mm
SL04-5036NR～SL04-5076NR：-0.1～ -0.7mm



d 400～440mm

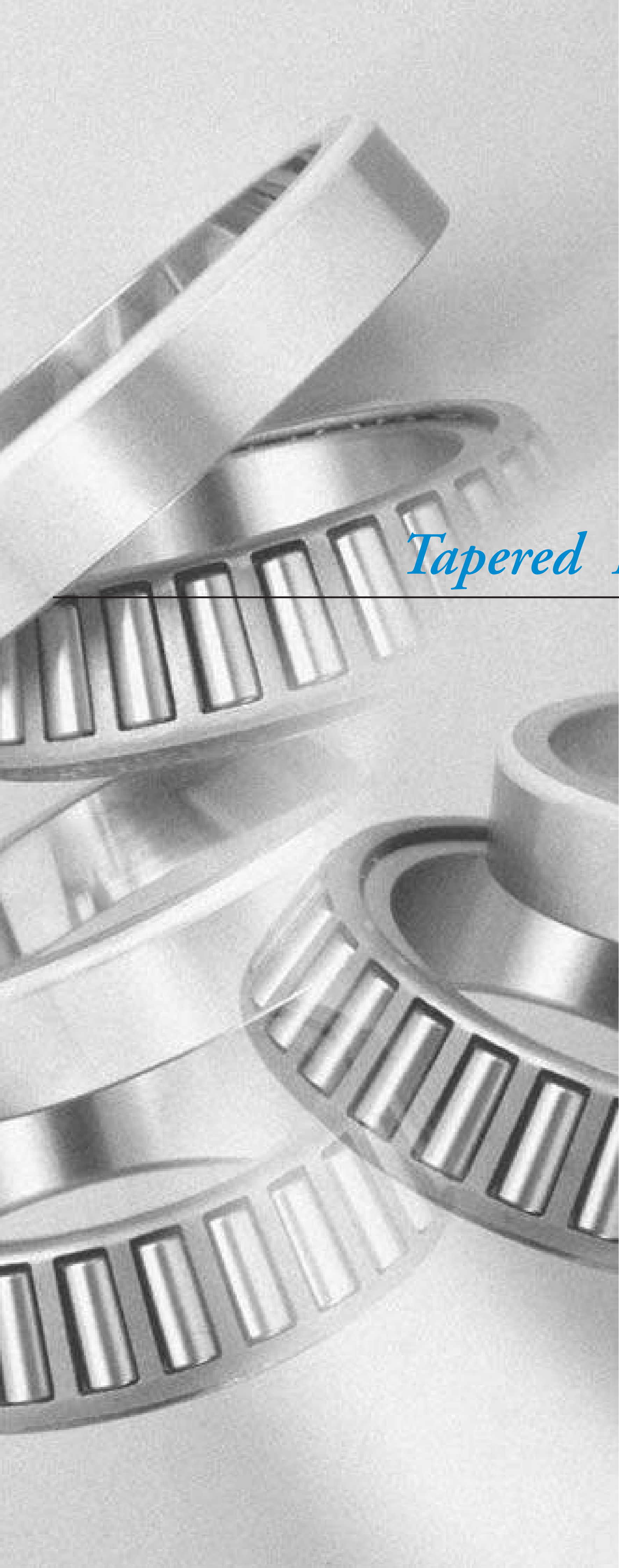
Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B	C	t	r	C_r	C_{or}	C_r	C_{or}	
400	600	272	270	3.5	3	4,250	9,950	435,000	1,010,000	**SL04-5080NR**
420	620	272	270	3.5	3	4,350	10,300	445,000	1,050,000	**SL04-5084NR**
440	650	280	278	4.5	4	4,500	11,000	460,000	1,120,000	**SL04-5088NR**

Note 1. The above are greased bearings. 2. The above are treated for rust prevention.
3. The above are non contact shielded bearings. Also, contact sealed can be applied upon request.



Dimensions mm					Abutment and fillet dimensions mm			Mass kg
J	E (approx.)	f	Cf	S	d_a	E_1	Cf_1 ❶	(approx.)
470	626	12	210	30	412	675	210	281
486	646	12	210	30	432	695	210	292
518	676	12	210	34	456	725	210	331

❶ Cf_1 deviation **SL04-5080NR～SL04-5088NR**：-0.1～ -0.7mm



Tapered Roller bearings

1. Type, Structure and Characteristics

Tapered roller bearings are designed such that their conical rollers and raceways are arranged so that all elements of the roller and race way cones meet at a common apex on the bearing axis. (Refer to **Fig.1**) The rolling elements perform the real rotating movement on the raceway; the synthesized force from the inner and outer ring raceways guides the rollers, pressing them to the large rib on the inner ring. Metric and inch series are considered standard and both systems are widely used.

The inner ring, rollers and cage can be separated as a unit, or the CONE, from the outer ring, or the CUP. The cup and cone are called sub-units. Sub-unit dimensions for the nominal cup small inside diameter and bearing contact angle, as shown in **Fig. 2**, are standardized by ISO and ABMA and are compatible between sub-units. Double row and four row bearings are available in addition to single row bearings. Models and characteristics are shown in **Tables 1** and **2**.

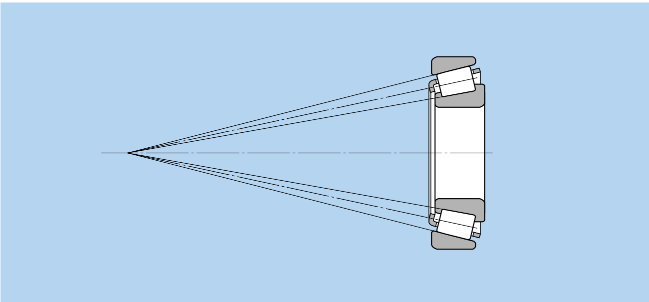


Fig.1

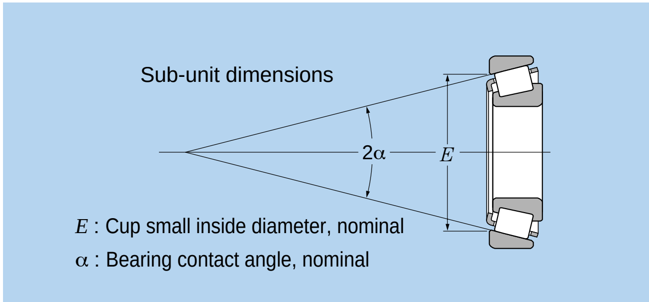


Fig.2

Table 1 Structure and characteristics of double row tapered roller bearings

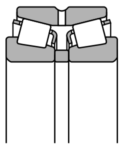
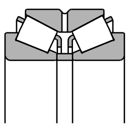
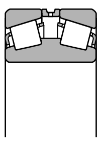
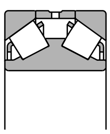
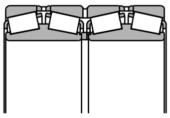
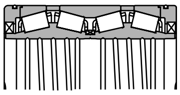
Model	Drawing	Nominal number	Characteristics
Double row with vertex of contact angles outside of the bearing		413XXX 423XXX 430XXX 432XXX CRI	● These bearings are designed with one double row outer ring and two pairs of inner rings with rollers. Bearings are adjusted so that their internal clearance becomes the specified value, the parts which have the same serial numbers should be assembled according to the assembly codes. ● These bearings support radial and axial loads. Since the cone pressure apex is wide, bearings are suitable where moment loads are applied. ● These bearings have the same function as the back-to-back duplex arrangement of single row bearings.
Double row with vertex of contact steep angles outside of the bearing		CRI	● This bearing model has a larger and steeper contact angle than the double row with vertex of contact angles outside the bearing. These bearings are used when the axial load is large. ● Since these bearings are adjusted so that the internal clearance is a specified value (like the double row with vertex of contact angles outside of bearing) the parts which have the same serial numbers should be assembled according to the assembly codes.
Double row with vertex of contact angles inside of the bearing		3230XX 3231XX CRD	● These bearings are designed with one double row inner ring with rollers and two pairs of outer rings and an outer ring spacer. ● These bearings accept the radial and axial loads. Since the cone pressure apex is short, bearings are not suitable when the moment is applied. ● Since these bearings are adjusted so that the internal clearance is the specified value (like the double row with vertex of contact angles outside of bearing) the parts which have the same serial numbers should be assembled according to the assembly codes.
Double row with vertex of contact steep angles inside of the bearing		CRD	● This bearing model has a larger and steeper contact angle than the double row with vertex of contact angles inside the bearing. These bearings are used when the axial load is large or only axials are applied. ● Models without an outer ring spacer and with a key groove or notch on the inner ring (refer to the drawing) are also available. Consult **NTN** Engineering about this bearing's fit. ● These bearings may be pressurized by using a spring between the housing shoulder and outer ring end.

Table 2 Structure and characteristics of the four row tapered roller bearings

Model	Drawing	Nominal numbers	Characteristics
Four row tapered roller bearing		6259XX 6230XX 6231XX CRO	● These bearings are designed with two double row inner rings with rollers, one double row outer ring, two single outer ring and outer ring spacer/inner ring spacer. Bearings are adjusted so that their internal clearance becomes the specified value, the parts which have the same serial numbers should be assembled according to the assembly codes. ● The bearing is mainly used for the roll neck of rolling mill, and designed so as to become the maximum rating load for the allowable space in the roll neck part. ● The bearing uses the clearance-fit to make assemble and disassembley easier. For this purpose, bearings are designed with a helical groove on the inner ring bore to prevent wearing of the inner ring bore when creep occurs and uses the carbonized steel to prevent cracks on inner ring and improve the shock resistance. ● Please consult with **NTN** Engineering for fitting and bearing internal clearance.
Four row tapered roller bearing enclosed type		CRO···LL	● Bearings are designed with oil seals on both side of the bearing which is the same as the four row tapered roller bearings. ● Please consult with **NTN** Engineering for fitting and bearing internal clearance.

2. Dimensional Accuracy/Rotation Accuracy

Metric system bearings ·········**Table 3.4 (Page A-14)**
Inch system bearings ············**Table 3.5 (Page A-16)**

3. Recommended Fitting

Metric system bearings ·········**Table 4.2 (Page A-24)**
Inch system bearings ············**Table 4.5, 4.6 (Page A-27)**

4. Bearing Internal Clearance

Metric system bearings ·········**Table 5.7 (Page A-32)**
Inch system bearings ············**Table 5.9 (Page A-34)**

5. General Operating Cautions

Slippage between the balls and raceways may occur when bearings are operated under small loads, or when the ratio between axial and radial loads of the duplexed bearings exceeds the value "e," and may cause smearing. This is most apparent when using large size tapered roller bearings due to the large cage mass. Please consult **NTN** Engineering for further details.

Inch system sizes: Tapered Roller Bearings (Single row・Double row) index

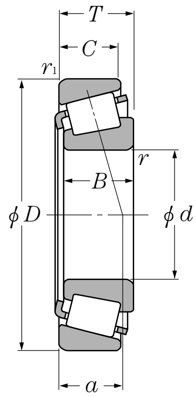
Inch system sizes: Tapered Roller Bearings (Single row・Double row) index

Inch system sizes: Tapered Roller Bearings (Single row・Double row) index

Inch system sizes: Tapered Roller Bearings (Four Row) index

Inch system sizes: Tapered Roller Bearings (Four Row) index

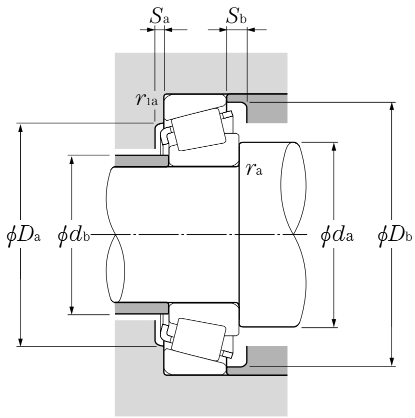
Metric system sizes



d 100～120mm

	Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	T	B	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
100	140	25	25	20	1.5	1.5	121	206	12,300	21,000	32920XU
	140	25	24	20	1.5	1.5	97.5	162	9,950	16,500	32920❷
	150	32	32	24	2	1.5	170	281	17,300	28,600	32020XU
	150	39	39	32.5	2	1.5	224	390	22,800	39,500	33020U
	180	37	34	29	3	2.5	258	335	26,300	34,500	30220U
	180	49	46	39	3	2.5	330	465	33,500	47,500	32220U
	215	51.5	47	39	4	3	410	500	41,500	51,000	30320U
	215	51.5	47	39	3	3	345	400	35,000	40,500	30320❷
	215	56.5	51	35	4	3	355	435	36,000	44,000	31320XU
	215	77.5	73	60	4	3	570	770	58,500	78,500	32320U
105	145	25	25	20	1.5	1.5	126	219	12,800	22,400	32921XA❷
	160	35	35	26	2.5	2	201	335	20,500	34,000	32021XU
	160	43	43	34	2.5	2	245	420	25,000	43,000	33021U
	190	39	36	30	3	2.5	287	380	29,300	38,500	30221U
	190	53	50	43	3	2.5	380	540	38,500	55,500	32221U
	225	53.5	49	41	4	3	435	535	44,500	54,500	30321U
	225	53.5	49	41	3	3	365	420	37,000	43,000	30321❷
	225	58	53	36	4	3	380	470	39,000	47,500	31321XU
	225	81.5	77	63	4	3	610	825	62,500	84,500	32321U
110	150	25	25	20	1.5	1.5	127	226	13,000	23,100	32922XA❷
	170	38	38	29	2.5	2	236	390	24,000	39,500	32022XU
	170	47	47	37	2.5	2	288	500	29,400	51,000	33022U
	200	41	38	32	3	2.5	325	435	33,000	44,000	30222U
	200	56	53	46	3	2.5	420	605	43,000	62,000	32222U
	240	54.5	50	42	4	3	480	590	49,000	60,000	30322U
	240	54.5	50	42	3	3	400	465	40,500	47,000	30322❷
	240	63	57	38	4	3	430	535	44,000	54,500	31322XU
	240	84.5	80	65	4	3	705	970	72,000	98,500	32322U
	240	84.5	80	65	3	3	620	830	63,500	84,500	32322❷
120	165	29	29	23	1.5	1.5	162	294	16,500	30,000	32924XU
	165	29	27	23	1.5	1.5	118	205	12,000	20,900	32924❷
	180	38	38	29	2.5	2	245	420	25,000	43,000	32024XU
	215	43.5	40	34	3	2.5	345	470	35,500	48,000	30224U
	215	61.5	58	50	3	2.5	460	680	47,000	69,500	32224U
	260	59.5	55	46	4	3	560	695	57,000	71,000	30324U
	260	59.5	55	46	3	3	465	550	47,500	56,000	30324❷

❶ Minimal allowable dimension for chamfer dimension r or r_1. ❷ This bearing does not incorporate the subunit dimensions.



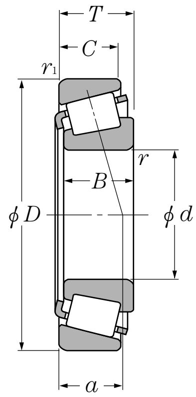
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm									Load center mm	Constant	Axial load factors		Mass kg
d_a	d_b	D_a		D_b	S_a	S_b	r_{as}	r_{1as}					
min	max	max	min	min	min	min	max	max	a	e	Y_2	Y_o	(approx.)
108.5	107.5	131.5	127.5	135.5	4	5	1.5	1.5	24.5	0.33	1.82	1.00	1.14
108.5	107.5	131.5	127.5	135.5	4	5	1.5	1.5	25	0.35	1.73	0.95	1.08
110	109	141.5	134	144	6	8	2	1.5	32.5	0.46	1.31	0.72	1.91
110	108	141.5	135	143	7	6.5	2	1.5	29.5	0.29	2.09	1.15	2.37
114	116	168	157	168	5	8	2.5	2	36	0.42	1.43	0.79	3.78
114	114	168	154	171	5	10	2.5	2	41.5	0.42	1.43	0.79	5.12
118	127	201	184	200	5	12.5	3	2.5	41.5	0.35	1.74	0.96	8.56
118	127	201	184	200	5	12.5	3	2.5	42	0.35	1.73	0.95	7.72
118	121	201	168	202	7	21.5	3	2.5	69	0.83	0.73	0.40	8.67
118	121	201	177	200	5	17.5	3	2.5	53	0.35	1.74	0.96	12.7
113.5	113.5	136.5	131.5	140.5	5	5	1.5	1.5	25	0.34	1.76	0.97	1.2
117	116	150	143	154	6	9	2	2	34.5	0.44	1.35	0.74	2.42
117	116	150	145	153	7	9	2	2	31	0.28	2.12	1.17	3
119	122	178	165	178	6	9	2.5	2	38	0.42	1.43	0.79	4.39
119	119	178	161	180	6	10	2.5	2	44	0.42	1.43	0.79	6.25
123	132	211	193	209	6	12.5	3	2.5	43.5	0.35	1.74	0.96	9.79
123	132	211	193	209	6	12.5	3	2.5	43.5	0.35	1.73	0.95	8.93
123	126	211	176	211	7	22	3	2.5	71.5	0.83	0.73	0.40	9.68
123	128	211	185	209	6	18.5	3	2.5	55	0.35	1.74	0.96	14.5
118.5	117.5	141.5	137	145.5	5	5	1.5	1.5	26.5	0.36	1.69	0.93	1.23
122	122	160	152	163	7	9	2	2	36.5	0.43	1.39	0.77	3.07
122	121	160	152	161	7	10	2	2	33.5	0.29	2.09	1.15	3.8
124	129	188	174	188	6	9	2.5	2	40	0.42	1.43	0.79	5.18
124	126	188	170	190	6	10	2.5	2	47	0.42	1.43	0.79	7.43
128	141	226	206	222	6	12.5	3	2.5	45.5	0.35	1.74	0.96	11.4
128	141	226	206	222	6	12.5	3	2.5	44	0.35	1.73	0.95	10.5
128	135	226	188	224	7	25	3	2.5	76	0.83	0.73	0.40	11.9
128	135	226	198	222	6	19.5	3	2.5	57.5	0.35	1.74	0.96	18
128	135	226	198	222	6.5	19.5	3	2.5	56	0.35	1.73	0.95	16.9
128.5	128.5	156.5	150	160	6	6	1.5	1.5	29.5	0.35	1.72	0.95	1.77
128.5	130.5	156.5	147.5	159.5	6	6	1.5	1.5	31	0.37	1.60	0.88	1.63
132	131	170	161	173	7	9	2	2	39	0.46	1.31	0.72	3.25
134	140	203	187	203	6	9.5	2.5	2	44	0.44	1.38	0.76	6.23
134	136	203	181	204	6	11.5	2.5	2	51.5	0.44	1.38	0.76	9.08
138	152	246	221	239	6	13.5	3	2.5	49	0.35	1.74	0.96	14.2
138	152	246	221	239	6	13.5	3	2.5	48.5	0.35	1.73	0.95	13.2

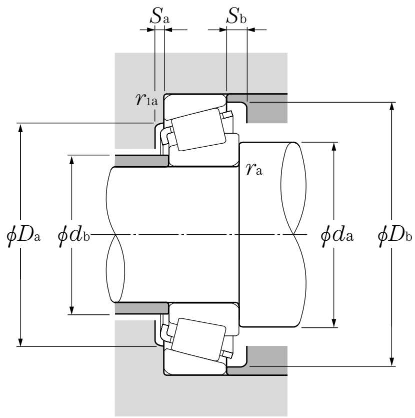
Metric system sizes



d 120～160mm

							Basic load ratings				Bearing numbers
Boundary dimensions							dynamic	static	dynamic	static	
mm							kN		kgf		
d	D	T	B	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
120	260	68	62	42	4	3	515	655	52,500	67,000	31324XU
	260	90.5	86	69	4	3	815	1,130	83,000	116,000	32324U
130	180	32	32	25	2	1.5	194	350	19,800	36,000	32926XU
	180	32	30	26	2	2	142	252	14,500	25,700	32926❷
	200	45	45	34	2.5	2	320	545	32,500	55,500	32026XU
	230	43.75	40	34	4	3	375	505	38,000	51,500	30226U
	230	67.75	64	54	4	3	530	815	54,000	83,000	32226U
	280	63.75	58	49	5	4	650	830	66,000	84,500	30326U
	280	72	66	44	5	4	600	780	61,500	79,500	31326XU
	280	98.75	93	78	4	4	895	1,240	91,000	126,000	32326
140	190	32	32	25	2	1.5	200	375	20,400	38,000	32928XU
	210	45	45	34	2.5	2	330	580	33,500	59,500	32028XU
	250	45.75	42	36	4	3	420	570	43,000	58,500	30228U
	250	45.75	42	36	3	3	375	485	38,000	49,500	30228❷
	250	71.75	68	58	4	3	610	920	62,500	94,000	32228U
	300	67.75	62	53	5	4	735	950	75,000	97,000	30328U
	300	67.75	62	53	4	4	640	780	65,000	80,000	30328❷
	300	77	70	47	5	4	685	905	70,000	92,500	31328XU
	300	107.75	102	85	4	4	985	1,370	101,000	140,000	32328
150	210	38	38	30	2.5	2	268	490	27,300	50,000	32930XU
	225	48	48	36	3	2.5	370	655	37,500	67,000	32030XU
	270	49	45	38	4	3	450	605	46,000	61,500	30230U
	270	77	73	60	4	3	700	1,070	71,500	109,000	32230U
	320	72	65	55	5	4	825	1,070	84,000	109,000	30330U
	320	72	65	55	4	4	680	875	69,500	89,000	30330❷
	320	82	75	50	5	4	775	1,030	79,000	105,000	31330XU
	320	114	108	90	4	4	1,160	1,750	119,000	179,000	32330
160	220	38	38	30	2.5	2	276	520	28,200	53,000	32932XU
	240	51	51	38	3	2.5	435	790	44,500	80,500	32032XU
	290	52	48	40	4	3	525	720	53,500	73,500	30232U
	290	84	80	67	4	3	890	1,420	90,500	145,000	32232U
	340	75	68	58	5	4	915	1,200	93,500	122,000	30332U
	340	75	68	58	4	4	755	975	77,000	99,500	30332❷
	340	121	114	95	4	4	1,230	1,840	126,000	188,000	32332

❶ Minimal allowable dimension for chamfer dimension r or r_1. ❷ This bearing does not incorporate the subunit dimensions.



Equivalent bearing load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

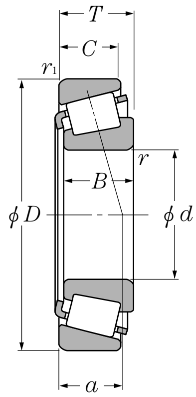
$P_{or} = 0.5F_r + Y_o F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm									Load center mm	Constant	Axial load factors		Mass kg
d_a	d_b	D_a		D_b	S_a	S_b	r_{as}	r_{1as}					
min	max	max	min	min	min	min	max	max	a	e	Y_2	Y_o	(approx.)
138	145	246	203	244	9	26	3	2.5	82.5	0.83	0.73	0.40	15.4
138	145	246	213	239	6	21.5	3	2.5	61.5	0.35	1.74	0.96	22.4
140	139	171.5	163.5	174	6	7	2	1.5	31.5	0.34	1.77	0.97	2.36
140	139	170	163.5	174	6	6	2	2	34	0.37	1.60	0.88	2.22
142	144	190	178	192	8	11	2	2	43.5	0.43	1.38	0.76	4.96
148	152	216	203	218	7	9.5	3	2.5	45.5	0.44	1.38	0.76	7.25
148	146	216	193	219	7	13.5	3	2.5	57	0.44	1.38	0.76	11.2
152	164	262	239	255	8	14.5	4	3	53.5	0.35	1.74	0.96	17.4
152	155.5	262	214.5	263	9	28	4	3	87.5	0.83	0.73	0.40	19
148	160.5	262	230	264	2.4	20	3	3	67.5	0.35	1.73	0.95	27.2
150	150	181.5	177	184	6	6	2	1.5	34	0.36	1.67	0.92	2.51
152	153	200	187	202	8	11	2	2	46	0.46	1.31	0.72	5.28
158	163	236	219	237	7	9.5	3	2.5	48.5	0.44	1.38	0.76	9.26
158	163	236	219	237	7	9.5	2.5	2.5	47.5	0.43	1.39	0.77	8.37
158	158	236	210	238	9	13.5	3	2.5	61	0.44	1.38	0.76	14.1
162	179	282	251	273	9	14.5	4	3	56.5	0.35	1.74	0.96	21.2
162	179	282	252	273	9	14.5	4	3	57	0.35	1.73	0.95	20.4
162	165	282	234	280	9	30	4	3	94	0.83	0.73	0.40	23
158	170.5	282	244	281	1.5	20	3	3	74.5	0.35	1.73	0.95	33.2
162	162	200	192	202	7	8	2	2	36.5	0.33	1.83	1.01	3.92
164	164	213	200	216	8	12	2.5	2	49.5	0.46	1.31	0.72	6.37
168	175	256	234	255	7	11	3	2.5	51.5	0.44	1.38	0.76	11.2
168	170	256	226	254	8	17	3	2.5	64.5	0.44	1.38	0.76	18.2
172	193	302	269	292	8	17	4	3	61	0.35	1.74	0.96	25.5
172	193	302	269	292	8	17	4	3	62.5	0.37	1.60	0.88	24.7
172	176	302	250	302	9	32	4	3	100	0.83	0.73	0.40	27.7
168	184	302	254	298	4.3	24	3	3	80	0.37	1.60	0.88	42
172	170.5	210	199	213.5	7	8	2	2	38.5	0.35	1.73	0.95	4.15
174	175	228	213	231	8	13	2.5	2	52.5	0.46	1.31	0.72	7.8
178	189	276	252	272	8	12	3	2.5	55.5	0.44	1.38	0.76	12.9
178	182	276	242	275	10	17	3	2.5	70	0.44	1.38	0.76	23.5
182	205	322	286	310	10	17	4	3	64	0.35	1.74	0.96	29.9
182	205	322	286	311	10	17	4	3	65.5	0.37	1.60	0.88	29.2
178	197.5	322	272	318.5	2.3	26	3	3	85	0.37	1.60	0.88	49

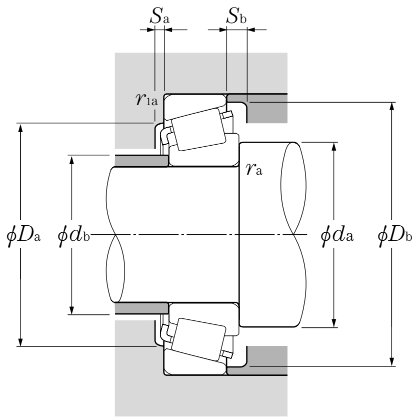
Metric system sizes



d 170～220mm

Boundary dimensions (mm) d	D	T	B	C	$r_{s\,min}$❶	$r_{1s\,min}$❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers
170	230	38	38	30	2.5	2	286	560	29,200	57,000	32934XU
	260	57	57	43	3	2.5	500	895	51,000	91,000	32034XU
	310	57	52	43	5	4	610	845	62,000	86,500	30234U
	310	91	86	71	5	4	1,000	1,600	102,000	163,000	32234U
	360	80	72	62	5	4	1,010	1,320	103,000	135,000	30334U
	360	80	72	62	4	4	845	1,100	86,000	113,000	30334❷
	360	127	120	100	4	4	1,310	1,940	133,000	198,000	32334
180	250	45	45	34	2.5	2	350	700	36,000	71,500	32936XU
	280	64	64	48	3	2.5	645	1,170	66,000	119,000	32036XUE1
	320	57	52	43	5	4	630	890	64,000	91,000	30236U
	320	91	86	71	5	4	1,030	1,690	105,000	172,000	32236U
	380	83	75	64	4	4	910	1,190	93,000	121,000	30336
	380	134	126	106	4	4	1,440	2,150	147,000	219,000	32336
190	260	45	45	34	2.5	2	355	710	36,000	72,000	32938XU
	260	45	42	36	2.5	2.5	280	525	28,600	53,500	32938❷
	290	64	64	48	3	2.5	655	1,210	67,000	124,000	32038XUE1
	340	60	55	46	5	4	715	1,000	73,000	102,000	30238U
	340	97	92	75	5	4	1,150	1,850	117,000	189,000	32238U
	340	97	92	75	4	4	1,000	1,670	102,000	171,000	32238❷
	400	86	78	65	5	5	935	1,200	95,000	123,000	30338
	400	140	132	109	5	5	1,590	2,390	162,000	244,000	32338
200	280	51	51	39	3	2.5	485	895	49,000	91,000	32940XUE1
	310	70	70	53	3	2.5	800	1,470	81,500	149,000	32040XUE1
	360	64	58	48	5	4	785	1,110	80,000	113,000	30240U
	360	104	98	82	5	4	1,320	2,130	134,000	217,000	32240U
	360	104	98	82	4	4	1,150	1,970	118,000	201,000	32240❷
	420	89	80	67	5	5	1,050	1,370	107,000	140,000	30340
	420	146	138	115	5	5	1,740	2,650	178,000	270,000	32340
220	300	51	51	39	3	2.5	480	950	49,000	97,000	32944XUE1
	300	51	48	41	2.5	2.5	345	670	35,500	68,500	32944E1❷
	340	76	76	57	4	3	920	1,690	94,000	173,000	32044XU
	400	72	65	54	4	4	815	1,220	83,000	124,000	30244
	400	114	108	90	4	4	1,390	2,410	142,000	246,000	32244
	460	97	88	73	5	5	1,260	1,690	129,000	172,000	30344
	460	154	145	122	5	5	2,020	3,050	206,000	315,000	32344

❶ Minimal allowable dimension for chamfer dimension r or r_1. ❷ This bearing does not incorporate the subunit dimensions.



Equivalent bearing load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

$P_{or} = 0.5F_r + Y_o F_a$

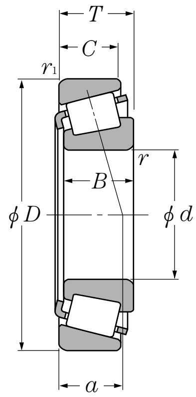
When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm									Load center mm	Constant	Axial load factors		Mass kg
d_a min	d_b max	D_a max	D_a min	D_b min	S_a min	S_b min	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
182	183	220	213	222	7	8	2	2	42.5	0.38	1.57	0.86	4.4
184	187	248	230	249	10	14	2.5	2	56	0.44	1.35	0.74	10.5
192	203	292	266	288	8	14	4	3	60.5	0.44	1.38	0.76	17
192	201	292	258	293	10	20	4	3	75	0.44	1.38	0.76	28.7
192	221	342	303	329	10	18	4	3	68	0.35	1.74	0.96	35.3
192	221	342	303	332	10	18	4	3	69.5	0.37	1.60	0.88	34.8
188	209	342	287	336	1.5	27	3	3	89.5	0.37	1.60	0.88	56.5
192	193	240	225	241	8	11	2	2	54	0.48	1.25	0.69	6.54
194	199	268	247	267	10	16	2.5	2	59.5	0.42	1.42	0.78	14.5
202	211	302	274	297	9	14	4	3	63	0.45	1.33	0.73	17.7
202	204	302	267	305	10	20	4	3	77.5	0.45	1.33	0.73	30.7
198	227.5	362	314	345	1.5	19	3	3	72.5	0.37	1.60	0.88	38.9
198	221	362	305	357	2.4	28	3	3	95	0.37	1.60	0.88	67.8
202	204	250	235	251	8	11	2	2	55	0.48	1.26	0.69	6.77
202	204	248	235	251	8	9	2	2	48.5	0.37	1.60	0.88	6.43
204	209	278	257	279	10	16	2.5	2	62.5	0.44	1.36	0.75	15.1
212	228	322	295	316	9	14	4	3	64	0.44	1.38	0.76	20.8
212	216	322	282	323	11	22	4	3	82	0.44	1.38	0.76	36.1
212	216	322	286	323	11	22	4	3	87.5	0.49	1.23	0.68	33.3
212	242	378	335	366.5	2.3	21	4	4	74.5	0.37	1.60	0.88	43.5
212	233.5	378	320	373.5	1.5	31	4	4	100	0.37	1.60	0.88	76.9
214	214	268	254	271	9	12	2.5	2	53.5	0.39	1.52	0.84	8.88
214	221	298	273	297	11	17	2.5	2	66.5	0.43	1.39	0.77	19.3
222	242	342	311	336	10	16	4	3	70	0.44	1.38	0.76	25.4
222	230	342	298	340	11	22	4	3	85	0.41	1.48	0.81	43.6
222	230	342	302	344	11	22	4	3	91.5	0.49	1.23	0.68	43.6
222	252.5	398	350	382.5	5.3	22	4	4	77	0.37	1.60	0.88	51.5
222	243.5	398	335	391.5	3.2	31	4	4	105	0.37	1.60	0.88	88.8
234	234	288	271	290	10	12	2.5	2	59.5	0.43	1.41	0.78	10.2
234	235	288	274	290	10	10	2.5	2	57	0.39	1.55	0.85	9.63
238	243	326	300	326	12	19	3	2.5	72.5	0.43	1.39	0.77	25
238	263	382	334	368	3.4	18	3	3	82	0.49	1.23	0.68	34.7
238	255	382	323	380.5	4.4	24	3	3	102	0.49	1.23	0.68	59.9
242	276.5	438	383	418.5	4.2	24	4	4	86.5	0.37	1.60	0.88	66.7
242	267.5	438	371	431	1.5	32	4	4	112	0.37	1.60	0.88	112.8

NTN

Metric system sizes

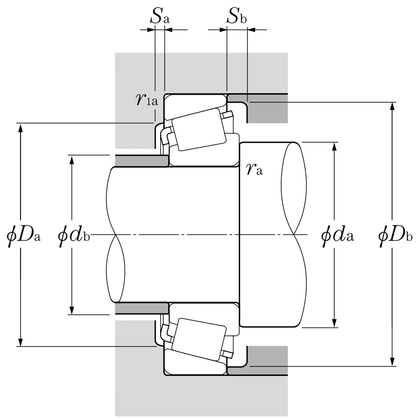


d 240～380mm

Boundary dimensions (mm)							Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	T	B	C	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{or}	C_r	C_{or}	
240	320	51	51	39	3	2.5	490	1,000	50,000	102,000	32948XUE1
	360	76	76	57	4	3	930	1,760	95,000	179,000	32048XU
	440	79	72	60	4	4	975	1,480	99,500	151,000	30248
	440	127	120	100	4	4	1,700	2,750	174,000	280,000	32248
	500	105	95	80	5	5	1,480	2,000	151,000	204,000	30348
	500	165	155	132	5	5	2,330	3,600	238,000	365,000	32348
260	360	63.5	63.5	48	3	2.5	705	1,430	72,000	146,000	32952XUE1
	400	87	87	65	5	4	1,200	2,270	123,000	231,000	32052XU
	480	89	80	67	5	5	1,170	1,810	119,000	185,000	30252
	480	137	130	106	5	5	1,880	3,350	192,000	340,000	32252
280	380	63.5	63.5	48	3	2.5	725	1,520	74,000	155,000	32956XUE1
	420	87	87	65	5	4	1,220	2,350	125,000	240,000	32056XU
	500	89	80	67	5	5	1,240	1,910	126,000	195,000	30256
	500	137	130	106	5	5	1,980	3,500	202,000	355,000	32256
	580	187	175	145	6	6	3,250	5,250	335,000	535,000	32356
300	420	76	76	57	4	3	1,010	2,090	103,000	213,000	32960XUE1
	460	100	100	74	5	4	1,490	2,830	152,000	289,000	32060XU
	540	96	85	71	5	5	1,420	2,220	145,000	226,000	30260
	540	149	140	115	5	5	2,300	4,100	235,000	420,000	32260
320	440	76	76	57	4	3	1,010	2,150	103,000	219,000	32964XUE1
	440	76	72	63	3	3	865	1,880	88,000	192,000	32964E1[2]
	480	100	100	74	5	4	1,520	2,940	155,000	300,000	32064XU
	580	104	92	75	5	5	1,660	2,580	170,000	263,000	30264
	580	159	150	125	5	5	2,620	4,650	267,000	470,000	32264
340	460	76	76	57	4	3	1,040	2,270	106,000	232,000	32968XUE1
	460	76	72	63	3	3	910	1,980	93,000	201,000	32968E1[2]
	520	112	106	90	5	5	1,650	3,150	169,000	320,000	32068
360	480	76	76	57	4	3	1,050	2,330	107,000	238,000	32972XUE1
	540	112	106	90	5	5	1,740	3,300	178,000	340,000	32072
380	520	87	82	72	4	4	1,140	2,500	116,000	255,000	32976
	560	112	106	90	5	5	1,920	3,800	196,000	390,000	32076

[1] Minimal allowable dimension for chamfer dimension r or r_1. [2] This bearing does not incorporate the subunit dimensions.

Single Row Tapered Roller Bearings



Equivalent bearing load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

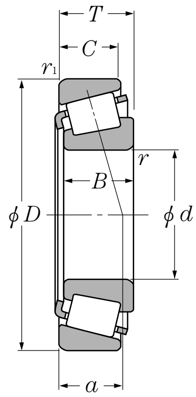
$P_{or} = 0.5F_r + Y_o F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions (mm) d_a min	d_b max	D_a max	D_a min	D_b min	S_a min	S_b min	r_{as} max	r_{1as} max	Load center (mm) a	Constant e	Axial load factors Y_2	Y_o	Mass (kg) (approx.)
254	254	308	290	311	10	12	2.5	2	65.5	0.46	1.31	0.72	10.9
258	261	346	318	346	12	19	3	2.5	78	0.46	1.31	0.72	26.8
258	290	422	368	408	3.9	19	3	3	91	0.49	1.23	0.68	47.7
258	277.5	422	365	421.5	4.1	27	3	3	107	0.43	1.39	0.77	78.8
262	301	478	417	456	8.1	25	4	4	94	0.37	1.60	0.88	87.2
262	291	478	402	467	1.5	33	4	4	120.5	0.37	1.60	0.88	141.9
274	279	348	325	347	11	15	2.5	2	69.5	0.41	1.48	0.81	18.8
282	287	382	352	383	14	22	4	3	85.5	0.43	1.38	0.76	39.4
282	312	458	396	438.5	4.2	22	4	4	99.5	0.49	1.23	0.68	63.4
282	302	458	385	453	2.9	31	4	4	121.5	0.49	1.23	0.68	103.6
294	298	368	344	368	11	15	2.5	2	75	0.43	1.39	0.76	20
302	305	402	370	402	14	22	4	3	90.5	0.46	1.31	0.72	41.8
302	331	478	422	464.5	5.9	22	4	4	102	0.49	1.23	0.68	66.6
302	318	478	405	473	6.4	31	4	4	123.5	0.49	1.23	0.68	110
308	340.5	552	469.5	540.5	3.4	42	5	5	137.5	0.37	1.60	0.88	222
318	324	406	379	405	13	19	3	2.5	80	0.39	1.52	0.84	31.4
322	329	442	404	439	15	26	4	3	98	0.43	1.38	0.76	57.2
322	356	518	453	498	4.9	25	4	4	111	0.49	1.23	0.68	84.3
322	345	518	438	511.5	2.6	34	4	4	135.5	0.49	1.23	0.68	138.7
338	344	426	398	426	13	19	3	2.5	85	0.42	1.44	0.79	33.1
338	344	426	398	425	13	13	3	2.5	85	0.39	1.55	0.85	33.2
342	344.5	462	418.5	463	15	26	4	3	104	0.46	1.31	0.72	60.2
342	379	558	485	531.5	4.7	29	4	4	118.5	0.47	1.27	0.70	103.9
342	369	558	473	551	3.9	34	4	4	142	0.47	1.27	0.70	172.1
358	362	446	417	446	13	19	3	2.5	90.5	0.44	1.37	0.75	34.9
358	362	446	414	445.5	13	13	3	2.5	87	0.39	1.55	0.85	36
362	374	498	452	496	3.5	22	4	4	103.5	0.37	1.60	0.88	78.7
378	381	466	436	466	13	19	3	2.5	96.5	0.46	1.31	0.72	36.6
382	393.5	518	476	519	5.5	22	4	4	106	0.37	1.60	0.88	83.7
398	408	502	464.5	503	4	15	3	3	101	0.40	1.49	0.82	51.3
402	412.5	538	495	539	6.5	22	4	4	109.5	0.37	1.60	0.88	89.3

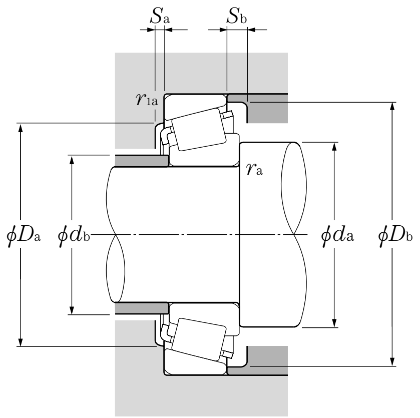
Metric system sizes



d 400～850mm

	Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	*D*	*T*	*B*	*C*	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
400	540	87	82	71	4	4	1,200	2,710	122,000	276,000	32980
	600	125	118	100	5	5	2,180	4,250	222,000	435,000	32080
420	560	87	82	71	4	4	1,230	2,840	125,000	290,000	32984
	620	125	118	100	6	5	2,280	4,550	233,000	465,000	32084
440	600	100	95	82	4	4	1,600	3,450	164,000	355,000	32988
	650	130	122	104	6	6	2,530	5,000	258,000	510,000	32088
500	640	87.36	82	72	4	4	1,330	3,300	141,000	335,000	CR-10010
	750	150	140	120	7.5	7.5	3,100	6,950	315,000	705,000	☆CR-10024
530	670	100	95	82	5	5	1,540	3,800	157,000	385,000	CR-10601
570	695	57	52	50	3	2.5	865	2,080	88,000	212,000	CR-11402
600	870	118	111	93	6	6	2,870	5,700	292,000	580,000	CR-12006
720	880	80	75	60	5	5	1,300	3,450	132,000	350,000	CR-14403
740	900	80	75	65	5	5	1,370	3,700	140,000	375,000	CR-14803
750	1,000	110	107	80	6	6	2,620	5,800	267,000	590,000	CR-15002
780	925	95	92	75	5	5	2,120	6,600	216,000	675,000	CR-15602
850	1,120	118	112	80	6	6	2,880	7,100	294,000	720,000	CR-17001

❶ Minimal allowable dimension for chamfer dimension *r* or r_1. ❷ This bearing does not incorporate the subunit dimensions.
Remarks: 1. Bearing numbers marked ☆ designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

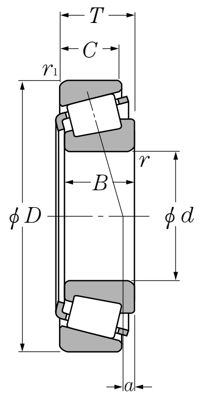
$P_{or} = 0.5F_r + Y_oF_a$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm									Load center mm	Constant	Axial load factors		Mass kg
d_a min	d_b max	D_a max	D_a min	D_b min	S_a min	S_b min	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
418	427	522	482	521.5	4	16	3	3	106	0.42	1.43	0.79	54
422	434.5	578	526	575	5	25	4	4	119	0.37	1.60	0.88	115
438	445.5	542	501.5	543	3.5	16	3	3	111.5	0.44	1.37	0.76	56.6
422	455.5	598	549	598	6.5	25	4	4	120	0.37	1.60	0.88	121
458	472.5	582	543	580.5	3.5	18	3	3	106	0.35	1.70	0.93	76
468	475	622	576.5	627.5	5	26	5	5	127	0.37	1.60	0.88	136
518	523.5	622	584.5	627.5	3.5	15	3	3	125	0.45	1.34	0.74	64.3
536	566.5	714	658.5	722.5	1.5	30	6	6	154	0.41	1.48	0.81	224
552	552	648	616.5	653	1.5	18	4	4	111	0.33	1.80	0.99	76.2
584	598.5	683	652.5	675.5	5	7	2.5	2	102.5	0.36	1.67	0.92	41.7
628	656	842	782.5	828	1.5	25	5	5	147	0.37	1.60	0.88	208
742	757	858	818	853.5	5.5	20	4	4	158.5	0.46	1.31	0.72	94
762	775.5	878	839	877.5	5	15	4	4	159	0.46	1.31	0.72	96
778	801.5	972	915	954	7	30	5	5	155	0.37	1.60	0.88	210
802	810	903	873.5	907	9.5	20	4	4	137.5	0.33	1.80	0.99	115
878	920.5	1,092	1,026.5	1,063	8.5	38	5	5	154.5	0.33	1.80	0.99	276

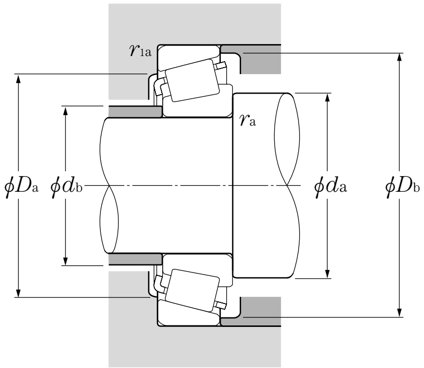
Inch system sizes



d 114.300～174.625mm

d	Boundary dimensions mm D	T	B	C	Basic load ratings dynamic kN C_r	static kN C_{or}	dynamic kgf C_r	static kgf C_{or}
114.300	273.050	82.550	82.550	53.975	760	975	77,500	99,500
	279.400	82.550	82.550	53.975	760	975	77,500	99,500
120.650	273.050	82.550	82.550	53.975	760	975	77,500	99,500
127.000	295.275	82.550	87.312	57.150	880	1,190	89,500	122,000
	304.800	88.900	82.550	57.150	820	1,120	83,500	115,000
139.700	288.925	82.550	87.312	57.150	880	1,190	89,500	122,000
	295.275	82.550	87.312	57.150	880	1,190	89,500	122,000
	307.975	88.900	93.662	66.675	1,010	1,390	103,000	142,000
146.050	304.800	88.900	82.550	57.150	820	1,120	83,500	115,000
	311.150	88.900	82.550	57.150	820	1,120	83,500	115,000
152.400	307.975	88.900	93.662	61.912	880	1,310	89,500	133,000
	307.975	88.900	93.662	66.675	1,010	1,390	103,000	142,000
155.575	330.200	85.725	79.375	53.975	875	1,260	89,000	129,000
	342.900	85.725	79.375	53.975	875	1,260	89,000	129,000
158.750	304.800	66.675	69.106	42.862	540	780	55,000	79,500
160.325	288.925	63.500	63.500	47.625	680	1,070	69,000	109,000
161.925	374.650	87.312	79.375	60.325	845	1,140	86,500	117,000
165.100	288.925	63.500	63.500	47.625	550	950	56,000	97,000
	288.925	63.500	63.500	47.625	680	1,070	69,000	109,000
	311.150	82.550	82.550	65.088	925	1,480	94,500	151,000
	336.550	92.075	95.250	69.850	1,060	1,510	108,000	154,000
168.275	330.200	85.725	79.375	53.975	875	1,260	89,000	129,000
174.625	288.925	63.500	63.500	47.625	550	950	56,000	97,000
	288.925	63.500	63.500	47.625	680	1,070	69,000	109,000
	298.450	82.550	82.550	63.500	810	1,330	83,000	136,000
	311.150	82.550	82.550	63.500	810	1,330	83,000	136,000
	311.150	82.550	82.550	65.088	925	1,480	94,500	151,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

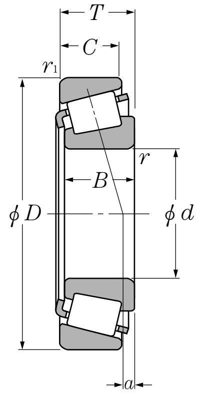
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_o F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load[1] center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
T-HH926744/HH926710	164	147	230	253	6.4	6.4	6.6	0.63	0.95	0.52	22.2
T-HH926744/HH926716	164	147	233	253	6.4	6.4	6.6	0.63	0.95	0.52	23.5
T-HH926749/HH926710	168	147	230	253	6.4	6.4	6.6	0.63	0.95	0.52	21.7
T-HH231637/HH231615	174	150	258	264	13.5	6.4	26.7	0.32	1.88	1.04	27.1
T-HH932132/HH932110	182	172	260	288	6.4	6.4	–1.9	0.73	0.82	0.45	32.8
T-HH231649/HH231610	177	161	255	264	9.7	6.4	26.7	0.32	1.88	1.04	24.4
T-HH231649/HH231615	177	161	258	264	9.7	6.4	26.7	0.32	1.88	1.04	25.8
T-HH234031/HH234010	180	168	276.1	285.5	9.7	6.8	26.7	0.33	1.84	1.01	30.9
T-HH932145/HH932110	195	174	260	288	6.4	6.4	–1.9	0.73	0.82	0.45	30.6
T-HH932145/HH932115	195	174	262	288	6.4	6.4	–1.9	0.73	0.82	0.45	32.2
T-EE450601/451212	189	177	269	275	9.7	6.8	28.2	0.33	1.84	1.01	29.4
T-HH234048/HH234010	191	179	276	285	9.7	6.8	26.4	0.33	1.84	1.01	29.4
T-H936340/H936310	209	193	282	311	6.4	6.4	–16.9	0.81	0.74	0.41	34.9
T-H936340/H936316	209	193	287	311	6.4	6.4	–16.9	0.81	0.74	0.41	38.4
EE280626/281200	192	180	279	282	6.4	3.3	12.5	0.36	1.67	0.92	20.8
T-HM237532/HM237510	192	181	266	271	7	3.3	11.6	0.32	1.88	1.04	16.0
EE117063/117148	207	197	322	341	6.4	3.3	–11.5	0.71	0.85	0.47	47.9
T-94649/94113	197	186	259	272	7	3.3	0.9	0.47	1.28	0.70	17.1
T-HM237535/HM237510	195	184	266	271	7	3.3	11.6	0.32	1.88	1.04	15.6
T-H238140/H238110	198	188	280	289	6.4	6.4	18.8	0.33	1.81	1.00	27.5
T-HH437549/HH437510	196	196	297	308	3.3	6.4	21.4	0.37	1.62	0.89	36.6
T-H936349/H936310	218	193	282	311.4	6.4	6.4	–16.9	0.81	0.74	0.41	33.2
T-94687/94113	204	193	259	272	7	3.3	0.9	0.47	1.28	0.70	14.7
T-HM237542/HM237510	202	191	266	271	7	3.3	11.6	0.32	1.88	1.04	14.7
T-EE219068/219117	204	193	269	282	6.4	6.4	15.3	0.38	1.59	0.87	21.1
T-EE219068/219122	204	193	275	282	6.4	6.4	15.3	0.38	1.59	0.87	23.9
T-H238148/H238110	205	195	280	289	6.4	6.4	18.8	0.33	1.81	1.00	23.9

[1] "–" means that load center at outside on end of inner ring.

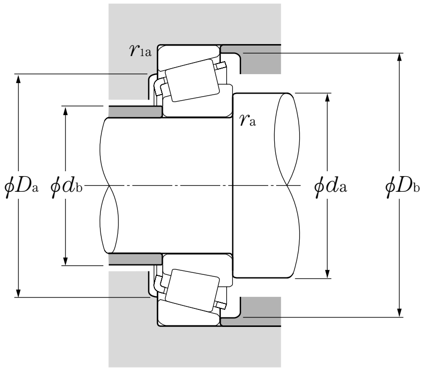
Inch system sizes



d 177.800～206.375mm

	Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
177.800	288.925	63.500	63.500	47.625	550	950	56,000	97,000
	288.925	63.500	63.500	47.625	680	1,070	69,000	109,000
	※289.974	63.500	63.500	48.000	680	1,070	69,000	109,000
	319.964	88.900	85.725	65.088	930	1,400	94,500	142,000
	428.625	106.362	95.250	61.912	1,190	1,610	122,000	165,000
※179.975	317.500	63.500	63.500	46.038	615	1,160	63,000	118,000
187.325	282.575	50.800	47.625	36.512	365	615	37,000	63,000
	319.964	88.900	85.725	65.088	925	1,400	94,500	142,000
	320.675	88.900	85.725	65.088	925	1,400	94,500	142,000
190.500	282.575	50.800	47.625	36.512	365	615	37,000	63,000
	317.500	63.500	63.500	46.038	615	1,160	63,000	118,000
	336.550	98.425	95.250	73.025	1,030	1,830	105,000	187,000
	365.049	92.075	88.897	63.500	975	1,600	99,500	164,000
	428.625	106.362	95.250	61.912	1,190	1,610	122,000	165,000
193.675	282.575	50.800	47.625	36.512	365	615	37,000	63,000
200.025	292.100	57.945	57.945	46.038	535	1,030	54,500	105,000
	317.500	63.500	63.500	46.038	615	1,160	63,000	118,000
	384.175	112.712	112.712	90.488	1,460	2,730	149,000	279,000
	393.700	111.125	111.125	84.138	1,340	2,020	137,000	206,000
203.200	276.225	42.862	42.862	34.133	340	690	35,000	70,500
	282.575	46.038	46.038	36.512	360	785	37,000	80,000
	292.100	57.945	57.945	46.038	535	1,030	54,500	105,000
	317.500	63.500	63.500	46.038	615	1,160	63,000	118,000
	346.075	79.375	80.962	60.325	900	1,460	92,000	149,000
	365.049	92.075	88.897	63.500	975	1,600	99,500	164,000
	406.400	92.075	85.725	57.150	960	1,480	98,000	151,000
	482.600	117.475	95.250	73.025	1,310	1,860	134,000	190,000
204.788	292.100	57.945	57.945	46.038	535	1,030	54,500	105,000
206.375	282.575	46.038	46.038	36.512	360	785	37,000	80,000
	336.550	98.425	100.012	77.788	1,110	2,030	113,000	207,000
	482.600	117.475	95.250	73.025	1,310	1,860	134,000	190,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

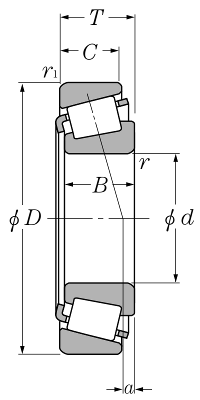
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$
For values of e, Y_2 and Y_0 see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load[1] center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_0	(approx.)
T-94700/94113	207	195	259	272	7	3.3	0.9	0.47	1.28	0.70	14.4
T-HM237545/HM237510	205	194	266	271	7	3.3	11.6	0.32	1.88	1.04	14.4
T-HM237545/HM237513	205	194	267	272	7	3	11.6	0.32	1.88	1.04	14.6
T-H239640/H239610	202	198	293	301	3.5	4.8	22.3	0.32	1.88	1.04	30.2
EE350701/351687	230	221	365	383	6.4	6.4	–13.8	0.76	0.79	0.43	77.7
T-93708/93125	209	204	286	300	3.5	3.3	–7.9	0.52	1.15	0.63	19.0
T-87737/87111	207	201	261	267	3.5	3.3	–3.8	0.42	1.44	0.79	10.9
T-H239649/H239610	214	205	293	301	5.5	4.8	22.3	0.32	1.88	1.04	28.7
T-H239649/H239612	214	205	293	301	5.5	4.8	22.3	0.32	1.88	1.04	28.9
T-87750/87111	209	203	261	267	3.5	3.3	–3.8	0.42	1.44	0.79	10.6
T-93750/93125	218	212	286	300	4.3	3.3	–7.9	0.52	1.15	0.63	17.9
T-HH840249/HH840210	234	216	290	318	6.4	6.4	5.4	0.58	1.04	0.57	36.4
T-EE420751/421437	227	218	329	334	6.4	3.3	15.4	0.40	1.49	0.82	42.9
EE350750/351687	240	237	365	383	6.4	6.4	–13.9	0.76	0.79	0.43	75.3
T-87762/87111	211	206	261	267	3.5	3.3	–3.8	0.42	1.44	0.79	10.3
T-M241543/M241510	219	215	272	279	3.5	3.3	4.7	0.33	1.80	0.99	11.5
T-93787/93125	225	219	286	300	4.3	3.3	–7.9	0.52	1.15	0.63	18.3
T-H247535/H247510	241	231	346	362	6.4	6.4	28.1	0.33	1.80	0.99	53.0
HH144642/HH144614	235	226	352	357	6.4	6.4	35.1	0.30	2.01	1.11	55.9
LM241149/LM241110	220	214.1	260	267	3.5	3.3	–2.1	0.32	1.88	1.04	6.56
T-67983/67920	222	216	260	275	3.5	3.3	–15.9	0.51	1.18	0.65	7.76
T-M241547/M241510	221	217	272	279	3.5	3.3	4.7	0.33	1.80	0.99	11.2
T-93800/93125	227	222	286	300	4.3	3.3	–7.9	0.52	1.15	0.63	16.5
T-HM542948/HM542911	224	224	315	322	1.5	3.3	9	0.39	1.55	0.85	28.8
T-EE420801/421437	230	227	329	334.4	3.3	3.3	15.4	0.40	1.49	0.82	40.7
EE114080/114160	246	237	349	374	6.4	6.4	–27.9	0.80	0.75	0.41	54.8
☆T-EE380080/380190G2	262	256	402	428	6.4	6.4	–34.3	0.87	0.69	0.38	108
T-M241549/M241510	223	219	272	279	3.5	3.3	4.7	0.33	1.80	0.99	11.0
T-67985/67920	224	219	260	275	3.5	3.3	–15.9	0.51	1.18	0.65	8.4
T-H242649/H242610	231	227	306	318	3.3	3.3	25.4	0.33	1.80	0.99	32.1
☆T-EE380081/380190G2	264	258	402	428	6.4	6.4	–34.3	0.87	0.69	0.38	107

[1] "–" means that load center at outside on end of inner ring.

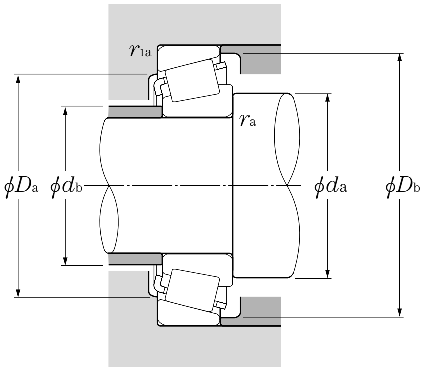
Inch system sizes



d 209.550～237.330mm

Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	*D*	*T*	*B*	*C*	C_r	C_{or}	C_r	C_{or}
209.550	282.575	46.038	46.038	36.512	360	785	37,000	80,000
	317.500	63.500	63.500	46.038	615	1,160	63,000	118,000
212.725	285.750	46.038	46.038	34.925	380	820	38,500	83,500
215.900	285.750	46.038	46.038	34.925	380	820	38,500	83,500
	290.010	31.750	31.750	22.225	206	405	21,100	41,000
216.408	285.750	46.038	49.212	34.925	380	820	38,500	83,500
220.662	314.325	61.912	61.912	49.212	625	1,220	63,500	125,000
228.397	431.800	92.075	85.725	49.212	855	1,240	87,000	126,000
228.460	431.800	92.075	85.725	49.212	855	1,240	87,000	126,000
228.600	300.038	33.338	31.750	23.812	215	435	22,000	44,500
	327.025	52.388	52.388	36.512	475	950	48,500	97,000
	355.600	68.262	66.675	47.625	640	1,270	65,500	130,000
	355.600	69.850	69.850	49.212	715	1,260	73,000	128,000
	355.600	69.850	69.850	50.800	720	1,240	73,500	127,000
	358.775	71.438	71.438	53.975	815	1,640	83,000	168,000
	400.050	88.900	87.312	63.500	945	1,620	96,500	166,000
	488.950	123.825	111.125	73.025	1,570	2,260	161,000	231,000
231.775	300.038	33.338	31.750	23.812	215	435	22,000	44,500
	336.550	65.088	65.088	50.800	710	1,410	72,500	144,000
	358.775	71.438	71.438	53.975	815	1,640	83,000	168,000
234.950	311.150	46.038	46.038	33.338	405	820	41,500	83,500
	314.325	49.212	49.212	36.512	470	935	48,000	95,500
	327.025	52.388	52.388	36.512	475	950	48,500	97,000
	355.600	68.262	66.675	47.625	640	1,270	65,500	130,000
	381.000	74.612	74.612	57.150	885	1,790	90,500	183,000
	384.175	112.712	112.712	90.488	1,460	2,730	149,000	279,000
237.330	336.550	65.088	65.088	50.800	710	1,410	72,500	144,000
	358.775	71.438	71.438	53.975	815	1,640	83,000	168,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

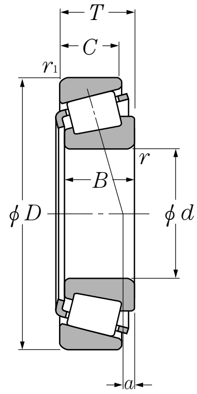
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load❶ center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
T-67989/67920	227	221	260	275	3.5	3.3	–15.9	0.51	1.18	0.65	7.23
T-93825/93125	233	227	286	300	4.3	3.3	–7.9	0.52	1.15	0.63	15.8
T-LM742745/LM742710	230	225	266	279	3.5	3.3	–14.2	0.48	1.25	0.69	7.33
T-LM742749/LM742710	233	227	266	279	3.5	3.3	–14.2	0.48	1.25	0.69	7.05
543085/543114	232	226	272	276	3.5	3.3	–12.5	0.38	1.58	0.87	5.20
T-LM742747/LM742710	233	227	266	279	3.5	3.3	–14.2	0.48	1.25	0.69	7.40
T-M244249/M244210	245	235	293	300	6.4	3.3	4.4	0.33	1.80	0.99	13.6
EE113089/113170	274	267	375	397	6.4	6.4	–40.3	0.88	0.68	0.37	59.4
EE113091/113170	274	267	375	397	6.4	6.4	–40.3	0.88	0.68	0.37	59.4
T-544090/544118	244	240	282	287	3.5	3.3	–15.8	0.40	1.49	0.82	6.05
T-8573/8520	255	244	305	313	6.4	3.3	–7.8	0.41	1.48	0.81	12.5
T-96900/96140	260	249	318	334	7	3.3	–16.9	0.59	1.02	0.56	24.3
T-EE130902/131400	257	247	329	330	6.8	1.5	9.9	0.33	1.82	1.00	22.7
HM746646/HM746610	258	248	324	338.7	6.4	6.4	–6	0.47	1.27	0.70	22.7
T-M249732/M249710	256	251	335	343	3.5	3.3	6.9	0.33	1.80	0.99	23.9
EE430900/431575	271	253	360	364	10.5	3.3	2.8	0.44	1.36	0.75	46.0
☆T-HH949549/HH949510G2	297	280	416	456	6.4	6.4	–39.9	0.94	0.64	0.35	111
T-544091/544118	247	243	282	287	3.5	3.3	–15.8	0.40	1.49	0.82	5.81
T-M246942/M246910	258	249	313	322	6.4	3.3	4.7	0.33	1.80	0.99	16.9
T-M249734/M249710	263	254	335	343	6.4	3.3	6.9	0.33	1.80	0.99	23.4
LM446349/LM446310	252	246	294	301	3.5	3.3	–6.6	0.36	1.66	0.91	8.38
T-LM545849/LM545810	252	246	296	306	3.5	3.3	–8.4	0.40	1.51	0.83	9.38
T-8575/8520	259	248	305	313	6.4	3.3	–7.8	0.41	1.48	0.81	11.9
T-96925/96140	265	254	318	334	7	3.3	–16.9	0.59	1.02	0.56	22.5
T-M252330/M252310	271	261	356	364	6.4	3.3	6.2	0.33	1.80	0.99	29.3
T-H247549/H247510	269	259	346	362	6.4	6.4	28.1	0.33	1.80	0.99	45.5
T-M246949/M246910	262	253	313	322	6.4	3.3	4.7	0.33	1.80	0.99	16.2
T-M249736/M249710	267	258	335	343	6.4	3.3	6.9	0.33	1.80	0.99	22.6

❶ "－" means that load center at outside on end of inner ring.

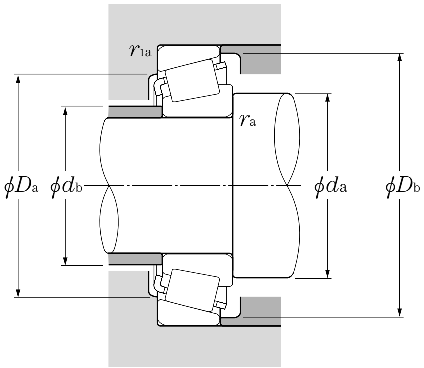
Inch system sizes



d 241.300～266.700mm

	Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
241.300	327.025	52.388	52.388	36.512	475	950	48,500	97,000
	349.148	57.150	57.150	44.450	550	1,000	56,000	103,000
	368.300	50.800	50.800	33.338	460	810	47,000	83,000
	393.700	73.817	69.850	50.005	780	1,400	79,500	143,000
	444.500	101.600	100.012	76.200	1,390	2,120	142,000	216,000
244.475	381.000	79.375	76.200	57.150	755	1,440	77,000	147,000
247.650	346.075	63.500	63.500	50.800	720	1,450	73,500	148,000
	368.300	50.800	50.800	33.338	460	815	47,000	83,000
	381.000	74.612	74.612	57.150	885	1,790	90,500	183,000
	406.400	115.888	117.475	93.662	1,650	3,000	168,000	305,000
249.250	381.000	79.375	76.200	57.150	755	1,440	77,000	147,000
254.000	323.850	22.225	22.225	15.875	126	315	12,800	32,500
	358.775	71.438	71.438	53.975	815	1,640	83,000	168,000
	365.125	58.738	58.738	42.862	615	1,190	62,500	122,000
	393.700	73.817	69.850	50.005	780	1,400	79,500	143,000
	422.275	86.121	79.771	66.675	1,160	1,800	119,000	184,000
	533.400	133.350	120.650	77.788	1,680	2,610	171,000	266,000
257.175	342.900	57.150	57.150	44.450	580	1,270	59,000	130,000
	342.900	57.150	57.150	44.450	580	1,270	59,000	130,000
260.350	365.125	58.738	58.738	42.862	615	1,190	62,500	122,000
	400.050	69.850	67.470	46.038	710	1,230	72,500	126,000
	419.100	85.725	84.138	61.912	925	1,610	94,000	165,000
	422.275	86.121	79.771	66.675	1,160	1,800	119,000	184,000
	488.950	120.650	120.650	92.075	1,760	2,970	180,000	305,000
263.525	325.438	28.575	28.575	25.400	211	520	21,600	53,000
	355.600	57.150	57.150	44.450	625	1,330	64,000	136,000
266.700	323.850	22.225	22.225	15.875	126	315	12,800	32,500
	325.438	28.575	28.575	25.400	211	520	21,600	53,000
	355.600	57.150	57.150	44.450	625	1,340	54,000	136,000
	355.600	57.150	57.150	44.450	500	995	51,000	101,000
	393.700	73.817	69.850	50.005	780	1,400	79,500	143,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

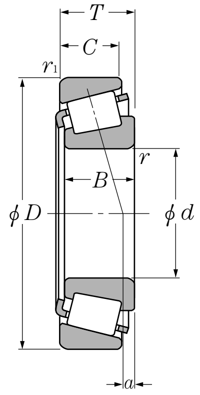
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load❶ center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
T-8578/8520	264	253	305	313	6.4	3.3	–7.8	0.41	1.48	0.81	11.2
EE127095/127135	267	257	325	329	6.4	3.3	–3.2	0.35	1.70	0.93	15.9
EE170950/171450	269	260	340	337	6.4	3.3	–6.2	0.36	1.65	0.90	17.2
T-EE275095/275155	278	268	366	378	6.4	6.4	–2.5	0.40	1.49	0.82	34.3
☆T-EE923095/923175G2	277	268	403	407	6.4	4.8	19.3	0.34	1.78	0.98	68.0
EE126097/126150	275	266	343	358	6.4	4.8	–8	0.52	1.16	0.64	32.6
T-M348449/M348410	273	263	321	332	6.4	6.4	1.3	0.34	1.75	0.96	16.2
EE170975/171450	274	264	340	337	6.4	3.3	–6.2	0.36	1.65	0.90	16.5
T-M252337/M252310	280	271	356	364	6.4	3.3	6.2	0.33	1.80	0.99	27.3
HH249949/HH249910	284	275	366	383	6.4	6.4	28.9	0.33	1.80	0.99	55.6
EE126098/126150	279	269	343	358	6.4	4.8	–8	0.52	1.16	0.64	31.7
29875/29820	267	266	310	312	1.5	1.5	–21.1	0.35	1.73	0.95	3.92
T-M249749/M249710	274	270	335	343	3.5	3.3	–6.9	0.33	1.80	0.99	20.1
T-EE134100/134143	281	272	339	347	6.4	6.4	–5	0.37	1.60	0.88	17.7
T-EE275100/275155	287	277	366	378	6.4	6.4	–2.5	0.40	1.49	0.82	32.1
T-HM252343/HM252310	287	281	392	400	6.8	3.3	9.3	0.33	1.80	0.99	47.1
HH953749/HH953710	328	306.3	455	496	6.4	6.4	–44.7	0.94	0.64	0.35	141
M349549/M349510	281	269	322	333	6.4	3.3	–2.5	0.35	1.73	0.95	12.9
M349549A/M349510	289	269	322	333	10.7	3.3	–2.5	0.35	1.73	0.95	12.9
T-EE134102/134143	286	276	339	347	6.4	6.4	–5	0.37	1.60	0.88	16.8
EE221026/221575	296	280	366	372	9.7	6.4	–1.8	0.39	1.52	0.84	27.0
EE435102/435165	295	285	376	395	6.4	3.3	–20.7	0.61	0.99	0.54	44.4
T-HM252348/HM252310	292	285	392	400	6.8	3.3	9.3	0.33	1.80	0.99	45.7
EE295102/295193	299	290	444	451	6.4	6.4	28.7	0.31	1.92	1.06	90.3
T-38880/38820	275	275	312	315	1.5	1.5	–20.5	0.37	1.64	0.90	4.56
T-LM451345/LM451310	283	279	335	343	3.5	3.3	–4.7	0.36	1.67	0.92	14.2
29880/29820	277	275	310	312	1.5	1.5	–21.1	0.35	1.73	0.95	3.28
T-38885/38820	277	277	312	315	1.5	1.5	–20.5	0.37	1.64	0.90	4.35
T-LM451349/LM451310	285	281	335	343	3.5	3.3	–4.7	0.36	1.67	0.92	15.0
T-LM451349A/LM451310	299	281	335	343	10.5	3.3	–4.7	0.36	1.67	0.92	13.8
T-EE275105/275155	296	287	366	378	6.4	6.4	–2.5	0.40	1.49	0.82	29.7

❶ "−" means that load center at outside on end of inner ring.

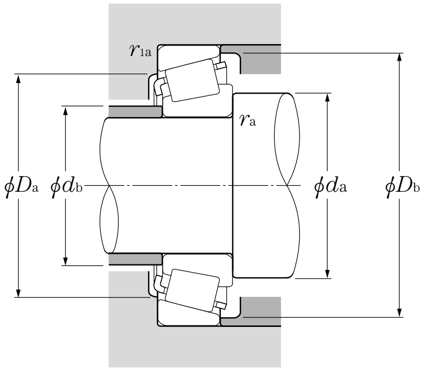
Inch system sizes



d 266.700～304.800mm

Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
266.700	444.500	120.650	117.475	88.900	1,570	3,050	160,000	310,000
269.875	381.000	74.612	74.612	57.150	885	1,790	90,500	183,000
273.050	393.700	73.817	69.850	50.005	780	1,400	79,500	143,000
276.225	352.425	36.512	34.925	23.812	295	605	30,000	61,500
279.400	374.650	47.625	47.625	34.925	470	1,010	48,000	103,000
	469.900	95.250	93.662	69.850	1,180	2,170	121,000	222,000
	488.950	120.650	120.650	92.075	1,760	2,970	180,000	305,000
279.982	380.898	65.088	65.088	49.212	660	1,550	67,500	159,000
280.000	406.400	69.850	67.673	53.975	760	1,550	77,500	158,000
280.192	406.400	69.850	67.673	53.975	760	1,550	77,500	158,000
285.750	358.775	33.338	31.750	22.225	263	540	26,900	55,000
	380.898	65.088	65.088	49.212	660	1,550	67,500	159,000
288.925	406.400	77.788	77.788	60.325	1,010	2,080	103,000	212,000
292.100	374.650	47.625	47.625	34.925	470	1,010	48,000	103,000
	469.900	95.250	93.662	69.850	1,180	2,170	121,000	222,000
	558.800	136.525	136.525	98.425	1,950	3,800	199,000	385,000
298.450	444.500	63.500	61.912	39.688	630	1,150	64,000	117,000
※299.974	495.300	141.288	141.288	114.300	2,440	4,900	249,000	500,000
300.038	422.275	82.550	82.550	63.500	1,130	2,400	116,000	245,000
304.800	393.700	50.800	50.800	38.100	485	1,030	49,500	105,000
	406.400	63.500	63.500	47.625	700	1,580	71,500	161,000
	438.048	76.200	76.992	53.975	805	1,590	82,000	163,000
	444.500	63.500	61.912	39.688	630	1,150	64,000	117,000
	495.300	76.200	74.612	53.975	1,140	1,940	116,000	198,000
	495.300	95.250	92.075	69.850	1,230	2,350	126,000	240,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

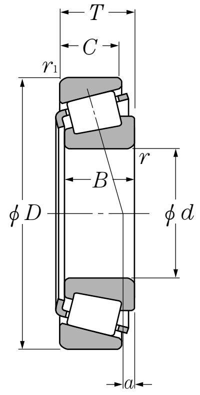
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load[1] center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
H852849/H852810	315	297	390	422	6.4	0.6	0.3	0.58	1.04	0.57	73.3
T-M252349/M252310	296	287	356	364	6.4	3.3	6.2	0.33	1.80	0.99	25.4
T-EE275108/275155	301	291	366	378	6.4	6.4	–2.5	0.40	1.49	0.82	28.5
L853049/L853010	293	288	332	342	3.5	3.3	–34.8	0.54	1.12	0.62	8.40
L555233/L555210	300	296	355	362	3.5	3.3	–17	0.40	1.49	0.82	13.0
EE722110/722185	321	314	430	433	9.7	3.3	6.3	0.38	1.58	0.87	65.3
EE295110/295193	303	304	444	451	1.3	6.4	28.7	0.31	1.92	1.06	84.9
T-LM654642/LM654610	302	298	356	368	3.5	3.3	–11.5	0.43	1.39	0.76	19.0
EE128112/128160	308	307	378	384	6.4	3.3	–4.4	0.39	1.56	0.86	29.1
EE128111/128160	309	307	378	384	6.8	3.3	–4.4	0.39	1.56	0.86	29.1
545112/545141A	302	298	340	345	3.5	3.3	–33.9	0.49	1.22	0.67	7.54
T-LM654649/LM654610	306	302	356	368	3.5	3.3	–11.5	0.43	1.39	0.76	18.0
M255449/M255410A	316	310	379	388	6.4	3.3	4.1	0.34	1.78	0.98	27.8
L555249/L555210	309	305	355	362	3.5	3.3	–17	0.40	1.49	0.82	11.5
EE722115/722185	330	324	430	433	9.7	3.3	6.3	0.38	1.58	0.87	62.0
EE790114/790221	335	329	501	513	6.4	6.4	23.8	0.39	1.52	0.84	135
EE291175/291750	332	320	416	415	8	1.5	–9.1	0.38	1.58	0.87	33.1
☆HH258248/HH258210G2	342	332	448	467	6.4	6.4	35.4	0.33	1.80	0.99	96.0
☆T-HM256849/HM256810G2	328	319	394	403	6.4	3.3	5.7	0.34	1.78	0.98	31.9
L357049/L357010	329	319	374	380	6.4	3.3	–12.5	0.36	1.67	0.92	13.8
T-LM757049/LM757010	331	322	380	393	6.4	3.3	–16.3	0.44	1.36	0.75	20.1
T-EE129120X/129172	334	328	406	411	6.4	4.8	–7.3	0.42	1.44	0.79	34.8
EE291201/291750	337	324	416	415	8	1.5	–9.1	0.38	1.58	0.87	31.9
EE941205/941950A	339	329	459	463	6.4	3.3	–10	0.40	1.49	0.82	55.8
EE724120/724195	359	330	450	459	16	6.4	0.9	0.40	1.49	0.82	69.7

❶ "—" means that load center at outside on end of inner ring.

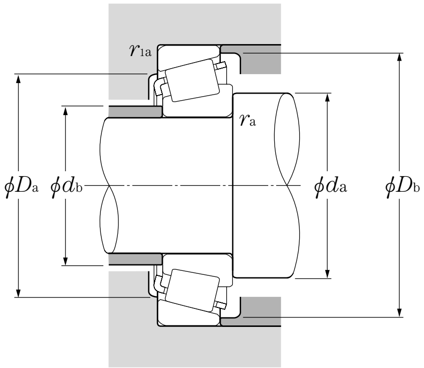
Inch system sizes



d 304.800～381.000mm

	Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
304.800	558.800	136.525	136.525	98.425	1,950	3,800	199,000	385,000
317.500	444.500	63.500	61.912	39.688	630	1,150	64,000	117,000
	447.675	85.725	85.725	68.262	1,160	2,390	118,000	244,000
	622.300	147.638	131.762	82.550	2,080	3,550	212,000	365,000
330.200	415.925	47.625	47.625	34.925	445	1,060	45,000	108,000
	415.925	47.625	47.625	34.925	445	1,060	45,000	108,000
	482.600	60.325	55.562	38.100	700	1,430	71,500	146,000
	482.600	85.725	80.167	60.325	955	1,970	97,500	201,000
333.375	469.900	90.488	90.488	71.438	1,350	2,760	138,000	282,000
342.900	450.850	66.675	66.675	52.388	785	1,780	80,000	182,000
	457.098	68.262	63.500	47.625	705	1,640	72,000	167,000
	533.400	76.200	76.200	50.800	1,070	1,730	109,000	176,000
346.075	482.600	60.325	55.562	38.100	700	1,430	71,500	146,000
	488.950	95.249	95.250	74.612	1,420	3,000	145,000	305,000
	488.950	95.250	95.250	74.612	1,480	3,200	151,000	325,000
349.250	501.650	90.488	84.138	69.850	1,190	2,280	122,000	233,000
355.600	444.500	60.325	60.325	47.625	655	1,740	67,000	177,000
	469.900	60.325	55.562	38.100	700	1,430	71,500	146,000
	482.600	60.325	55.562	38.100	700	1,430	71,500	146,000
	501.650	74.612	66.675	50.800	900	1,830	92,000	187,000
	501.650	90.488	84.138	69.850	1,190	2,280	122,000	233,000
361.950	406.400	23.812	23.812	17.462	173	470	17,600	48,000
368.249	523.875	101.600	101.600	79.375	1,520	3,250	155,000	335,000
371.475	501.650	74.612	66.675	50.800	900	1,830	92,000	187,000
374.650	522.288	85.725	84.138	61.912	1,060	2,270	108,000	232,000
381.000	479.425	49.212	47.625	34.925	540	1,270	55,500	130,000
	508.000	63.500	58.738	38.100	540	1,130	55,000	116,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

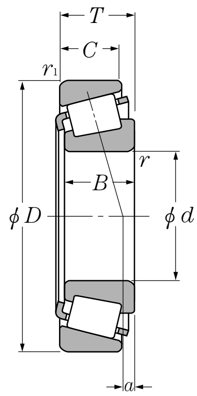
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load center[1] mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
EE790120/790221	335	335	501	513	1.3	6.4	23.8	0.39	1.52	0.84	131
EE291250/291750	346	334	416	415	8	1.5	–9.1	0.38	1.58	0.87	29.5
T-HM259048/HM259010	341	337	418	428	3.5	3.3	4.8	0.33	1.79	0.99	37.3
☆H961649/H961610G2	410	373	531	582	14.3	12.7	–60.7	0.95	0.63	0.35	203
T-L860048/L860010	367	345	394	402	12.7	3.3	–35.4	0.50	1.20	0.66	13.3
T-L860049/L860010	349	345	394	402	3.5	3.3	–35.4	0.50	1.20	0.66	13.3
T-EE161300/161900	367	356	451	455	7	6.4	–33.6	0.50	1.20	0.66	35.9
EE526130/526190	360	351	449	454	6.4	3.3	–2.8	0.39	1.53	0.84	51.0
HM261049/HM261010A	363	357	439	449	6.4	3.3	5.4	0.33	1.79	0.99	43.4
LM361649/LM361610	373	360	425	435	8.5	3.5	–8.7	0.35	1.71	0.94	25.0
LM961548/LM961511	367	363	423	443	3.3	3.3	–53.6	0.71	0.84	0.46	30.0
EE971354/972100	373	367	501	501	4.8	3.3	–2.5	0.33	1.80	0.99	55.6
T-EE161363/161900	379	368	451	455	7	6.4	–33.6	0.50	1.20	0.66	32.8
T-HM262748/HM262710	377	367	456	467	6.4	3.3	6.4	0.33	1.79	0.99	52.5
☆T-HM262749/HM262710G2	377	367	456	467	6.4	3.3	6.4	0.33	1.79	0.99	49.7
EE333137/333197	382	372	470	478	6.4	3.3	–1.9	0.36	1.65	0.90	56.4
T-L163149/L163110	374	370	422	430	3.5	3.3	–7.2	0.31	1.95	1.07	18.8
T-EE161400/161850	386	375	445	455	7	6.4	–33.6	0.50	1.20	0.66	27.3
T-EE161400/161900	386	375	451	455	7	6.4	–33.6	0.50	1.20	0.66	30.8
T-EE231400/231975	388	379	472	481	6.4	3.3	–19.8	0.44	1.36	0.75	44.9
EE333140/333197	387	377	470	483	6.4	3.3	–1.9	0.36	1.65	0.90	50.8
LL562749/LL562710	372	371	396	401	2.3	1.5	–38.3	0.40	1.49	0.82	3.56
☆HM265049/HM265010G2	400	394	487	499	6.4	6.4	8	0.33	1.80	0.99	61.7
T-EE231462/231975	400	390	472	481	6.4	3.3	–19.8	0.44	1.36	0.75	40.7
LM565943/LM565910	407	397	493	500	6.4	3.3	–7.6	0.39	1.56	0.86	54.5
L865547/L865512	407	395	456	465	6.4	3.3	–42.4	0.49	1.21	0.67	20.0
EE192150/192200	410	400	478	482	6.4	3.3	–40.6	0.53	1.13	0.62	34.4

[1] "−" means that load center at outside on end of inner ring.

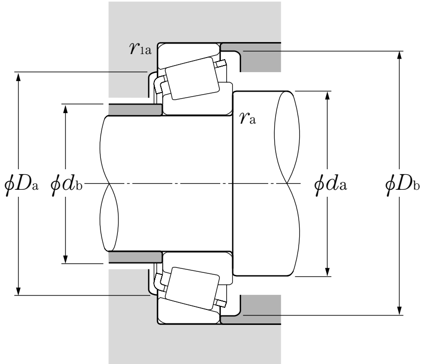
Inch system sizes



d 381.000～457.200mm

	Boundary dimensions				Basic load ratings			
	mm				dynamic kN	static kN	dynamic kgf	static kgf
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
381.000	522.288	85.725	84.138	61.912	1,060	2,270	108,000	232,000
	523.875	85.725	84.138	61.912	1,060	2,270	108,000	232,000
	546.100	104.775	104.775	82.550	1,720	3,700	176,000	375,000
	546.100	104.775	104.775	82.550	1,840	4,000	188,000	410,000
	590.550	114.300	114.300	88.900	2,140	4,700	218,000	480,000
384.175	441.325	28.575	28.575	20.638	246	655	25,100	66,500
	546.100	104.775	104.775	82.550	1,720	3,700	176,000	375,000
	546.100	104.775	104.775	82.550	1,840	4,000	188,000	410,000
385.762	514.350	82.550	82.550	63.500	1,230	2,780	126,000	283,000
387.248	546.100	87.312	87.312	68.262	1,390	3,150	142,000	325,000
396.875	546.100	76.200	61.120	55.562	775	1,640	79,500	167,000
403.225	460.375	28.575	28.575	20.638	206	600	21,000	61,500
406.400	508.000	61.912	61.912	47.625	660	1,690	67,500	172,000
	546.100	76.200	61.120	55.562	775	1,640	79,500	167,000
	549.275	85.725	84.138	61.912	1,320	2,920	135,000	298,000
	590.550	107.950	107.950	80.962	1,640	3,400	167,000	345,000
	609.600	92.075	84.138	60.325	1,260	2,400	129,000	245,000
409.575	546.100	87.312	87.312	68.262	1,350	3,050	137,000	310,000
415.925	590.550	114.300	114.300	88.900	2,140	4,700	218,000	480,000
431.800	533.400	46.038	46.038	34.925	555	1,310	56,500	134,000
	552.450	44.450	44.450	31.750	615	1,340	62,500	137,000
	571.500	74.612	74.612	52.388	1,090	2,470	112,000	252,000
	603.250	76.200	73.025	50.800	975	2,050	99,500	209,000
	673.100	88.900	87.833	60.325	1,490	2,670	152,000	272,000
447.675	552.450	44.450	44.450	31.750	615	1,340	62,500	137,000
	635.000	120.650	120.650	95.250	2,420	5,550	247,000	565,000
457.200	552.450	44.450	44.450	31.750	615	1,340	62,500	137,000
	573.088	74.612	74.612	57.150	1,000	2,680	103,000	274,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

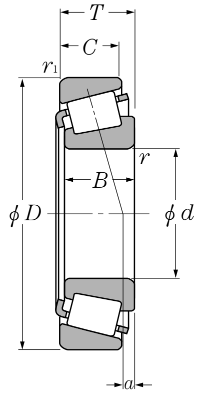
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions (mm)						Load[1] center (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
LM565949/LM565910	411	402	493	500	6.4	3.3	–7.6	0.39	1.56	0.86	52.5
LM565949/LM565912	411	402	493	500	6.4	3.3	–7.6	0.39	1.56	0.86	53.2
T-HM266446/HM266410	415	405	507	520	6.4	6.4	7.1	0.33	1.80	0.99	76.0
☆T-HM266447/HM266410G2	415	405	507	520	6.4	6.4	7.1	0.33	1.80	0.99	70.1
☆T-M268730/M268710G2	425	415	549	561	6.4	6.4	9.4	0.33	1.80	0.99	102
LL365348/LL365310	399	393	427	433	3.5	3.3	–30	0.34	1.77	0.97	5.89
T-HM266448/HM266410	417	407	507	519	6.4	6.4	7.1	0.33	1.80	0.99	69.0
☆T-HM266449/HM266410G2	417	407	507	519	6.4	6.4	7.1	0.33	1.80	0.99	69.0
LM665949/LM665910	415	406	482	495	6.4	3.3	–16.3	0.42	1.43	0.79	41.8
☆M667935/M667911G2	424	414	510	528	6.4	6.4	–16.2	0.42	1.43	0.79	56.6
EE234156/234215	428	418	504	516	6.4	6.4	–35.8	0.47	1.27	0.70	51.5
LL566848/LL566810	418	414	445	452	3.5	3.3	–41.5	0.40	1.49	0.82	6.17
L467549/L467510	426	423	483	492	3.3	3.3	–19.6	0.37	1.63	0.90	25.1
EE234160/234215	435	425	504	516	6.4	6.4	–35.8	0.47	1.27	0.70	48.7
LM567949/LM567910	437	427	519	525	6.4	3.3	–14.7	0.41	1.47	0.81	56.2
EE833160X/833232	448	435	549	561	9.7	6.4	8.5	0.33	1.84	1.01	86.6
EE911600/912400	443	439	567	570	6.8	6.4	–11.5	0.38	1.57	0.86	91.3
M667948/M667911	440	431	510	528	6.4	6.4	–16.2	0.42	1.43	0.79	49.8
☆T-M268749/M268710G2	451	441	549	561	6.4	6.4	9.4	0.33	1.80	0.99	87.8
T-80385/80325	450	446	510	510	3.3	3.3	–23.4	0.31	1.94	1.07	19.7
80170/80217	456	452	531	536	3.3	3.3	–27.5	0.32	1.88	1.04	23.1
T-LM869448/LM869410	457	453	537	549	3.3	3.3	–50.1	0.55	1.10	0.60	45.7
EE241701/242375	446	457	558	564	6.4	6.4	–46.5	0.53	1.14	0.63	64.9
EE571703/572650	472	466	630	632.6	6.4	3.3	–21.4	0.40	1.49	0.82	114
80176/80217	467	464	531	536	3.3	3.3	–27.5	0.32	1.88	1.04	20.4
☆M270749/M270710AG2	484	474	591	606	6.4	6.4	8.5	0.33	1.80	0.99	107
80180/80217	474	471	531	536	3.3	3.3	–27.5	0.32	1.88	1.04	18.7
L570649/L570610	485	475	543	558	6.4	6.4	–26.2	0.40	1.49	0.82	38.9

[1] "－" means that load center at outside on end of inner ring.

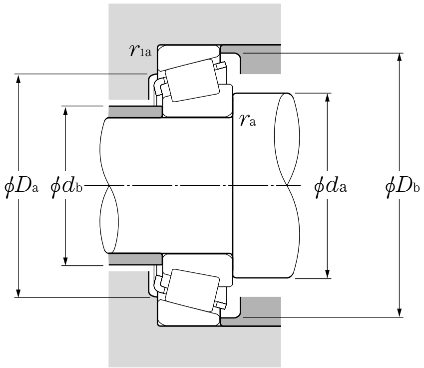
Inch system sizes



d 457.200～584.200mm

	Boundary dimensions				Basic load ratings			
	mm				dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	T	B	C	C_r	C_{or}	C_r	C_{or}
457.200	596.900	76.200	73.025	53.975	975	2,350	99,500	239,000
	603.250	85.725	84.138	60.325	1,140	2,680	116,000	274,000
	615.950	85.725	85.725	66.675	1,350	3,350	138,000	340,000
	730.148	120.650	114.300	82.550	2,540	4,350	259,000	445,000
476.250	565.150	41.275	41.275	31.750	405	1,200	41,500	122,000
479.425	679.450	128.588	128.588	101.600	2,850	6,500	290,000	660,000
482.600	615.950	85.725	85.725	66.675	1,350	3,350	138,000	340,000
	634.873	80.962	80.962	63.500	1,170	3,100	119,000	315,000
488.950	634.873	84.138	84.138	61.912	1,460	3,450	149,000	355,000
	660.400	93.662	94.458	69.850	1,830	4,000	186,000	410,000
489.026	634.873	80.962	80.962	63.500	1,170	3,100	119,000	315,000
498.475	634.873	80.962	80.962	63.500	1,170	3,100	119,000	315,000
501.650	711.200	136.525	136.525	106.362	2,940	6,850	300,000	695,000
508.000	838.200	146.050	139.700	104.775	3,150	6,400	325,000	655,000
533.400	635.000	50.800	50.800	38.100	695	1,680	71,000	171,000
536.575	761.873	146.050	146.050	114.300	3,450	7,600	350,000	775,000
539.750	635.000	50.800	50.800	38.100	695	1,680	71,000	171,000
549.275	692.150	80.962	80.962	61.912	1,350	3,500	138,000	355,000
558.800	736.600	76.200	76.200	50.800	1,200	2,690	122,000	275,000
	736.600	88.108	88.108	63.500	1,460	3,350	148,000	345,000
	736.600	104.775	104.775	80.962	1,850	4,400	189,000	450,000
571.500	812.800	155.575	155.575	120.650	4,050	9,150	415,000	935,000
584.200	685.800	49.212	49.212	34.925	705	1,930	72,000	197,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

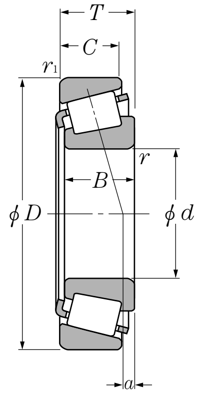
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_o F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load[1] center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
EE244180/244235	494	478	567	570	9.7	3.3	–27.1	0.40	1.48	0.82	53.9
LM770949/LM770910	489	479	570	579	6.4	3.3	–29.7	0.46	1.32	0.72	63.8
☆LM272235/LM272210G2	493	483	585	597	6.4	6.4	–11.3	0.33	1.80	0.99	63.8
EE671801/672873	507	491	675	681	9.7	6.4	–6.6	0.39	1.53	0.84	188
LL771948/LL771911	495	491	543	549	3.3	3.3	–58.4	0.47	1.28	0.70	16.7
☆T-M272749/M272710G2	516	507	633	648	6.4	6.4	8.9	0.33	1.80	0.99	130
☆LM272249/LM272210G2	513	501	585	597	6.4	6.4	–11.3	0.33	1.80	0.99	54.9
EE243190/243250	516	510	603	609	6.4	3.3	–18.5	0.34	1.76	0.97	60.2
LM772748/LM772710A	522	510	600	613	6.4	3.3	–40.4	0.47	1.27	0.70	60.3
☆T-EE640192/640260G2	522	513	624	630	6.4	6.4	–4.9	0.31	1.95	1.07	85.2
EE243192/243250	522	516	603	609	6.4	3.3	–18.5	0.34	1.76	0.97	58.0
EE243196/243250	528	522	603	609	6.4	3.3	–18.5	0.34	1.76	0.97	54.7
☆M274149/M274110G2	540	534	663	678	6.4	6.4	11.8	0.33	1.80	0.99	152
EE426200/426330	564	552	759	768	9.7	9.7	–26.1	0.48	1.25	0.69	296
LL575343/LL575310	558	549	612	621	6.4	6.4	–50.3	0.41	1.48	0.81	26.4
☆M276449/M276410G2	576	570	711	726	6.4	6.4	10.5	0.33	1.80	0.99	187
LL575349/LL575310	564	555	612	621	6.4	6.4	–50.3	0.41	1.48	0.81	24.9
L476549/L476510	579	570	657	666	6.4	6.4	–32.2	0.38	1.59	0.88	68.2
EE542220/542290	594	585	696	705	6.4	6.4	–66.6	0.51	1.17	0.65	76.7
EE843220/843290	591	585	699	708	6.4	6.4	–21.8	0.34	1.76	0.97	88.7
LM377449/LM377410	594	585	696	708	6.4	6.4	–15.6	0.35	1.73	0.95	106
☆M278749/M278710AG2	615	609	756	774	6.4	6.4	12.7	0.33	1.80	0.99	227
T-LL778149/LL778110	603	600	663	669	3.5	3.3	–64.5	0.44	1.37	0.75	27.8

❶ "－" means that load center at outside on end of inner ring.

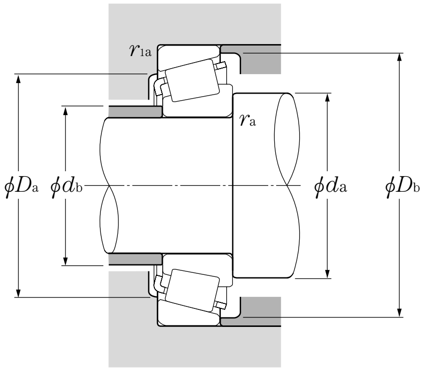
Inch system sizes



d 596.900～1,270.000mm

d	D	T	B	C	C_r (dynamic, kN)	C_{or} (static, kN)	C_r (dynamic, kgf)	C_{or} (static, kgf)
Boundary dimensions mm					Basic load ratings			
596.900	685.800	31.750	31.750	25.400	335	895	34,000	91,000
609.396	762.000	95.250	92.075	71.438	1,770	4,850	180,000	495,000
609.600	762.000	95.250	92.075	71.438	1,770	4,850	180,000	495,000
	787.400	93.662	93.662	69.850	2,190	5,050	223,000	515,000
	812.800	82.550	82.550	60.325	1,670	3,900	170,000	400,000
635.000	736.600	57.150	53.975	41.275	695	1,980	71,000	202,000
660.400	812.800	95.250	95.250	73.025	1,950	5,150	199,000	530,000
673.100	793.750	66.675	61.912	49.212	985	2,700	101,000	275,000
685.800	876.300	93.662	92.075	69.850	2,060	5,450	210,000	555,000
711.200	914.400	85.725	82.550	60.325	1,810	4,450	185,000	455,000
723.900	914.400	84.138	80.962	60.325	1,810	4,450	185,000	455,000
749.300	990.600	159.500	160.337	123.000	4,300	11,300	440,000	1,160,000
774.700	965.200	93.662	80.962	66.675	1,530	3,450	156,000	350,000
838.200	1,041.400	93.662	88.900	66.675	2,120	5,200	216,000	530,000
977.900	1,130.300	66.675	63.500	47.625	1,190	3,600	122,000	365,000
1,063.625	1,219.200	65.088	65.088	42.862	1,410	4,300	144,000	435,000
1,066.800	1,219.200	65.088	65.088	42.862	1,410	4,300	144,000	435,000
	1,320.800	95.250	88.900	69.850	2,330	6,200	237,000	635,000
1,092.200	1,320.800	95.250	88.900	69.850	2,330	6,200	237,000	635,000
1,270.000	1,435.100	69.850	65.088	47.625	1,590	5,050	162,000	515,000

Remarks: 1. With regard to the chamfer dimensions on the back face of the inner and outer rings, installation dimensions r_{as} and r_{1as} are larger than the maximum value.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r=XF_r+YF_a$

$\frac{F_a}{F_r}\leqq e$		$\frac{F_a}{F_r}>e$	
X	Y	X	Y
1	0	0.4	Y_2

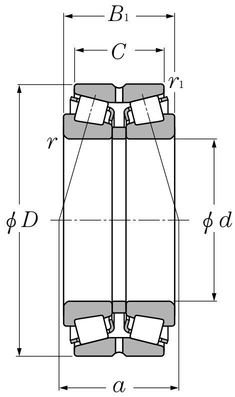
static
$P_{or}=0.5F_r+Y_oF_a$
When $P_{or}<F_r$ use $P_{or}=F_r$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm						Load[❶] center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} max	r_{1as} max	a	e	Y_2	Y_o	(approx.)
680235/680270	615	615	663	669	3.5	3.3	–94.8	0.53	1.14	0.63	15.8
L879946/L879910	642	633	720	741	6.4	6.4	–58.2	0.49	1.23	0.68	95.7
L879947/L879910	642	633	720	741	6.4	6.4	–58.2	0.49	1.23	0.68	95.6
☆EE649240/649310G2	642	633	747	764	6.4	6.4	–23.8	0.33	1.80	0.99	112
EE743240/743320	645	636	768	768	6.4	6.4	–31.8	0.33	1.83	1.01	104
80780/80720	654	651	714	717	3.3	3.3	–69.2	0.44	1.37	0.75	38.3
L281148/L281110A	693	681	777	789	6.4	6.4	–27.7	0.33	1.80	0.99	93.5
LL481448/LL481411	702	690	765	771	6.4	6.4	–53.8	0.36	1.67	0.92	51.3
☆EE655270/655345G2	723	714	831	843	6.4	6.4	–56.6	0.42	1.43	0.79	134
☆EE755280/755360G2	750	741	873	876	6.4	6.4	–52.4	0.38	1.58	0.87	136
☆EE755285/755360G2	756	750	873	876	5.5	6.4	–54	0.38	1.58	0.87	126
☆LM283649/LM283610G2	792	786	936	952	6.4	6.4	–4.4	0.33	1.80	0.99	309
EE752305/752380	810	798	921	924	6.4	3.3	–66.6	0.40	1.49	0.82	126
☆EE763330/763410G2	876	870	996	1,000	6.4	6.4	–85.3	0.44	1.36	0.75	172
LL687949/LL687910	1,010	1,005	1,095	1,100	6.4	6.4	–118.2	0.44	1.37	0.75	103
LL788345/LL788310	1,090	1,085	1,185	1,190	3.3	3.3	–142.8	0.48	1.26	0.69	422
LL788349/LL788310	1,090	1,090	1,185	1,190	3.3	3.3	–142.8	0.48	1.26	0.69	422
EE776420/776520	1,115	1,115	1,260	1,289	6.4	6.4	–175.6	0.57	1.05	0.58	796
EE776430/776520	1,135	1,130	1,260	1,289	6.4	6.4	–175.6	0.57	1.05	0.58	794
LL889049/LL889010	1,305	1,300	1,395	1,405	6.4	6.4	–220.2	0.58	1.04	0.57	666

❶ "－" means that load center at outside on end of inner ring.

NTN

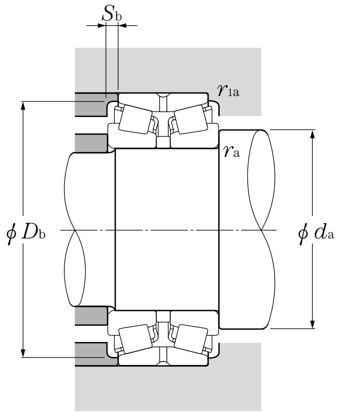
Metric system sizes



d 100～120mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
100	165	52	46	2.5	0.8	204	305	20,800	31,500	CRI-2052
	180	82	66	3	1	440	675	45,000	68,500	CRI-2059
	180	83	67	3	1	440	675	45,000	68,500	430220XU
	180	107	87	3	1	565	925	58,000	94,500	432220XU
	180	140	115	2.5	1	585	1,090	59,500	111,000	CRI-2010
	190	124.5	102	3	1	760	1,220	77,500	124,000	CRI-2072
	215	112	87	4	1	700	995	71,500	102,000	430320XU
	215	112	87	3	1	590	800	60,000	81,500	430320X
	215	162	127	4	1	980	1,540	100,000	157,000	432320U
105	190	88	70	3	1	490	760	50,000	77,500	430221XU
	190	115	95	3	1	650	1,080	66,000	111,000	432221XU
	190	117	96	3	1	650	1,080	66,000	111,000	CRI-2152
	225	116	91	4	1	750	1,060	76,000	109,000	430321XU
	225	116	91	3	1	625	845	63,500	86,000	430321X
	225	170	133	3	1	955	1,470	97,500	150,000	432321
110	160	57.5	47.5	1.5	0.5	218	450	22,200	46,000	CRI-2258
	180	56	50	2.5	0.6	228	340	23,300	35,000	413122
	180	70	56	2.5	0.6	298	485	30,500	49,500	423122
	180	125	100	2.5	0.6	515	980	52,500	99,500	CRI-2219
	200	92	74	3	1	555	865	56,500	88,500	430222XU
	200	121	101	3	1	720	1,210	73,500	124,000	432222XU
	240	118	93	4	1	825	1,180	84,000	120,000	430322U
	240	118	93	3	1	685	925	69,500	94,500	430322
	240	181	142	4	1	1,210	1,940	123,000	197,000	432322U
	240	181	142	3	1	1,070	1,660	109,000	169,000	432322
120	180	46	41	2.5	0.6	193	298	19,700	30,500	413024
	180	58	46	2.5	0.6	230	375	23,500	38,000	423024
	200	62	55	2.5	0.6	263	435	26,800	44,500	413124
	200	78	62	2.5	0.6	370	610	38,000	62,500	423124
	200	78	62	2.5	0.6	370	610	38,000	62,500	CRI-2460
	200	100	84	2.5	1	530	1,100	54,000	113,000	CRI-2416
	215	97	78	3	1	595	940	60,500	96,000	430224XU
	215	132	109	3	1	790	1,360	80,500	139,000	432224XU
	260	128	101	4	1	960	1,390	97,500	142,000	430324XU
	260	128	101	3	1	800	1,100	81,500	112,000	430324X
	260	188	145	4	1	1,400	2,270	143,000	231,000	432324U

❶ Minimum allowable dimension for chamfer dimension r or r_1.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

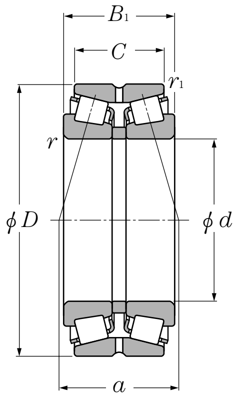
static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
112	153	3	2	0.8	53.5	0.33	2.03	3.02	1.98	3.94
114	169	8	2.5	1	80.5	0.42	1.61	2.39	1.57	8.08
114	168	8	2.5	1	81.5	0.42	1.61	2.39	1.57	8.11
114	171	10	2.5	1	92	0.42	1.61	2.39	1.57	10.7
112	168.5	12.5	2	1	97.5	0.33	2.06	3.06	2.01	13.8
114	179.5	11.5	2.5	1	95.5	0.33	2.02	3.00	1.97	14.3
118	200	12.5	3	1	92	0.35	1.96	2.91	1.91	18.4
118	200	12.5	3	1	93.5	0.35	1.95	2.90	1.91	16.5
118	200	17.5	3	1	113	0.35	1.96	2.91	1.91	26.5
119	178	9	2.5	1	86	0.42	1.61	2.39	1.57	9.73
119	180	10	2.5	1	97.5	0.42	1.61	2.39	1.57	13.1
119	179.5	10.5	2.5	1	99.5	0.42	1.61	2.39	1.57	12.9
123	209	12.5	3	1	96.5	0.35	1.96	2.91	1.91	21
123	209	12.5	3	1	96.5	0.35	1.95	2.90	1.91	19.6
119	208	18.5	2.5	1	117.5	0.35	1.96	2.90	1.91	30.2
118.5	146	5	1.5	0.5	60.5	0.36	1.90	2.83	1.86	3.41
122	169	3	2	0.6	66.5	0.40	1.68	2.50	1.64	5.2
122	166	7	2	0.6	66.5	0.33	2.03	3.02	1.98	6.38
122	168	12.5	2	0.6	87	0.26	2.55	3.80	2.50	11.2
124	188	9	2.5	1	90	0.42	1.61	2.39	1.57	11.4
124	190	10	2.5	1	102	0.42	1.61	2.39	1.57	15.5
128	222	12.5	3	1	100	0.35	1.96	2.91	1.91	24.5
128	222	12.5	3	1	97.5	0.35	1.95	2.90	1.91	22.1
128	222	19.5	3	1	127	0.35	1.96	2.91	1.91	38.2
128	222	19.5	3	1	124	0.35	1.95	2.90	1.91	35.6
132	171	2.5	2	0.6	59	0.37	1.80	2.69	1.76	3.85
132	170	6	2	0.6	66	0.37	1.80	2.69	1.76	4.41
132	184	3.5	2	0.6	76.5	0.43	1.57	2.34	1.53	7.24
132	188	8	2	0.6	76.5	0.37	1.80	2.69	1.76	8.96
132	187	8	2	0.6	81.5	0.37	1.80	2.69	1.76	8.78
132	190.5	8	2	1	87.5	0.34	1.96	2.92	1.92	12.6
134	203	9.5	2.5	1	98	0.44	1.55	2.31	1.52	13.6
134	204	11.5	2.5	1	112	0.44	1.55	2.31	1.52	18.9
138	239	13.5	3	1	107	0.35	1.96	2.91	1.91	30.5
138	239	13.5	3	1	106	0.35	1.95	2.90	1.91	29.4
138	239	21.5	3	1	130	0.35	1.96	2.91	1.91	47

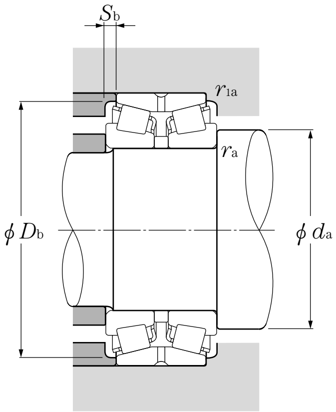
Metric system sizes



d 125～150mm

	Boundary dimensions					Basic load ratings				Bearing numbers
						dynamic	static	dynamic	static	
	mm					kN		kgf		
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
125	210	110	88	3	1	570	1,080	58,000	110,000	CRI-2555
130	200	52	46	2.5	0.6	224	365	22,900	37,500	413026
	200	65	52	2.5	0.6	294	490	29,900	50,000	423026
	210	64	57	2.5	0.6	315	485	32,000	49,500	413126
	210	80	64	2.5	0.6	410	675	42,000	69,000	423126
	210	109	90	2.5	0.6	530	1,100	54,000	113,000	CRI-2619
	214	115	98	2.5	0.6	540	1,040	55,000	106,000	CRI-2651
	230	95	75	3	1	560	840	57,000	86,000	CRI-2614
	230	98	78.5	4	1	640	1,010	65,500	103,000	430226XU
	230	100	80.5	3	1	560	840	57,000	86,000	CRI-2655
	230	145	115	3	1	895	1,460	91,000	149,000	CRI-2616
	230	145	117.5	4	1	905	1,630	92,500	166,000	432226XU
	230	149	120	3	1	905	1,630	92,500	166,000	CRI-2654
	280	137	107.5	5	1.5	1,110	1,660	113,000	169,000	430326XU
	280	205	163.5	4	1.5	1,530	2,470	156,000	252,000	432326
140	210	53	47	2.5	0.6	262	415	26,700	42,500	413028
	210	66	53	2.5	0.6	300	535	30,500	54,500	423028
	210	106	94	2.5	0.6	580	1,220	59,000	124,000	CRI-2818
	225	68	61	3	1	370	580	37,500	59,500	413128
	225	84	68	3	1	390	650	40,000	66,000	423128
	225	85	68	3	1	390	650	40,000	66,000	CRI-2872
	230	120	94	2.5	0.8	680	1,280	69,500	131,000	CRI-2855
	230	140	110	3	1	750	1,470	76,500	150,000	CRI-2825
	240	132	106	3	1.5	755	1,480	77,000	150,000	CRI-2869
	250	102	82.5	3	1	640	970	65,500	99,000	430228X
	250	102	82.5	4	1	720	1,140	73,500	117,000	430228XU
	250	153	125.5	4	1	1,050	1,840	107,000	188,000	432228XU
	270	120	95	4	3	835	1,240	85,000	127,000	CRI-2874
	300	102	77	2.5	1	645	1,010	66,000	103,000	CRI-2834
	300	145	115.5	4	1.5	1,100	1,560	112,000	160,000	430328X
	300	145	115.5	5	1.5	1,260	1,900	129,000	194,000	430328XU
	300	223	177.5	4	1.5	1,690	2,740	173,000	279,000	432328
150	225	56	50	3	1	274	430	27,900	44,000	413030
	225	70	56	3	1	355	630	36,000	64,500	423030
	250	80	71	3	1	485	805	49,500	82,000	413130
	250	100	80	3	1	600	1,040	61,500	106,000	423130

❶ Minimum allowable dimension for chamfer dimension r or r_1.



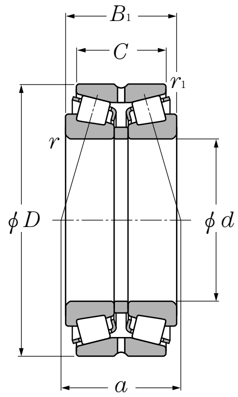
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{las} max	a	e	Y_1	Y_2	Y_o	(approx.)
139	197.5	11	2.5	1	101	0.42	1.62	2.42	1.59	14.5
142	186	3	2	0.6	66	0.37	1.80	2.69	1.76	5.55
142	189	6.5	2	0.6	71.5	0.37	1.80	2.69	1.76	6.62
142	196	3.5	2	0.6	69	0.33	2.03	3.02	1.98	7.83
142	198	8	2	0.6	79.5	0.37	1.80	2.69	1.76	9.77
142	191.5	9.5	2	0.6	89	0.34	1.96	2.90	1.90	14.2
142	198	8.5	2	0.6	111	0.46	1.47	2.20	1.40	15.5
144	215.5	10	2.5	1	96	0.43	1.57	2.30	1.50	15
148	218	9.5	3	1	102	0.44	1.55	2.31	1.52	15.9
144	215.5	9.5	2.5	1	101	0.43	1.57	2.30	1.50	15.8
144	220	15	2.5	1	117.5	0.40	1.68	2.50	1.60	23
148	219	13.5	3	1	124	0.44	1.55	2.31	1.52	24.1
144	220	14.5	2.5	1	128	0.44	1.55	2.30	1.50	24.6
152	255	14.5	4	1.5	116	0.35	1.96	2.91	1.91	37.9
148	264	20.5	3	1.5	143	0.35	1.95	2.90	1.90	56.6
152	199	3	2	0.6	68.5	0.37	1.80	2.69	1.76	5.88
152	197	6.5	2	0.6	75	0.37	1.84	2.74	1.80	7.11
152	201.5	6	2	0.6	93	0.35	1.95	2.90	1.91	12.5
154	210	3.5	2.5	1	73.5	0.33	2.03	3.02	1.98	9.18
154	209	8	2.5	1	88	0.37	1.80	2.69	1.76	11.8
154	211	8.5	2.5	1	88	0.37	1.80	2.69	1.76	11.8
152	214	13	2	0.8	108	0.40	1.68	2.50	1.64	15.5
154	216	15	2.5	1	106	0.32	2.12	3.15	2.07	20.5
154	226.5	13	2.5	1.5	124.5	0.44	1.53	2.27	1.49	22.1
158	237	9.5	3	1	106	0.43	1.57	2.34	1.53	18
158	237	9.5	3	1	107	0.44	1.55	2.31	1.52	19.9
158	238	13.5	3	1	131	0.44	1.55	2.31	1.52	30.1
158	249	12.5	3	2.5	104	0.33	2.05	3.05	2.00	27.6
152	264	12.5	2	1	129	0.55	1.24	1.84	1.21	32.5
162	272	14.5	4	1.5	123	0.35	1.95	2.90	1.91	44.4
162	273	14.5	4	1.5	123	0.35	1.96	2.91	1.91	46.6
158	282	22.5	3	1.5	156	0.35	1.95	2.90	1.91	69
164	213	3	2.5	1	73.5	0.37	1.80	2.69	1.76	6.66
164	212	7	2.5	1	79.5	0.37	1.80	2.69	1.76	8.76
164	231	4.5	2.5	1	82.5	0.33	2.03	3.02	1.98	14.3
164	234	10	2.5	1	96.5	0.37	1.80	2.69	1.76	18

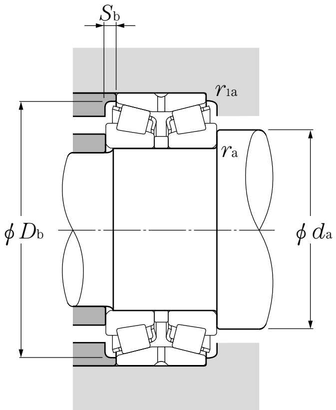
Metric system sizes



d 150～180mm

	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
150	250	115	95	2.5	1	660	1,230	67,500	126,000	CRI-3015
	250	137	112	2.5	1	865	1,590	88,500	162,000	CRI-3061
	260	150	115	4	1	945	1,820	96,000	185,000	CRI-3063
	270	109	87	4	1	770	1,210	78,500	123,000	430230U
	270	164	130	4	1	1,200	2,140	122,000	218,000	432230XU
	320	154	120	5	1.5	1,410	2,140	144,000	218,000	430330U
	320	154	120	4	1.5	1,170	1,750	119,000	178,000	430330
160	240	60	53	3	1	330	535	34,000	54,500	413032
	240	75	60	3	1	430	765	44,000	78,000	423032
	240	110	90	2.5	0.6	660	1,230	67,500	126,000	CRI-3256
	270	86	76	3	1	595	965	60,500	98,000	413132E1
	270	108	86	3	1	675	1,180	69,000	120,000	423132E1
	270	110	86	2.5	1	785	1,360	80,000	138,000	CRI-3210
	270	140	120	2.5	1	960	1,910	98,000	195,000	CRI-3225
	270	150	120	2.5	1	960	1,860	98,000	190,000	CRI-3219
	280	150	125	4	1	1,090	1,940	112,000	198,000	CRI-3258
	290	115	91	4	1	900	1,440	92,000	147,000	430232U
	290	178	144	4	1	1,530	2,840	156,000	290,000	432232U
	340	160	126	5	1.5	1,570	2,390	160,000	244,000	430332XU
	340	160	126	4	1.5	1,290	1,950	132,000	199,000	430332X
165	290	150	125	5	1	1,030	1,820	105,000	186,000	CRI-3309
	350	146	108	7.5	1.5	1,220	1,980	124,000	202,000	CRI-3305
170	250	85	65	2.5	1	425	815	43,500	83,000	CRI-3420
	260	67	60	3	1	365	620	37,000	63,500	413034
	260	84	67	3	1	490	865	50,000	88,000	423034
	280	88	78	3	1	550	900	56,000	92,000	413134E1
	280	110	88	3	1	725	1,270	74,000	130,000	423134E1
	280	134	106	3	1	855	1,790	87,500	182,000	CRI-3452
	280	150	130	2.5	1	980	1,880	100,000	192,000	CRI-3410
	310	125	97	5	1.5	1,050	1,690	107,000	173,000	430234U
	310	192	152	5	1.5	1,710	3,200	174,000	325,000	432234XU
180	280	74	66	3	1	425	735	43,000	75,000	413036E1
	280	93	74	3	1	580	1,050	59,500	107,000	423036E1
	280	134.5	108	2.5	1	885	1,800	90,000	183,000	CRI-3623
	300	96	85	4	1.5	705	1,190	72,000	121,000	413136E1

❶ Minimum allowable dimension for chamfer dimension r or r_1.



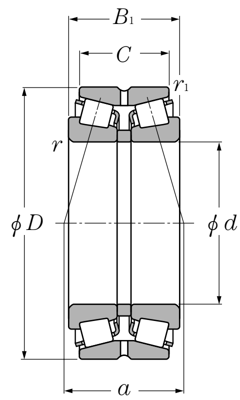
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
162	234	10	2	1	107.5	0.37	1.80	2.69	1.76	21.2
162	238	12.5	2	1	119	0.41	1.66	2.47	1.62	27.7
168	239.5	17.5	3	1	125	0.41	1.66	2.47	1.62	31.4
168	255	11	3	1	114	0.44	1.55	2.31	1.52	24.4
168	254	17	3	1	139	0.44	1.55	2.31	1.52	37.3
172	292	17	4	1.5	132	0.35	1.96	2.91	1.91	55.4
172	292	17	4	1.5	135	0.37	1.80	2.69	1.76	52.8
174	227	3.5	2.5	1	79	0.37	1.80	2.69	1.76	8.29
174	227	7.5	2.5	1	85.5	0.37	1.80	2.69	1.76	10.7
172	231.5	10	2	0.6	107	0.37	1.80	2.69	1.76	15.6
174	254	5	2.5	1	98.5	0.40	1.68	2.50	1.64	18.2
174	250	11	2.5	1	106	0.37	1.80	2.69	1.76	22.8
172	250.5	12	2	1	95	0.31	2.21	3.29	2.16	22.9
172	251.5	10	2	1	113.5	0.32	2.12	3.15	2.07	31.8
172	252	15	2	1	119.5	0.32	2.12	3.15	2.07	32.8
178	264.5	12.5	3	1	119.5	0.32	2.12	3.15	2.07	34.8
178	272	12	3	1	122	0.44	1.55	2.31	1.52	31.9
178	275	17	3	1	150	0.44	1.55	2.31	1.52	46.9
182	310	17	4	1.5	138	0.35	1.96	2.91	1.91	65.5
182	311	17	4	1.5	141	0.37	1.80	2.69	1.76	62.4
187	274	12.5	4	1	127.5	0.32	2.12	3.15	2.07	37.5
201	308.5	19	6	1.5	124.5	0.34	2.00	2.98	1.96	61.2
182	237.5	10	2	1	103	0.44	1.54	2.29	1.50	12.6
184	242	3.5	2.5	1	86.5	0.37	1.80	2.69	1.76	11.6
184	244	8.5	2.5	1	93.5	0.37	1.80	2.69	1.76	14.3
184	260	5	2.5	1	104	0.40	1.68	2.50	1.64	19.5
184	260	11	2.5	1	109	0.37	1.80	2.69	1.76	24.7
184	250.5	14	2.5	1	132.5	0.44	1.52	2.26	1.49	32.8
182	265	10	2	1	125.5	0.33	2.03	3.02	1.98	34.3
192	290.5	14	4	1.5	132	0.44	1.55	2.31	1.52	38
192	293	20	4	1.5	160	0.44	1.55	2.31	1.52	58.2
194	260	4	2.5	1	94	0.37	1.80	2.69	1.76	15.9
194	262	9.5	2.5	1	102	0.37	1.80	2.69	1.76	19
192	266	13.5	2	1	122	0.37	1.80	2.69	1.76	27
198	280	5.5	3	1.5	111	0.40	1.68	2.50	1.64	24.6

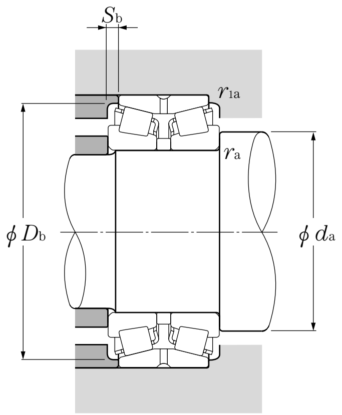
Metric system sizes



d 180～220mm

	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
180	300	120	96	4	1.5	885	1,530	90,500	156,000	423136E1
	300	164	134	3	1	1,150	2,270	118,000	231,000	CRI-3625
	320	127	99	5	1.5	1,080	1,780	110,000	182,000	430236U
	320	192	152	5	1.5	1,760	3,350	180,000	345,000	432236U
	340	180	140	4	1.5	1,390	2,590	142,000	264,000	CRI-3618
190	290	75	67	3	1	430	740	44,000	75,500	413038E1
	290	94	75	3	1	615	1,110	63,000	113,000	423038E1
	320	104	92	4	1.5	780	1,280	79,500	131,000	413138
	320	130	104	4	1.5	985	1,710	100,000	174,000	423138
	340	133	105	5	1.5	1,230	2,010	125,000	205,000	430238U
	340	204	160	5	1.5	1,970	3,700	201,000	380,000	432238U
	340	204	160	4	1.5	1,710	3,350	175,000	340,000	432238
200	310	82	73	3	1	530	940	54,000	96,000	413040E1
	310	103	82	3	1	720	1,320	73,000	135,000	423040E1
	310	151	123	2.5	1	1,020	2,080	105,000	212,000	CRI-4020
	310	170	140	4	1	1,270	2,690	130,000	274,000	CRI-4027
	320	146	110	4	1.5	910	1,950	92,500	199,000	CRI-4036
	330	180	140	4	1.5	1,330	2,610	136,000	266,000	CRI-4030
	340	112	100	4	1.5	965	1,660	98,500	169,000	413140
	340	140	112	4	1.5	1,090	1,910	111,000	195,000	423140
	340	184	150	3	1.5	1,530	3,000	156,000	305,000	CRI-4019
	360	142	110	5	1.5	1,350	2,210	137,000	226,000	430240U
	360	218	174	5	1.5	2,260	4,250	230,000	435,000	432240U
	360	218	174	4	1.5	1,980	3,950	201,000	400,000	432240
206	283	102	83	3	0.6	540	1,320	55,000	134,000	CRI-4107
210	355	116	103	3	1.5	880	1,500	89,500	153,000	CRI-4202
220	300	110	88	2.5	1	660	1,550	67,500	158,000	CRI-4410
	340	90	80	4	1.5	595	1,060	61,000	108,000	413044E1
	340	113	90	4	1.5	880	1,650	89,500	168,000	423044E1
	340	158	130	4	1	1,340	2,750	137,000	281,000	CRI-4409
	340	164	130	3	1	1,360	2,810	139,000	287,000	CRI-4411
	370	120	107	5	1.5	1,110	1,920	113,000	196,000	413144
	370	150	120	5	1.5	1,220	2,260	125,000	230,000	423144
	370	150	120	5	1.5	1,440	2,550	147,000	260,000	CRI-4416

❶ Minimum allowable dimension for chamfer dimension r or r_1.



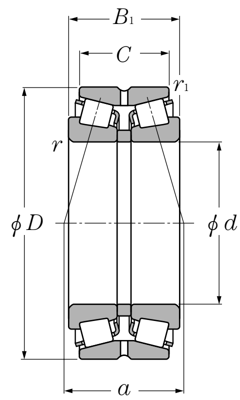
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
198	279	12	3	1.5	119	0.37	1.80	2.69	1.76	31.4
194	281	15	2.5	1	125.5	0.26	2.55	3.80	2.50	43.7
202	297	14	4	1.5	139	0.45	1.50	2.23	1.47	39.4
202	305	20	4	1.5	165	0.45	1.50	2.23	1.47	60.6
198	302	20	3	1.5	142.5	0.32	2.12	3.15	2.07	68.5
204	271	4	2.5	1	96	0.37	1.80	2.69	1.76	16.2
204	272	9.5	2.5	1	104	0.37	1.80	2.69	1.76	19.6
208	300	6	3	1.5	119	0.40	1.68	2.50	1.64	30.8
208	299	13	3	1.5	126	0.37	1.80	2.69	1.76	38.6
212	316	14	4	1.5	141	0.44	1.55	2.31	1.52	45.4
212	323	22	4	1.5	174	0.44	1.55	2.31	1.52	73.3
212	323	22	4	1.5	185	0.49	1.38	2.06	1.35	75.8
214	288	4.5	2.5	1	101	0.37	1.80	2.69	1.76	20.6
214	291	10.5	2.5	1	112	0.37	1.80	2.69	1.76	25.7
212	296	14	2	1	141	0.37	1.80	2.69	1.76	38.2
218	296	15	3	1	138	0.33	2.03	3.02	1.98	42.4
218	299	18	3	1.5	160.5	0.52	1.31	1.95	1.28	40.1
218	314	20	3	1.5	161.5	0.42	1.60	2.39	1.57	55.5
218	320	6	3	1.5	125	0.40	1.68	2.50	1.64	38.6
218	316	14	3	1.5	134	0.37	1.80	2.69	1.76	47.5
214	324	17	2.5	1.5	149	0.32	2.12	3.15	2.07	67
222	336	16	4	1.5	154	0.44	1.55	2.31	1.52	62.8
222	340	22	4	1.5	180	0.41	1.66	2.47	1.62	95.2
222	340	22	4	1.5	193	0.49	1.38	2.06	1.35	90.7
220	275	9.5	2.5	0.6	134	0.52	1.31	1.95	1.28	16.9
224	331	6.5	2.5	1.5	130.5	0.40	1.68	2.50	1.64	44
232	289	11	2	1	121.5	0.39	1.74	2.59	1.70	21.1
238	318	5	3	1.5	112	0.37	1.80	2.69	1.76	26.7
238	319	11.5	3	1.5	125	0.37	1.80	2.69	1.76	33.3
238	324	14	3	1	138.5	0.33	2.03	3.02	1.98	46.7
234	323	17	2.5	1	145	0.35	1.95	2.90	1.91	48.5
242	346	6.5	4	1.5	135	0.40	1.68	2.50	1.64	47.8
242	341	15	4	1.5	154	0.40	1.68	2.50	1.64	59.6
242	346.5	15	4	1.5	142	0.35	1.95	2.90	1.91	59.0

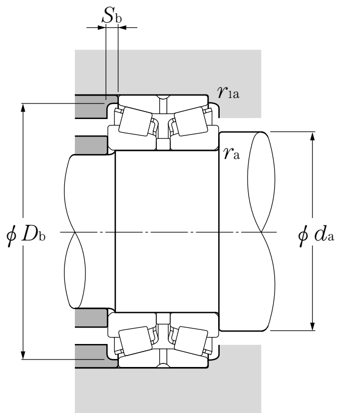
Metric system sizes



d 220～300mm

	Boundary dimensions					Basic load ratings				Bearing numbers
	mm					dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
220	400	158	122	4	1.5	1,400	2,440	143,000	249,000	430244
	420	130	100	5	2.5	1,160	1,820	119,000	185,000	CRI-4407
230	380	175	115	4	2	1,540	2,890	157,000	295,000	CRI-4612
	380	200	160	4	2	1,740	3,700	178,000	380,000	CRI-4606
	400	188	136	8	1.5	1,620	3,250	165,000	330,000	CRI-4605
235	330	115	85	5	1.5	745	1,700	76,000	173,000	CRI-4701
240	320	110	90	2.5	1	795	1,890	81,000	193,000	CRI-4813
	360	92	82	4	1.5	655	1,160	66,500	118,000	413048E1
	360	115	92	4	1.5	910	1,770	92,500	181,000	423048E1
	360	164	130	3	1	1,420	3,050	145,000	310,000	CRI-4806
	360	170	142	3	1	1,360	2,810	139,000	287,000	CRI-4805
	400	128	114	5	1.5	1,230	2,130	126,000	217,000	413148
	400	160	128	5	1.5	1,400	2,600	142,000	265,000	423148
	400	209	168	4	1.5	2,140	4,350	218,000	445,000	CRI-4807
	440	165	127	4	1.5	1,680	2,960	171,000	300,000	430248
	440	266	212	4	1.5	2,920	5,500	298,000	560,000	432248
250	380	98	87	3	1.5	750	1,360	76,500	139,000	CRI-5004
260	400	104	92	5	1.5	840	1,540	85,500	157,000	413052
	400	130	104	5	1.5	1,150	2,190	117,000	223,000	423052
	400	185	146	4	1.5	1,720	3,650	175,000	370,000	CRI-5218
	440	144	128	5	1.5	1,500	2,630	152,000	268,000	413152
	440	172	145	4	2	1,960	3,750	200,000	380,000	CRI-5224
	440	180	144	5	1.5	1,960	3,750	200,000	380,000	423152
280	400	150	120	5	1.5	1,380	3,150	141,000	325,000	CRI-5615
	420	106	94	5	1.5	890	1,630	91,000	166,000	413056
	420	133	106	5	1.5	1,200	2,340	123,000	238,000	423056
	460	146	130	6	2	1,640	2,900	167,000	296,000	413156
	460	183	146	6	2	1,940	3,650	198,000	375,000	423156
290	400	120	90	4	1.5	1,200	2,600	122,000	265,000	CRI-5808
	430	150	135	4	1.5	1,350	3,200	138,000	325,000	CRI-5810
300	460	118	105	5	1.5	1,070	1,990	109,000	203,000	413060

❶ Minimum allowable dimension for chamfer dimension r or r_1.



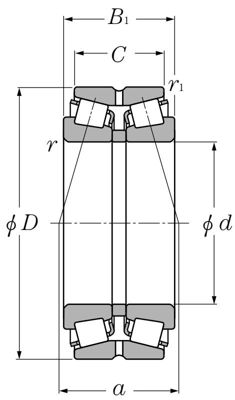
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o
see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
238	368	18	3	1.5	178.5	0.49	1.38	2.06	1.40	77.5
242	378	15	4	2	148	0.40	1.68	2.50	1.64	73.1
248	359	30	3	2	154.5	0.40	1.68	2.50	1.64	67
248	355	20	3	2	164	0.33	2.03	3.02	1.98	84.4
266	367	26	6	1.5	181	0.44	1.54	2.29	1.50	88.5
257	312.5	15	4	1.5	129.5	0.41	1.66	2.47	1.62	27.3
252	314	10	2	1	139.5	0.46	1.47	2.19	1.44	21.6
258	339	5	3	1.5	117	0.37	1.80	2.69	1.76	30.2
258	339	11.5	3	1.5	131	0.37	1.80	2.69	1.76	36.5
254	356	17	2.5	1	145	0.32	2.12	3.15	2.07	53
254	347	14	2.5	1	161	0.37	1.80	2.69	1.76	53.8
262	375	7	4	1.5	144	0.40	1.68	2.50	1.64	58.9
262	373	16	4	1.5	164	0.40	1.68	2.50	1.64	71.7
258	376	20.5	3	1.5	167.5	0.32	2.12	3.15	2.07	96
258	406	19	3	1.5	189	0.49	1.38	2.06	1.35	100.4
258	421.5	27	3	1.5	226	0.43	1.57	2.34	1.53	164.8
264	357	5.5	2.5	1.5	123.5	0.37	1.80	2.69	1.80	35.3
282	372	6	4	1.5	131	0.37	1.80	2.69	1.76	41.5
282	374	13	4	1.5	143	0.37	1.80	2.69	1.76	53
278	376	19.5	3	1.5	154.5	0.29	2.32	3.45	2.26	79
282	412	8	4	1.5	161	0.40	1.68	2.50	1.64	82.2
278	416.5	13.5	3	1.5	175	0.40	1.68	2.50	1.64	99.0
282	413	18	4	1.5	176	0.40	1.68	2.50	1.64	101
302	383	15	4	1.5	161	0.39	1.70	2.59	1.70	53.8
302	394	6	4	1.5	136	0.37	1.80	2.69	1.76	47.2
302	397	13.5	4	1.5	148	0.37	1.80	2.69	1.76	57.3
308	435	8	5	2	168	0.40	1.68	2.50	1.64	87.4
308	433	18.5	5	2	177	0.40	1.68	2.50	1.64	109
308	386	15	3	1.5	154	0.42	1.62	2.42	1.59	40
308	407	7.5	3	1.5	162	0.39	1.74	2.59	1.70	72.7
322	428	6.5	4	1.5	151	0.37	1.80	2.69	1.76	65.6

Metric system sizes

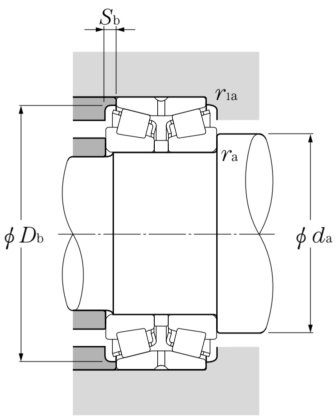


d 300～400mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}	
300	460	148	118	5	1.5	1,610	3,150	165,000	320,000	423060
	500	160	142	6	2	2,010	3,600	205,000	370,000	413160
	500	200	160	6	2	2,100	4,050	214,000	415,000	423160
	540	208	158	5	2.5	2,440	4,450	249,000	450,000	CRI-6010
320	480	121	108	5	1.5	1,190	2,250	121,000	229,000	413064
	480	151	121	5	1.5	1,580	3,100	162,000	315,000	423064
	540	176	157	6	2	2,240	4,100	228,000	415,000	413164
	540	220	176	6	2	2,500	4,900	255,000	500,000	423164
	550	240	180	5	2.5	3,300	6,500	340,000	665,000	☆CRI-6410
330	500	190	150	6	1.5	2,480	5,550	252,000	565,000	CRI-6603
340	460	160	128	3	1	1,630	4,250	167,000	430,000	CRI-6808
	500	249	203	5	1.5	2,690	6,200	274,000	630,000	CRI-6812
	520	133	118	6	2	1,480	2,870	150,000	293,000	413068
	520	165	133	6	2	1,890	3,750	193,000	380,000	423068
	580	190	169	6	2	2,690	4,900	274,000	500,000	413168
	580	238	190	6	2	3,350	6,500	345,000	660,000	423168
360	540	134	120	6	2	1,470	2,810	150,000	287,000	413072
	540	169	134	6	2	2,050	4,200	209,000	430,000	423072
	600	192	171	6	2	2,720	5,050	277,000	515,000	413172
	600	240	192	6	2	3,200	6,500	325,000	660,000	423172
380	508	139.7	88.9	6.4	1.5	920	2,270	94,000	232,000	CRI-7619
	560	135	122	6	2	1,690	3,350	172,000	340,000	413076
	560	171	135	6	2	2,080	4,350	213,000	445,000	423076
	620	194	173	6	2	2,840	5,250	289,000	535,000	413176
	620	241	170	5	2	3,700	7,400	380,000	755,000	CRI-7614
	620	243	194	6	2	3,350	6,700	340,000	685,000	423176
390	600	185	130	4	2	2,680	5,550	273,000	565,000	☆CRI-7803
400	540	140	100	6.4	1.5	1,620	3,800	165,000	390,000	CRI-8005
	600	148	132	6	2	1,860	3,700	190,000	375,000	413080
	600	185	148	6	2	2,530	5,450	258,000	555,000	423080
	650	200	178	6	3	3,000	5,800	305,000	590,000	413180
	650	250	200	6	3	3,750	7,850	385,000	800,000	423180

❶ Minimum allowable dimension for chamfer dimension r or r_1.

Remarks: 1. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



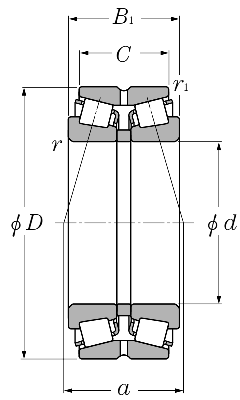
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
322	434	15	4	1.5	163	0.37	1.80	2.69	1.76	80.2
328	471	9	5	2	182	0.40	1.68	2.50	1.64	115
328	467	20	5	2	202	0.40	1.68	2.50	1.64	144
322	498	25	4	2	238	0.49	1.38	2.06	1.35	184
342	449	6.5	4	1.5	157	0.37	1.80	2.69	1.76	70.9
342	455	15	4	1.5	170	0.37	1.80	2.69	1.76	85.4
348	505	9.5	5	2	197	0.40	1.68	2.50	1.64	150
348	504.5	22	5	2	217	0.40	1.68	2.50	1.64	186
342	514	30	4	2	233	0.40	1.68	2.50	1.64	223
358	477	20	5	1.5	195	0.39	1.74	2.59	1.70	117
354	441	16	2.5	1	161.5	0.32	2.12	3.15	2.07	70
362	481	23	4	1.5	218.5	0.33	2.03	3.02	1.98	154
368	488	7.5	5	2	170	0.37	1.80	2.69	1.76	89.2
368	489	16	5	2	184	0.37	1.80	2.69	1.76	113
368	548	10.5	5	2	213	0.40	1.68	2.50	1.64	188
368	542	24	5	2	237	0.40	1.68	2.50	1.64	235
388	507	7	5	2	176	0.37	1.80	2.69	1.76	98.2
388	509	17.5	5	2	192	0.37	1.80	2.69	1.76	120
388	561	10.5	5	2	219	0.40	1.68	2.50	1.64	199
388	563	24	5	2	240	0.40	1.68	2.50	1.64	248
408	483	25.5	5	1.5	221	0.53	1.27	1.89	1.24	69.5
408	528	6.5	5	2	183	0.37	1.80	2.69	1.76	95.9
408	529	18	5	2	196	0.37	1.80	2.69	1.76	126
408	583	10.5	5	2	225	0.40	1.68	2.50	1.64	210
402	582	35.5	4	2	263	0.46	1.47	2.19	1.44	252
408	578	24.5	5	2	249	0.40	1.68	2.50	1.64	262
408	564	27.5	3	2	216.5	0.40	1.70	2.50	1.66	175
428	519.5	20	5	1.5	216	0.48	1.41	2.09	1.37	80.6
428	564	8	5	2	194	0.37	1.80	2.69	1.76	105
428	564	18.5	5	2	210	0.37	1.80	2.69	1.76	163
428	610	11	5	2.5	232	0.40	1.68	2.50	1.64	236
428	610	25	5	2.5	256	0.40	1.68	2.50	1.64	294

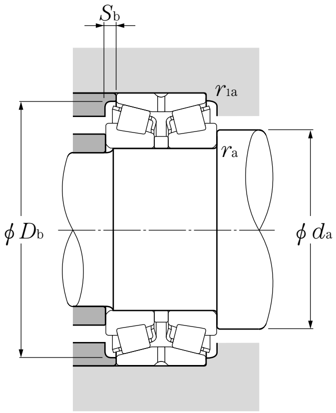
Metric system sizes



d 420～560mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
420	620	150	134	6	2	2,110	4,250	215,000	435,000	413084
	620	188	150	6	2	2,650	5,900	270,000	600,000	423084
	700	224	200	6	3	3,700	7,200	375,000	735,000	413184
	700	274	200	6	2.5	4,850	9,850	495,000	1,000,000	☆CRI-8403
	700	280	224	6	3	4,800	9,700	490,000	990,000	423184
440	650	157	140	6	3	2,470	5,150	252,000	525,000	413088
	650	196	157	6	3	2,600	5,450	266,000	560,000	423088
	720	226	201	6	3	4,000	7,800	410,000	795,000	413188
	720	283	226	6	3	5,000	10,300	510,000	1,050,000	423188
460	680	163	145	6	3	2,600	5,350	265,000	550,000	413092
	680	204	163	6	3	3,100	6,750	315,000	685,000	423092
	760	240	214	7.5	4	4,550	9,150	465,000	930,000	413192
	760	300	240	7.5	4	4,900	10,300	500,000	1,050,000	423192
480	700	165	147	6	3	2,490	5,000	254,000	510,000	413096
	700	206	165	6	3	3,050	6,700	310,000	685,000	423096
	790	248	221	7.5	4	4,800	9,600	490,000	975,000	413196
	790	310	248	7.5	4	5,300	11,100	540,000	1,130,000	423196
500	670	180	130	5	2	2,400	6,100	245,000	625,000	CRI-10004
	720	167	149	6	3	2,610	5,400	266,000	550,000	4130/500
	720	209	167	6	3	3,050	6,900	315,000	700,000	4230/500
	830	264	235	7.5	4	5,200	10,500	530,000	1,070,000	4131/500
	830	330	264	7.5	4	6,400	14,000	650,000	1,420,000	☆4231/500G2
530	780	185	163	6	3	2,910	5,900	297,000	600,000	4130/530
	780	231	185	6	3	4,050	9,050	415,000	920,000	4230/530
	870	272	239	7.5	4	6,000	12,200	615,000	1,240,000	☆4131/530G2
	870	340	272	7.5	4	7,750	16,700	790,000	1,710,000	☆4231/530AG2
560	735	225	180	6.4	1.5	3,150	8,800	325,000	895,000	CRI-11206
	740	190	140	6.4	1.5	2,360	6,250	241,000	640,000	CRI-11211
	820	195	173	6	3	3,600	7,850	370,000	800,000	☆CRI-11214
	820	244	195	6	3	4,750	11,000	485,000	1,120,000	☆CRI-11213
	920	280	246	7.5	4	5,900	12,100	600,000	1,230,000	4131/560
	920	350	280	7.5	4	7,600	17,400	775,000	1,780,000	☆4231/560G2

❶ Minimum allowable dimension for chamfer dimension r or r_1.
Remarks: 1. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



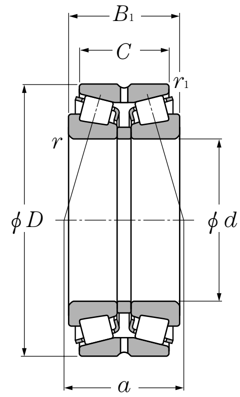
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
448	586	8	5	2	200	0.37	1.80	2.69	1.76	135
448	583	19	5	2	220	0.37	1.80	2.69	1.76	172
448	655	12	5	2.5	258	0.40	1.68	2.50	1.64	317
448	649	37	5	2	245	0.32	2.12	3.15	2.07	387
448	659	28	5	2.5	287	0.40	1.68	2.50	1.64	394
468	618	8.5	5	2.5	208	0.37	1.80	2.69	1.76	160
468	614	19.5	5	2.5	229	0.37	1.80	2.69	1.76	198
468	675	12.5	5	2.5	263	0.40	1.68	2.50	1.64	330
468	678	28.5	5	2.5	288	0.40	1.68	2.50	1.64	412
488	646	9	5	2.5	217	0.37	1.80	2.69	1.76	179
488	644	20.5	5	2.5	239	0.37	1.80	2.69	1.76	225
496	714	13	6	3	276	0.40	1.68	2.50	1.64	395
496	712	30	6	3	305	0.40	1.68	2.50	1.64	493
508	665	9	5	2.5	223	0.37	1.80	2.69	1.76	189
508	664	20.5	5	2.5	246	0.37	1.80	2.69	1.76	236
516	743	13.5	6	3	281	0.40	1.68	2.50	1.64	442
516	738	31	6	3	329	0.40	1.68	2.50	1.64	548
522	637	25	4	2	242	0.40	1.68	2.50	1.64	175
528	686	9	5	2.5	230	0.37	1.80	2.69	1.76	202
528	683	21	5	2.5	250	0.37	1.80	2.69	1.76	247
536	780	14.5	6	3	296	0.40	1.68	2.50	1.64	528
536	773	33	6	3	331	0.40	1.68	2.50	1.64	678
558	740	11	5	2.5	250	0.37	1.80	2.69	1.76	265
558	738.5	23	5	2.5	276	0.37	1.80	2.69	1.76	331
566	820	16.5	6	3	303	0.38	1.77	2.64	1.73	620
566	822.5	34	6	3	340	0.39	1.74	2.59	1.70	774
588	709	22.5	5	1.5	257	0.35	1.95	2.90	1.91	232
588	705.5	25	5	1.5	231	0.34	1.98	2.94	1.93	198
588	777	11	5	2.5	277	0.39	1.74	2.59	1.70	340
588	774	24.5	5	2.5	272	0.33	2.03	3.02	1.98	415
596	865	17	6	3	326	0.40	1.68	2.50	1.64	1,310
596	865	35	6	3	362	0.40	1.68	2.50	1.64	894

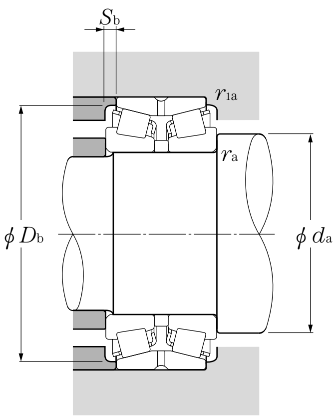
Metric system sizes



d 570～1,115mm

						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
Boundary dimensions (mm) d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
570	815	345	265	6	3	6,300	16,600	640,000	1,690,000	**CRI-11401**
590	780	255	178	5	2.5	3,900	10,500	400,000	1,070,000	**CRI-11801**
600	870	200	176	6	3	3,900	8,550	400,000	870,000	**4130/600**
	980	300	264	7.5	4	7,400	15,400	755,000	1,570,000	**☆4131/600G2**
	980	388	300	7.5	4	8,600	18,400	875,000	1,870,000	**☆4231/600G2**
670	830	180	145	4	1.5	3,050	9,150	310,000	935,000	**☆CRI-13402**
	880	185	130	4	2	3,500	9,100	360,000	930,000	**☆CRI-13401**
	1,090	336	295	7.5	4	9,250	19,700	945,000	2,010,000	**☆4131/670G2**
	1,090	392	336	7.5	4	10,500	24,800	1,070,000	2,530,000	**☆4231/670G2**
710	1,030	236	208	7.5	4	5,900	13,900	600,000	1,420,000	**☆4130/710G2**
	1,030	236	208	7.5	4	5,750	14,000	590,000	1,430,000	**☆CRI-14207**
	1,030	295	236	7.5	4	6,900	16,100	700,000	1,640,000	**☆CRI-14209**
800	1,150	350	256	7.5	4	9,350	24,200	955,000	2,470,000	**☆CRI-16001**
1,040	1,290	350	270	6	2.5	8,850	30,000	900,000	3,050,000	**☆CRI-20802**
1,115	1,460	300	220	5	2.5	8,200	24,000	835,000	2,450,000	**☆CRI-22303**

❶ Minimum allowable dimension for chamfer dimension r or r_1.
Remarks: 1. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



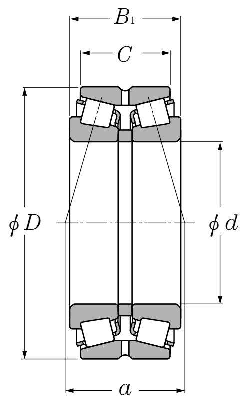
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b min	S_b min	r_{as} max	r_{las} max	a	e	Y_1	Y_2	Y_o	(approx.)
598	781	40	5	2.5	318	0.35	1.95	2.90	1.91	512
612	754	38.5	4	2	288	0.39	1.74	2.59	1.70	291
628	828	12	5	2.5	277	0.37	1.80	2.69	1.76	348
636	925	18	6	3	350	0.40	1.68	2.50	1.64	858
636	923	44	6	3	380	0.38	1.77	2.64	1.73	1,050
688	809	17.5	3	1.5	283	0.40	1.68	2.50	1.64	201
688	845.5	27.5	3	2	317	0.45	1.51	2.25	1.48	277
706	1,033	20.5	6	3	397	0.40	1.68	2.50	1.64	1,180
706	1,021	28	6	3	397	0.37	1.80	2.69	1.76	1,410
746	974	14	6	3	327	0.37	1.80	2.69	1.76	640
746	974	14	6	3	324	0.36	1.87	2.79	1.83	654
746	982	29.5	6	3	362	0.39	1.73	2.58	1.69	810
836	1,092.5	47	6	3	400	0.37	1.80	2.69	1.76	1,119
1,068	1,260	40	5	2	472.3	0.40	1.68	2.50	1.64	975
1,137	1,396.5	40	4	2	554	0.47	1.43	2.12	1.40	1,255

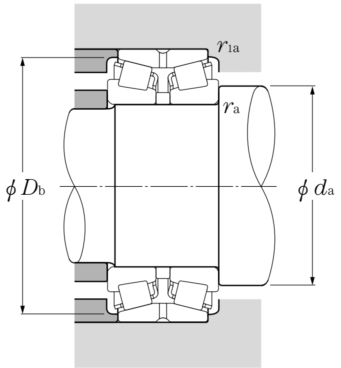
Inch system sizes



d 139.700 ～204.788mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	C_r	C_{or}	C_r	C_{or}	
139.700	307.975	200.025	155.575	1,740	2,780	177,000	283,000	T-HH234031/HH234011D+A
152.400	307.975	200.025	146.050	1,510	2,620	154,000	267,000	T-EE450601/451215D+A
	307.975	200.025	155.575	1,740	2,780	177,000	283,000	T-HH234048/HM234011D+A
160.325	288.925	142.875	111.125	1,160	2,140	119,000	218,000	T-HM237532/HM237510D+A
165.100	288.925	142.875	111.125	940	1,900	96,000	194,000	T-94649/94114D+A
	288.925	142.875	111.125	1,160	2,140	119,000	218,000	T-HM237535/HM237510D+A
174.625	288.925	142.875	111.125	940	1,900	96,000	194,000	T-94687/94114D+A
	288.925	142.875	111.125	1,160	2,140	119,000	218,000	T-HM237542/HM237510D+A
177.800	288.925	142.875	111.125	940	1,900	96,000	194,000	T-94700/94114D+A
	288.925	142.875	111.125	1,160	2,140	119,000	218,000	T-HM237545/HM237510D+A
	320.675	185.738	138.112	1,300	2,480	132,000	253,000	EE222070/222127D+A
	320.675	185.738	138.112	1,590	2,790	162,000	285,000	T-H239640/H239612D+A
187.325	282.575	107.950	79.375	625	1,230	63,500	126,000	T-87737/87112D+A
	320.675	185.738	138.112	1,590	2,790	162,000	285,000	T-H239649/H239612D+A
190.500	282.575	107.950	79.375	625	1,230	63,500	126,000	T-87750/87112D+A
	317.500	146.050	111.125	1,060	2,310	108,000	236,000	T-93750/93127D+A
	368.300	193.675	136.525	1,670	3,200	170,000	330,000	T-EE420751/421451D+A
193.675	282.575	107.950	79.375	625	1,230	63,500	126,000	T-87762/87112D+A
200.025	292.100	125.415	101.600	915	2,070	93,000	211,000	T-M241543/M241510D+A
	317.500	146.050	111.125	1,060	2,310	108,000	236,000	T-93787/93727D+A
	384.175	238.125	193.675	2,500	5,450	255,000	555,000	T-H247535/H247510D+A
203.200	276.225	90.485	73.025	585	1,380	60,000	141,000	LM241149/LM241110D+A
	282.575	101.600	82.550	620	1,570	63,000	160,000	T-67983/67920D+A
	292.100	125.415	101.600	915	2,070	93,000	211,000	T-M241547/M241510D+A
	317.500	146.050	111.125	1,060	2,310	108,000	236,000	T-93800/93127D+A
	368.300	193.675	136.525	1,670	3,200	170,000	330,000	T-EE420801/421451D+A
	406.400	196.850	127.000	1,650	2,950	168,000	300,000	EE114080/114161D+A
204.788	292.100	125.415	101.600	915	2,070	93,000	211,000	T-M241549/M241510D+A

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

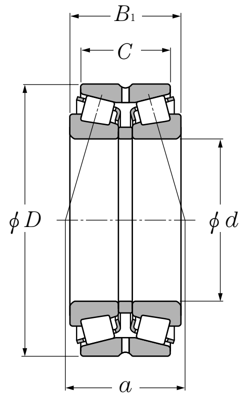
$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm				Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b max	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
180	285	9.7	2.3	149.5	0.33	2.07	3.08	2.02	65.9
189	275	9.7	2.3	143.5	0.33	2.07	3.08	2.02	62.6
191	285	9.7	2.3	149.5	0.33	2.07	3.08	2.02	62.6
192	271	7	1.5	119.5	0.32	2.12	3.15	2.07	36.1
197	272	7	1.5	141	0.47	1.44	2.15	1.41	35.1
195	271	7	1.5	119.5	0.32	2.12	3.15	2.07	35.1
204	272	7	1.5	141	0.47	1.44	2.15	1.41	33.1
202	271	7	1.5	119.5	0.32	2.12	3.15	2.07	33.1
207	272	7	1.5	141	0.47	1.44	2.15	1.41	32.4
205	271	7	1.5	119.5	0.32	2.12	3.15	2.07	32.4
204	298	3.5	1.5	152.5	0.40	1.68	2.50	1.64	57.8
202	301	3.5	1.5	141	0.32	2.12	3.15	2.07	57.8
207	267	3.5	1.5	115.5	0.42	1.62	2.42	1.59	21.1
214	301	5.5	1.5	141	0.32	2.12	3.15	2.07	55
209	267	3.5	1.5	115.5	0.42	1.62	2.42	1.59	20.6
218	300	4.3	1.5	162	0.52	1.29	1.92	1.26	41.2
227	334.4	6.4	1.5	163	0.40	1.68	2.50	1.64	84.1
211	267	3.5	1.5	115.5	0.42	1.62	2.42	1.59	20
219	279	3.5	1.5	116	0.33	2.03	3.02	1.98	24.8
225	300	4.3	1.5	162	0.52	1.29	1.92	1.26	38.8
241	362	6.4	1.5	182	0.33	2.03	3.02	1.98	112
220	267	3.5	0.8	95	0.32	2.12	3.15	2.07	13.8
222	275	3.5	0.8	133.5	0.51	1.33	1.97	1.30	17.1
221	279	3.5	1.5	116	0.33	2.03	3.02	1.98	24.1
227	300	4.3	1.5	162	0.52	1.29	1.92	1.26	37.1
230	334.4	3.3	1.5	163	0.40	1.68	2.50	1.64	79.9
246	374	6.4	3.3	252.5	0.80	0.85	1.26	0.83	107
223	279	3.5	1.5	116	0.33	2.03	3.02	1.98	23.8

Double Row Tapered Roller Bearings (Outside Direction)

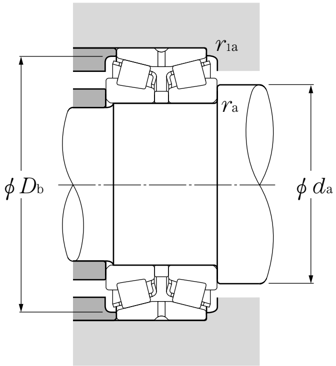
Inch system sizes



d 206.375～241.300mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	C_r	C_{or}	C_r	C_{or}	
206.375	282.575	101.600	82.550	620	1,570	63,000	160,000	**T-67985/67920D+A**
	336.550	211.138	169.862	1,900	4,050	194,000	415,000	**T-H242649/H242610D+A**
209.550	282.575	101.600	82.550	620	1,570	63,000	160,000	**T-67989/67920D+A**
	317.500	146.050	111.125	1,060	2,310	108,000	236,000	**T-93825/93127D+A**
212.725	285.750	98.425	76.200	650	1,640	66,500	167,000	**T-LM742745/LM742710D+A**
215.900	285.750	98.425	76.200	650	1,640	66,500	167,000	**T-LM742749/LM742710D+A**
	287.338	69.850	50.800	355	810	36,000	82,500	**543085/543115D+A**
220.662	314.325	131.762	106.362	1,070	2,450	109,000	250,000	**T-M244249/M244210D+A**
228.460	431.800	196.850	111.125	1,470	2,480	150,000	253,000	**EE113091/113171D+A**
228.600	327.025	114.300	82.550	815	1,900	83,000	194,000	**T-8573/8520D+A**
	355.600	152.400	111.125	1,100	2,540	112,000	259,000	**T-96900/96140D+A**
	355.600	152.400	111.125	1,230	2,510	125,000	256,000	**T-EE130902/131401D+A**
	355.600	152.400	114.300	1,230	2,490	126,000	254,000	**HM746646/HM746610D+A**
	358.775	152.400	117.475	1,390	3,300	142,000	335,000	**T-M249732/M249710D+A**
	400.050	187.325	136.525	1,620	3,250	165,000	330,000	**EE430900/431576D+A**
	488.950	254.000	152.400	2,700	4,550	275,000	460,000	**☆T-HH949549/HH949510DG2+A**
231.775	358.775	152.400	117.475	1,390	3,300	142,000	335,000	**T-M249734/M249710D+A**
234.950	311.150	98.425	73.025	695	1,640	71,000	167,000	**LM446349/LM446310D+A**
	327.025	114.300	82.550	815	1,900	83,000	194,000	**T-8575/8520D+A**
	355.600	152.400	111.125	1,100	2,540	112,000	259,000	**T-96925/96140D+A**
	384.175	238.125	193.675	2,500	5,450	255,000	555,000	**T-H247549/H247510D+A**
237.330	358.775	152.400	117.475	1,390	3,300	142,000	335,000	**T-M249736/M249710D+A**
241.300	327.025	114.300	82.550	815	1,900	83,000	194,000	**T-8578/8520D+A**
	349.148	127.000	101.600	940	2,010	96,000	205,000	**EE127095/127136D+A**
	368.300	120.650	85.725	790	1,630	80,500	166,000	**EE170950/171450D+A**
	393.700	157.162	109.538	1,340	2,800	137,000	286,000	**T-EE275095/275156D+A**
	406.400	215.900	184.150	2,460	4,750	251,000	485,000	**T-H249148/H249111D+A**
	444.500	209.550	158.750	2,380	4,250	243,000	430,000	**☆T-EE923095/923176DG2+A**

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



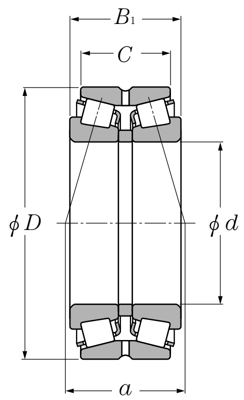
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm				Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b max	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
224	275	3.5	0.8	133.5	0.51	1.33	1.97	1.30	16.5
231	318	3.3	1.5	160	0.33	2.03	3.02	1.98	65.2
227	275	3.5	0.8	133.5	0.51	1.33	1.97	1.30	16
233	300	4.3	1.5	161	0.52	1.29	1.92	1.26	36.3
230	279	3.5	0.8	126.5	0.48	1.40	2.09	1.37	15.7
233	279	3.5	0.8	126.5	0.48	1.40	2.09	1.37	15.1
232	276	3.5	0.8	94.5	0.38	1.77	2.64	1.73	11
245	300	6.4	1.5	122.5	0.33	2.03	3.02	1.98	28.9
274	397	6.4	3.3	276	0.88	0.77	1.14	0.75	116
255	313	6.4	1.5	129.5	0.41	1.66	2.47	1.62	27.3
260	334	7	1.5	185	0.59	1.14	1.70	1.12	49.4
257	330	6.8	1.5	132.5	0.33	2.04	3.04	2.00	49.4
258	339	6.4	1.5	164	0.47	1.43	2.12	1.40	49.4
256	343	3.5	1.5	138.5	0.33	2.03	3.02	1.98	50.9
271	367	10.5	1.5	181.5	0.44	1.54	2.29	1.50	88.3
297	456	6.4	1.5	333.5	0.94	0.72	1.07	0.70	207
263	343	6.4	1.5	138.5	0.33	2.03	3.02	1.98	50
252	301	3.5	0.8	111.5	0.36	1.86	2.77	1.82	17.9
259	313	6.4	1.5	129.5	0.41	1.66	2.47	1.62	25.9
265	334	7	1.5	185	0.59	1.14	1.70	1.12	47.5
269	362	6.4	1.5	181.5	0.33	2.03	3.02	1.98	96.2
267	343	6.4	1.5	138.5	0.33	2.03	3.02	1.98	48.2
264	313	6.4	1.5	129.5	0.41	1.66	2.47	1.62	24.3
267	329	6.4	1.5	133	0.35	1.91	2.85	1.87	35.4
269	337	6.4	1.5	132.5	0.36	1.85	2.76	1.81	40.8
278	378.1	6.4	1.5	162	0.40	1.68	2.50	1.64	66.5
273	385	6.4	1.5	177.5	0.33	2.03	3.02	1.98	101
277	407	6.4	1.5	170.5	0.34	2.00	2.98	1.96	128

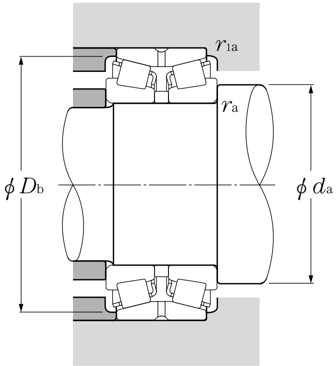
Inch system sizes



d 244.475～280.192mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	C_r	C_{or}	C_r	C_{or}	
244.475	381.000	171.450	127.000	1,300	2,880	132,000	294,000	EE126097/126151D+A
247.650	368.300	120.650	85.725	790	1,630	80,500	166,000	EE170975/171451D+A
	406.400	247.650	203.200	2,830	6,000	289,000	615,000	HH249949/HH249910D+A
249.250	381.000	171.450	127.000	1,300	2,880	132,000	294,000	EE126098/126151D+A
254.000	323.850	63.500	50.800	216	635	22,000	64,500	29875/29820D+A
	358.775	152.400	117.475	1,390	3,300	142,000	335,000	T-M249749/M249710D+A
	365.125	130.175	98.425	1,050	2,380	107,000	243,000	T-EE134100/134144D+A
	393.700	157.162	109.538	1,340	2,800	137,000	286,000	T-EE275100/275156D+A
	422.275	178.592	139.700	2,000	3,600	204,000	365,000	T-HM252343/HM252310D+A
	533.400	276.225	165.100	2,880	5,200	293,000	530,000	HH953749/HH953710D+A
260.350	365.125	130.175	98.425	1,050	2,380	107,000	243,000	T-EE134102/134144D+A
	400.050	155.575	107.950	1,220	2,460	124,000	251,000	EE221026/221576D+A
	419.100	184.150	136.525	1,580	3,250	161,000	330,000	EE435102/435165D+A
	422.275	178.592	139.700	2,000	3,600	204,000	365,000	T-HM252348/HM252310D+A
	488.950	254.000	196.850	3,000	5,950	310,000	605,000	EE295102/295192D+A
263.525	355.600	127.000	101.600	1,070	2,670	110,000	272,000	T-LM451345/LM451310D+A
266.700	323.850	63.500	50.800	216	635	22,000	64,500	29880/29820D+A
	355.600	127.000	101.600	1,070	2,670	110,000	272,000	T-LM451349/LM451310D+A
	393.700	157.162	109.538	1,340	2,800	137,000	286,000	T-EE275105/275156D+A
269.875	381.000	158.750	123.825	1,520	3,600	155,000	365,000	T-M252349/M252310D+A
273.050	393.700	157.162	109.538	1,340	2,800	137,000	286,000	T-EE275108/275156D+A
279.400	374.650	104.775	79.375	810	2,020	82,500	206,000	L555233/L555210D+A
	469.900	200.025	149.225	2,030	4,350	207,000	445,000	EE722110/722186D+A
	488.950	254.000	196.850	3,000	5,950	310,000	605,000	EE295110/295192D+A
279.982	380.898	139.700	107.950	1,140	3,100	116,000	315,000	T-LM654642/LM654610D+A
280.192	406.400	149.225	117.475	1,310	3,100	133,000	315,000	EE128111/128160D+A

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.



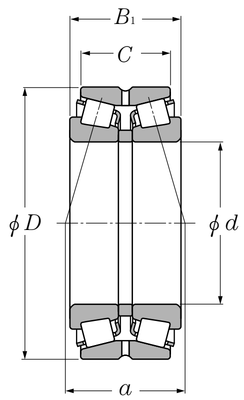
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm				Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b max	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
275	358	6.4	1.5	186.5	0.52	1.31	1.95	1.28	64
274	337	6.4	1.5	132.5	0.36	1.85	2.76	1.81	39.2
284	383	6.4	1.5	189.5	0.33	2.03	3.02	1.98	112
279	358	6.4	1.5	186.5	0.52	1.31	1.95	1.28	62.2
267	312	1.5	0.8	105	0.35	1.95	2.90	1.91	11.2
274	343	3.5	1.5	138.5	0.33	2.03	3.02	1.98	42.8
281	347	6.4	1.5	140	0.37	1.80	2.69	1.76	39.2
287	378	6.4	1.5	162.5	0.40	1.68	2.50	1.64	62.2
287	400	6.8	1.5	160	0.33	2.03	3.02	1.98	88.9
328	496	6.4	1.5	365.5	0.94	0.71	1.06	0.70	266
286	347	6.4	1.5	140	0.37	1.80	2.69	1.76	37.3
296	372	9.7	1.5	159	0.39	1.71	2.54	1.67	62.7
295	395	6.4	1.5	225.5	0.61	1.11	1.66	1.09	86.8
292	400	6.8	1.5	160	0.33	2.03	3.02	1.98	86.3
299	451	6.4	1.5	196.5	0.31	2.16	3.22	2.12	190
283	343	3.5	1.5	136.5	0.36	1.87	2.79	1.83	31.7
277	312	1.5	0.8	105	0.35	1.95	2.90	1.91	9.37
285	343	3.5	1.5	136.5	0.36	1.87	2.79	1.83	30.7
296	378	6.4	1.5	162.5	0.40	1.68	2.50	1.64	57.6
296	364	6.4	1.5	146.5	0.33	2.03	3.02	1.98	52.3
301	378	6.4	1.5	162.5	0.40	1.68	2.50	1.64	55.3
300	362	3.5	1.5	138.5	0.40	1.68	2.50	1.64	28.5
321	433	9.7	1.5	187.5	0.38	1.78	2.65	1.74	125
303	451	1.3	1.5	196.5	0.31	2.16	3.22	2.12	179
302	368	3.5	1.5	163	0.43	1.56	2.33	1.53	40.7
309	384	6.8	1.5	158	0.39	1.75	2.61	1.71	56.5

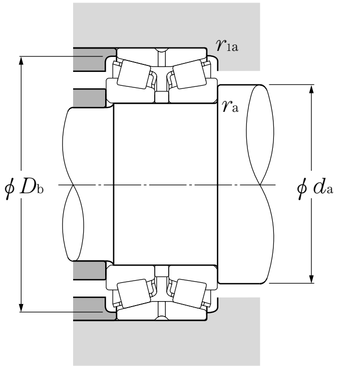
Inch system sizes



d 285.750～355.600mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	C_r	C_{or}	C_r	C_{or}	
285.750	358.775	76.200	53.975	450	1,080	46,000	110,000	545112/545142DA+A
	380.898	139.700	107.950	1,140	3,100	116,000	315,000	T-LM654649/LM654610D+A
	501.650	203.200	120.650	1,960	3,700	200,000	375,000	EE147112/147198D+A
288.925	406.400	165.100	130.175	1,740	4,150	177,000	425,000	M255449/M255410DA+A
292.100	374.650	104.775	79.375	810	2,020	82,500	206,000	L555249/L555210D+A
	469.900	200.025	149.225	2,030	4,350	207,000	445,000	EE722115/722186D+A
298.450	444.500	146.050	98.425	1,080	2,300	110,000	234,000	EE291175/291751D+A
299.974	495.300	301.625	247.650	4,200	9,800	425,000	1,000,000	☆HH258248/HH258210DG2+A
300.038	422.275	174.625	136.525	1,950	4,800	198,000	490,000	☆T-HM256849/HM256810DG2+A
304.800	393.700	107.950	82.550	835	2,070	85,500	211,000	L357049/L357010D+A
	438.048	165.100	120.650	1,380	3,200	141,000	325,000	T-EE129120X/129120D+A
	444.500	146.050	98.425	1,080	2,300	110,000	234,000	EE291201/291751D+A
	495.300	196.850	146.050	2,120	4,700	216,000	480,000	EE724120/724196D+A
317.500	444.500	146.050	98.425	1,080	2,300	110,000	234,000	EE291250/291751D+A
	447.675	180.975	146.050	1,990	4,800	203,000	485,000	T-HM259049/HM259010D+A
	622.300	304.800	174.625	3,250	6,250	330,000	640,000	☆H961649/H961610DG2+A
330.200	482.600	133.350	88.900	1,200	2,870	122,000	293,000	T-EE161300/161901D+A
	482.600	177.800	127.000	1,640	3,950	167,000	400,000	EE526130/526191D+A
333.375	469.900	190.500	152.400	2,320	5,500	237,000	565,000	HM261049/HM261010DA+A
342.900	457.098	142.875	104.775	1,210	3,300	124,000	335,000	LM961548/LM961511D+A
	533.400	165.100	114.300	1,830	3,450	187,000	355,000	EE971354/972102D+A
346.075	482.600	133.350	88.900	1,200	2,870	122,000	293,000	T-EE161363/161901D+A
	488.950	200.025	158.750	2,540	6,400	259,000	650,000	☆T-HM262749/HM262710DG2+A
349.250	514.350	193.675	152.400	2,040	4,550	209,000	465,000	EE333137/333203D+A
355.600	444.500	136.525	111.125	1,120	3,500	114,000	355,000	T-L163149/L163110D+A
	482.600	133.350	88.900	1,200	2,870	122,000	293,000	T-EE161400/161901D+A

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



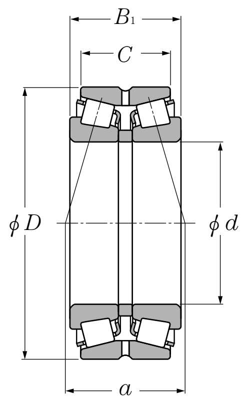
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm				Load center mm	Constant	Axial load factors			Mass kg
d_a min	D_b max	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
302	345	3.5	1.5	144	0.49	1.38	2.05	1.34	15.7
306	368	3.5	1.5	163	0.43	1.56	2.33	1.53	38.7
329	468	6.4	3.3	307	0.84	0.81	1.20	0.79	151
316	388	6.4	1.5	157	0.34	2.00	2.98	1.96	59
309	362	3.5	1.5	138.5	0.40	1.68	2.50	1.64	25.2
330	433	9.7	1.5	187.5	0.38	1.78	2.65	1.74	118
332	414	8	1.5	164	0.38	1.78	2.65	1.74	69.3
342	467	6.4	1.5	231	0.33	2.03	3.02	1.98	205
328	403	6.4	1.5	163.5	0.34	2.00	2.99	1.96	67.4
329	380	6.4	1.5	133	0.36	1.87	2.79	1.83	29.3
334	411	6.4	1.5	179.5	0.42	1.62	2.42	1.59	71.4
337	414	8	1.5	164	0.38	1.78	2.65	1.74	66.8
359	459	16	1.5	195	0.40	1.68	2.50	1.64	131
346	414	8	1.5	164	0.38	1.78	2.65	1.74	61.8
341	428	3.5	1.5	162	0.33	2.02	3.00	1.97	78.8
410	582	14.3	3.3	430	0.95	0.71	1.06	0.70	382
367	455	7	1.5	200.5	0.50	1.35	2.01	1.32	72.2
360	454	6.4	1.5	183.5	0.39	1.72	2.56	1.68	96.3
363	449	6.4	1.5	179.5	0.33	2.02	3.00	1.97	91.3
367	443.1	3.3	1.5	253.5	0.71	0.95	1.41	0.93	57.1
373	496	4.8	1.5	170	0.33	2.03	3.02	1.98	120
379	455	7	1.5	200.5	0.50	1.35	2.01	1.32	66
377	467	6.4	1.5	187.5	0.33	2.02	3.00	1.97	104
382	478	6.4	1.5	197.5	0.36	1.85	2.76	1.81	121
374	430	3.5	1.5	151	0.31	2.20	3.27	2.15	42.5
386	455	7	1.5	200.5	0.50	1.35	2.01	1.32	62.1

Inch system sizes

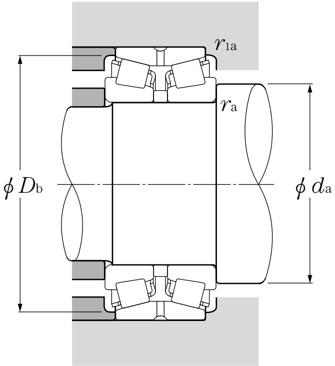


d 355.600～482.600mm

	Boundary dimensions (mm)			Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	C_r	C_{or}	C_r	C_{or}	
355.600	501.650	155.575	107.950	1,550	3,650	158,000	375,000	**T-EE231400/231976D+A**
	514.350	193.675	152.400	2,040	4,550	209,000	465,000	**EE333140/333203D+A**
368.249	523.875	214.312	169.862	2,610	6,550	266,000	665,000	**☆HM265049/HM265010DG2+A**
371.475	501.650	155.575	107.950	1,550	3,650	158,000	375,000	**T-EE231462/231976D+A**
381.000	508.000	139.700	88.900	920	2,270	94,000	232,000	**EE192150/192201D+A**
	546.100	222.250	177.800	2,950	7,350	300,000	750,000	**T-HM266446/HM266410D+A**
	590.550	244.475	193.675	3,650	9,450	375,000	965,000	**☆T-M268730/M268710DG2+A**
384.175	441.325	68.262	52.388	360	1,060	36,500	108,000	**LL365340/LL365310D+A**
	546.100	222.250	177.800	2,950	7,350	300,000	750,000	**T-HM266448/HM266410D+A**
	546.100	222.250	177.800	3,150	8,050	320,000	820,000	**☆T-HM266449/HM266410DG2+A**
385.762	514.350	177.800	139.700	2,120	5,550	216,000	565,000	**LM665949/LM665910D+A**
396.875	539.750	142.875	101.600	1,330	3,300	136,000	335,000	**EE234156/234213D+A**
	546.100	158.750	117.475	1,330	3,300	136,000	335,000	**EE234156/234216D+A**
406.400	539.750	142.875	101.600	1,330	3,300	136,000	335,000	**EE234160/234213D+A**
	609.600	187.325	123.825	2,110	4,650	215,000	475,000	**EE911600/912401D+A**
415.925	590.550	244.475	193.675	3,650	9,450	375,000	965,000	**☆T-M268749/M268710DG2+A**
431.800	571.500	155.575	111.125	1,880	4,950	191,000	505,000	**T-LM869448/LM869410D+A**
	603.250	159.639	104.775	1,670	4,100	171,000	420,000	**EE241701/242377D+A**
	673.100	192.639	127.000	2,560	5,350	261,000	545,000	**EE571703/572651D+A**
447.675	635.000	257.175	206.375	4,150	11,100	425,000	1,130,000	**☆M270749/M270710DAG2+A**
457.200	596.900	165.100	120.650	1,670	4,700	170,000	480,000	**EE244180/244236D+A**
	730.148	254.000	177.800	4,350	8,750	445,000	895,000	**EE671801/672875D+A**
479.425	679.450	276.225	222.250	4,900	13,000	500,000	1,320,000	**☆T-M272749/M272710DG2+A**
482.600	615.950	184.150	146.050	2,320	6,700	237,000	685,000	**☆LM272249/LM272210DG2+A**
	634.873	177.800	142.875	2,000	6,150	204,000	630,000	**EE243190/243251D+A**

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

Double Row Tapered Roller Bearings (Outside Direction)



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

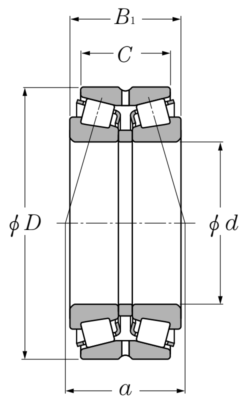
static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions (mm)				Load center (mm)	Constant	Axial load factors			Mass (kg)
d_a min	D_b max	r_{as} max	r_{las} max	a	e	Y_1	Y_2	Y_o	(approx.)
388	481	6.4	1.5	195	0.44	1.53	2.28	1.50	85.2
387	478	6.4	1.5	197.5	0.36	1.85	2.76	1.81	117
400	499	6.4	1.5	198.5	0.33	2.03	3.02	1.98	142
400	481	6.4	1.5	195	0.44	1.53	2.28	1.50	77.3
410	482	6.4	1.5	221	0.53	1.27	1.89	1.24	69
415	519	6.4	1.5	208	0.33	2.03	3.02	1.98	149
425	561	6.4	1.5	226	0.33	2.03	3.02	1.98	247
399	433	3.5	0.8	128.5	0.34	1.99	2.96	1.94	14.1
417	519	6.4	1.5	208	0.33	2.03	3.02	1.98	146
417	520	6.4	1.5	208	0.33	2.03	3.02	1.98	146
415	495	6.4	1.5	210.5	0.42	1.61	2.40	1.58	90
428	516	6.4	1.5	214.5	0.47	1.43	2.12	1.40	83.6
428	516	6.4	1.5	230.5	0.47	1.43	2.12	1.40	97.7
435	518	6.4	1.5	214.5	0.47	1.43	2.12	1.40	78.8
443	570	6.8	1.5	209	0.38	1.76	2.62	1.72	169
451	561	6.4	1.5	226	0.33	2.03	3.02	1.98	188
457	549	3.3	1.5	255.5	0.55	1.24	1.84	1.21	95.3
446	561	6.4	1.5	252.5	0.53	1.28	1.91	1.25	124
472	630	6.4	1.5	235.5	0.40	1.68	2.50	1.64	225
484	606	6.4	1.5	240	0.33	2.03	3.02	1.98	228
494	570	9.7	1.5	219	0.40	1.67	2.49	1.63	106
507	681	9.7	1.5	266	0.39	1.72	2.56	1.68	360
516	648	6.4	1.5	258.5	0.33	2.03	3.02	1.98	310
513	597	6.4	1.5	206.5	0.33	2.03	3.02	1.98	118
516	609	6.4	1.5	215	0.34	1.98	2.94	1.93	148

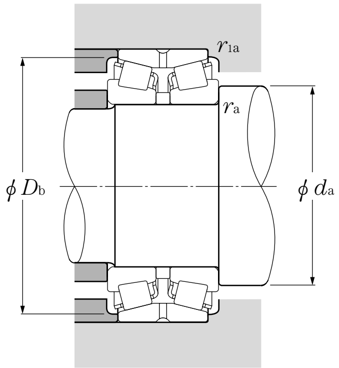
Inch system sizes



d 488.950～1,270.000mm

d	D	B_1	C	C_r (dynamic, kN)	C_{or} (static, kN)	C_r (dynamic, kgf)	C_{or} (static, kgf)	Bearing numbers
488.950	634.873	180.975	136.525	2,500	6,950	255,000	710,000	**LM772748/LM772710DA+A**
	660.400	206.375	158.750	3,150	8,050	320,000	820,000	**☆T-EE640192/640261DG2+A**
489.026	634.873	177.800	142.875	2,000	6,150	204,000	630,000	**EE243192/243251D+A**
498.475	634.873	177.800	142.875	2,000	6,150	204,000	630,000	**EE243196/243251D+A**
508.000	838.200	304.800	222.250	5,450	12,800	555,000	1,310,000	**EE426200/426331D+A**
533.400	812.800	269.875	187.325	4,450	10,400	455,000	1,060,000	**EE626210/626321D+A**
536.575	761.873	311.150	247.650	5,900	15,200	600,000	1,550,000	**☆M276449/M276410DG2+A**
549.275	692.150	174.625	136.525	2,320	6,950	236,000	710,000	**L476549/L476510D+A**
558.800	736.600	165.100	114.300	2,050	5,400	209,000	550,000	**EE542220/542291D+A**
	736.600	187.328	138.112	2,500	6,750	255,000	690,000	**EE843220/843291D+A**
	736.600	225.425	177.800	3,150	8,800	325,000	895,000	**LM377449/LM377410D+A**
571.500	812.800	333.375	263.525	6,950	18,300	710,000	1,870,000	**☆M278749/M278710DAG2+A**
609.600	787.400	206.375	158.750	3,750	10,100	380,000	1,030,000	**☆EE649240/649311DG2+A**
	812.800	190.500	146.050	2,860	7,850	292,000	800,000	**EE743240/743321D+A**
660.400	812.800	203.200	158.750	3,250	10,300	330,000	1,060,000	**L281148/L281110DA+A**
711.200	914.400	190.500	139.700	3,100	8,950	315,000	910,000	**☆EE755280/755361DG2+A**
723.900	914.400	187.325	139.700	3,100	8,950	315,000	910,000	**☆EE755285/755361DG2+A**
977.900	1,130.300	139.700	101.600	2,050	7,200	209,000	735,000	**LL687949/LL687910D+A**
1,270.000	1,435.100	146.050	101.600	2,730	10,100	278,000	1,030,000	**LL889049/LL889010D+A**

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

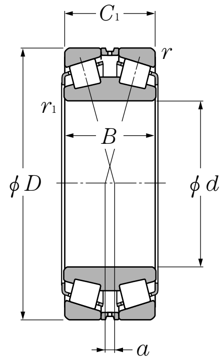
static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions (mm)				Load center (mm)	Constant	Axial load factors			Mass (kg)
d_a min	D_b max	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
522	613	6.4	1.5	262	0.47	1.43	2.12	1.40	130
522	627	6.4	1.5	216	0.31	2.20	3.27	2.15	178
522	609	6.4	1.5	215	0.34	1.98	2.94	1.93	140
528	609	6.4	1.5	215	0.34	1.98	2.94	1.93	129
564	768	9.7	3.3	357	0.48	1.41	2.09	1.37	592
585	762	9.7	3.3	322.5	0.44	1.52	2.26	1.49	444
576	726	6.4	1.5	290	0.33	2.03	3.02	1.98	398
579	666	6.4	1.5	239	0.38	1.79	2.67	1.75	135
594	705	6.4	3.3	298	0.51	1.32	1.96	1.29	166
591	708	6.4	1.5	231	0.34	1.98	2.94	1.93	189
594	708	6.4	1.5	256.5	0.35	1.95	2.90	1.91	227
615	774	6.4	1.5	308	0.33	2.03	3.02	1.98	487
642	764	6.4	1.5	254	0.33	2.03	3.02	1.98	235
645	765	6.4	3.3	254	0.33	2.06	3.06	2.01	241
693	789	6.4	1.5	667.5	0.37	1.80	2.69	1.76	199
750	876	6.4	3.3	295.5	0.38	1.77	2.64	1.73	275
756	876	5.5	3.3	295.5	0.38	1.77	2.64	1.73	256
1,010	1,100	6.4	3.3	376	0.44	1.54	2.30	1.51	196
1,305	1,400	6.4	3.3	586.5	0.58	1.17	1.75	1.15	285

Metric system sizes

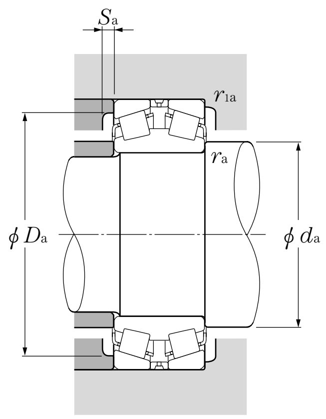


d 100～180mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B	C_1	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
100	250	116	116	4	4	790	1,050	80,500	107,000	CRD-2051
105	170	90	90	2.5	2.5	420	860	42,500	87,500	CRD-2151
110	180	56	56	2	2.5	298	485	30,500	49,500	323122
	190	102	98	3	1.5	515	950	52,500	96,500	CRD-2252
	200	82	82	2.5	1	555	865	56,500	88,500	CRD-2254
120	170	120	120	2	2	415	890	42,500	91,000	CRD-2421
	180	46	46	2	2.5	230	375	23,500	38,000	323024
	200	62	62	2	2.5	370	610	38,000	62,500	323124
	215	113	113	2.5	2.5	735	1,300	75,000	133,000	CRD-2420
	280	150	140	3	3	1,130	1,840	115,000	187,000	CRD-2422
130	190	120	120	1.5	1.5	415	840	42,000	85,500	CRD-2652
	195	120	120	2.5	1.5	475	1,040	48,500	106,000	CRD-2654
	200	52	52	2	2.5	294	490	29,900	50,000	323026
	210	64	64	2	2.5	410	675	42,000	69,000	323126
140	210	53	53	2	2.5	300	535	30,500	54,500	323028
	225	68	68	2.5	3	390	650	40,000	66,000	323128
150	225	56	56	2.5	3	355	630	36,000	64,500	323030
	250	80	80	2.5	3	600	1,040	61,500	106,000	323130
	250	110	110	2.5	2.5	855	1,590	87,500	162,000	CRD-3052
160	240	60	60	2.5	3	430	765	44,000	78,000	323032
	240	110	110	2.5	2.5	750	1,560	76,500	159,000	CRD-3254
	260	130	130	3	1.5	880	1,740	89,500	178,000	CRD-3253
	270	86	86	2.5	3	675	1,180	69,000	120,000	323132E1
	270	116	116	2.5	2.5	835	1,640	85,500	167,000	CRD-3208
170	260	67	67	2.5	3	490	865	50,000	88,000	323034
	280	76	76	2.5	2.5	550	900	56,000	92,000	CRD-3413
	280	88	88	2.5	3	725	1,270	74,000	130,000	323134E1
177.000	248.000	90.488	90.488	3.3	1.57	515	1,180	52,500	120,000	∗CRD-3502
180	280	74	74	2.5	3	580	1,050	59,500	107,000	323036E1

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ "−" means the load center is out side the inner ring.

Remarks: 1. The marked "∗" bearings are inch system sizes.



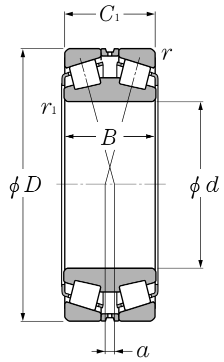
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm						Load[2] center mm	Constant	Axial load factors			Mass kg
d_a max	D_a max	D_a min	S_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
135	232	200	4.5	3	3	– 14.5	0.40	1.68	2.50	1.64	30
124.5	158	148.5	2.5	2	2	– 22.5	0.29	2.35	3.50	2.30	7.92
124	170	160	8	2	2	1	0.33	2.03	3.02	1.98	5.6
128.5	176	160	5	2.5	1.5	– 16	0.42	1.62	2.42	1.59	12.1
128.5	188	170.5	4	2	1	– 2	0.42	1.61	2.39	1.57	11.3
130.5	160	149	0.4	2	2	– 49	0.25	2.69	4.00	2.63	8.57
134	170	164	8	2	2	12	0.37	1.80	2.69	1.76	4.08
134	190	175	8	2	2	6.5	0.37	1.80	2.69	1.76	7.82
141	203	180.5	4.3	2	2	– 22	0.35	1.95	2.90	1.91	17.7
172	266	237	7.3	2.5	2.5	– 28.5	0.33	2.03	3.02	1.98	47.3
144	181.5	171	2	1.5	1.5	– 43.5	0.33	2.03	3.02	1.98	11.4
142.5	183	166	2.7	2	1.5	– 26.5	0.47	1.43	2.12	1.40	12.5
144	190	184	8	2	2	13.5	0.37	1.80	2.69	1.76	5.92
144	200	185	8	2	2	7.5	0.37	1.80	2.69	1.76	8.58
155	200	190	8	2	2	10	0.37	1.84	2.74	1.80	6.4
156	213	200	10	2	2.5	8	0.37	1.80	2.69	1.76	10.7
165	213	205	10	2	2.5	15.5	0.37	1.80	2.69	1.76	7.76
168	238	220	10	2	2.5	6.5	0.37	1.80	2.69	1.76	15.7
169	238	213	4.4	2	2	1	0.46	1.47	2.19	1.44	21.7
175	228	215	10	2	2.5	17.5	0.37	1.80	2.69	1.76	9.46
175.5	228	211	2.1	2	2	– 14.5	0.33	2.03	3.02	1.98	17.3
175	246	213	3.5	2.5	1.5	15	0.62	1.09	1.62	1.06	26.9
178	258	240	10	2	2.5	8	0.37	1.80	2.69	1.76	20
184.5	258	227	4.2	2	2	– 4.5	0.40	1.68	2.50	1.64	27.1
185	248	235	10	2	2.5	18	0.37	1.80	2.69	1.76	12.8
195	264	245	4.5	2	2	18	0.40	1.68	2.50	1.64	18.5
188	268	250	10	2	2.5	8.5	0.37	1.80	2.69	1.76	21.5
189	234	218	3.4	3.3	1.5	15.5	0.44	1.52	2.26	1.49	13.45
198	268	250	10	2	2.5	17	0.37	1.80	2.69	1.76	16.5

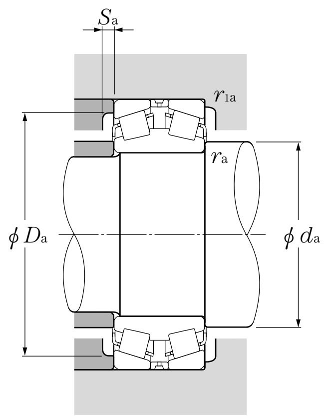
Metric system sizes



d 180～280mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B	C_1	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
180	300	96	96	3	4	885	1,530	90,500	156,000	323136E1
	330	190	190	5	1.5	1,710	3,250	175,000	330,000	CRD-3615
190	290	75	75	2.5	3	615	1,110	63,000	113,000	323038E1
	320	104	104	3	4	985	1,710	100,000	174,000	323138
195	305	120	120	2.5	3	1,130	2,200	115,000	225,000	CRD-3906
200	310	82	82	2.5	3	720	1,320	73,000	135,000	323040E1
	340	112	112	3	4	1,090	1,910	111,000	195,000	323140
	340	140	140	3	3	1,490	2,780	152,000	283,000	CRD-4019
	340	150	150	3	1.5	1,290	2,490	131,000	254,000	CRD-4015
	420	235	235	5	2	3,000	5,350	305,000	545,000	☆CRD-4020
220	320	76.2	76.2	2.5	2.5	630	1,220	64,500	125,000	CRD-4405
	340	90	90	3	4	880	1,650	89,500	168,000	323044E1
	370	120	120	4	5	1,220	2,260	125,000	230,000	323144
240	360	92	92	3	4	910	1,770	92,500	181,000	323048E1
	395	124	124	4	4	1,400	2,630	143,000	268,000	CRD-4804
	400	128	128	4	5	1,400	2,600	142,000	265,000	323148
	400	160	160	4	4	1,770	3,550	181,000	360,000	CRD-4805
	400	160	160	4	4	1,770	3,550	181,000	36,000	CRD-4811
241.300	355.524	109.538	109.538	3.3	1.57	940	2,010	96,000	205,000	∗CRD-4803
259.5	481	250	250	5	2	3,250	6,650	330,000	680,000	CRD-5215
260	400	104	104	4	5	1,150	2,190	117,000	223,000	323052
	400	150	150	4	4	1,470	3,200	150,000	325,000	CRD-5212
	440	144	144	4	5	1,960	3,750	200,000	380,000	323152
260.350	419.100	180.000	158.750	3.3	1.57	1,580	3,250	161,000	330,000	∗CRD-5217
270	395	94	94	3	4	1,090	2,290	111,000	233,000	CRD-5403
280	420	106	106	4	5	1,200	2,340	123,000	238,000	323056
	460	146	146	5	6	1,940	3,650	198,000	375,000	323156

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ "−" means the load center is out side the inner ring.
Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



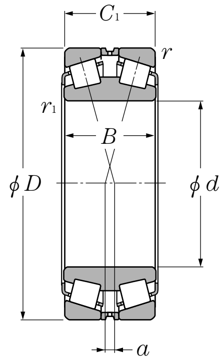
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm						Load❷ center mm	Constant	Axial load factors			Mass kg
d_a	D_a		S_a	r_{as}	r_{1as}						
max	max	min	min	max	max	a	e	Y_1	Y_2	Y_o	(approx.)
200	286	265	12	2.5	3	8	0.37	1.80	2.69	1.76	27.2
197.5	238	264	3.5	4	1.5	– 5.5	0.58	1.17	1.75	1.15	71.6
208	278	260	12	2	2.5	17.5	0.37	1.80	2.69	1.76	17.9
212	306	285	12	2.5	3	8.5	0.37	1.80	2.69	1.76	34
215	293	267	5.4	2	2.5	– 1	0.37	1.80	2.69	1.76	32.5
218	298	280	12	2	2.5	19	0.37	1.80	2.69	1.76	21.7
222	326	300	12	2.5	3	8.5	0.37	1.80	2.69	1.76	41.7
226.5	326	290	7.8	2.5	2.5	– 1.5	0.40	1.68	2.50	1.64	52.1
224	326	277.5	3.1	2.5	1.5	– 2.5	0.42	1.60	2.39	1.57	55.9
248.5	398	341	6.3	4	2	– 48.5	0.37	1.80	2.69	1.76	158
244	308	288	5.5	2	2	28.5	0.39	1.74	2.59	1.70	20.3
242	326	310	12	2.5	3	21.5	0.37	1.80	2.69	1.76	29.8
248	352	325	14	3	4	14	0.40	1.68	2.50	1.64	52.2
262	346	330	14	2.5	3	23.5	0.37	1.80	2.69	1.76	32.6
276	377	345	6.6	3	3	20.5	0.40	1.68	2.50	1.64	60.2
268	382	355	14	3	4	17	0.40	1.68	2.50	1.64	64.6
275	382	343	7.5	3	3	– 1	0.40	1.68	2.50	1.64	80.7
275	382	342	7.5	3	3	– 1	0.40	1.68	2.50	1.64	80.7
265	341	311.5	3.5	3.3	1.5	11	0.35	1.91	2.85	1.87	36.8
297	459	385	3.5	4	2	– 7	0.49	1.38	2.06	1.35	202
285	382	365	14	3	4	25	0.37	1.80	2.69	1.76	47.3
289	382	345	3.4	3	3	15	0.43	1.57	2.34	1.53	68.3
290	422	385	16	3	4	16.5	0.40	1.68	2.50	1.64	90
287	405	355	7.5	3.3	1.5	49.5	0.61	1.11	1.66	1.09	95.7
300	381	353	7.1	2.5	3	27	0.35	1.95	2.90	1.91	38.5
305	402	385	16	3	4	29.5	0.37	1.80	2.69	1.76	51.2
315	438	400	16	4	5	16	0.40	1.68	2.50	1.64	95.8

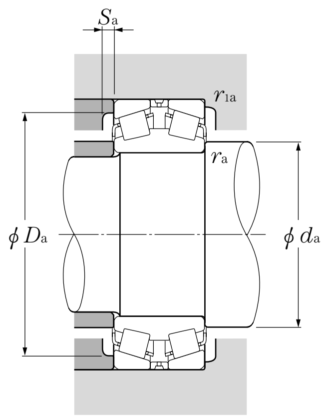
Metric system sizes



d 300～420mm

	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B	C_1	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
300	460	118	118	4	5	1,610	3,150	165,000	320,000	**323060**
	500	160	160	5	6	2,100	4,050	214,000	415,000	**323160**
304.648	438.048	128.575	138.112	4.83	3.3	1,480	3,450	151,000	350,000	**＊CRD-6132**
320	480	121	121	4	5	1,580	3,100	162,000	315,000	**323064**
	510.8	220	220	4	4	3,100	6,850	320,000	700,000	**CRD-6409**
	540	176	176	5	6	2,500	4,900	255,000	500,000	**323164**
	580	240	240	5	3	3,700	7,800	380,000	795,000	**☆CRD-6415**
	620	280	280	5	5	5,250	10,300	535,000	1,050,000	**☆CRD-6420**
340	470	110	110	3	3	1,320	3,050	134,000	310,000	**CRD-6804**
	520	133	133	5	6	1,890	3,750	193,000	380,000	**323068**
	580	190	190	5	6	3,350	6,500	345,000	660,000	**323168**
350	480	110	110	4	4	1,400	3,150	143,000	320,000	**CRD-7015**
	590	192	192	5	5	3,200	6,100	330,000	620,000	**CRD-7011**
360	540	134	134	5	6	2,050	4,200	209,000	430,000	**323072**
	600	192	192	5	6	3,200	6,500	325,000	660,000	**323172**
	680	320	330	6	6	6,500	13,900	665,000	1,410,000	**☆CRD-7207**
379	681.5	307	307	6	6	6,450	14,300	660,000	1,460,000	**☆CRD-7615**
	681.5	307	307	6	6	6,450	14,300	660,000	1,460,000	**☆CRD-7621**
380	560	135	135	5	6	2,080	4,350	213,000	445,000	**323076**
	620	194	194	5	6	3,350	6,700	340,000	685,000	**323176**
385	530	180	180	4	2	2,370	5,750	241,000	590,000	**CRD-7701**
400	590	142	142	5	5	2,400	5,050	245,000	515,000	**☆CRD-8008**
	590	142	142	5	5	2,080	4,150	212,000	425,000	**☆CRD-8012**
	600	148	148	5	6	2,530	5,450	258,000	555,000	**323080**
	650	200	200	6	6	3,750	7,850	385,000	800,000	**323180**
	650	250	250	6	6	4,900	10,500	500,000	1,070,000	**☆CRD-8017**
	730	340	340	7.5	7.5	7,400	15,900	755,000	1,620,000	**☆CRD-8029**
	780	380	380	7.5	7.5	8,800	17,700	900,000	1,800,000	**☆CRD-8040**
420	520	90	90	4	1.5	1,020	2,700	105,000	275,000	**CRD-8402**

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ "－" means the load center is out side the inner ring.
Remarks: 1. The marked "＊" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



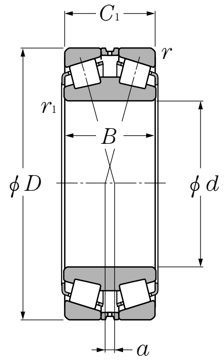
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm						Load center[2] mm	Constant	Axial load factors			Mass kg
d_a	D_a		S_a	r_{as}	r_{1as}						
max	max	min	min	max	max	a	e	Y_1	Y_2	Y_o	(approx.)
330	442	425	16	3	4	31	0.37	1.80	2.69	1.76	70.7
335	478	440	16	4	5	18	0.40	1.68	2.50	1.64	126
327	416	379.5	5.2	4.8	3.3	73	0.60	1.12	1.67	1.10	62.8
350	462	440	16	3	4	34	0.37	1.80	2.69	1.76	76.3
358	493	442.5	2.5	3	3	– 23	0.35	1.95	2.90	1.91	173
355	518	480	18	4	5	18.5	0.40	1.68	2.50	1.64	164
379	558	480	5.5	2.5	4	3	0.43	1.57	2.34	1.53	288
360	598	544	19.5	4	4	– 16.5	0.43	1.57	2.34	1.53	390
369	456	424	6.5	2.5	2.5	49.5	0.40	1.68	2.50	1.64	57.8
370	498	480	18	4	5	36	0.37	1.80	2.69	1.76	101
380	558	515	18	4	5	35.5	0.40	1.68	2.50	1.64	207
376.5	462	436	5.4	3	3	57.5	0.42	1.62	2.42	1.59	58.7
407	568	515	3.5	4	4	6	0.33	2.03	3.02	1.98	218
395	518	495	18	4	5	41	0.37	1.80	2.69	1.76	107
400	578	535	18	4	5	25.5	0.40	1.68	2.50	1.64	218
431	652	552	16.5	5	5	– 12	0.47	1.43	2.12	1.40	570
456	653.5	575	19.5	5	5	– 18.5	0.40	1.68	2.50	1.64	525
456	653.5	575	15.5	5	5	– 18.5	0.40	1.68	2.50	1.64	525
418	538	504	18	4	5	44.5	0.37	1.80	2.69	1.76	110
428	598	537.5	20	4	5	29	0.40	1.68	2.50	1.64	231
407.5	512	476	7.5	2	3	26	0.43	1.57	2.34	1.53	116
440.5	568	533	8.5	4	4	28.5	0.33	2.03	3.02	1.98	134
440.5	568	533	8.5	4	4	36.5	0.33	2.03	3.02	1.98	134
440	578	550	18	4	5	45	0.37	1.80	2.69	1.76	146
445	622	580	20	5	5	32.5	0.40	1.68	2.50	1.64	259
457.5	622	565	11.5	5	5	– 1	0.39	1.74	2.59	1.70	325
470	694	604	20.5	6	6	– 32	0.40	1.68	2.50	1.64	672
477.5	744	639	16.6	6	6	– 47	0.40	1.68	2.50	1.64	895
441	502	486	6.5	1.5	3	99.5	0.47	1.43	2.12	1.40	41.9

Metric system sizes



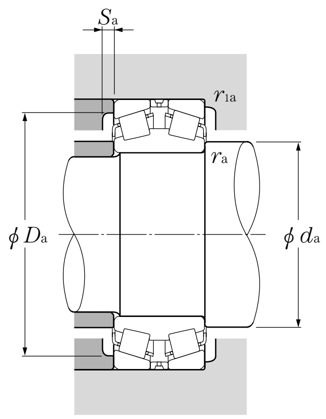
d 420～630mm

	Boundary dimensions					Basic load ratings				Bearing numbers
	mm					dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	
d	D	B	C_1	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}	
420	620	150	150	5	6	2,650	5,900	270,000	600,000	323084
	700	224	224	6	6	4,800	9,700	490,000	990,000	323184
	735	406	406	7.5	7.5	8,600	20,400	880,000	2,080,000	☆CRD-8405
440	650	157	157	6	6	2,600	5,450	266,000	560,000	323088
	720	226	226	6	6	5,000	10,300	510,000	1,050,000	323188
	730	290	290	6	6	6,400	13,900	650,000	1,420,000	☆CRD-8822
450	720	300	300	7.5	4	5,550	12,600	565,000	1,290,000	☆CRD-9011
458	830.5	377	377	7.5	7.5	9,250	20,100	940,000	2,050,000	☆CRD-9203
460	680	163	163	6	6	3,050	6,600	310,000	670,000	323092
	760	240	240	7.5	7.5	4,900	10,300	500,000	1,050,000	323192
	860	420	420	6	6	10,500	22,700	1,070,000	2,320,000	☆CRD-9204
480	700	165	165	6	6	3,050	6,700	310,000	685,000	323096
	790	248	248	7.5	7.5	5,300	11,100	540,000	1,130,000	323196
481.228	615.950	158.750	158.750	6.4	3.3	2,240	6,450	228,000	660,000	☆∗CRD-9605
482.600	615.950	158.750	158.750	6.4	3.3	2,240	6,450	228,000	660,000	☆∗CRD-9709
	615.950	163.750	158.750	6.4	3.3	2,430	7,100	248,000	725,000	☆∗CRD-9708
500	670	150	150	5	2.5	2,400	6,100	245,000	625,000	CRD-10005
	720	167	167	6	6	3,100	6,900	315,000	700,000	3230/500
	820	256	256	9.5	9.5	5,250	11,900	535,000	1,210,000	CRD-10008
	830	264	264	7.5	7.5	6,400	14,000	650,000	1,420,000	☆3231/500G2
560	820	195	195	6	6	4,550	10,300	465,000	1,050,000	☆CRD-11207
585.788	771.525	230.188	230.188	6.4	3.3	4,300	12,900	440,000	1,310,000	☆∗CRD-11701
600	760	115	115	4	4	1,740	4,400	178,000	450,000	CRD-12005
	870	380	400	7.5	4	8,500	24,100	865,000	2,460,000	☆CRD-12006
630	920	212	212	7.5	7.5	5,350	12,800	545,000	1,310,000	☆3230/630G2

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ "−" means the load center is out side the inner ring.

Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

Double Row Tapered Roller Bearings (Inside Direction)



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

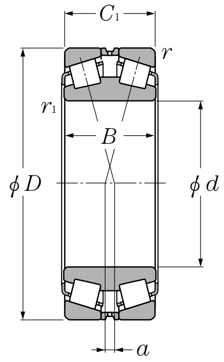
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm						Load center[2] mm	Constant	Axial load factors			Mass kg
d_a max	D_a max	D_a min	S_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
460	598	570	20	4	5	48.5	0.37	1.80	2.69	1.76	154
465	672	625	25	5	5	60	0.40	1.68	2.50	1.64	346
489.5	699	609	6.2	6	6	– 67	0.37	1.80	2.69	1.76	780
480	622	600	20	5	5	53.5	0.37	1.80	2.69	1.76	177
485	692	645	25	5	5	44	0.40	1.68	2.50	1.64	361
503.5	702	632	10	5	5	– 24.5	0.33	2.03	3.02	1.98	513
500.5	684	619.5	15.5	3	6	– 8	0.43	1.57	2.34	1.53	483
537	794.5	690.5	19.5	6	6	– 29	0.40	1.68	2.50	1.64	890
500	652	620	25	5	5	56.5	0.37	1.80	2.69	1.76	201
525	724	660	25	6	6	34.5	0.40	1.68	2.50	1.64	431
547	832	709.5	19.5	5	5	– 43	0.40	1.68	2.50	1.64	1,120
520	672	640	25	5	5	63	0.37	1.80	2.69	1.76	211
547.5	754	688.5	30	6	6	36	0.40	1.68	2.50	1.64	478
500	577	557	6.5	3.3	6.4	133.5	0.61	1.11	1.66	1.09	108
500	577	557	6.5	3.3	6.4	133.5	0.61	1.11	1.66	1.09	108
504	585	567.5	6.5	3.3	6.4	35.5	0.33	2.03	3.02	1.98	121
536	648	609	7.5	2	4	75.5	0.40	1.68	2.50	1.64	148
540	692	655	25	5	5	61.5	0.37	1.80	2.69	1.76	221
583.5	776	709	7.5	8	8	44	0.40	1.68	2.50	1.64	535
550	794	740	30	6	6	37.5	0.40	1.68	2.50	1.64	570
620	792	738	11	5	5	54.5	0.35	1.92	2.86	1.88	347
622.5	743.5	698	10.5	3.3	6.4	31.5	0.35	1.95	2.90	1.91	285
639	742	708	5	3	3	110.5	0.37	1.80	2.69	1.76	120
641	834	747	7.5	3	6	5.5	0.47	1.43	2.12	1.40	758
399	884	825.5	8.5	6	6	93.5	0.40	1.68	2.50	1.64	479

Double Row Tapered Roller Bearings (Inside Direction)

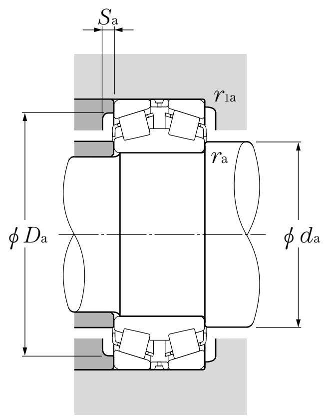
Metric system sizes



d 660.4～1,400mm

d	D	B	C_1	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	dynamic C_r (kN)	static C_{or} (kN)	dynamic C_r (kgf)	static C_{or} (kgf)	Bearing numbers
	Boundary dimensions (mm)					Basic load ratings				
660.400	762.000	98.425	101.600	3	2.5	1,250	4,250	128,000	435,000	∗CRD-13209
700	890	150	160	5	5	2,850	8,600	291,000	880,000	CRD-14003
710	1,150	345	345	12	12	10,900	25,300	1,120,000	2,580,000	☆3231/710BG2
850	1,250	370	370	7.5	7.5	11,800	31,500	1,210,000	3,250,000	☆CRD-17003
1,400	1,600	180	180	5	2.5	4,400	16,300	445,000	1,670,000	CRD-28003

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ "－" means the load center is out side the inner ring.
Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



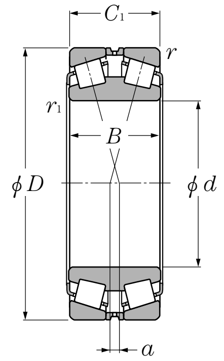
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm						Load[2] center mm	Constant	Axial load factors			Mass kg
d_a	D_a		S_a	r_{as}	r_{1as}						
max	max	min	min	max	max	a	e	Y_1	Y_2	Y_o	(approx.)
684	748	724	4.5	2	2.5	198.5	0.53	1.27	1.89	1.24	71.1
746	868	817	6.5	4	4	– 5.5	0.45	1.50	2.24	1.47	224
828	1,098	1,012	1.5	10	10	23	0.32	2.12	3.15	2.07	1,464
942	1,214	1,104	13.5	6	6	81.5	0.40	1.68	2.50	1.64	1,562
1,437.5	1,578	1,524	11.5	2	4	445.5	0.55	1.24	1.84	1.21	534

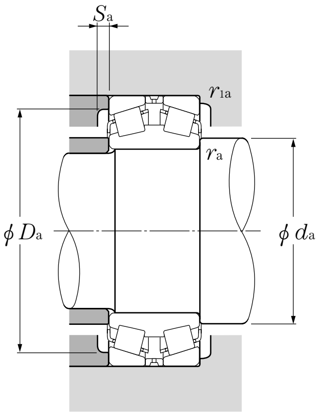
Inch system sizes



d 152.400～276.225mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B	C_1	C_r	C_{or}	C_r	C_{or}
152.400	307.975	171.450	161.924	1,510	2,620	154,000	267,000
177.800	288.925	123.825	123.825	940	1,900	96,000	194,000
	288.925	123.825	123.825	1,160	2,140	119,000	218,000
187.325	319.964	161.925	168.276	1,590	2,790	162,000	285,000
190.500	365.049	152.400	158.750	1,670	3,200	171,000	330,000
203.200	317.500	123.825	123.825	1,060	2,310	108,000	236,000
	365.049	152.400	158.750	1,670	3,200	171,000	330,000
206.375	336.550	184.150	180.976	1,900	4,050	194,000	415,000
215.900	285.750	85.725	85.725	650	1,640	66,500	167,000
219.075	358.775	200.025	196.850	2,130	4,550	217,000	465,000
220.662	314.325	115.888	115.886	1,070	2,450	109,000	250,000
228.600	400.050	139.700	139.700	1,500	2,870	153,000	293,000
241.478	349.148	107.950	107.950	940	2,010	96,000	205,000
244.475	327.025	92.075	92.075	835	2,050	85,000	209,000
	381.000	146.050	146.050	1,300	2,880	132,000	294,000
247.650	406.400	219.075	215.900	2,830	6,000	289,000	615,000
254.000	358.775	130.175	130.175	1,390	3,300	142,000	335,000
	368.300	92.862	92.710	790	1,630	80,500	166,000
260.350	400.050	114.300	119.060	1,220	2,460	124,000	251,000
266.700	355.600	109.538	107.950	1,070	2,670	110,000	272,000
269.875	381.000	136.525	136.525	1,520	3,600	155,000	365,000
276.225	393.700	130.175	130.175	1,340	2,800	137,000	286,000

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

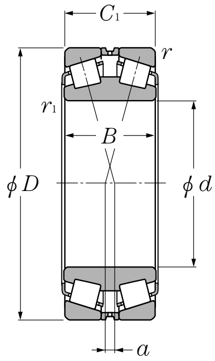
static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm				Load❶ center mm	Constant	Axial load factors			Mass kg
	d_a min	D_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
T-450900D/451212+A	187.5	269	9.7	6.8	–40.5	0.33	2.07	3.08	2.02	60.5
T-94706D/94113+A	195	259	1.5	3.3	1.5	0.47	1.44	2.15	1.41	31.6
T-HM237546D/HM237510+A	194	266	1.5	3.3	–20	0.32	2.12	3.15	2.07	31.6
T-H239649D/H239610+A	209	293	3.3	4.8	–35	0.32	2.12	3.15	2.07	53.7
T-EE420750D/421437+A	221	329	3.3	3.3	–5.5	0.40	1.68	2.50	1.64	72.8
T-93800D/93125+A	222	286	1.5	3.3	19	0.52	1.29	1.92	1.26	36.3
T-EE420800D/421437+A	230	329	3.3	3.3	–5.5	0.40	1.68	2.50	1.64	69.0
T-H242649D/H242610+A	227	306	1.5	3.3	–35	0.33	2.03	3.02	1.98	64.1
T-LM742749D/LM742710+A	229	266	2.3	3.3	35	0.48	1.40	2.09	1.37	14.8
H244849D/H244810A+A	242	323	1.5	6.4	–42	0.33	2.03	3.02	1.98	79.5
T-M244249D/M244210+A	235	293	1.5	3.3	–97	0.33	2.03	3.02	1.98	28.6
EE529091D/529157+A	256	367	3.3	3.3	–8	0.31	2.18	3.24	2.13	74.2
EE127097D/127135+A	258	325	1.5	3.3	12.5	0.35	1.91	2.85	1.87	33.8
LM247748D/LM247710A+A	257	310	1.5	3.3	12.5	0.32	2.09	3.11	2.04	21.4
EE126096D/126150+A	269	343	3.3	4.8	28.5	0.52	1.31	1.95	1.28	61.4
HH249949D/HH249910+A	278	366	3.3	6.4	–42	0.33	2.03	3.02	1.98	112
T-M249748D/M249710+A	273	335	3.3	3.3	–1	0.33	2.03	3.02	1.98	41.2
EE170975D/171450+A	269	340	1.5	3.3	20	0.36	1.85	2.76	1.81	32.5
EE221025D/221575+A	290	366	6.4	6.4	24.5	0.39	1.71	2.54	1.67	52.0
T-LM451349D/LM451310+A	281	335	1.5	3.3	16	0.36	1.87	2.79	1.83	29.9
T-M252349D/M252310+A	290	356	3.3	3.3	0.5	0.33	2.03	3.02	1.98	48.6
T-EE275109D/275155+A	294	366	1.5	6.4	22.5	0.40	1.68	2.50	1.64	50.5

❶ "−" means the load center is out side the inner ring.

Double Row Tapered Roller Bearings (Inside Direction)

Inch system sizes

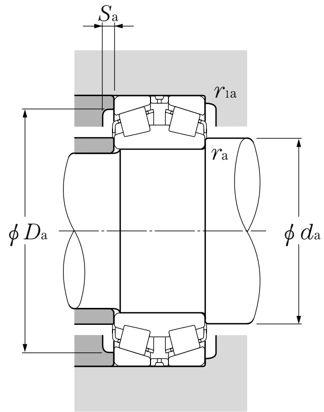


d 279.400～384.175mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B	C_1	C_r	C_{or}	C_r	C_{or}
279.400	393.700	127.000	127.000	1,130	2,670	115,000	272,000
	457.200	244.475	244.475	3,550	7,900	365,000	805,000
285.750	380.898	117.475	117.475	1,140	3,100	116,000	315,000
288.925	406.400	144.462	144.463	1,740	4,150	177,000	425,000
300.038	422.275	150.812	150.813	1,950	4,800	198,000	490,000
304.648	438.048	131.762	131.762	1,440	3,250	147,000	330,000
304.800	419.100	130.175	130.175	1,400	3,400	142,000	350,000
	444.500	107.950	111.126	1,080	2,300	110,000	234,000
304.902	412.648	128.588	128.588	1,500	3,700	153,000	380,000
305.000	438.048	134.145	138.112	1,530	3,450	156,000	350,000
317.500	422.275	128.588	128.587	1,320	3,500	135,000	360,000
	447.675	158.750	158.750	1,990	4,800	203,000	485,000
333.375	469.900	166.688	166.688	2,320	5,500	237,000	565,000
343.052	457.098	122.238	122.238	1,380	3,450	141,000	350,000
346.075	488.950	174.625	174.625	2,490	6,150	254,000	630,000
347.662	469.900	138.112	138.112	1,860	4,550	190,000	465,000
355.600	444.500	114.300	112.712	1,120	3,500	114,000	355,000
	457.200	120.650	120.650	1,440	3,900	147,000	400,000
	482.600	128.588	133.350	1,630	3,850	166,000	390,000
	488.950	153.988	153.988	2,030	5,000	207,000	510,000
	501.650	111.125	127.000	1,550	3,650	158,000	375,000
368.300	523.875	185.738	185.738	2,610	6,550	266,000	665,000
384.175	546.100	193.675	193.675	3,150	8,050	320,000	820,000

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

Double Row Tapered Roller Bearings (Inside Direction)



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

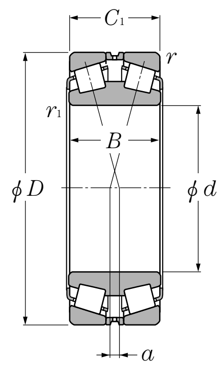
$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm				Load❶ center mm	Constant	Axial load factors			Mass kg
	d_a min	D_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
EE135111D/135155+A	297	368	1.5	6.4	24	0.40	1.68	2.50	1.64	48.1
HH255149D/HH255110+A	309	412	1.5	6.4	–49	0.33	2.03	3.02	1.98	158
T-LM654648D/LM654610+A	302	356	1.5	3.3	36	0.43	1.56	2.33	1.53	36.7
M255449D/M255410A+A	310	379	3.3	3.3	3	0.34	2.00	2.98	1.96	58.1
☆T-HM256849D/HM256810G2+A	322	394	3.3	3.3	66	0.34	2.00	2.99	1.96	65.6
EE329119D/329172+A	327	410	3.3	3.3	11.5	0.33	2.04	3.04	2.00	64.3
M257149D/M257110+A	322	392	1.5	6.4	12.5	0.33	2.03	3.02	1.98	53.1
EE291200D/291750+A	337	416	7.9	1.5	34	0.38	1.78	2.65	1.74	55.7
M257248D/M257210+A	325	388	3.3	3.3	9.5	0.32	2.12	3.15	2.07	49
M757449D/M757410+A	328	407	3.3	4.8	44	0.47	1.43	2.12	1.40	65.3
LM258648D/LM258610+A	334	398	1.5	3.3	9	0.32	2.10	3.13	2.06	49.1
T-HM259049D/HM259010+A	340	418	3.3	3.3	3	0.33	2.02	3.00	1.97	77.9
HM261049D/HM261010A+A	357	439	3.3	3.3	3.5	0.33	2.02	3.00	1.97	90.1
LM761649D/LM761610+A	361	432	1.5	3.3	63	0.47	1.43	2.12	1.40	55
☆T-HM262749D/HM262710G2+A	371	456	3.3	3.3	2	0.33	2.02	3.00	1.97	103
M262449D/M262410+A	369	443	3.3	3.3	14.5	0.33	2.03	3.02	1.98	68
T-L163149D/L163110+A	370	422	1.5	3.3	22.5	0.31	2.20	3.27	2.15	40.1
LM263149D/LM263110+A	372	434	1.5	3.3	23	0.32	2.12	3.15	2.07	49.1
LM763449D/LM763410+A	375	453	1.5	3.3	62.5	0.47	1.43	2.14	1.40	67.4
M263349D/M263310+A	374	459	1.5	3.3	11.5	0.33	2.03	3.02	1.98	85.4
T-EE231401D/231975+A	382	472	3.3	3.3	62	0.44	1.53	2.28	1.50	68.5
☆HM265049D/HM265010G2+A	394	487	3.3	6.4	1.5	0.33	2.03	3.02	1.98	130
☆T-HM266449D/HM266410G2+A	411	507	3.3	6.4	1.5	0.33	2.03	3.02	1.98	153

❶ "－" means the load center is out side the inner ring.

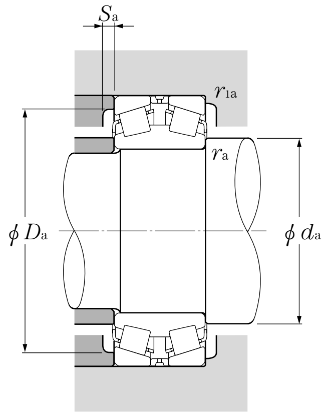
Inch system sizes



d 393.700～584.200mm

	Boundary dimensions			Basic load ratings			
	mm			kN		kgf	
				dynamic	static	dynamic	static
d	D	B	C_1	C_r	C_{or}	C_r	C_{or}
393.700	546.100	138.112	138.112	1,870	5,100	191,000	520,000
406.400	546.100	138.112	138.112	1,870	5,100	191,000	520,000
	590.550	193.675	193.674	2,820	6,800	287,000	690,000
409.575	546.100	161.925	161.925	2,390	6,350	243,000	645,000
415.925	590.550	209.550	209.550	3,650	9,450	375,000	965,000
431.800	571.500	133.350	136.526	1,880	4,950	191,000	505,000
	571.500	161.925	161.925	2,160	5,900	221,000	600,000
447.675	635.000	223.838	223.838	4,150	11,100	425,000	1,130,000
457.200	596.900	133.350	136.525	2,070	5,200	211,000	530,000
	596.900	133.350	136.525	2,070	5,200	211,000	530,000
479.425	679.450	238.125	238.125	4,900	13,000	500,000	1,320,000
482.600	615.950	158.750	158.750	2,320	6,700	237,000	685,000
	647.700	201.612	201.612	3,700	10,100	380,000	1,030,000
489.026	634.873	153.988	153.988	2,500	6,950	255,000	710,000
501.650	711.200	250.825	250.825	5,050	13,700	515,000	1,390,000
514.350	673.100	203.200	203.200	3,450	10,200	355,000	1,040,000
519.112	736.600	258.762	258.762	5,300	14,400	540,000	1,470,000
536.575	761.873	269.875	269.875	5,900	15,200	600,000	1,550,000
	761.873	269.875	269.875	5,900	15,200	600,000	1,550,000
558.800	736.600	155.575	155.575	2,500	6,750	255,000	690,000
	736.600	196.850	196.850	3,550	10,300	365,000	1,050,000
571.500	812.800	285.750	285.750	6,950	18,300	710,000	1,870,000
584.200	762.000	188.912	193.675	3,850	11,200	390,000	1,140,000

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

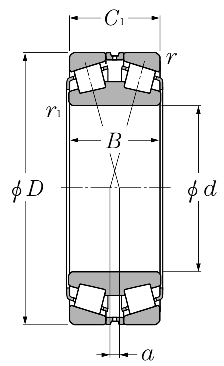
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm				Load❶ center mm	Constant	Axial load factors			Mass kg
	d_a min	D_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
LM767745D/LM767710+A	418	510	1.5	6.4	78	0.48	1.42	2.11	1.38	97.4
LM767749D/LM767710+A	427	510	1.5	6.4	78	0.48	1.42	2.11	1.38	90.5
EE833160XD/833232+A	435	549	3.3	6.4	5.5	0.33	2.07	3.09	2.03	175
☆M667947D/M667910G2+A	431	510	1.5	6.4	47	0.42	1.61	2.40	1.58	104
☆T-M268749D/M268710G2+A	444	549	3.3	6.4	0.5	0.33	2.03	3.02	1.98	181
T-LM869449D/LM869410+A	453	537	1.5	3.3	113	0.55	1.24	1.84	1.21	92.1
LM769349D/LM769310+A	453	534	1.5	6.4	62.5	0.44	1.52	2.26	1.49	112
☆M270749D/M270710AG2+A	478	591	3.3	6.4	0.5	0.33	2.03	3.02	1.98	224
☆L770847D/L770810AG2+A	478	567	1.5	3.3	97	0.47	1.43	2.12	1.40	96.7
L770849D/L770810+A	478	567	1.5	3.3	97	0.47	1.43	2.12	1.40	96.7
☆T-M272749D/M272710G2+A	510	633	3.3	6.4	1.5	0.33	2.03	3.02	1.98	293
☆LM272249D/LM272210G2+A	504	585	3.3	6.4	35.5	0.33	2.03	3.02	1.98	115
☆M272647D/M272610G2+A	510	609	3.3	6.4	18	0.33	2.03	3.02	1.98	185
LM772749D/LM772710A+A	516	600	3.3	3.3	95	0.47	1.43	2.12	1.40	124
☆M274149D/M274110G2+A	534	663	3.3	6.4	–1.5	0.33	2.03	3.02	1.98	314
LM274449D/LM274410+A	540	636	3.3	6.4	23	0.33	2.03	3.02	1.98	189
☆M275349D/M275310G2+A	552	684	3.3	6.4	–1.5	0.33	2.03	3.02	1.98	348
☆M276448D/M276410G2+A	564	711	3.3	6.4	1	0.33	2.03	3.02	1.98	389
☆M276449D/M276410G2+A	564	711	3.3	6.4	1	0.33	2.03	3.02	1.98	389
EE843220D/843290+A	585	699	3.3	6.4	64.5	0.34	1.98	2.94	1.93	177
☆LM377449D/LM377410G2+A	588	696	3.3	6.4	43	0.35	1.95	2.9.0	1.91	223
☆M278749D/M278710AG2+A	609	756	3.3	6.4	0	0.33	2.03	3.02	1.98	470
☆LM778549D/LM778510G2+A	615	717	3.3	6.4	108	0.47	1.43	2.14	1.40	223

❶ "−" means the load center is out side the inner ring.

Inch system sizes

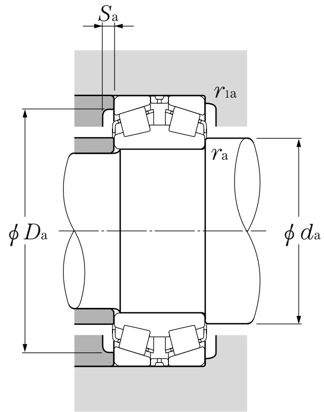


d 595.312～939.800mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B	C_1	C_r	C_{or}	C_r	C_{or}
595.312	844.550	296.862	296.862	7,350	20,200	750,000	2,060,000
609.600	787.400	171.450	171.450	3,500	9,950	360,000	1,020,000
	863.600	317.500	317.500	7,900	21,100	805,000	2,150,000
635.000	901.700	317.500	317.500	8,300	22,100	845,000	2,250,000
657.225	933.450	328.612	328.612	8,950	24,000	910,000	2,450,000
660.400	812.800	176.212	176.212	3,600	11,600	370,000	1,180,000
679.450	901.700	265.112	265.112	6,500	19,000	665,000	1,940,000
685.800	876.300	168.275	171.450	3,550	10,900	360,000	1,110,000
708.025	930.275	273.050	273.050	6,750	20,400	690,000	2,080,000
711.200	914.400	149.225	149.225	3,100	8,950	315,000	910,000
749.300	990.600	293.000	293.000	7,400	22,700	750,000	2,310,000
762.000	1,066.800	352.425	365.125	10,300	29,300	1,050,000	2,990,000
	1,079.500	381.000	381.000	11,100	32,000	1,130,000	3,250,000
863.600	1,130.300	323.850	323.850	9,200	29,600	935,000	3,000,000
	1,219.200	425.450	438.150	14,000	41,500	1,430,000	4,200,000
938.212	1,270.000	400.050	400.050	13,100	40,000	1,340,000	4,100,000
939.800	1,333.500	349.250	463.550	16,900	48,500	1,720,000	4,950,000

Remarks: 1. The above chamfer of inner and outer ring are bigger than r_{as} max or r_{1as} max.
2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

Double Row Tapered Roller Bearings (Inside Direction)



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

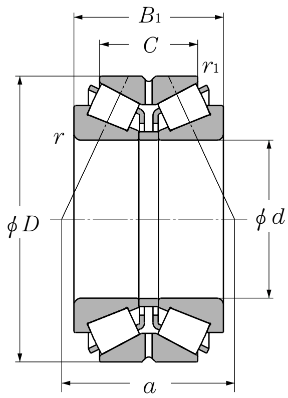
static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm				Load center❶ mm	Constant	Axial load factors			Mass kg
	d_a min	D_a min	r_{as} max	r_{1as} max	a	e	Y_1	Y_2	Y_o	(approx.)
☆M280049D/M280010G2+A	633	786	3.3	6.4	1	0.33	2.03	3.02	1.98	525
☆T-EE649241D/649310G2+A	636	747	3.3	6.4	79	0.37	1.82	2.71	1.78	210
☆M280349D/M280310G2+A	648	807	3.3	6.4	–4.5	0.33	2.03	3.02	1.98	585
☆M281049D/M281010G2+A	675	843	3.3	6.4	6	0.33	2.03	3.02	1.98	641
☆M281649D/M281610G2+A	699	870	3.3	6.4	6	0.33	2.03	3.02	1.98	711
☆L281149D/L281110G2+A	684	777	3.3	6.4	89	0.37	1.80	2.69	1.76	195
☆LM281849D/LM281810G2+A	714	852	3.3	6.4	31.5	0.33	2.03	3.02	1.98	459
☆EE655271D/655345G2+A	717	831	3.3	6.4	129	0.42	1.61	2.4.0	1.58	247
☆LM282549D/LM282510G2+A	741	879	3.3	6.4	33	0.33	2.03	3.02	1.98	490
☆EE755281D/755360G2+A	744	873	3.3	6.4	127	0.38	1.77	2.64	1.73	243
☆LM283649D/LM283610G2+A	786	936	3.3	6.4	34.5	0.33	2.03	3.02	1.98	606
☆M284148D/M284111G2+A	819	996	special chamfer	12.7	14	0.33	2.03	3.02	1.98	968
☆M284249D/M284210G2+A	810	1,005	4.8	12.7	0	0.33	2.03	3.02	1.98	1,097
☆LM286249D/LM286210G2+A	906	1,065	4.8	12.7	49.5	0.33	2.03	3.02	1.98	848
☆EE547341D/547480G2+A	918	1,135	4.8	12.7	1.5	0.33	2.03	3.02	1.98	1,552
☆LM287649D/LM287610G2+A	990	1,190	4.8	12.7	30.5	0.33	2.03	3.02	1.98	1,444
☆LM287849D/LM287810G2+A	999	1,240	4.8	12.7	3.5	0.33	2.03	3.02	1.98	1,540

❶ "–" means the load center is out side the inner ring.



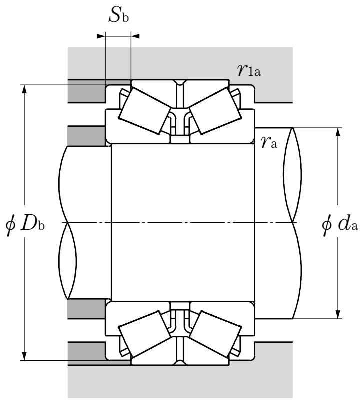
d 100～533.400mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
100	215	115	74	3	1	510	680	52,000	69,500	CRI-2054
105	240	110	75	3	1	585	790	60,000	80,500	CRI-2105
110	240	118	81	3	1	585	790	60,000	80,500	CRI-2262
	240	119	74	3	1	585	790	60,000	80,500	CRI-2252
115	230	116	84	3	1.5	680	1,100	69,000	112,000	CRI-2301
125	230	116	84	3	2	735	1,240	75,000	127,000	CRI-2554
128	229	116	74	3	1	525	830	53,500	84,500	CRI-2663
130	280	137	93.5	4	1.5	835	1,170	85,500	120,000	CRI-2618
	299	137	87.5	4	1.5	895	1,420	91,500	145,000	CRI-2624
140	260	120	84	3	1.5	735	1,210	75,000	123,000	CRI-2826
155	330	180	120	5	1.5	1,350	2,210	137,000	226,000	CRI-3101
230	380	175	115	4	1.5	1,410	2,970	144,000	305,000	CRI-4613
260	530	275	163.9	6	2.5	2,880	5,200	293,000	530,000	CRI-5215
305	560	223	130	5	2.5	2,530	4,700	258,000	480,000	☆CRI-6108
317.500	558.800	254.000	162.000	5	2	3,000	5,900	310,000	600,000	☆∗CRI-6412
370	680	280	188	7.5	4	4,300	8,400	440,000	855,000	☆CRI-7402
533.400	736.600	225.425	177.800	6.4	1.5	3,300	9,250	340,000	940,000	☆∗CRI-10702

❶ Minimum allowable dimension for chamfer dimension r or r_1.

Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

NTN

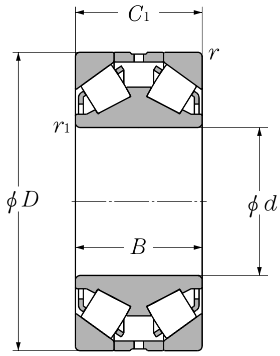


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

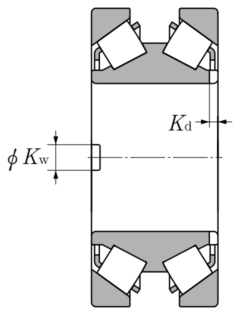
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

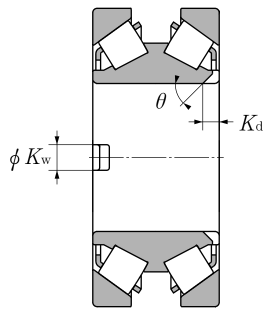
Abutment and fillet dimensions					Load center	Constant	Axial load factors			Mass
mm					mm					kg
d_a min	D_b min	S_b min	r_{as} max	r_{las} max	a	e	Y_1	Y_2	Y_o	(approx.)
114	202	20.5	2.5	1	54	0.81	0.83	1.23	0.81	18.2
119	227.5	17.5	2.5	1	146	0.81	0.83	1.23	0.81	23.6
124	228	18.5	2.5	1	153	0.81	0.83	1.23	0.81	22
124	223.5	22.5	2.5	1	152	0.81	0.83	1.23	0.81	25
129	221	16	2.5	1.5	143.5	0.74	0.92	1.36	0.90	21.2
139	221	16	2.5	2	143.5	0.74	0.92	1.36	0.90	19.9
142	220.5	21	2.5	1	192.5	1.10	0.61	0.91	0.60	17.8
148	268.5	21.5	3	1.5	176.5	0.81	0.83	1.23	0.81	34.5
148	270	24.5	3	1.5	184.5	0.83	0.81	1.21	0.79	45.8
154	245	18	2.5	1.5	155.5	0.74	0.92	1.36	0.90	26.6
177	313	30	4	1.5	219	0.81	0.83	1.24	0.82	66
248	363.5	30	3	1.5	241	0.80	0.85	1.26	0.83	73.9
288	494	55.5	5	2	364.5	0.94	0.71	1.06	0.70	248
327	530	46.5	4	2	414	1.09	0.62	0.92	0.61	227
339.5	531.5	46	4	2	351	0.81	0.84	1.25	0.82	248
406	633	46	6	3	370.5	0.70	0.97	1.44	0.94	420
561.5	718.5	24	5	1.5	399.5	0.70	0.97	1.44	0.94	268



Drawing A



Drawing B



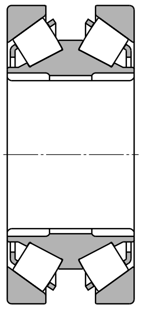
Drawing C

d 100～260mm

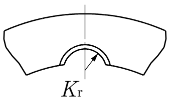
	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Drawing No.
d	D	B	C_r	$r_{s\,min}$ ❶	$r_{ls\,min}$ ❶	C_r	C_{or}	C_r	C_{or}		
100	215	105	110	3	1	585	825	60,000	84,500	CRD-2005	A
	250	120	120	3	2.5	750	1,080	76,500	110,000	CRD-2011	A
110	240	118	118	3	1	750	1,080	76,500	110,000	CRD-2214	A
120	260	130	130	3	1	830	1,200	85,000	122,000	CRD-2410	A
125	305	180	180	3	3	1,410	2,250	143,000	230,000	CRD-2503	B
140	305	160	160	5	1.5	1,160	1,850	118,000	189,000	CRD-2819	A
150	320	144	144	4	4	1,050	1,490	107,000	152,000	CRD-3013	A
	380	235	235	5	2.5	2,320	4,000	236,000	410,000	CRD-3011	A
160	260	130	130	3	1.5	880	1,740	89,500	178,000	CRD-3253	A
170	300	100	100	3	2.5	845	1,450	86,000	148,000	CRD-3423	A
	360	144	160	4	2.5	1,270	2,000	129,000	204,000	CRD-3414	A
	360	144	160	4	1.5	1,440	2,300	147,000	234,000	CRD-3416	A
180	330	190	190	5	1.5	1,710	3,250	175,000	330,000	CRD-3615	A
	380	158	158	3	4	1,380	1,980	141,000	202,000	CRD-3623	A
	400	232	232	4	4	2,090	3,600	213,000	370,000	CRD-3622	A
190	320	104	104	3	3	810	1,460	83,000	149,000	CRD-3801	A
	320	104	104	3	4	850	1,540	86,500	157,000	CRD-3813	A
	350	135	135	3	3	1,130	1,950	116,000	199,000	CRD-3811	A
210	480	230	230	6	6	2,690	4,300	274,000	440,000	CRD-4209	A
228.600	431.800	177.800	177.800	5	5	1,630	3,100	166,000	315,000	＊CRD-4604	A
240	460	140	140	5	5	1,380	2,510	140,000	256,000	☆CRD-4808	B
254	585	260	285	4	4	3,700	6,450	375,000	660,000	☆CRD-5102	A
260	458	155	155	5	5	1,740	3,150	177,000	320,000	☆CRD-5214	B
	459	155	155	5	5	1,740	3,150	177,000	320,000	☆CRD-5216	A
	459	155	155	4	4	1,740	3,150	177,000	320,000	☆CRD-5224	B

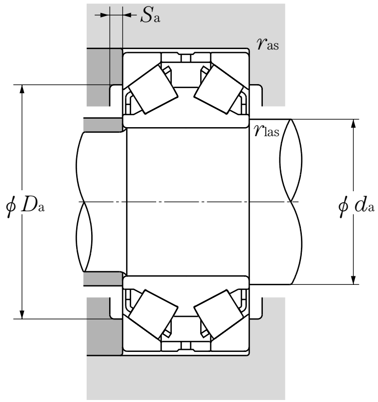
❶ Minimum allowable dimension for chamfer dimension r or r_1.

Remarks: 1. The marked "＊" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Drawing D



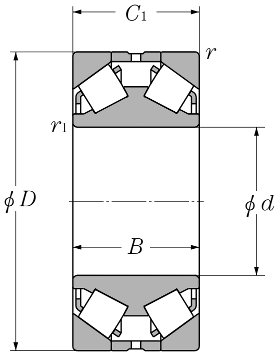


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

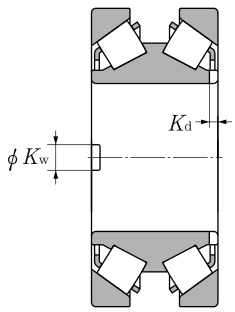
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

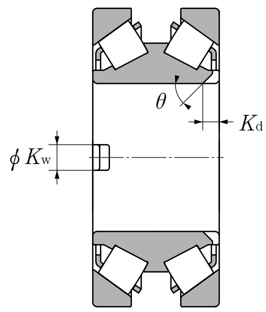
Groove dimensions					Abutment and fillet dimensions					Constant	Axial load factors			Mass
mm			numbers	mm	mm									kg
width K_w	depth K_d	angle θ °	× side face	key groove K_r	d_a max	D_a min	S_a min	r_{as} max	r_{1as} max	e	Y_1	Y_2	Y_o	(approx.)
—	—	—	—	—	117.5	201	3.7	2.5	3	0.81	0.83	1.23	0.81	19.7
—	—	—	—	—	130.5	236	6.6	2.5	3	0.81	0.83	1.23	0.81	31.2
—	—	—	—	—	129	226	5.8	2.5	3	0.81	0.83	1.23	0.81	26.6
—	—	—	—	—	147.5	246	3.1	2.5	3	0.81	0.83	1.23	0.81	34.2
30.2	11	90	1-2	—	160.5	291	1.5	2.5	3	0.73	0.93	1.38	0.91	68.9
—	—	—	—	—	168.5	283	7.5	4	5	0.73	0.92	1.37	0.90	58.1
—	—	—	—	—	180	302	8	3	4	0.81	0.83	1.23	0.81	56.9
—	—	—	—	—	186.5	358	6.5	4	5	0.81	0.83	1.23	0.81	142
—	—	—	—	—	177	246	3.5	2.5	3	0.62	1.09	1.62	1.06	27
—	—	—	—	—	195	286	5.4	2.5	3	0.70	0.97	1.44	0.94	30.2
—	—	—	—	—	204.5	342	1.5	3	4	1.10	0.62	0.92	0.60	79.7
—	—	—	—	—	197	342	1.5	3	4	1.10	0.61	0.91	0.60	79.7
—	—	—	—	—	200.5	308	3.5	4	5	0.58	1.17	1.75	1.15	71.9
—	—	—	—	—	208.5	366	3.4	2.5	3	0.81	0.83	1.23	0.81	87.6
—	—	—	—	—	211.5	382	6.8	3	4	0.81	0.83	1.23	0.81	146.5
—	—	—	—	—	216.5	306	5.5	2.5	3	0.73	0.92	1.37	0.90	34.1
—	—	—	—	—	214	306	4.6	2.5	3	0.80	0.85	1.26	0.83	34.1
—	—	—	—	—	216	336	5.5	2.5	3	0.81	0.83	1.23	0.81	57.7
—	—	—	—	—	253	367	5.9	5	5	0.81	0.83	1.23	0.81	212
—	—	—	—	—	278	410	1.5	4	5	1.01	0.67	0.99	0.65	118
50	15	90	2-2	—	296	438	1.5	4	5	0.87	0.78	1.16	0.76	107
—	—	—	—	—	301	567	4.5	3	4	1.17	0.58	0.86	0.56	392
32	15	90	2-2	—	304	436	1.5	4	5	0.87	0.78	1.16	0.76	109
—	—	—	—	—	304	437	1.5	4	5	0.87	0.78	1.16	0.76	110
32	15	90	2-2	—	304	441	1.5	3	4	0.87	0.78	1.16	0.76	110



Drawing A



Drawing B

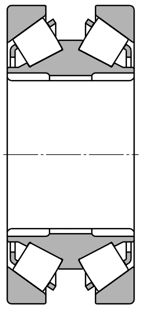


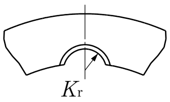
Drawing C

d 279.400～305.105mm

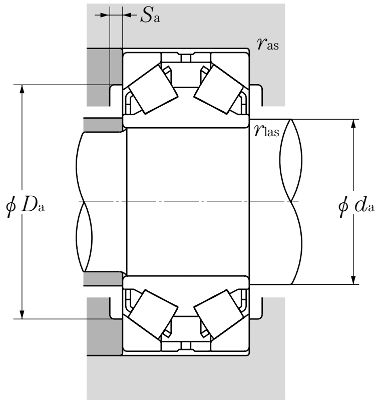
	Boundary dimensions					Basic load ratings				Bearing numbers	Drawing No.
	mm					dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)		
d	D	B	C_r	$r_{s\,min}$ ❶	$r_{ls\,min}$ ❶	C_r	C_{or}	C_r	C_{or}		
279.400	533.400	241.300	266.700	6.4	2	3,150	6,100	320,000	620,000	☆∗**CRD-5613**	A
280	410	110	110	2.5	2.5	985	1,960	101,000	200,000	**CRD-5616**	A
285	380	92	92	2.5	1	730	1,720	74,500	176,000	**CRD-5704**	C
300	440	105	105	4	4	1,000	2,150	102,000	219,000	**CRD-6025**	C
	440	105	105	3	3	1,000	2,150	102,000	219,000	**CRD-6027**	C
	500	180	180	5	5	1,720	3,300	176,000	340,000	**CRD-6006**	B
	500	200	200	5	5	2,460	5,300	251,000	540,000	☆**CRD-6028**	C
	500	200	200	5	6	2,480	5,400	253,000	550,000	☆**CRD-6030**	A
	520	180	210	4	4	2,200	4,650	225,000	475,000	**CRD-6026**	A
304.800	499.948	158.750	203.200	6.4	3.3	1,670	3,300	171,000	340,000	∗**CRD-6109**	A
	499.948	200.000	200.000	6	6	1,670	3,300	171,000	340,000	∗**CRD-6123**	A
305.000	500.000	200.000	200.000	5	5	2,170	5,050	222,000	515,000	∗**CRD-6120**	C
	500.000	200.000	200.000	special chamfer	5	2,460	5,300	251,000	540,000	☆∗**CRD-6148**	C
	500.000	200.000	200.000	5	5	2,170	5,050	222,000	515,000	∗**CRD-6151**	C
	500.000	200.000	200.000	5	5	2,460	5,300	251,000	540,000	☆∗**CRD-6137**	C
	559.968	169.977	176.434	4	4	2,020	3,950	206,000	405,000	∗**CRD-6140**	A
	560.000	200.000	200.000	10	6.4	2,340	4,700	239,000	480,000	☆∗**CRD-6146**	B
	560.000	200.000	200.000	20	6.4	2,340	4,700	239,000	480,000	☆∗**CRD-6154**	B
	560.000	200.000	200.000	10	6.4	2,270	4,500	232,000	460,000	☆∗**CRD-6135**	C
305.003	559.867	169.977	176.352	4	6.4	2,010	3,950	205,000	400,000	☆∗**CRD-6113**	A
305.069	559.999	200.000	200.000	19.7	6.4	2,270	4,500	232,000	460,000	∗**CRD-6112**	A.D❷
	559.999	200.000	200.000	9.5	6	2,270	4,500	232,000	460,000	∗**CRD-6152**	C
	560.000	200.000	200.000	19.7	6.4	2,530	4,700	258,000	480,000	☆∗**CRD-6136**	B
305.079	500.000	200.000	200.000	5	6	2,170	5,050	222,000	515,000	∗**CRD-6125**	C
	500.000	200.000	200.000	5	6	2,440	5,900	249,000	600,000	∗**CRD-6101**	D
	500.000	200.000	200.000	5	6	2,440	5,900	249,000	600,000	∗**CRD-6116**	D
305.105	559.867	169.977	200.000	3	4	2,160	4,300	220,000	440,000	∗**CRD-6104**	A
	559.867	169.977	200.508	4	4	2,230	4,500	227,000	455,000	☆∗**CRD-6117**	A
	559.968	200.000	200.000	19	7	2,530	4,700	258,000	480,000	☆∗**CRD-6110**	B
	599.968	170.434	170.434	4	2.5	2,040	4,000	208,000	410,000	☆∗**CRD-6115**	A

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ This bearing's shape is half of drawing 3 and 4.
Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.





Drawing D

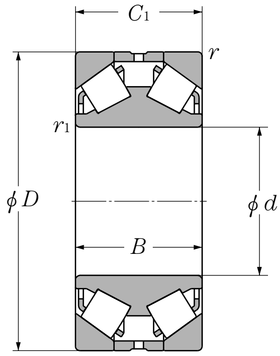


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

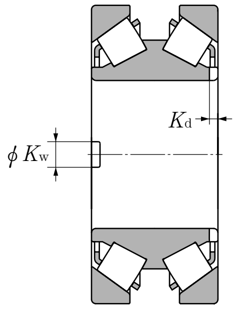
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

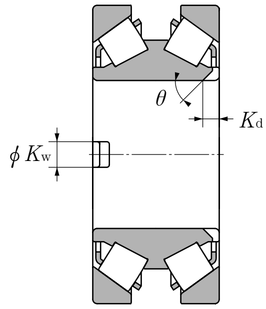
Groove dimensions					Abutment and fillet dimensions					Constant	Axial load factors			Mass
mm			numbers	mm	mm									kg
width K_w	depth K_d	angle θ °	× side face	key groove K_r	d_a max	D_a min	S_a min	r_{as} max	r_{1as} max	e	Y_1	Y_2	Y_o	(approx.)
—	—	—	—	—	306	505.5	1.5	5	5	1.09	0.62	0.92	0.61	272
—	—	—	—	—	300	398	5	2	2.5	1.05	0.64	0.96	0.63	49
32	13	45	1-2	—	299.5	368	6.5	2	2.5	0.81	0.83	1.23	0.81	29
32.13	22.225	45	1-2	—	325	422	4.5	3	4	0.81	0.83	1.23	0.81	54
32.1	22.2	45	1-2	—	325	381.5	4.5	2.5	3	0.81	0.83	1.23	0.81	54
40	15	90	2-2	—	345	478	1.5	4	5	1.19	0.57	0.85	0.56	143
50.8	34.925	45	2-2	—	342	478	1.5	4	5	0.76	0.88	1.31	0.86	158
—	—	—	—	—	341	478	1.5	4	5	0.76	0.88	1.31	0.86	158
—	—	—	—	—	332.5	502	1.5	3	4	1.17	0.58	0.86	0.56	187
—	—	—	—	—	344	472	1.5	5	5	1.19	0.57	0.84	0.55	158
—	—	—	—	—	343	472	2.5	5	5	1.19	0.57	0.84	0.55	155
51.5	35	45	2-2	—	347	478	1.5	4	5	0.70	0.97	1.44	0.94	135
50.9	35	45	2-2	—	342	478	1.5	4	5	0.76	0.88	1.31	0.86	155
40.5	35	45	2-2	—	347	478	1.5	4	5	0.70	0.97	1.44	0.94	155
50.8	34.925	45	1-2	—	342	478	1.5	4	5	0.76	0.88	1.31	0.86	155
—	—	—	—	—	372.5	542	1.5	3	4	0.92	0.73	1.09	0.72	193
50	19	90	2-2	—	369	514	1.5	9	5	1.09	0.62	0.92	0.61	218
50	19	90	2-2	—	369	468	1.5	19	5	1.09	0.62	0.92	0.61	218
50.7	39.7	45	1-2	—	372	514	1.5	9	5	1.09	0.62	0.92	0.61	218
—	—	—	—	—	350	542	1.5	3	5	1.09	0.62	0.92	0.61	192
50.8	19.05	90	2-2	14.5	372	470	1.5	18	5	1.09	0.62	0.92	0.61	218
50.8	39.69	45	2-2	—	372	516	1.5	8	5	1.09	0.62	0.92	0.61	218
50.8	19.05	90	2-2	—	354	470	4.7	18	5	1.09	0.62	0.92	0.61	218
50.8	34.9	45	1-2	—	347	478	1.5	4	5	0.70	0.97	1.44	0.94	155
—	—	—	—	7.938	334	478	3.5	5	4	0.70	0.97	1.44	0.94	155
—	—	—	—	7.938	334	478	3.5	5	4	0.70	0.97	1.44	0.94	155
—	—	—	—	—	355	546	1.5	3	2.5	1.09	0.62	0.92	0.61	217
—	—	—	—	—	350	532	8	3	3	1.09	0.62	0.92	0.61	217
50.7	19	90	2-2	—	353.5	476	4.7	5	17	1.09	0.62	0.92	0.61	217
—	—	—	—	—	350	582	5.5	2	3	1.09	0.62	0.92	0.61	169



Drawing A



Drawing B



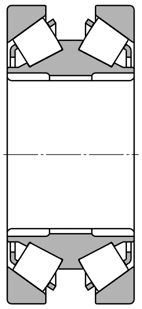
Drawing C

d 330～460mm

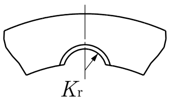
Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing No.
d	D	B	C_r	$r_{s\,min}$ [1]	$r_{ls\,min}$ [1]	C_r	C_{or}	C_r	C_{or}		
330	458	120	120	3	3	990	2,220	101,000	226,000	CRD-6604	B
	650	248	248	7.5	6	3,450	6,500	350,000	665,000	CRD-6608	A
350	590	192	192	3	3	2,990	6,400	305,000	655,000	☆CRD-7017	B[2]
	618	200	200	6	6	3,000	5,700	310,000	580,000	☆CRD-7004	A[2]
360	540	200	200	5	5	2,480	6,150	253,000	630,000	CRD-7201	B
370	630	240	240	5	6	3,550	7,450	365,000	760,000	☆CRD-7401	B
380	559.5	160	160	5	5	1,890	4,250	192,000	435,000	CRD-7614	A
	650	240	240	6	3	3,600	7,950	370,000	810,000	☆CRD-7623	C
	650	240	240	6	3	3,600	7,950	370,000	810,000	☆CRD-7612	B
400	650	200	200	17.4	6	3,050	6,100	310,000	625,000	☆CRD-8010	C
	650	240	240	6	3	3,350	7,450	340,000	760,000	☆CRD-8013	C
	650	240	240	6	4	3,600	8,450	365,000	865,000	☆CRD-8026	C
	650	240	240	6	3	3,350	7,450	340,000	760,000	☆CRD-8027	C
	650	240	240	6	4	3,600	8,450	365,000	865,000	☆CRD-8032	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8034	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8035	C
	650	240	240	6	4	3,600	8,450	365,000	865,000	☆CRD-8038	C
	650	240	240	6	4	3,600	8,450	365,000	865,000	☆CRD-8039	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8042	C
	650	240	240	6	5	3,350	7,450	340,000	760,000	☆CRD-8044	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8046	D
	650	240	240	6	4	3,600	8,450	365,000	865,000	☆CRD-8047	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8048	C
	650	240	240	6	6	3,600	8,450	365,000	865,000	☆CRD-8049	C.D[3]
	650	240	240	6	3	3,350	7,450	340,000	760,000	☆CRD-8014	C
	650	240	240	6	6	3,350	7,450	340,000	760,000	☆CRD-8023	D
410	580	160	160	4	5	1,890	4,550	192,000	460,000	CRD-8201	B
440	650	155	155	6	6	2,330	5,300	238,000	540,000	☆CRD-8808	A
460	618	150	150	4	4	1,720	4,400	176,000	450,000	CRD-9202	B
	618	150	150	4	4	1,720	4,400	176,000	450,000	CRD-9211	A
	720	250	250	6	2.5	4,450	10,100	450,000	1,030,000	☆CRD-9214	C

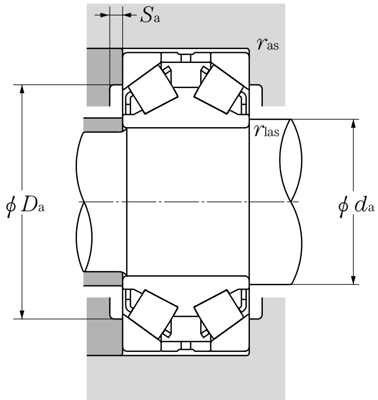
[1] Minimum allowable dimension for chamfer dimension r or r_1. [2] This bearing has slots at the side face of inner ring. [3] This bearing's shape is half of drawing 3 and 4.

Remarks: 1. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Drawing D



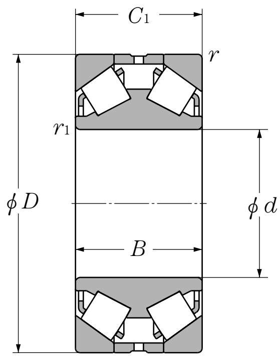


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

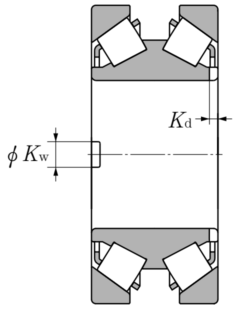
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

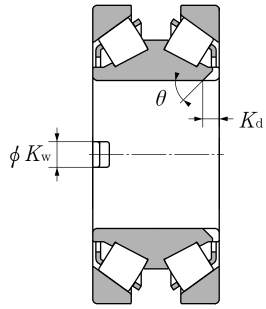
Groove dimensions mm width K_w	depth K_d	angle θ °	numbers × side face	mm key groove K_r	Abutment and fillet dimensions mm d_a max	D_a min	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
32	12	90	2-2	—	355.5	444	8	2.5	2.5	1.05	0.64	0.96	0.63	59.7
—	—	—	—	—	407	624	8	5	6	0.90	0.75	1.12	0.73	383
32	12	90	2-2	—	409.5	576	6.5	2.5	2.5	0.55	1.24	1.84	1.21	209
50	20	90	2-2	—	410	510	1.5	5	5	0.87	0.78	1.16	0.76	252
40	12	90	2-2	—	389.5	518	4.7	4	4	0.70	0.97	1.44	0.94	160
34	20	90	2-2	—	420	608	8	5	4	0.76	0.88	1.31	0.86	316
—	—	—	—	—	414.5	537.5	1.5	4	4	0.70	0.97	1.44	0.94	133
50.8	40	45	2-2	—	435	622	1.5	2.5	5	1.05	0.64	0.96	0.63	329
50	15	90	2-2	—	430	622	8	2.5	5	1.05	0.64	0.96	0.63	338.2
50.4	38.1	45	1-2	—	449	618	2.5	5	12	0.81	0.83	1.23	0.81	260
64.3	32	45	1-2	—	437	622	8	2.5	5	1.05	0.64	0.96	0.63	303
63.6	32	45	1-2	—	456	535	2.5	3	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	437	622	8	2.5	5	1.05	0.64	0.96	0.63	303
64.3	32	45	1-2	—	454	622	2.5	3	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	454	622	1.5	5	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	454	622	8	5	5	0.80	0.85	1.26	0.83	303
63.6	32	45	2-2	—	454	622	2.5	3	5	0.80	0.85	1.26	0.83	302
64.3	32	45	1-2	—	454	622	8	4	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	454	622	2	5	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	437	525	8	4	5	1.05	0.64	0.96	0.63	292
—	—	—	—	11.25	454	622	1.5	5	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	454	622	2.5	3	5	0.80	0.85	1.26	0.83	303
64.3	32	45	2-2	—	454	622	1.5	5	5	0.80	0.85	1.26	0.83	303
63.6	32	45	1-2	11.25	454	622	1.5	5	5	0.80	0.85	1.26	0.83	303
64.3	32	45	1-2	—	437	622	8	2.5	5	1.05	0.64	0.96	0.63	303
—	—	—	—	11.25	437	622	8	5	5	1.05	0.64	0.96	0.63	303
50.8	10	90	1-2	—	440	562	1.5	4	3	0.83	0.81	1.21	0.79	133
—	—	—	—	—	487	622	6.5	5	5	0.80	0.85	1.26	0.83	163
50	15	90	2-2	—	489	600	8	3	3	1.05	0.64	0.96	0.63	126
—	—	—	—	—	489.5	600	1.5	3	3	1.05	0.64	0.96	0.63	120
50.8	35	45	2-2	—	500	692	4.8	2	5	0.80	0.85	1.26	0.83	388



Drawing A



Drawing B

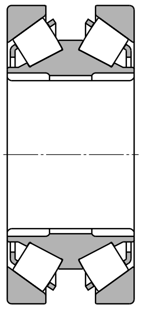


Drawing C

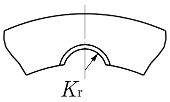
d **470～1,400mm**

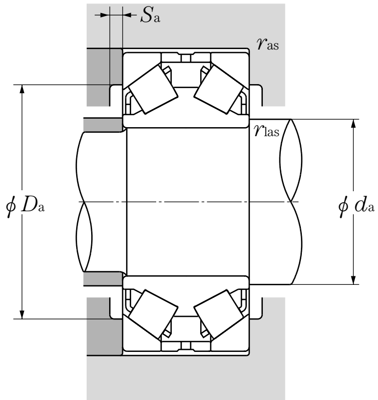
Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Drawing No.
d	D	B	C_r	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}		
470	720	216	216	6	6	2,790	6,800	284,000	690,000	**CRD-9404**	B
480	689.5	180	180	6	6	2,670	6,400	272,000	655,000	**☆CRD-9609**	B
	690	180	180	6	6	2,670	6,400	272,000	655,000	**☆CRD-9603**	B
482.600	615.950	158.750	158.750	6.4	3.3	2,240	6,450	228,000	660,000	**☆∗CRD-9709**	A❷
	733.500	200.000	200.000	17.5	5	2,740	6,550	279,000	665,000	**☆∗CRD-9704**	C
509.948	733.425	200.02	200.02	5	5	3,250	8,350	330,000	855,000	**☆∗CRD-10208**	C
510.134	800.001	284.493	284.493	6.4	6.4	5,200	12,100	530,000	1,230,000	**☆∗CRD-10206**	C
550	920	330	330	7.5	7.5	6,800	15,700	695,000	1,600,000	**☆CRD-11001**	B
600	1,000	350	350	7.5	7.5	8,250	19,500	840,000	1,990,000	**☆CRD-12002**	A
660.000	814.000	176.212	176.212	6.4	3.3	2,600	8,200	266,000	835,000	**☆∗CRD-13208**	C
685.800	939.800	234.950	228.575	3.3	6.4	4,950	13,500	505,000	1,380,000	**☆∗CRD-13702**	B
685.876	939.876	234.950	227.813	3.3	6.4	4,950	13,500	505,000	1,380,000	**☆∗CRD-13701**	C
720	920	130	150	5	4	2,760	7,300	281,000	745,000	**☆CRD-14403**	A
780	1,000	200	200	5	2	4,200	12,900	430,000	1,320,000	**☆CRD-15601**	C
1,400	1,600	180	180	5	2.5	4,400	16,300	445,000	1,670,000	**CRD-28003**	A

❶ Minimum allowable dimension for chamfer dimension r or r_1. ❷ This bearing has a screw groove at inner ring's bore and slots at the side face of inner ring.
Remarks: 1. The marked "∗" bearings are inch system sizes. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.



Drawing D



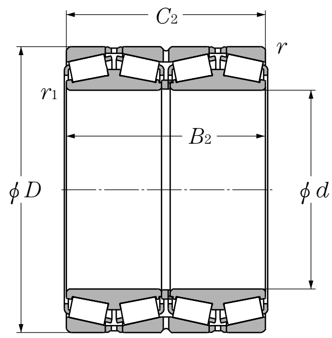


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Groove dimensions (mm) width K_w	depth K_d	angle θ °	numbers × side face	key groove (mm) K_r	Abutment and fillet dimensions (mm) d_a max	D_a min	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
63.6	30	90	1-2	—	503	692	3	5	5	1.09	0.62	0.92	0.61	315
50	15	90	2-2	—	525	661.5	8	5	5	0.87	0.78	1.16	0.76	223
50	15	90	2-1	—	525	662	8	5	5	0.87	0.78	1.16	0.76	224
—	—	—	—	—	500.5	588	6.5	2.5	5	0.61	1.11	1.66	1.09	115
50.8	38	45	2-2	—	546.5	669.5	8	4	12	1.09	0.62	0.92	0.61	301
50.8	38.1	45	2-2	—	560	711.5	8	4	4	0.87	0.78	1.16	0.76	256
70.358	44.45	45	1-2	12.865	560	772	8	5	5	0.81	0.83	1.23	0.81	511
56	22	90	1-2	—	629.5	884	4.5	6	6	0.87	0.78	1.16	0.76	914
—	—	—	—	—	687	964	8	6	6	0.87	0.78	1.16	0.76	1,130
50	20	45	2-2	—	684.5	886	8	2.5	5	0.70	0.97	1.44	0.94	202
63.5	19.05	90	2-2	—	738	926	1.5	5	2.5	0.70	0.97	1.44	0.94	478
63.5	38.1	45	2-2	—	738.5	926	8	5	2.5	0.70	0.97	1.44	0.94	435
—	—	—	—	—	760.5	898	5.8	3	4	0.81	0.83	1.23	0.81	240
90	35	45	1-2	—	824.5	978	3.6	2	4	0.80	0.85	1.26	0.83	384
—	—	—	—	—	1,437.5	1,578	12.5	2	4	0.55	1.24	1.84	1.21	532

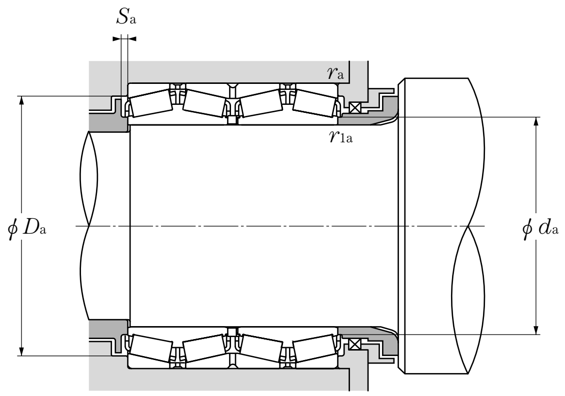


d 100～165.100mm

d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r (dynamic, kN)	C_{or} (static, kN)	C_r (dynamic, kgf)	C_{or} (static, kgf)
100	170	155	155	2.5	0.6	595	1,170	61,000	119,000
105	190	210	210	2.5	1	760	1,630	77,500	166,000
110	150	150	150	1.5	1.5	505	1,280	51,500	131,000
120	170	124	124	2	2.5	390	1,020	40,000	104,000
	180	100	100	2	2.5	395	745	40,000	76,000
	200	132	132	2	2.5	640	1,220	65,000	125,000
	210	174	174	2.5	2.5	855	1,710	87,500	174,000
120.650	174.625	141.288	139.703	1.5	0.8	510	1,220	52,000	124,000
127.000	182.562	158.750	158.750	3.3	1.5	660	1,730	67,000	177,000
130	184	134	134	2	2.5	480	1,190	49,000	122,000
135	180	160	160	2	1	500	1,360	51,000	138,000
136.525	190.500	161.925	161.925	3.3	1.5	695	1,900	71,000	193,000
139.700	200.025	157.165	160.340	3.3	0.8	700	1,950	71,500	199,000
140	198	144	144	2	2.5	575	1,460	58,500	149,000
	210	114	114	2	2.5	515	1,070	52,500	109,000
	210	115	115	2	2.5	515	1,070	52,500	109,000
146.050	244.475	192.088	187.325	3.3	1.5	955	1,980	97,000	202,000
150	210	190	190	2.5	1.5	860	2,240	87,500	229,000
	212	155	155	2.5	3	660	1,700	67,500	173,000
152.400	222.250	174.625	174.625	1.5	1.5	930	2,350	94,500	239,000
160	226	165	165	2.5	3	775	2,030	79,000	207,000
	265	173	173	2.5	2.5	1,100	2,270	112,000	231,000
165.100	225.425	165.100	168.275	3.3	0.8	745	2,220	76,000	226,000

Boundary dimensions: mm. Basic load ratings: kN / kgf.

❶ Minimum allowable dimension for chamfer dimension r or r_1.



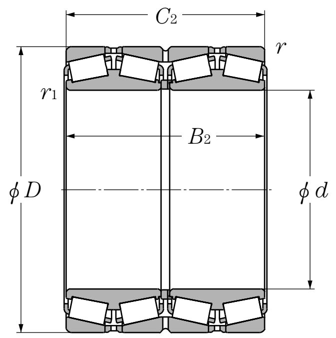
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions (mm) d_a	D_a	S_a min	r_{as} max	r_{las} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
CRO-2008	120	152.5	3.7	2	0.6	0.32	2.12	3.15	2.07	14.5
CRO-2151	135	168.5	2.5	2	1	0.42	1.60	2.38	1.56	26
CRO-2252	119	140.5	1.2	1.5	1.5	0.18	3.66	5.46	3.58	7.7
625924	135	155.5	5	2	2	0.33	2.03	3.02	1.98	8.97
623024	135	166.5	3.8	2	2	0.37	1.80	2.69	1.76	8.87
623124	143	182	4.1	2	2	0.37	1.80	2.69	1.76	16.7
CRO-2418	140	190	4.5	2	2	0.40	1.67	2.50	1.64	22.2
∗M224749D/M224710/M224710D	129	163	3	1.5	0.8	0.33	2.03	3.02	1.98	11.5
∗T-48290D/48220/48220D	137	168	4.5	3.3	1.5	0.31	2.21	3.29	2.16	14.3
625926	144.5	169	5	2	2	0.33	2.03	3.02	1.98	11.3
CRO-2701	143	165	2	2	1	0.33	2.03	3.02	1.98	13.5
∗T-48393D/48320/48320D	144	177	4	3.3	1.5	0.32	2.10	3.13	2.05	14.8
∗T-48680D/48620/48620D	150	185	3	3.3	0.8	0.34	2.01	2.99	1.96	17.3
625928	156	183	5	2	2	0.33	2.03	3.02	1.98	14
623028	159	193	3.5	2	2	0.37	1.84	2.74	1.80	13.8
CRO-2817	159	193	3.4	2	2	0.37	1.84	2.74	1.80	13.9
∗81576D/81962/81963D	163	225	6.5	3.3	1.5	0.35	1.92	2.86	1.88	36.8
CRO-3052	162	192.5	2.5	2	1.5	0.40	1.68	2.50	1.64	20.3
625930	167.5	195	5.5	2	2.5	0.33	2.03	3.02	1.98	16.9
∗T-M231649D/M231610/M231610D	165	207	4	1.5	1.5	0.36	1.87	2.79	1.83	24.7
625932	177.5	208.5	5.5	2	2.5	0.33	2.03	3.02	1.98	20.2
CRO-3209 (CRO-3210)	184	247	4.5	2	2	0.33	2.03	3.02	1.98	37.0
∗T-46791D/46720/46721D	175	209	3	0.8	2.5	0.38	1.76	2.62	1.72	20.7

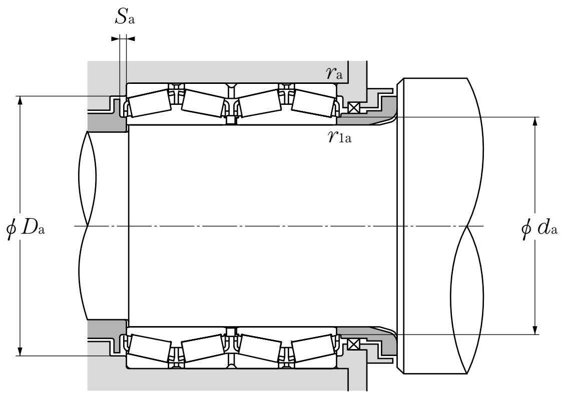
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings.
2. The bearing where parentheses adhered abolished inner ring spacer.



d 170～220mm

	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	*D*	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
170	240	175	175	2.5	3	835	2,200	85,500	224,000
	260	144	144	2.5	3	840	1,730	85,500	176,000
	280	181	181	2.5	2.5	1,150	2,420	117,000	247,000
	280	185	185	2.5	3	1,240	2,540	127,000	259,000
177.800	247.650	192.088	192.088	3.3	1.5	1,000	2,760	102,000	281,000
	279.400	234.950	234.947	3.3	1.5	1,420	3,400	145,000	345,000
	304.800	238.227	233.365	3.3	3.3	1,580	3,100	161,000	320,000
180	250	185	185	2	2.5	895	2,350	91,500	239,000
	254	185	185	2.5	3	910	2,390	93,000	244,000
	300	280	280	3	3	2,160	4,800	220,000	490,000
187.325	269.875	211.138	211.138	3.3	1.5	1,240	3,400	127,000	345,000
190.000	268	196	196	2.5	3	1,060	2,850	108,000	291,000
	270	190	190	2.5	2.5	1,080	2,940	111,000	300,000
	270	190	190	2.5	0.6	1,220	3,050	125,000	310,000
	292.100	225.425	225.425	3.3	1.5	1,570	4,150	160,000	425,000
190.500	266.700	187.325	188.912	3.3	1.5	1,040	2,990	106,000	305,000
198.438	284.162	225.425	225.425	3.3	1.5	1,530	4,000	156,000	410,000
200	282	206	206	2.5	3	1,200	3,300	122,000	335,000
	290	160	160	2.5	2.5	925	2,210	94,500	226,000
	310	200	200	3	3	1,530	3,300	156,000	340,000
203.200	317.500	215.900	209.550	3.3	3.3	1,270	2,820	129,000	288,000
206.375	282.575	190.500	190.500	3.3	0.8	1,120	2,890	114,000	294,000
215.900	288.925	177.800	177.800	3.3	0.8	1,110	3,250	114,000	335,000
216.103	330.200	263.525	269.875	3.3	1.5	2,000	5,150	204,000	525,000
220	300	230	230	2.5	2.5	1,360	3,650	138,000	375,000
	310	226	226	3	4	1,380	3,800	141,000	385,000
	320	200	200	3	1	1,390	3,400	141,000	345,000

❶ Minimum allowable dimension for chamfer dimension *r* or r_1.



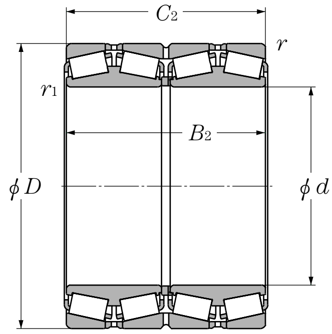
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm d_a	D_a	S_a min	r_{as} max	r_{las} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
625934	187.5	220	5.5	2	2.5	0.33	2.03	3.02	1.98	24.4
623034	192.5	239	3.8	2	2.5	0.37	1.80	2.69	1.76	27.5
CRO-3409	192	255	5	2	2	0.40	1.68	2.50	1.64	44
623134	197	253.5	6.4	2	2.5	0.37	1.80	2.69	1.76	45.2
∗67791D/67720/67721D (CRO-3664)	190	229	5	3.3	1.5	0.44	1.54	2.29	1.48	29.4
∗82681D/82620/82620D	195	251	5	1.5	3.3	0.53	1.28	1.91	1.25	55.3
∗EE280700D/281200/281201D (CRO-3663)	198	279	7	3.3	3.3	0.36	1.87	2.79	1.83	69.9
CRO-3658	195	229	3.1	2	2.5	0.44	1.54	2.30	1.51	27.5
625936	200.5	233.5	5.5	2	2.5	0.33	2.03	3.02	1.98	28.9
CRO-3617	201	274	5	2.5	2.5	0.37	1.80	2.69	1.76	69.4
∗M238849D/M238810/M238810D	199.9	250	4	3.3	1.5	0.33	2.03	3.02	1.98	41.8
625938	209	245.5	6	2	2.5	0.33	2.03	3.02	1.98	34.7
CRO-3812	205	250	6	2	2	0.33	2.03	3.02	1.98	34.7
CRO-3813	207	248.5	2.5	2	0.6	0.40	1.68	2.50	1.64	34.5
∗M241538D/M241510/M241510D	222	271	5	3.3	1.5	0.33	2.03	3.02	1.98	59.6
∗T-67885D/67820/67820D	204	246	3	1.5	2.5	0.48	1.41	2.11	1.38	33.6
∗M240648D/M240611/M240611D	212	264	5.5	3.3	1.5	0.33	2.03	3.02	1.98	46
625940	219.5	258	6	2	2.5	0.33	2.03	3.02	1.98	40.5
CRO-4013	221	271	5	2	2	0.37	1.80	2.69	1.76	35.1
CRO-4014	222	284	6	2.5	2.5	0.39	1.74	2.59	1.70	54.0
∗EE132082D/132125/132126D	224	294	9.5	3.3	3.3	0.31	2.15	3.20	2.10	62.5
∗T-67986D/67920/67920D	219	260	5	3.3	0.8	0.51	1.33	1.97	1.30	35.4
∗T-LM742749D/LM742714/LM742714D	227	267	5	0.8	2.5	0.48	1.40	2.09	1.37	34.3
∗9974D/9920/9920D	235	277	6	3.3	1.5	0.55	1.23	1.82	1.20	82.1
CRO-4412	236.5	277.5	6.5	0	2	0.43	1.59	2.36	1.55	42.1
625944	242	284.5	6	2.5	3	0.33	2.03	3.02	1.98	53.5
CRO-4411	245	294.5	6.5	2.5	2	0.35	1.95	2.90	1.91	53

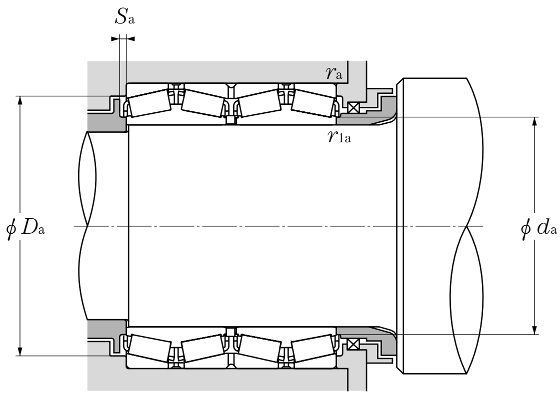
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings.
2. The bearing where parentheses adhered abolished inner ring spacer.



d 220～266.700mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
220	340	190	190	3	4	1,510	3,300	154,000	335,000
	340	194	194	3	3	1,510	3,300	154,000	335,000
220.662	314.325	239.712	239.712	3.3	1.5	1,840	4,900	187,000	500,000
228.600	364.000	296.875	296.875	3.3	3.3	2,370	5,550	242,000	565,000
	425.450	349.250	361.950	6.4	3.5	3,450	8,250	355,000	845,000
234.950	327.025	196.850	196.850	3.3	1.5	1,370	3,700	140,000	380,000
240	338	248	248	3	4	1,870	4,950	191,000	505,000
241.478	350.838	228.600	228.600	3.3	1.5	1,610	4,000	164,000	410,000
244.475	327.025	193.675	193.675	3.3	1.5	1,430	4,100	146,000	415,000
	381.000	304.800	304.800	4.8	3.3	2,220	5,750	227,000	590,000
245	380	255.5	254	6.4	1.5	2,060	4,750	210,000	485,000
250	365	270	270	3	1.5	2,150	6,150	219,000	630,000
	365	270	270	3	2	2,150	6,150	219,000	630,000
	370	220	220	4	4	2,050	5,750	209,000	590,000
254.000	358.775	269.875	269.875	3.3	3.3	2,390	6,550	244,000	670,000
	368.300	204.622	204.470	3.3	1.5	1,350	3,250	138,000	330,000
	444.500	279.400	279.400	6.4	3.3	2,890	5,900	294,000	600,000
260	360	272	272	2.5	1	2,080	5,750	212,000	585,000
	368	268	268	4	5	1,990	5,700	203,000	580,000
	400	220	220	4	5	1,970	4,400	201,000	445,000
	400	255	255	7.5	4	2,210	5,300	225,000	540,000
260.350	365.125	228.600	228.600	6.4	3.3	1,750	4,550	178,000	465,000
	400.050	255.588	253.995	6.4	1.5	2,090	4,950	213,000	505,000
	422.275	314.325	317.500	3.3	6.4	2,980	7,100	305,000	725,000
266.700	355.600	230.188	228.600	3.3	1.5	1,840	5,350	188,000	545,000
	355.600	230.188	228.600	3.3	1.5	1,430	4,350	146,000	445,000
	393.700	269.878	269.878	6.4	3.3	2,110	6,000	216,000	610,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



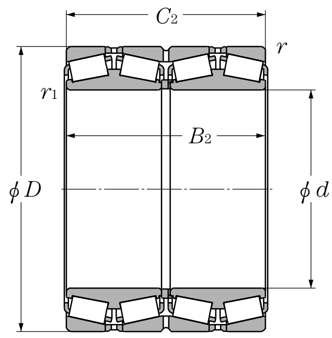
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
623044	250.5	312.5	5.5	2.5	3	0.37	1.80	2.69	1.76	63.2
CRO-4409	250.5	312.5	6	2.5	2.5	0.37	1.80	2.69	1.76	64.5
∗T-M244249D/M244210/M244210D	235	293	4	1.5	2.5	0.33	2.03	3.02	1.98	60.2
CRO-4606	262	332	6.5	3.3	3.3	0.32	2.12	3.15	2.07	117.9
∗EE700090D/700167/700168D	263	381	3	6.4	3.5	0.33	2.03	3.02	1.98	232
∗T-8576D/8520/8520D	250	305	5	3.3	1.5	0.41	1.66	2.47	1.62	53.6
625948A (CRO-4825)	260.5	312	6	3	2.5	0.33	2.03	3.02	1.98	70
∗EE127097D/127137/127137D	262	325	6.5	3.3	1.5	0.35	1.91	2.85	1.87	76.4
∗LM247748D/LM247710/LM247710DA	257	310	5	3.3	1.5	0.32	2.09	3.11	2.04	46.1
∗EE126096D/126150/126151D	262	343	6.5	3.3	4.8	0.52	1.31	1.95	1.28	132
CRO-4901	275.5	344.5	6.5	6.4	1.5	0.37	1.80	2.69	1.76	106.7
CRO-5004	275	339	5	2.5	1.5	0.33	2.03	3.02	1.98	82.1
CRO-5012	279	332.5	6	3	2	0.33	2.03	3.02	1.98	96.7
CRO-5001	276	344	6	3	3	0.26	2.55	3.80	2.49	87
∗T-M249748D/M249710/M249710D	272.5	335	5	2.5	2.5	0.33	2.03	3.02	1.98	85.6
∗EE171000D/171450/171451D	269	340	6	3.3	1.5	0.36	1.85	2.76	1.81	71.8
∗EE822101D/822175/822176D	289	406	8	6.4	3.3	0.34	1.98	2.94	1.93	185
CRO-5218	279	332.5	6.5	2.5	1	0.41	1.66	2.47	1.62	74.2
625952	287	338.5	6	3	3	0.33	2.03	3.02	1.98	90.3
623052	292	366.5	6.5	3	3	0.37	1.80	2.69	1.76	98.9
CRO-5215	290	359	8	6	3	0.39	1.71	2.54	1.67	106
∗EE134102D/134143/134144D	282	340	6.5	6.4	3.3	0.37	1.80	2.69	1.76	76.5
∗EE221027D/221575/221576D	292	367	8	6.4	1.5	0.39	1.71	2.54	1.67	117
∗HM252349D/HM252310/HM252310D	290	392	5.5	3.3	6.4	0.33	2.03	3.02	1.98	180
∗T-LM451349D/LM451310/LM451310D (CRO-5307)	281	335	6.5	3.3	1.5	0.36	1.87	2.79	1.83	62
∗CRO-5305	281	330.5	3.5	3.3	1.5	0.37	1.83	2.72	1.79	62.3
∗EE275106D/275155/275156D	292	367	5	6.4	3.3	0.40	1.68	2.50	1.64	116

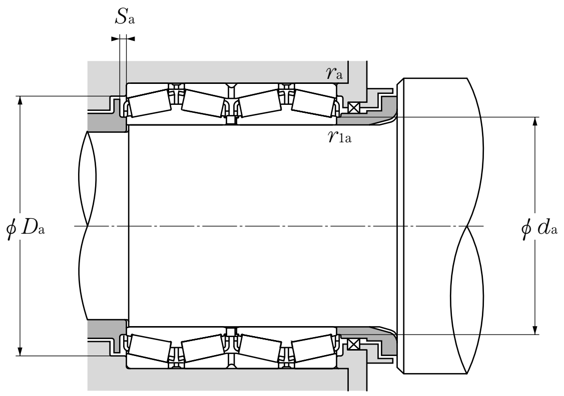
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings.
2. The bearing where parentheses adhered abolished inner ring spacer.



d 269.875～304.800mm

	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
269.875	381.000	282.575	282.575	3.3	3.3	2,470	6,850	252,000	700,000
270	410	222	222	4	4	1,910	4,550	195,000	465,000
275	385	200	200	3	3	1,610	4,250	165,000	435,000
276.225	406.400	268.290	260.355	6.4	1.5	2,110	6,000	216,000	610,000
279.400	381.000	269.875	269.875	3.3	1.5	2,240	6,450	229,000	655,000
	393.700	269.875	269.875	6.4	1.5	1,940	5,350	197,000	545,000
	419.100	292.100	292.100	6.4	3.3	2,770	6,950	283,000	705,000
	469.900	346.075	349.250	3.3	6.4	3,500	8,700	355,000	885,000
279.578	380.898	244.475	244.475	3.3	1.5	1,950	6,200	199,000	635,000
280	380	290	290	3.1	1.7	2,470	7,250	252,000	740,000
	395	288	288	4	5	2,560	7,100	261,000	725,000
285.750	380.898	244.475	244.475	3.3	1.5	1,950	6,200	199,000	635,000
288.925	406.400	298.450	298.450	3.3	3.3	2,980	8,300	305,000	850,000
292.100	476.250	296.047	292.100	3.3	1.5	3,050	6,800	310,000	695,000
300	424	310	310	4	5	2,570	7,450	262,000	760,000
	430	280	280	4	4	2,690	7,100	275,000	725,000
	430	300	300	4	4	2,690	7,100	275,000	725,000
	460	360	360	4	4	4,050	10,100	415,000	1,030,000
	470	270	270	4	4	3,200	7,250	325,000	740,000
	470	292	292	4	4	3,500	8,300	360,000	845,000
	500	332	332	5	6	3,600	8,100	370,000	825,000
300.038	422.275	311.150	311.150	3.3	3.3	3,350	9,600	340,000	980,000
304.648	438.048	279.400	279.400	3.3	3.3	2,470	6,500	252,000	665,000
	438.048	280.990	279.400	4.8	3.3	2,630	6,900	268,000	700,000
304.800	419.100	269.875	269.875	6.4	1.5	2,390	6,850	244,000	695,000
	444.500	247.650	241.300	1.5	8	1,850	4,600	188,000	470,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



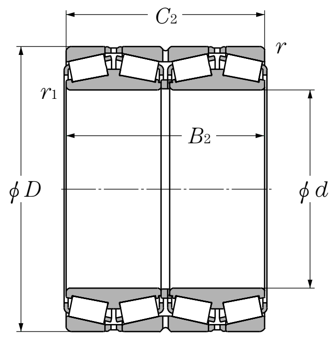
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm					Constant	Axial load factors			Mass kg
	d_a	D_a	S_a min	r_{as} max	r_{1as} max	e	Y_1	Y_2	Y_o	(approx.)
∗T-M252349D/M252310/M252310D	290	356	6	2.5	2.5	0.33	2.03	3.02	1.98	97.5
CRO-5403	305	382	6	3	3	0.27	2.49	3.71	2.43	91
CRO-5501	300	355	6	2.5	2.5	0.40	1.68	2.50	1.64	62.5
∗EE275109D/275160/275161D	293.6	366	8	6.4	1.5	0.40	1.68	2.69	1.64	122
∗CRO-5628	298.5	353	5	2.5	1.5	0.37	1.80	2.69	1.76	79.6
∗EE135111D/135155/135156D	297	368	6.5	5	1.5	0.40	1.68	2.50	1.64	103
CRO-5614	312.5	383.5	6	5	2.5	0.37	1.80	2.69	1.76	141
∗EE722111D/722185/722186D	316	432	5	3.3	6.4	0.37	1.78	2.65	1.74	258
∗T-LM654644D/LM654610/LM654610D (CRO-5679)	297	356	5	3.3	1.5	0.43	1.56	2.33	1.52	83.2
CRO-5650 (CRO-5676)	300	354	6.5	2.5	1.5	0.33	2.03	3.02	1.98	105
625956 (CRO-5684)	304.5	363.5	7	3	4	0.33	2.03	3.02	1.98	111
∗T-LM654648D/LM654610/LM654610D (CRO-5710)	302	356	5	1.5	2.5	0.43	1.56	2.33	1.53	82.5
∗M255449D/M255410/M255410DA	310	379	5	3.3	3.3	0.34	2.00	2.98	1.96	125
∗EE921150D/921875/921876D	321	441	7	3.3	1.5	0.29	2.30	3.42	2.25	208
625960	329	389.5	7	3	4	0.33	2.03	3.02	1.98	138
CRO-6019	325.5	395.5	8	3	3	0.47	1.45	2.16	1.42	132
CRO-6022	323	394	3	3	3	0.47	1.45	2.16	1.42	141
CRO-6015	330	427	10	3	3	0.31	2.21	3.29	2.16	180
☆CRO-6012	338	438	7	3	3	0.37	1.80	2.69	1.76	152
☆CRO-6013 (CRO-6033)	336	437	7	3	3	0.37	1.80	2.69	1.76	164
623160	346.5	449	5	4	4	0.40	1.68	2.50	1.64	257
☆∗T-HM256849D/HM256810/HM256810DG2	322	394	6	3.3	3.3	0.34	2.00	2.98	1.95	143
∗EE329119D/329172/329173D	328	409	8	3.3	3.3	0.33	2.04	3.04	2.00	143
∗M757448D/M757410/M757410D	328	407	7	4.8	3.3	0.47	1.43	2.12	1.39	140
∗M257149D/M257110/M257110D	322	392	5	6.4	1.5	0.33	2.03	3.02	1.98	115
∗EE291202D/291750/291751D	328	416	9.5	1.5	8	0.38	1.78	2.65	1.74	127

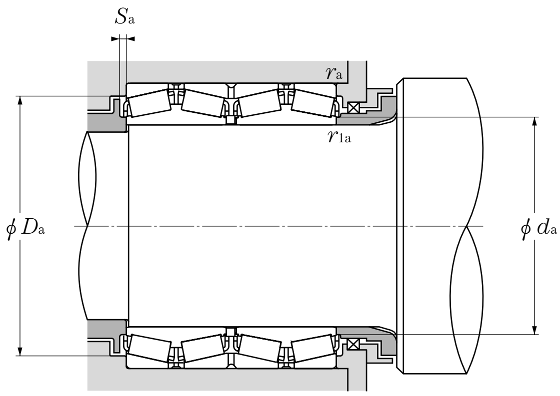
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.



d 304.800～355mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B_2	C_2	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}
304.800	495.300	342.900	349.250	6.4	3.3	3,650	9,400	370,000	960,000
304.902	412.648	266.700	266.700	3.3	3.3	2,610	7,450	267,000	760,000
305.003	438.048	280.990	279.400	4.8	3.3	2,630	6,900	268,000	700,000
310	430	310	310	4	2.2	2,880	8,100	294,000	825,000
	430	310	310	5.5	2.2	3,050	8,600	310,000	875,000
317.500	422.275	269.875	269.875	3.3	1.5	2,260	7,050	231,000	715,000
	447.675	327.025	327.025	3.3	3.3	3,400	9,550	345,000	995,000
320	460	338	338	4	5	2,940	8,650	300,000	880,000
327	445	230	230	4	2	2,150	5,650	219,000	575,000
330	470	340	340	2.5	2.5	3,150	10,200	320,000	1,040,000
	510	340	340	6	6	3,900	9,650	395,000	985,000
330.200	482.600	306.388	311.150	3.3	1.5	2,810	7,900	287,000	805,000
	533.400	254.000	254.000	6	6	3,200	6,750	330,000	690,000
333.375	469.900	342.900	342.900	3.3	3.3	4,000	11,000	405,000	1,130,000
340	480	350	350	5	6	3,450	10,400	350,000	1,060,000
	520	278	278	5	6	3,250	7,500	330,000	765,000
341.312	457.098	254.000	254.000	3.3	1.5	2,370	6,900	241,000	705,000
342.900	533.400	307.985	301.625	3.3	3.3	3,150	6,900	320,000	705,000
343.052	457.098	254.000	254.000	3.3	1.5	2,370	6,900	241,000	705,000
	457.098	254.000	254.000	3.3	1.5	2,430	6,750	248,000	685,000
346.075	488.950	358.775	358.775	3.3	3.3	4,350	12,800	445,000	1,300,000
347.662	469.900	292.100	292.100	3.3	3.3	3,200	9,100	325,000	925,000
355	490	316	316	3.3	1.5	3,500	10,000	355,000	1,020,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



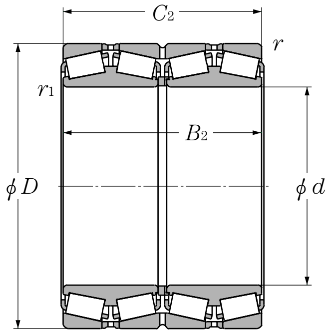
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
∗EE724121D/724195/724196D	330	450	3	6.4	3.3	0.40	1.68	2.50	1.64	273
∗M257248D/M257210/M257210D	325	388	5	3.3	3.3	0.32	2.12	3.15	2.07	107
∗M757449D/M757410/M757410D	328	407	7	4.8	3.3	0.47	1.43	2.12	1.39	139
CRO-6213	333	396.5	8.5	3	2	0.40	1.68	2.50	1.64	133
CRO-6204	333.5	397.5	7.5	4	2	0.33	2.03	3.02	1.98	136
LM258649D/LM258610/LM258610D (CRO-6431)	334	398	7	3.3	1.5	0.32	2.10	3.13	2.06	110
∗T-HM259049D/HM259010/HM259010D	339.6	418	5	2.5	2.5	0.33	2.02	3.00	1.97	161
625964	355	420.5	7	3	4	0.33	2.03	3.02	1.98	183
CRO-6501	353.5	416	5.5	3	2	0.33	2.03	3.02	1.98	99.8
CRO-6604	366	440	5.5	2	2	0.33	2.02	3.00	1.97	141
CRO-6602	366	469	5	5	5	0.40	1.68	2.50	1.64	221
∗EE526131D/526190/526191D	351	448	3	3.3	1.5	0.39	1.72	2.56	1.68	197
∗CRO-6606	378.5	488	6.5	5	5	0.37	1.80	2.69	1.76	221
∗HM261049D/HM261010/HM261010DA	357	439	5	2.5	2.5	0.33	2.02	3.00	1.97	187
625968	373	440	7	4	5	0.33	2.03	3.02	1.98	200
623068	382.5	478	6.5	4	4	0.37	1.80	2.69	1.76	213
∗LM761648D/LM761610/LM761610D	359	432	5	1.5	2.5	0.47	1.43	2.12	1.40	125
∗EE971355D/972100/972103D	378	502	11	3.3	3.3	0.33	2.03	3.02	1.98	252
∗LM761649D/LM761610/LM761610D (CRO-6945)	361	432	5	3.3	1.5	0.47	1.43	2.12	1.39	117
CRO-6910 (CRO-6944)	361	426	5	3.3	1.5	0.47	1.43	2.12	1.40	105
☆∗T-HM262749D/HM262710/HM262710DG2	371	456	6	2.5	2.5	0.33	2.02	3.00	1.97	227
∗M262449D/M262410/M262410D	369	443	8	3.3	3.3	0.33	2.03	3.02	1.98	148
CRO-7105	378	450	7	3.3	1.5	0.33	2.03	3.02	1.98	170

Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.

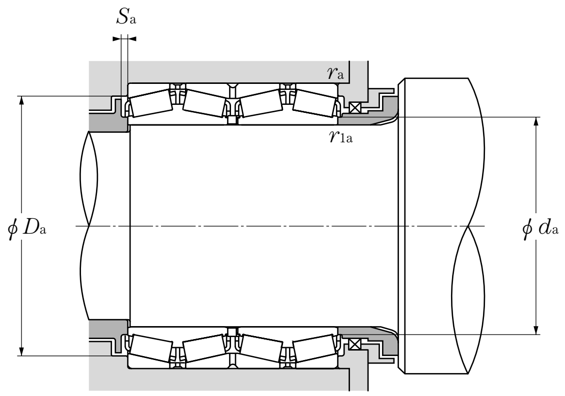


d 355.600～406.400mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
355.600	444.500	241.300	241.300	3.3	1.5	1,760	6,200	180,000	635,000
	457.200	252.412	252.412	3.3	1.5	2,470	7,850	251,000	800,000
	482.600	265.112	269.875	3.3	1.5	2,790	7,650	285,000	780,000
	488.950	317.500	317.500	3.3	1.5	3,500	10,000	350,000	1,020,000
360	508	370	370	5	6	3,700	11,200	380,000	1,140,000
	520	370	370	5.5	3.5	4,500	12,300	455,000	1,260,000
	520	410	410	5	5	5,150	14,700	525,000	1,500,000
	540	340	340	5	3	4,350	11,100	445,000	1,130,000
	600	540	540	5	5	6,700	18,100	685,000	1,840,000
	600	396	396	5	6	5,500	13,000	560,000	1,320,000
368.300	523.875	382.588	382.588	6.4	3.3	4,450	13,100	455,000	1,330,000
	596.900	342.900	342.900	6.4	6.4	4,600	10,600	470,000	1,090,000
374.650	501.650	250.825	260.350	3.3	1.5	2,360	6,250	241,000	640,000
380	536	390	390	5	6	4,900	14,100	500,000	1,440,000
	560	282	282	5	6	3,550	8,700	365,000	890,000
	560	285	285	5	5	3,250	7,700	330,000	785,000
	560	360	360	6	1.5	4,650	12,100	470,000	1,230,000
	560	360	360	5	1.5	5,050	13,500	515,000	1,380,000
384.175	546.100	400.050	400.050	6.4	3.3	5,400	16,100	550,000	1,640,000
385.762	514.350	317.500	317.500	3.3	3.3	3,650	11,100	370,000	1,130,000
390	510	350	350	3.5	1.5	3,700	11,800	375,000	1,210,000
393.700	546.100	288.925	288.925	6.4	1.5	3,200	10,200	325,000	1,040,000
395	545	268.7	288.7	7.5	4	2,970	8,650	305,000	880,000
400	560	380	380	5	5	4,800	14,100	490,000	1,440,000
	564	412	412	5	6	4,850	14,700	495,000	1,500,000
	635	470	470	5	2.5	7,200	18,000	735,000	1,840,000
406.400	546.100	268.288	288.925	6.4	1.5	2,290	6,550	233,000	670,000
	546.100	288.925	288.925	6.4	1.5	3,200	10,200	325,000	1,040,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.

NTN



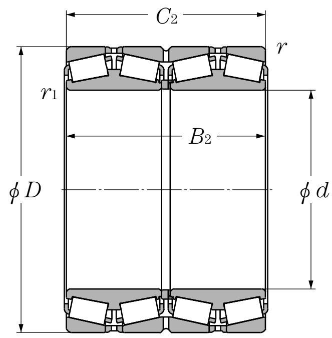
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
∗L163149D/L163110/L163110D	370	422	6.5	3.3	1.5	0.31	2.20	3.27	2.15	89.5
∗LM263149D/LM263110/LM263110D	372	434	6	3.3	1.5	0.32	2.12	3.15	2.07	106
∗LM763449D/LM763410/LM763410D	375	453	3	3.3	1.5	0.47	1.43	2.14	1.40	145
∗M263349D/M263310/M263310D (CRO-7123)	374	459	5	3.3	1.5	0.33	2.03	3.02	1.98	173
625972 (CRO-7227)	394	466.5	7	4	5	0.33	2.03	3.02	1.98	236
CRO-7220	391	0	5	4.5	3	0.33	2.03	3.02	1.98	260
☆CRO-7217	396	478	8.5	4	4	0.33	2.03	3.02	1.98	297
CRO-7211	400	496	5	4	2.5	0.33	2.03	3.02	1.98	270
CRO-7210	400	550	8	4	4	0.36	1.89	2.81	1.98	520
623172 (CRO-7228)	414.6	541.5	8	4	4.5	0.40	1.68	2.50	1.64	447
☆∗HM265049D/HM265010/HM265010DG2 (CRO-7406)	393.7	487	6	6.4	3.3	0.33	2.03	3.02	1.98	280
∗EE181455D/182350/182351D	421	541	7.5	6.4	6.4	0.42	1.62	2.42	1.59	373
∗LM765149D/LM765110/LM765110D	393	472	2	3.3	1.5	0.47	1.43	2.12	1.40	145
625976	410	494	8	4	5	0.33	2.03	3.02	1.98	277
623076	421	518	6.5	4	4	0.37	1.80	2.69	1.76	240
CRO-7612	417	525	7	4	4	0.40	1.68	2.50	1.64	208
CRO-7622	416	514	7	5	1.5	0.40	1.68	2.50	1.64	302.22
☆CRO-7621	423	515	6.5	4	1.5	0.40	1.68	2.50	1.64	312
☆∗T-HM266449D/HM266410/HM266410DG2	411	507	6.5	6.4	3.3	0.33	2.03	3.02	1.98	312
∗LM665949D/LM665910/LM665910D	409	482	7	2.5	2.5	0.42	1.61	2.40	1.58	240
CRO-7801	411	478	7	3	1.5	0.33	2.03	3.02	1.98	186
∗LM767745D/LM767710/LM767710D	418	510	6.5	6.4	1.5	0.48	1.42	2.11	1.38	219
CRO-7901	434	508	3	6	3	0.48	1.42	2.11	1.39	200
☆CRO-8005	436	515	8	4	4	0.40	1.68	2.50	1.64	300
625980	434	518.5	7	4	5	0.33	2.03	3.02	1.98	324
CRO-8010	447	579	6.5	4	2	0.33	2.03	3.02	1.98	564
∗EE234161D/234215/234216D	438	505	1.5	6.4	1.5	0.47	1.43	2.12	1.40	190
∗LM767749D/LM767710/LM767710D	427	510	6.5	6.4	1.5	0.48	1.42	2.11	1.38	201

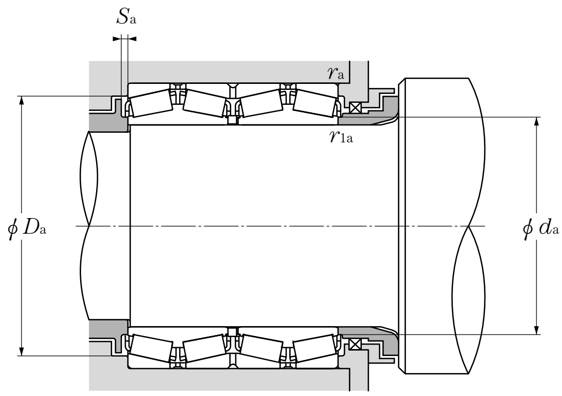
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.



d 406.400～488.950mm

d	Boundary dimensions (mm) D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}
406.400	565.150	381.000	381.000	6.4	3.3	4,750	14,100	485,000	1,440,000
	590.550	400.050	400.050	6.4	3.3	4,850	13,600	490,000	1,380,000
	609.600	309.562	317.500	6.4	3.5	3,700	9,600	380,000	980,000
409.575	546.100	334.962	334.962	6.4	1.5	4,100	12,700	415,000	1,290,000
415.925	590.550	434.975	434.975	6.4	3.3	6,300	18,900	640,000	1,930,000
420	592	432	432	5	6	5,350	16,300	545,000	1,660,000
	650	460	460	5	5	6,950	18,300	710,000	1,870,000
431.800	571.500	279.400	279.400	3.3	1.5	3,200	9,850	330,000	1,010,000
	571.500	336.550	336.550	6.4	1.5	3,700	11,800	380,000	1,200,000
	635.000	355.600	355.600	6.4	6.4	5,650	15,000	580,000	1,530,000
432.003	609.524	317.500	317.500	6.4	3.5	4,350	11,500	445,000	1,170,000
440	620	454	454	6	6	6,500	19,900	665,000	2,030,000
	635	470	470	6.4	3.3	7,100	22,100	725,000	2,260,000
	650	355	355	7.5	4	5,350	13,400	545,000	1,370,000
	650	460	460	6	6	6,750	20,700	690,000	2,110,000
447.675	635.000	463.550	463.550	6.4	3.3	7,100	22,100	725,000	2,260,000
457.200	596.900	276.225	279.400	3.3	1.5	2,900	9,150	296,000	935,000
	596.900	276.225	279.400	3.3	1.6	2,870	9,400	292,000	955,000
	660.400	323.850	323.847	6.4	3.3	4,150	11,200	425,000	1,140,000
460	650	474	474	6	6	6,500	19,900	665,000	2,030,000
475	660	450	450	5	3	6,300	20,400	645,000	2,080,000
480	678	494	494	6	6	6,250	19,600	640,000	2,000,000
	678	494	494	6	6	6,250	19,600	640,000	2,000,000
	700	390	390	6	6	4,700	13,400	480,000	1,370,000
482.600	615.950	330.200	330.200	6.4	3.3	4,000	13,400	405,000	1,370,000
488.950	660.400	365.125	361.950	6.4	8	5,350	16,100	550,000	1,640,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



Equivalent bearing load

dynamic

$P_r=XF_r+YF_a$

$\frac{F_a}{F_r}\leqq e$		$\frac{F_a}{F_r}>e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

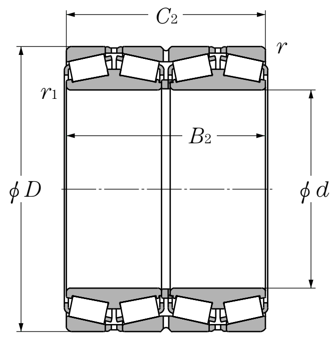
static

$P_{or}=F_r+Y_oF_a$

For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions (mm) d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
CRO-8103	441	525	6.5	6.4	3.3	0.35	1.95	2.90	1.91	310
∗EE833161D/833232/833233D	448	549	6.5	6.4	3.3	0.33	2.07	3.09	2.03	395
∗EE911603D/912400/912401D	441	568	1.5	6.4	3.5	0.38	1.76	2.62	1.72	332
☆∗M667947D/M667911/M667911DG2	431	510	5.5	6.4	1.5	0.42	1.61	2.40	1.57	226
☆∗T-M268749D/M268710/M268710DG2	444	549	9	6.4	3.3	0.33	2.03	3.02	1.98	421
625984 (CRO-8414)	457	545	7	4	5	0.33	2.03	3.02	1.98	374
CRO-8402	455	593	8	4	4	0.33	2.03	3.02	1.98	600
∗T-LM869449D/LM869410/LM869410D	453	537	8	1.5	2.5	0.55	1.24	1.84	1.21	193
∗LM769349D/LM769310/LM769310D	453	534	6.5	6.4	1.5	0.44	1.52	2.26	1.49	232
☆∗EE931170D/931250/931251XDG2	490	607	6.6	5	5	0.32	2.12	3.15	2.07	402
EE736173D/736238/736239D	464	572	6.5	6.4	3.5	0.35	1.95	2.90	1.91	297
625988 (CRO-8839)	479	572.5	8	5	5	0.33	2.03	3.02	1.64	430
☆CRO-8808	494	607	9	5	5	0.33	2.03	3.02	1.98	498
☆CRO-8807	484	607	9	6	3	0.33	2.03	3.02	1.98	400
CRO-8806	483	595	11	5	5	0.33	2.03	3.02	1.98	600
☆∗M270749D/M270710/M270710DG2	478	591	8	6.4	3.3	0.33	2.03	3.02	1.98	509
∗L770849D/L770810/L770810D	478	567	5.5	3.3	1.5	0.47	1.43	2.12	1.39	201
∗EE244181D/244235/244236D	490	583	5.5	2.5	3	0.40	1.67	2.49	1.63	207
∗EE737179D/737260/737260D	495	616	6.5	6.4	3.3	0.37	1.80	2.69	1.76	379
625992A	499	598.5	7	5	5	0.33	2.03	3.02	1.98	493
CRO-9501	506	614	10	4	2.5	0.34	1.98	2.94	1.93	465
625996	525	623	7	5	5	0.33	2.03	3.02	1.98	563
CRO-9612	524	650	2	5	5	0.33	2.03	3.02	1.98	554
CRO-9602	517	645	8	5	5	0.4	1.68	2.50	1.64	436
☆∗LM272249D/LM272210/LM272210DG2	504	585	6.5	6.4	3.3	0.33	2.03	3.02	1.98	250
☆∗T-EE640193D/640260/640261DG2	519	624	9	6	5	0.31	2.20	3.27	2.15	364

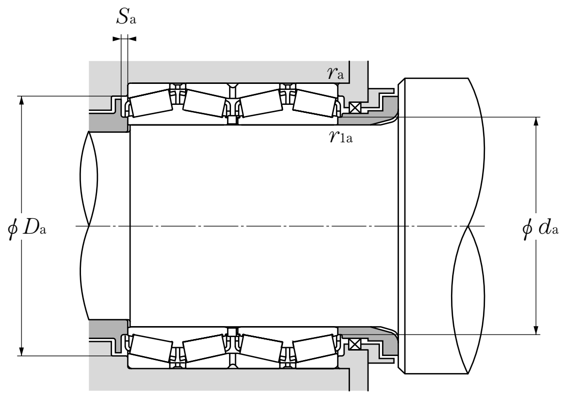
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.



d 489.026～585.788mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
489.026	634.873	320.675	320.675	3.3	3.3	3,650	12,000	370,000	1,220,000
500	670	515	515	5	1.5	6,900	24,600	700,000	2,510,000
	690	480	480	5	5	6,000	19,900	610,000	2,020,000
	705	515	515	6	6	8,450	27,100	860,000	2,760,000
	730	420	420	6	6	7,450	19,900	760,000	2,030,000
	730	440	440	6	6	7,200	20,600	735,000	2,100,000
501.650	711.200	520.700	520.700	6.4	3.3	8,650	27,300	885,000	2,790,000
508.000	762.000	463.550	463.550	6.4	6.4	7,800	21,400	795,000	2,180,000
509.948	654.924	377.000	379.000	6.4	1.5	5,100	17,600	520,000	1,790,000
514.350	673.100	422.275	422.275	6.4	3.3	5,950	20,500	605,000	2,090,000
519.112	736.600	536.575	536.575	6.4	3.3	9,100	28,700	925,000	2,930,000
520	735	535	535	5	7	9,100	28,700	925,000	2,930,000
533.400	965.200	495.300	495.300	7.5	7.5	11,100	28,700	1,130,000	2,920,000
536.575	761.873	558.800	558.800	6.4	3.3	10,100	30,500	1,030,000	3,100,000
539.750	784.225	339.725	342.900	6.4	3.3	4,800	12,200	490,000	1,240,000
555.625	698.500	349.250	349.250	6.4	3.2	4,350	14,300	445,000	1,460,000
558.800	736.600	322.265	322.268	6.4	3.3	4,300	13,500	435,000	1,380,000
	736.600	409.575	409.575	6.4	3.3	6,100	20,500	625,000	2,090,000
570	780	515	515	6	6	9,200	31,000	935,000	3,150,000
	810	590	590	6	6	11,000	35,500	1,120,000	3,600,000
571.500	812.800	593.725	593.725	6.4	3.3	11,900	36,500	1,220,000	3,750,000
584.200	762.000	396.875	401.638	6.4	3.3	6,550	22,300	670,000	2,280,000
585.788	771.525	479.425	479.425	6.4	3.3	8,550	29,000	875,000	2,960,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

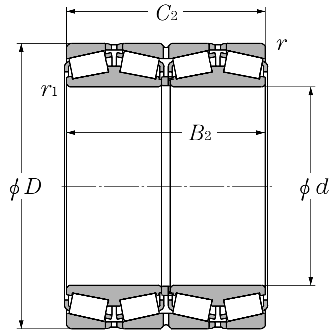
static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions (mm) d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
＊LM772749D/LM772710/LM772710DA	513	600	6.5	2.5	2.5	0.47	1.43	2.12	1.40	268
CRO-10008	520	616	8	4	1.5	0.40	1.68	2.50	1.64	598
CRO-10005	530	640	7	4	4	0.33	2.03	3.02	1.98	600
6259/500	553	649.5	7.5	5	5	0.33	2.03	3.02	1.98	632
☆CRO-10023	554	702	7.5	5	5	0.40	1.68	2.50	1.64	606
☆CRO-10003	550	683	11	5	5	0.33	2.03	3.02	1.98	535
☆＊M274149D/M274110/M274110DG2	534	663	9.5	6.4	3.3	0.33	2.03	3.02	1.98	726
☆＊EE531201D/531300/531301XDG2	549	711	9.5	5	5	0.38	1.77	2.64	1.73	740
☆CRO-10208 (CRO-10214)	533.5	527	5	5	5	0.41	1.65	2.46	1.61	320
＊LM274449D/LM274410/LM274410D	540	648	8	6.4	3.3	0.33	2.03	3.02	1.98	390
☆＊M275349D/M275310/M275310DG2 (CRO-10408)	552	684	9.5	6.4	3.3	0.33	2.03	3.02	1.98	761
☆CRO-10402	558	688	11	4	6	0.33	2.03	3.02	1.98	750
☆CRO-10702	680	929.2	7.5	6	6	0.32	2.12	3.15	2.07	1,662
☆＊M276449D/M276410/M276410DG2	564	711	9.5	6.4	3.3	0.33	2.03	3.02	1.98	890
＊EE522126D/523087/523088D	575	733	6.5	6.4	3.3	0.48	1.41	2.10	1.38	552
CRO-11101 (CRO-11103)	579	670.5	6.5	5	5	0.33	2.03	3.02	1.98	298
＊EE843221D/843290/843291D (CRO-11217)	585	699	8.5	6.4	3.3	0.34	1.98	2.94	1.93	388
☆＊LM377449D/LM377410/LM377410DG2 (CRO-11216)	588	696	8	6.4	3.3	0.35	1.95	2.90	1.90	502
☆CRO-11402	609	733	7.5	5	5	0.33	2.03	3.02	1.98	625
☆CRO-11403	620	760	10	5	5	0.33	2.03	3.02	1.98	845
☆＊M278749D/M278710/M278710DAG2	609	756	11	6.4	3.3	0.33	2.03	3.02	1.98	1,080
☆＊LM778549D/LM778510/LM778510DG2	615	717	7	6.4	3.3	0.47	1.43	2.14	1.40	511
＊LM278849D/LM278810/LM278810D	615	726	10	6.4	3.3	0.35	1.95	2.90	1.91	750

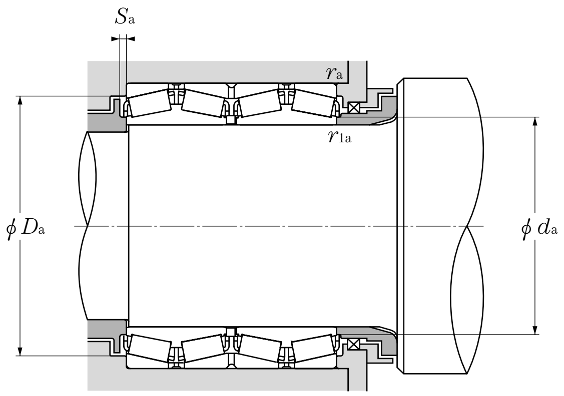
Remarks: 1. Bearing numbers marked "＊" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.



d 585.788～730mm

	Boundary dimensions					Basic load ratings			
						dynamic	static	dynamic	static
	mm					kN		kgf	
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
585.788	771.525	479.425	479.425	6.4	3.3	7,350	25,700	750,000	2,620,000
595.312	844.550	615.950	615.950	6.4	3.3	12,300	39,000	1,250,000	4,000,000
	844.550	615.950	615.950	6.4	3.3	12,600	40,500	1,290,000	4,100,000
609.600	787.400	361.950	361.950	6.4	3.3	6,450	20,300	655,000	2,070,000
	863.600	660.400	660.400	6.4	3.3	13,500	42,000	1,380,000	4,300,000
611.500	832.800	593.725	593.725	6.4	3.3	11,500	37,500	1,170,000	3,850,000
630	920	600	600	7.5	7.8	13,100	39,000	1,340,000	3,950,000
650	1,030	560	560	7.5	12	13,500	35,000	1,380,000	3,550,000
657.225	933.450	676.275	676.275	6.4	3.3	15,300	48,000	1,560,000	4,900,000
660	1,070	642	642	7.5	7.5	15,400	43,500	1,570,000	4,450,000
660.400	812.800	365.125	365.125	6.4	3.3	6,200	23,200	630,000	2,360,000
670	960	700	700	7.5	7.5	16,700	51,500	1,700,000	5,300,000
	1,090	710	710	7.5	7.5	19,100	50,000	1,950,000	5,100,000
	1,090	710	710	7.5	7.5	17,400	47,500	1,780,000	4,850,000
679.450	901.700	552.450	552.450	6.4	3.3	11,200	38,000	1,140,000	3,900,000
680	870	460	460	6	3	7,500	27,400	765,000	2,790,000
682.625	965.200	701.675	701.675	6.4	3.3	16,100	50,500	1,640,000	5,150,000
685.800	876.300	352.425	355.600	6.4	3.3	6,050	21,800	615,000	2,220,000
710	900	410	410	5	2.5	7,650	26,900	780,000	2,740,000
711.200	914.400	317.500	317.500	6.4	3.3	5,350	17,900	545,000	1,820,000
	914.400	317.500	317.500	6.4	16	5,350	17,900	545,000	1,820,000
730	1,070	642	642	7.5	7.5	15,400	46,500	1,570,000	4,750,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



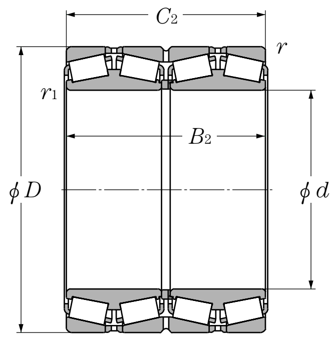
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_2 and Y_0 see the table below.

Bearing numbers	Abutment and fillet dimensions mm					Constant	Axial load factors			Mass kg
	d_a	D_a	S_a min	r_{as} max	r_{1as} max	e	Y_1	Y_2	Y_0	(approx.)
☆CRO-11701	628	718	9.5	6.4	3.3	0.35	1.95	2.90	1.91	610
☆CRO-11913	654	781	7	6.4	3.3	0.33	2.03	3.02	1.98	1,135
☆∗M280049D/M280010/M280010DG2	633	786	11	6.4	3.3	0.33	2.03	3.02	1.98	1,160
☆∗EE649241D/649310/649311DG2	636	747	9.5	6.4	3.3	0.33	2.03	3.02	1.98	458
☆∗M280349D/M280310/M280310DG2	659	796	13.5	6.4	3.3	0.33	2.03	3.02	1.98	1,250
☆CRO-12202	660	776	11.5	6.4	3.3	0.33	2.03	3.02	1.98	960
☆CRO-12604	702	848	7.5	6	6	0.33	2.03	3.02	1.98	1,390
☆CRO-13001	765	947	8.5	6	10	0.32	2.12	3.15	2.07	1,760
☆∗M281649D/M281610/M281610DG2	699	870	11	6.4	3.3	0.33	2.03	3.02	1.98	1,630
☆CRO-13202	760	991	9	6	6	0.32	2.12	3.15	2.07	1,950
☆∗L281149D/L281110/L281110DG2	682.8	777	9	6.4	3.3	0.33	2.03	3.02	1.98	448
☆CRO-13401	719	901	8	6	6	0.33	2.03	3.02	1.98	1,600
☆CRO-13404	782	997	13.5	6	6	0.29	2.32	3.45	2.26	2,690
☆CRO-13402	799	995	13.5	6	6	0.32	2.12	3.15	2.07	2,600
☆∗LM281849D/LM281810/LM281810DG2	714	852	11	6.4	3.3	0.33	2.03	3.02	1.98	1,040
CRO-13602	713	824	8	5	2.5	0.43	1.57	2.34	1.53	582
☆M282249D/M282210/M282210DG2	723	900	13	6.4	3.3	0.33	2.03	3.02	1.98	1,770
☆∗EE655271D/655345/655346DG2 (CRO-13708)	717	831	8	6.4	3.3	0.42	1.61	2.40	1.57	539
☆CRO-14208	745	850	10	4	2	0.33	2.03	3.02	1.98	620
☆∗EE755281D/755360/755361DG2	744	873	9.5	2.5	5	0.38	1.77	2.64	1.73	527
☆∗EE755280D/755360/755361DG2	762	873	8	6.4	3.3	0.38	1.77	2.64	1.73	527
☆CRO-14601	780	1,020	7	6	6	0.33	2.03	3.02	1.98	1,900

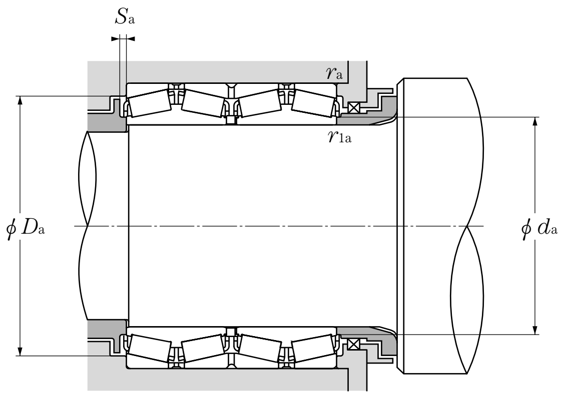
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.



d 730.250～1,200.150mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}
730.250	1,035.050	755.650	755.650	6.4	3.3	18,100	59,500	1,850,000	6,050,000
749.300	990.600	605.000	605.000	6.4	3.3	12,600	45,500	1,290,000	4,650,000
762.000	1,066.800	723.900	736.600	12.7	4.3	17,700	58,500	1,800,000	5,950,000
	1,079.500	787.400	787.400	12.7	4.8	19,200	65,000	1,960,000	6,600,000
800	1,120	820	820	7.5	7	21,000	72,500	2,140,000	7,400,000
825.500	1,168.400	844.550	844.550	12.7	4.8	22,300	76,500	2,270,000	7,800,000
840	1,170	840	840	6	6	21,900	76,500	2,230,000	7,800,000
863.600	1,130.300	669.925	669.925	12.7	4.8	15,800	59,500	1,610,000	6,050,000
	1,219.200	876.300	889.000	12.7	4.8	24,100	83,000	2,450,000	8,450,000
938.212	1,270.000	825.500	825.500	12.7	4.8	22,500	80,000	2,300,000	8,150,000
950	1,360	880	880	7.5	4	27,000	89,000	2,750,000	9,050,000
1,200.150	1,593.850	990.600	990.600	12.7	4.8	33,500	132,000	3,400,000	13,500,000

❶ Minimum allowable dimension for chamfer dimension r or r_1.



Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

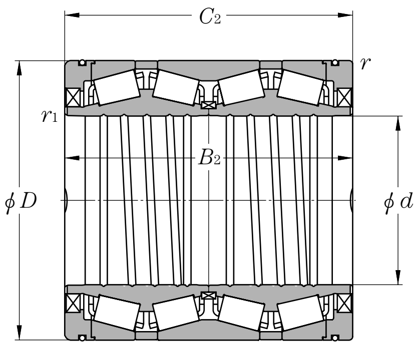
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Bearing numbers	Abutment and fillet dimensions mm d_a	D_a	S_a min	r_{as} max	r_{1as} max	Constant e	Axial load factors Y_1	Y_2	Y_o	Mass kg (approx.)
☆∗M283449D/M283410/M283410D	774	966	13	6.4	3.3	0.33	2.03	3.02	1.98	2,210
☆∗LM283649D/LM283610/LM283610DG2	786	936	10.5	6.4	3.3	0.33	2.03	3.02	1.98	1,250
☆∗M284148D/M284111/M284110DG2	840	985	3.5	12.7	4.3	0.33	2.03	3.02	1.98	2,220
☆∗M284249D/M284210/M284210DG2	810	1,005	13	12.7	4.8	0.33	2.03	3.02	1.98	2,480
☆CRO-16001	858	1,052	10	6	6	0.33	2.03	3.02	1.98	3,960
☆∗M285848D/M285810/M285810DG2	879	1,085	13	12.7	4.8	0.33	2.03	3.02	1.98	3,010
☆CRO-16803	897	1,099	12	5	5	0.33	2.03	3.02	1.98	3,970
☆∗LM286249D/LM286210/LM286210DG2	906	1,065	11	12.7	4.8	0.33	2.03	3.02	1.98	1,950
☆∗EE547341D/547480/547481DG2 (CRO-17301)	918	1,135	6.5	12.7	4.8	0.33	2.03	3.02	1.98	3,640
☆∗LM287649D/LM287610/LM287610DG2	990	1,190	10	12.7	4.8	0.33	2.03	3.02	1.98	4,100
☆CRO-19001	1,030	1,278	12	6	3	0.35	1.95	2.90	1.91	4,100
☆∗LM288949D/LM288910/LM288910DG2	1,260	1,500	13	12.7	4.8	0.33	2.03	3.02	1.98	6,130

Remarks: 1. Bearing numbers marked "∗" designate inch system bearings. 2. Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.
3. The bearing where parentheses adhered abolished inner ring spacer.

Sealed Four Row Tapered Roller Bearings



d 140～711.200mm

Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_2	C_2	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
140	198	174	174	2	1.5	595	1,470	60,500	150,000	CRO-2810LL
	198	174	174	2	1.5	615	1,510	63,000	154,000	CRO-2812LL
200	282	206	206	2.5	2.5	950	2,450	97,000	250,000	CRO-4022LL
216.103	330.2	263.525	269.875	3.3	1.5	1,770	4,000	180,000	405,000	∗CRO-4303LL
220	295	315	315	2.5	1	1,270	3,850	130,000	395,000	CRO-4424LL
	310	280	280	2.5	1	1,590	4,100	162,000	420,000	CRO-4427LL
	320	290	290	3	2.7	1,780	4,850	181,000	495,000	CRO-4436LL
240	338	248	248	3	3	1,590	4,200	162,000	430,000	CRO-4811LL
	338	340	340	2.5	1	2,040	6,000	208,000	610,000	CRO-4817LL
245	345	310	310	3	1	2,070	5,950	211,000	610,000	CRO-4906LL
250	365	270	270	3	2.5	1,920	4,750	196,000	485,000	CRO-5015LL
254	358.775	269.875	269.875	3.3	1.5	1,940	4,900	198,000	500,000	∗CRO-5117LL
	358.775	269.875	269.875	3.3	3.3	1,850	4,750	188,000	485,000	∗CRO-5116LL
260	365	339	339	4	1	2,250	5,950	229,000	610,000	CRO-5224LL
260.35	422.275	314.325	317.5	3.3	4.8	2,680	5,950	274,000	606,000	∗CRO-5227LL
279.4	393.7	269.875	269.875	6.4	1.5	2,000	4,950	204,000	505,000	∗CRO-5652LL
280	380	290	290	3	1	2,060	5,750	210,000	585,000	CRO-5660LL
	395	290	290	4	1.5	2,120	5,450	216,000	560,000	CRO-5665LL
	395	340	340	2.5	3.2	2,590	7,150	264,000	730,000	CRO-5664LL
	410	268	268	6.4	2.2	2,140	5,000	219,000	505,000	CRO-5639LL
285	400	340	340	4	1	2,560	7,650	261,000	780,000	CRO-5709LL
290	400	346	346	4	3.1	2,560	7,650	261,000	780,000	CRO-5814LL
300	400	254	254	4	5	1,920	5,300	196,000	540,000	CRO-6038LL
	420	310	310	4	3.2	2,510	6,850	256,000	695,000	CRO-6042LL
	430	295	305	5	1	2,150	5,550	219,000	565,000	CRO-6031LL
304.648	438.048	280.99	279.4	3.7	2.8	2,250	5,450	229,000	555,000	∗CRO-6143LL
310	430	310	310	4	1.5	2,340	6,600	239,000	670,000	CRO-6220LL
	430	350	350	2.5	3.2	2,820	7,950	288,000	815,000	CRO-6222LL
320	480	360	360	4	2	3,600	8,850	370,000	900,000	CRO-6426LL
343.052	457.098	254	254	3.3	1.5	2,060	5,500	210,000	560,000	∗CRO-6930LL
	457.098	254	254	3.3	0.6	1,900	5,050	194,000	515,000	∗CRO-6920LL
	457.098	299	299	3.3	1.5	2,470	7,100	252,000	725,000	∗CRO-6936LL
355	490	316	316	4	2.3	2,520	6,600	257,000	675,000	CRO-7109LL
360	480	375	375	3	2.8	3,400	10,200	345,000	1,040,000	CRO-7226LL
410	546	400	400	5	1.5	3,850	11,900	390,000	1,210,000	CRO-8204LL
420	620	395	320	6	6	4,550	11,800	465,000	1,200,000	CRO-8412LL
440	590	480	480	6	1.5	4,550	13,900	465,000	1,420,000	CRO-8830LL
	620	454	454	6	1.5	5,800	16,600	595,000	1,700,000	CRO-8832LL
457.2	596.9	276.225	279.4	3.3	1.5	2,540	6,800	259,000	695,000	∗CRO-9107LL
479.425	679.45	495.3	495.3	6.4	0.6	6,450	18,400	660,000	1,870,000	∗CRO-9610LL
482.6	615.95	330.2	330.2	6.4	3.3	3,200	9,650	330,000	985,000	∗CRO-9725LL
530	715	590	590	6	4	8,200	26,900	835,000	2,740,000	CRO-10607LL
595.312	844.55	615.95	615.95	6.4	3.0	10,600	32,000	1,080,000	3,250,000	∗CRO-11919LL
711.2	914.4	387.35	387.35	6.4	3.3	6,300	19,600	645,000	2,000,000	∗CRO-14214LL
	914.4	410	410	5	2.5	6,400	20,700	655,000	2,110,000	∗CRO-14209LL

❶ Minimum allowable dimension for chamfer dimension r or r_1.
Remarks: 1. The marked "∗" bearings are inch system sizes.

Constant	Axial load factors			Mass
				kg
e	Y_1	Y_2	Y_o	(approx.)
0.40	1.68	2.50	1.64	16
0.47	1.43	2.12	1.40	15.5
0.33	2.03	3.02	1.98	39
0.55	1.23	1.82	1.20	78.2
0.37	1.80	2.69	1.76	57.5
0.33	2.03	3.02	1.98	63.5
0.39	1.74	2.59	1.70	77
0.43	1.57	2.34	1.53	67.8
0.40	1.68	2.50	1.64	94.4
0.40	1.68	2.50	1.64	90.5
0.40	1.68	2.50	1.64	90
0.40	1.68	2.50	1.64	83
0.55	1.24	1.84	1.21	81.7
0.40	1.68	2.50	1.64	103
0.55	1.24	1.84	1.21	177
0.47	1.43	2.12	1.40	96.4
0.33	2.03	3.02	1.98	90
0.33	2.07	3.09	2.03	108
0.40	1.68	2.50	1.64	126
0.33	2.07	3.09	2.03	116
0.40	1.68	2.50	1.64	134
0.40	1.68	2.50	1.64	129
0.28	2.43	3.61	2.37	84.6
0.40	1.68	2.50	1.64	128
0.33	2.03	3.02	1.98	136
0.47	1.43	2.12	1.40	136
0.40	1.68	2.50	1.64	133
0.40	1.68	2.50	1.64	150
0.47	1.43	2.12	1.40	228
0.47	1.43	2.12	1.40	105
0.33	2.03	3.02	1.98	107
0.43	1.57	2.34	1.53	130
0.33	2.03	3.02	1.98	159
0.33	2.03	3.02	1.98	180
0.33	2.03	3.02	1.98	253
0.37	1.80	2.69	1.76	384
0.33	2.03	3.02	1.98	358
0.33	2.03	3.02	1.98	426
0.47	1.43	2.12	1.40	192
0.33	2.03	3.02	1.98	565
0.33	2.03	3.02	1.98	225
0.32	2.12	3.15	2.07	700
0.33	2.03	3.02	1.98	1130
0.38	1.78	2.65	1.74	616
0.38	1.77	2.64	1.73	596

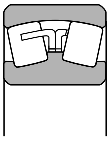
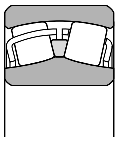
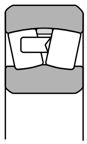
Spherical Roller bearings

1. Type, Structure and Characteristics

The barrel shaped spherical rolling elements of a self-aligning bearing track along two rows of raceway grooves in the inner ring. The center of the outer ring's raceway aligns with the center of the bearing. The self-aligning feature accommodates errors in housing assembly and misalignments between the inner and outer rings caused by bent shafts. The bearings have a large load capacity and are suitable for applications with vibration and impact loads.

In addition to a cylindrical shaft bore, the bearings are available with a tapered shaft bore. The tapered bore bearings can be shaft mounted using an adapter or removable sleeves. **Table 1** shows the types of the self-aligning roller bearings. Please consult with **NTN** Engineering for the special product (do part number starts with 2p)

Table 1 Model of Self-Aligning Roller Bearings

Model	Standard (Model B)	Model C	Model 213
Structure			
Bearing Series	Bearings except Model C	24024～24038	213's bore should be more than 55mm.
Roller	A symmetrical roller	Symmetrical roller	A symmetrical roller
Roller guide type	Guided by the inner rib which is united with the inner ring.	By the guide ring located between two rows of rollers.	By the guide ring located between the rollers on the outer ring raceway.
Cage type	Pressed cage Machined cage	Pressed cage	Machined cage

1.2 Lubrication holes and grooves

Holes and grooves to supply lubricant are provided on self-aligning roller bearings with outside diameters greater than 320mm. If required, lubrication holes and grooves can be manufactured for bearings with ODs smaller than 320mm. Consult **NTN** Engineering for further details and add the supplemental code D1 to the part number. **Table 2** shows the dimensions for lubrication holes and grooves. The number of lubrication holes are shown in **Table 3**.

When a knock pin for lubricant retention is necessary, please contact **NTN** Engineering.

Table 2 Lubrication hole and groove dimensions

Unit mm

Nominal bearing width over	incl	Oil groove width W_o	Oil hole dia d_o	Oil groove depth h Width series 1, 2, 3	Width series 4
80	100	14	8	2.5	2.0
100	120	16	10	3.0	2.5
120	160	20	12	3.5	3.0
160	200	27	16	5.0	3.5
200	315	33	20	6.0	5.0
315	—	42	25	7.0	6.5

Table 3 Lubrication hole number

Nominal bearing outside dia. mm over	incl	Hole number Z_o
—	320	4
320	1,010	8
1,010	—	12

2. Dimensional Accuracy/Rotation Accuracy

Refer to Table 3.3 (Page A-12)

3. Recommended Fitting

Refer to Table 4.2 (Page A-24)

4. Bearing Internal Clearance

Refer to Table 5.10 (Page A-36)

5. Allowable aligning angle

These bearings have a self-aligning function, and their allowable aligning angle varies depending on the dimension series and load conditions, but are mostly described as follows.

Normal load (Equivalent load to 0.09 C_r) ··· 0.009rad (0.5˚)
Light load ······································ 0.035rad (2˚)

6. Assembly of Tapered Hole Roller Bearings

Tapered hole spherical roller bearings use the measurement method as shown in **Fig.1**. A suitable tightening rate can be achieved by pushing the bearing toward the axial direction until it reaches the reduction rate of the radial internal clearance or pushing rate of axial direction. When heavy and high speed loads are applied, or when it is necessary to keep a higher tightening rate as the temperature difference between the inner and outer rings rises, be sure to have the maximum reduction rate of radial internal clearance or the pushing rate of the axial direction, as shown in **Table 4**, by using a bearing with a radial internal clearance of more than C3. The clearance after mounting in this case should be larger than the minimum clearance after mounting as shown in **Table 4**.

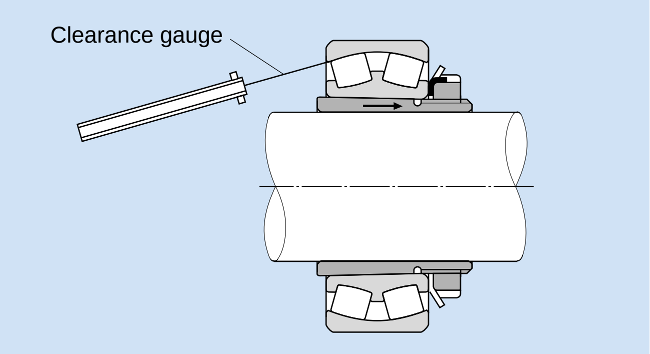


Fig.1 Measurement method of spherical roller bearing internal clearance

Table 4 Assembly of tapered hole spherical roller bearings

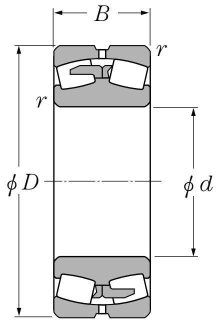
Unit:mm

Nominal bearing bore *d* over	incl	Reduction rate of radial internal clearance min	max	Pushing rate of axial direction taper 1/12 min	max	taper 1/30 min	max	Minimum residual internal clearance CN	C3	C4
80	100	0.045	0.055	0.7	0.8	1.75	2.25	0.035	0.05	0.08
100	120	0.05	0.06	0.75	0.9	1.9	2.25	0.05	0.065	0.1
120	140	0.065	0.075	1.1	1.2	2.75	3	0.055	0.08	0.11
140	160	0.075	0.09	1.2	1.4	3	3.75	0.055	0.09	0.13
160	180	0.08	0.1	1.3	1.6	3.25	4	0.06	0.1	0.15
180	200	0.09	0.11	1.4	1.7	3.5	4.25	0.07	0.1	0.16
200	225	0.1	0.12	1.6	1.9	4	4.75	0.08	0.12	0.18
225	250	0.11	0.13	1.7	2	4.25	5	0.09	0.13	0.2
250	280	0.12	0.15	1.9	2.4	4.75	6	0.1	0.14	0.22
280	315	0.13	0.16	2	2.5	5	6.25	0.11	0.15	0.24
315	355	0.15	0.18	2.4	2.8	6	7	0.12	0.17	0.26
355	400	0.17	0.21	2.6	3.3	6.5	8.25	0.13	0.19	0.29
400	450	0.2	0.24	3.1	3.7	7.75	9.25	0.13	0.2	0.31
450	500	0.21	0.26	3.3	4	8.25	10	0.16	0.23	0.35
500	560	0.24	0.3	3.7	4.6	9.25	11.5	0.17	0.25	0.36
560	630	0.26	0.33	4	5.1	10	12.5	0.2	0.29	0.41
630	710	0.3	0.37	4.6	5.7	11.5	14.5	0.21	0.31	0.45
710	800	0.34	0.43	5.3	6.7	13.3	16.5	0.23	0.35	0.51
800	900	0.37	0.47	5.7	7.3	14.3	18.5	0.27	0.39	0.57
900	1,000	0.41	0.53	6.3	8.2	15.8	20.5	0.3	0.43	0.64
1,000	1,120	0.45	0.58	6.8	8.7	17	22.5	0.32	0.48	0.7
1,120	1,250	0.49	0.63	7.4	9.4	18.5	24.5	0.34	0.54	0.77

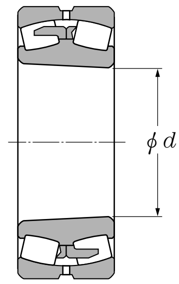
7. General Operating Cautions

Pressed cages or machined cages are standard depending on the bearing type and dimensions. However, a standard cage may not be used under high speed specifications or in conditions under severe vibration or impact.

When bearings are operated under small loads (about $F_r \leqq 0.04C_{or}$), or under axial loads only, prevent rolling elements from smearing by operating in conditions where $F_a/F_r \leqq 2e$. (Refer to the dimension table for the value of "e.") This is most apparent when using large size spherical roller bearings due to the large roller and cage mass. Please consult **NTN** Engineering for further details.



Cylindrical bore

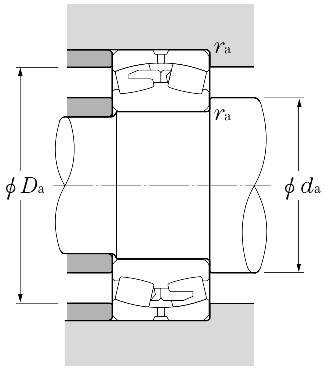


Tapered bore
taper 1:12

d 100～140mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Abutment and fillet dimensions (mm)		
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered❷ bore	d_a min	D_a max	r_{as} max
100	165	52	2	310	470	31,500	47,500	23120B	23120BK	110	155	2
	170	65	2	380	590	38,500	60,000	2P2009	2P2009K	110	160	2
	170	65	2	405	640	41,500	65,500	☆2P2014	2P2014K	110	160	2
	180	46	2.1	315	415	32,000	42,500	22220B	22220BK	112	168	2
	180	60.3	2.1	405	580	41,500	59,000	23220B	23220BK	112	168	2
	215	47	3	370	465	37,500	47,500	21320	21320K	114	201	2.5
	215	73	3	605	755	61,500	77,000	22320B	22320BK	114	201	2.5
110	170	45	2	282	455	28,800	46,500	23022B	23022BK	120	160	2
	180	56	2	370	580	37,500	59,500	23122B	23122BK	120	170	2
	180	69	2	450	755	46,000	77,000	24122B	24122BK30	120	170	2
	200	53	2.1	410	570	42,000	58,000	22222B	22222BK	122	188	2
	200	69.8	2.1	515	760	52,500	77,500	23222B	23222BK	122	188	2
	240	50	3	495	615	50,500	62,500	21322	21322K	124	226	2.5
	240	80	3	745	930	76,000	95,000	22322B	22322BK	124	226	2.5
120	180	46	2	296	495	30,000	50,500	23024B	23024BK	130	170	2
	180	60	2	390	670	39,500	68,500	24024B	24024BK30	130	170	2
	180	60	2	395	695	40,000	71,000	☆24024C	24024CK30	130	170	2
	180	69	2	415	785	42,500	80,000	☆2P2416	2P2416K	130	170	2
	200	62	2	455	705	46,500	71,500	23124B	23124BK	130	190	2
	200	80	2	575	945	58,500	96,500	24124B	24124BK30	130	190	2
	215	58	2.1	485	700	49,500	71,500	22224B	22224BK	132	203	2
	215	76	2.1	585	880	59,500	89,500	23224B	23224BK	132	203	2
	260	86	3	880	1,120	89,500	114,000	22324B	22324BK	134	246	2.5
130	200	52	2	375	620	38,500	63,500	23026B	23026BK	140	190	2
	200	69	2	505	895	51,500	91,000	24026B	24026BK30	140	190	2
	200	69	2	490	860	50,000	87,500	☆24026C	24026CK30	140	190	2
	210	64	2	495	795	50,500	81,000	23126B	23126BK	140	200	2
	210	80	2	585	995	60,000	102,000	24126B	24126BK30	140	200	2
	230	64	3	570	790	58,000	80,500	22226B	22226BK	144	216	2.5
	230	80	3	685	1,060	70,000	108,000	23226B	23226BK	144	216	2.5
	280	93	4	1,000	1,290	102,000	131,000	22326B	22326BK	148	262	3
139.734	218	80	1.1	605	1,050	61,500	106,000	2P2803	2P2803K	146	211	1
140	210	53	2	405	690	41,000	70,500	23028B	23028BK	150	200	2
	210	69	2	510	945	52,000	96,500	24028B	24028BK30	150	200	2

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.

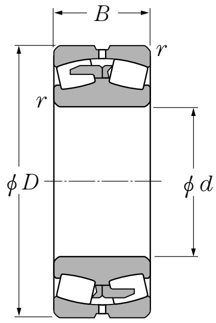


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

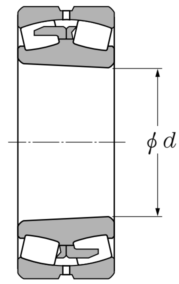
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant e	Axial load factors Y_1	Y_2	Y_o	Mass (approx.) kg Cylindrical bore	tapered bore
0.32	2.12	3.15	2.07	4.3	4.16
0.38	1.78	2.65	1.74	5.84	5.62
0.38	1.75	2.61	1.72	5.91	5.69
0.26	2.55	3.80	2.49	4.95	4.84
0.34	1.98	2.94	1.93	6.47	6.28
0.22	3.01	4.48	2.94	8.89	8.78
0.37	1.80	2.69	1.76	12.4	12.1
0.26	2.59	3.85	2.53	3.71	3.58
0.31	2.17	3.24	2.13	5.4	5.22
0.38	1.76	2.63	1.73	7.07	6.96
0.27	2.51	3.74	2.46	7.2	7.04
0.35	1.91	2.84	1.86	9.71	9.43
0.21	3.20	4.77	3.13	11.2	11.1
0.36	1.87	2.79	1.83	17.1	16.7
0.25	2.69	4.01	2.63	4.05	3.9
0.33	2.06	3.07	2.02	5.48	5.39
0.32	2.12	3.15	2.07	5.48	4.91
0.35	1.95	2.90	1.91	5.95	5.65
0.31	2.17	3.24	2.13	7.7	7.46
0.40	1.68	2.50	1.64	10.3	10.1
0.27	2.47	3.68	2.42	9.1	8.89
0.36	1.89	2.82	1.85	12.1	11.7
0.37	1.80	2.69	1.76	21.5	21
0.26	2.63	3.92	2.57	5.9	5.69
0.34	1.98	2.95	1.94	8.08	7.95
0.32	2.12	3.15	2.07	7.91	7.78
0.30	2.23	3.32	2.18	8.47	8.2
0.38	1.78	2.65	1.74	11	10.8
0.28	2.39	3.56	2.33	11.2	10.9
0.35	1.92	2.86	1.88	14.3	13.9
0.37	1.81	2.69	1.77	26.8	26.2
0.35	1.91	2.84	1.86	10.8	10.3
0.25	2.73	4.06	2.67	6.35	6.12
0.32	2.09	3.12	2.05	8.57	8.43



Cylindrical bore

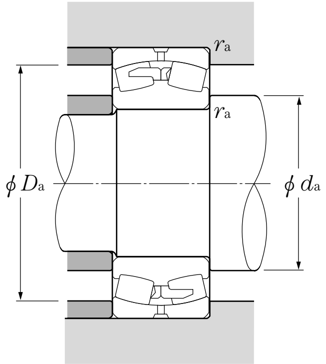


Tapered bore
taper 1:12

d 140～180mm

	Boundary dimensions			Basic load ratings				Bearing numbers		Abutment and fillet dimensions		
	mm			dynamic kN	static kN	dynamic kgf	static kgf			mm		
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered❷ bore	d_a min	D_a max	r_{as} max
140	210	69	2	520	940	53,000	95,500	☆24028C	24028CK30	150	200	2
	225	68	2.1	540	895	55,000	91,000	23128B	23128BK	152	213	2
	225	85	2.1	670	1,150	68,500	117,000	24128B	24128BK30	152	213	2
	250	68	3	685	975	70,000	99,500	22228B	22228BK	154	236	2.5
	250	88	3	805	1,270	82,000	129,000	23228B	23228BK	154	236	2.5
	300	102	4	1,130	1,460	115,000	149,000	22328B	22328BK	158	282	3
150	225	56	2.1	445	775	45,500	79,000	23030B	23030BK	162	213	2
	225	75	2.1	585	1,060	59,500	108,000	24030B	24030BK30	162	213	2
	225	75	2.1	600	1,090	61,000	111,000	☆24030C	24030CK30	162	213	2
	250	80	2.1	730	1,190	74,500	121,000	23130B	23130BK	162	238	2
	250	100	2.1	885	1,520	90,500	155,000	24130B	24130BK30	162	238	2
	270	73	3	775	1,160	79,000	119,000	22230B	22230BK	164	256	2.5
	270	96	3	935	1,460	95,000	149,000	23230B	23230BK	164	256	2.5
	320	108	4	1,270	1,750	130,000	179,000	22330B	22330BK	168	302	3
160	220	45	2	320	610	33,000	62,500	23932	23932K	170	210	2
	240	60	2.1	505	885	51,500	90,000	23032B	23032BK	172	228	2
	240	80	2.1	650	1,200	66,500	122,000	24032B	24032BK30	172	228	2
	240	80	2.1	665	1,250	67,500	127,000	☆24032C	24032CK30	172	228	2
	270	86	2.1	840	1,370	85,500	140,000	23132B	23132BK	172	258	2
	270	109	2.1	1,040	1,780	106,000	181,000	24132B	24132BK30	172	258	2
	290	80	3	870	1,290	88,500	132,000	22232B	22232BK	174	276	2.5
	290	104	3	1,050	1,660	107,000	170,000	23232B	23232BK	174	276	2.5
	340	114	4	1,410	1,990	144,000	203,000	22332B	22332BK	178	322	3
170	230	45	2	330	650	34,000	66,000	23934	23934K	180	220	2
	260	67	2.1	630	1,080	64,000	110,000	23034B	23034BK	182	248	2
	260	90	2.1	800	1,470	81,500	150,000	24034B	24034BK30	182	248	2
	260	90	2.1	815	1,500	83,000	153,000	☆24034C	24034CK30	182	248	2
	280	88	2.1	885	1,490	90,500	152,000	23134B	23134BK	182	268	2
	280	109	2.1	1,080	1,880	110,000	191,000	24134B	24134BK30	182	268	2
	310	86	4	1,000	1,520	102,000	155,000	22234B	22234BK	188	292	3
	310	110	4	1,180	1,960	120,000	200,000	23234B	23234BK	188	292	3
	360	120	4	1,540	2,180	157,000	223,000	22334B	22334BK	188	342	3
180	250	52	2	440	835	45,000	85,000	23936	23936K	190	240	2
	280	74	2.1	740	1,290	75,500	132,000	23036B	23036BK	192	268	2
	280	100	2.1	965	1,770	98,500	181,000	24036B	24036BK30	192	268	2

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.

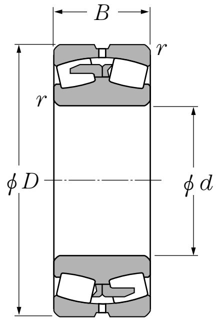


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

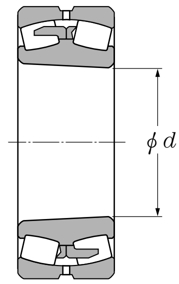
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.30	2.23	3.32	2.18	8.48	7.66
0.30	2.25	3.35	2.20	10.2	9.86
0.38	1.80	2.68	1.76	13.3	13.1
0.28	2.39	3.55	2.33	14	13.7
0.36	1.90	2.83	1.86	18.8	18.2
0.37	1.80	2.69	1.76	33.8	33
0.24	2.76	4.11	2.70	7.73	7.45
0.33	2.06	3.07	2.02	10.7	10.5
0.30	2.25	3.34	2.20	10.5	10.3
0.32	2.11	3.15	2.06	15.6	15.1
0.40	1.69	2.51	1.65	20.2	20
0.27	2.46	3.66	2.40	18.1	17.7
0.36	1.88	2.79	1.83	24.1	23.4
0.35	1.92	2.86	1.88	42.7	41.8
0.18	3.69	5.49	3.61	5.5	5.33
0.25	2.74	4.09	2.68	9.42	9.09
0.32	2.10	3.13	2.06	13	12.8
0.31	2.18	3.24	2.13	12	11.8
0.32	2.11	3.15	2.07	19.8	19.2
0.40	1.67	2.48	1.63	26	25.6
0.28	2.42	3.60	2.37	22.7	22.2
0.36	1.86	2.77	1.82	30	29.1
0.35	1.94	2.89	1.90	50.8	49.7
0.17	3.91	5.83	3.83	5.8	5.62
0.25	2.66	3.96	2.60	12.7	12.3
0.34	1.98	2.95	1.94	17.7	17.4
0.31	2.16	3.22	2.12	17.4	17.1
0.31	2.15	3.21	2.11	21.5	20.8
0.39	1.74	2.59	1.70	27.2	26.8
0.28	2.39	3.56	2.34	28	27.3
0.36	1.87	2.79	1.83	36.8	35.7
0.34	1.96	2.91	1.91	59.8	58.5
0.19	3.52	5.25	3.45	8.21	7.95
0.26	2.59	3.85	2.53	16.7	16.1
0.35	1.91	2.85	1.87	23.3	22.9



Cylindrical bore

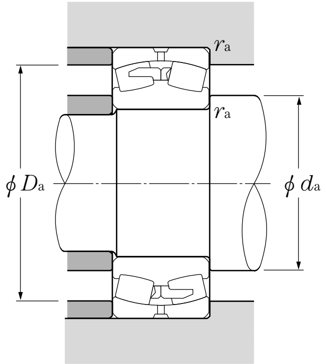


Tapered bore
taper 1:12

d 180～240mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Abutment and fillet dimensions (mm)		
d	D	B	$r_{s\,min}$ [1]	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered [2] bore	d_a min	D_a max	r_{as} max
180	280	100	2.1	965	1,770	98,500	181,000	☆24036C	24036CK30	192	268	2
	290	110	2.1	1,050	1,890	107,000	193,000	2P3604	2P3604K	192	278	2
	300	96	3	1,030	1,730	105,000	176,000	23136B	23136BK	194	286	2.5
	300	118	3	1,250	2,210	127,000	225,000	24136B	24136BK30	194	286	2.5
	320	86	4	1,040	1,610	106,000	164,000	22236B	22236BK	198	302	3
	320	112	4	1,230	2,000	125,000	204,000	23236B	23236BK	198	302	3
	380	126	4	1,740	2,560	177,000	261,000	22336B	22336BK	198	362	3
190	260	52	2	460	890	47,000	91,000	23938	23938K	200	250	2
	290	75	2.1	755	1,350	77,000	138,000	23038B	23038BK	202	278	2
	290	100	2.1	995	1,850	102,000	188,000	24038B	24038BK30	202	278	2
	290	100	2.1	970	1,820	98,500	186,000	☆24038C	24038CK30	202	278	2
	320	104	3	1,190	2,020	122,000	206,000	23138B	23138BK	204	306	2.5
	320	128	3	1,420	2,480	144,000	253,000	24138B	24138BK30	204	306	2.5
	340	92	4	1,160	1,810	118,000	185,000	22238B	22238BK	208	322	3
	340	120	4	1,400	2,330	143,000	237,000	23238B	23238BK	208	322	3
	400	132	5	1,870	2,790	191,000	284,000	22338B	22338BK	212	378	4
200	280	60	2.1	545	1,100	56,000	112,000	23940	23940K	212	268	2
	310	82	2.1	915	1,620	93,000	165,000	23040B	23040BK	212	298	2
	310	109	2.1	1,160	2,140	118,000	219,000	24040B	24040BK30	212	298	2
	340	112	3	1,350	2,270	137,000	231,000	23140B	23140BK	214	326	2.5
	340	140	3	1,630	2,900	166,000	295,000	24140B	24140BK30	214	326	2.5
	360	98	4	1,310	2,010	134,000	205,000	22240B	22240BK	218	342	3
	360	128	4	1,610	2,640	165,000	269,000	23240B	23240BK	218	342	3
	420	138	5	2,040	3,050	208,000	310,000	22340B	22340BK	222	398	4
220	300	60	2.1	565	1,170	57,500	119,000	23944	23944K	232	288	2
	340	90	3	1,060	1,920	108,000	195,000	23044B	23044BK	234	326	2.5
	340	118	3	1,350	2,570	138,000	262,000	24044B	24044BK30	234	326	2.5
	370	120	4	1,540	2,670	157,000	272,000	23144B	23144BK	238	352	3
	370	150	4	1,880	3,400	192,000	345,000	24144B	24144BK30	238	352	3
	400	108	4	1,580	2,460	161,000	251,000	22244B	22244BK	238	382	3
	400	144	4	2,010	3,350	205,000	340,000	23244B	23244BK	238	382	3
	400	150	4	2,040	3,400	208,000	345,000	2P4401	2P4401K30	238	382	3
	460	145	5	2,350	3,500	240,000	360,000	22344B	22344BK	242	438	4
240	320	60	2.1	565	1,190	58,000	121,000	23948	23948K	252	308	2
	360	92	3	1,130	2,140	116,000	219,000	23048B	23048BK	254	346	2.5

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.

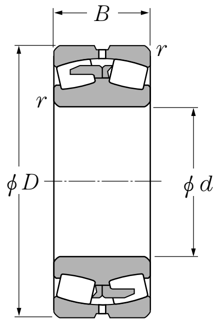


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

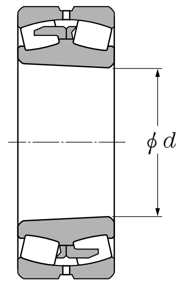
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.33	2.04	3.04	2.00	23	22.6
0.37	1.82	2.70	1.78	27.5	26.3
0.32	2.11	3.15	2.07	25.1	24.2
0.39	1.72	2.56	1.68	34.3	33.8
0.27	2.49	3.70	2.43	29.3	28.6
0.35	1.91	2.84	1.86	39	37.8
0.34	1.97	2.93	1.92	70	68.5
0.18	3.81	5.67	3.73	8.6	8.34
0.26	2.65	3.94	2.59	17.7	17.1
0.33	2.03	3.02	1.98	24.3	23.9
0.31	2.16	3.22	2.12	23	22.6
0.33	2.07	3.09	2.03	35.3	34.2
0.40	1.69	2.51	1.65	42.8	42.2
0.27	2.47	3.68	2.42	36.6	35.8
0.36	1.89	2.82	1.85	47.6	46.2
0.34	1.97	2.94	1.93	81	79.3
0.17	3.91	5.82	3.82	12.1	11.7
0.26	2.59	3.85	2.53	22.7	21.9
0.35	1.94	2.89	1.90	31	30.5
0.33	2.05	3.05	2.00	43.3	42
0.41	1.64	2.44	1.60	53.4	52.6
0.28	2.45	3.64	2.39	44	43
0.36	1.88	2.79	1.83	57.2	55.5
0.34	1.98	2.95	1.94	93.2	91.2
0.19	3.62	5.39	3.54	13.1	12.7
0.26	2.59	3.85	2.53	29.9	28.8
0.34	1.97	2.94	1.93	40.2	39.6
0.33	2.07	3.09	2.03	53.3	51.6
0.41	1.66	2.47	1.62	67	66
0.27	2.46	3.66	2.40	60.4	59.1
0.36	1.85	2.76	1.81	80	77.6
0.41	1.64	2.44	1.61	81.9	80.8
0.33	2.06	3.07	2.02	117	115
0.16	4.13	6.15	4.04	14	13.6
0.25	2.69	4.01	2.63	33.4	32.2



Cylindrical bore

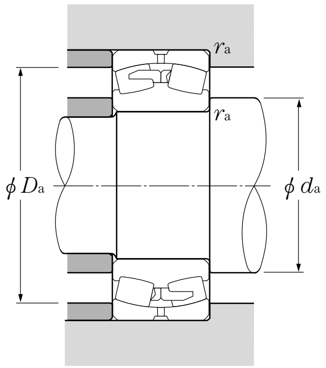


Tapered bore
taper 1:12

d 240～300mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Abutment and fillet dimensions (mm)		
d	D	B	$r_{s\,min}$ [1]	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered[2] bore	d_a min	D_a max	r_{as} max
240	360	118	3	1,410	2,770	144,000	282,000	24048B	24048BK30	254	346	2.5
	400	128	4	1,730	3,050	177,000	310,000	23148B	23148BK	258	382	3
	400	160	4	2,110	3,800	215,000	390,000	24148B	24148BK30	258	382	3
	440	120	4	1,940	3,100	198,000	315,000	22248B	22248BK	258	422	3
	440	160	4	2,430	4,100	247,000	420,000	23248B	23248BK	258	422	3
	500	155	5	2,720	4,100	278,000	420,000	22348B	22348BK	262	478	4
247.65	400.05	120.65	4	1,590	2,780	162,000	283,000	2P5002	2P5002K	266	382	3
260	360	70	2.1	805	1,590	82,000	163,000	2P5203	2P5203K	272	348	2
	360	75	2.1	760	1,580	77,500	161,000	23952	23952K	272	348	2
	400	104	4	1,420	2,620	144,000	267,000	23052B	23052BK	278	382	3
	400	140	4	1,830	3,550	186,000	365,000	24052B	24052BK30	278	382	3
	440	144	4	2,140	3,850	219,000	395,000	23152B	23152BK	278	422	3
	440	180	4	2,510	4,600	256,000	470,000	24152B	24152BK30	278	422	3
	480	130	5	2,230	3,600	228,000	365,000	22252B	22252BK	282	458	4
	480	174	5	2,760	4,700	281,000	480,000	23252B	23252BK	282	458	4
	540	165	6	3,100	4,750	320,000	485,000	22352B	22352BK	288	512	5
280	350	52	2	525	1,220	54,000	125,000	23856	23856K	290	340	2
	380	75	2.1	830	1,750	84,500	179,000	23956	23956K	292	368	2
	420	106	4	1,510	2,920	154,000	297,000	23056B	23056BK	298	402	3
	420	140	4	1,950	3,950	199,000	405,000	24056B	24056BK30	298	402	3
	440	160	4	2,180	4,250	222,000	435,000	2P5604	2P5604K	298	422	3
	460	146	5	2,300	4,250	234,000	435,000	23156B	23156BK	302	438	4
	460	180	5	2,730	5,200	278,000	530,000	24156B	24156BK30	302	438	4
	500	130	5	2,310	3,800	236,000	390,000	22256B	22256BK	302	478	4
	500	176	5	2,930	5,150	298,000	525,000	23256B	23256BK	302	478	4
	580	175	6	3,500	5,350	360,000	545,000	22356B	22356BK	308	552	5
290	430	110	4	1,380	2,860	141,000	291,000	2P5802	2P5802K	308	412	3
300	420	90	3	1,110	2,320	113,000	237,000	23960	23960K	314	406	2.5
	460	118	4	1,890	3,550	193,000	365,000	23060B	23060BK	318	442	3
	460	160	4	2,450	4,950	250,000	505,000	24060B	24060BK30	318	442	3
	500	160	5	2,750	5,000	280,000	510,000	23160B	23160BK	322	478	4
	500	200	5	3,300	6,400	340,000	650,000	24160B	24160BK30	322	478	4
	540	140	5	2,670	4,350	272,000	440,000	22260B	22260BK	322	518	4
	540	192	5	3,450	6,000	355,000	615,000	23260B	23260BK	322	518	4

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.

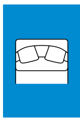


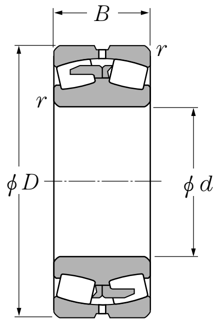
Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

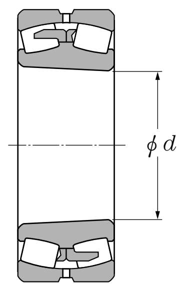
static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.32	2.09	3.12	2.05	43	42.3
0.32	2.11	3.15	2.07	65.8	63.8
0.40	1.69	2.51	1.65	82.2	80.9
0.28	2.43	3.62	2.38	81.7	80
0.37	1.83	2.72	1.79	108	105
0.32	2.10	3.13	2.06	148	145
0.31	2.18	3.24	2.13	58.2	56.3
0.18	3.76	5.60	3.67	21.6	21
0.19	3.53	5.26	3.45	24	23.3
0.26	2.63	3.92	2.57	48.5	46.8
0.34	1.96	2.91	1.91	65.2	64.1
0.33	2.05	3.06	2.01	91.4	88.6
0.41	1.63	2.43	1.60	114	112
0.28	2.45	3.64	2.39	106	104
0.37	1.83	2.72	1.79	141	137
0.32	2.13	3.18	2.09	183	179
0.12	5.42	8.07	5.30	11	10.6
0.17	3.88	5.78	3.79	26.4	25.6
0.25	2.73	4.06	2.67	52.4	50.6
0.33	2.06	3.07	2.02	69	67.9
0.35	1.92	2.86	1.88	88.6	84.9
0.32	2.13	3.18	2.09	97.7	94.6
0.39	1.73	2.58	1.69	120	118
0.26	2.57	3.83	2.51	112	110
0.36	1.90	2.83	1.86	150	145
0.31	2.16	3.22	2.12	224	220
0.25	2.69	4.00	2.63	56	54.1
0.20	3.34	4.98	3.27	40	38.7
0.25	2.66	3.96	2.60	72.4	70.2
0.34	1.97	2.93	1.92	98	96.4
0.32	2.11	3.15	2.07	131	127
0.40	1.69	2.51	1.65	161	159
0.26	2.57	3.83	2.51	141	138
0.36	1.88	2.79	1.83	193	187





Cylindrical bore

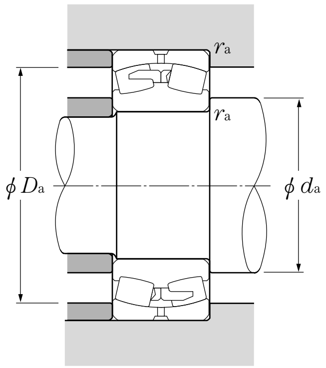


Tapered bore
taper 1:12

d 300～380mm

	Boundary dimensions			Basic load ratings				Bearing numbers		Abutment and fillet dimensions		
	mm			dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)			mm		
d	D	B	$r_{s\,min}$ [1]	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered [2] bore	d_a min	D_a max	r_{as} max
300	620	185	7.5	3,600	5,400	365,000	550,000	22360B	22360BK	336	584	6
320	400	80	2.1	870	2,210	89,000	226,000	24864	24864K30	332	388	2
	440	90	3	1,140	2,460	116,000	251,000	23964	23964K	334	426	2.5
	480	121	4	1,960	3,850	200,000	395,000	23064B	23064BK	338	462	3
	480	160	4	2,510	5,200	255,000	530,000	24064B	24064BK30	338	462	3
	540	176	5	3,100	5,800	320,000	590,000	23164B	23164BK	342	518	4
	540	218	5	3,850	7,300	390,000	745,000	24164B	24164BK30	342	518	4
	580	150	5	3,100	5,050	315,000	515,000	22264B	22264BK	342	558	4
	580	208	5	4,000	7,050	410,000	720,000	23264B	23264BK	342	558	4
	580	213	5	3,950	6,900	405,000	705,000	2P6404	2P6404K	342	558	4
330	540	186	5	3,100	6,000	315,000	615,000	2P6601	2P6601K	352	518	4
340	460	90	3	1,220	2,650	124,000	270,000	23968	23968K	354	446	2.5
	520	133	5	2,310	4,550	235,000	465,000	23068B	23068BK	362	498	4
	520	180	5	3,000	6,200	305,000	630,000	24068B	24068BK30	362	498	4
	580	190	5	3,600	6,600	365,000	670,000	23168B	23168BK	362	558	4
	580	243	5	4,600	8,950	470,000	910,000	24168B	24168BK30	362	558	4
	620	224	6	4,450	8,000	455,000	815,000	23268B	23268BK	368	592	5
	620	229	6	4,450	8,000	455,000	815,000	2P6802	2P6802K	368	592	5
360	440	60	2.1	735	1,830	74,500	187,000	23872	23872K	372	428	2
	480	75	3	1,090	2,350	111,000	239,000	2P7202	2P7202K	374	466	2.5
	480	90	3	1,320	2,930	135,000	298,000	23972	23972K	374	466	2.5
	520	133	5	1,790	3,900	182,000	395,000	2P7201	2P7201K	382	498	4
	530	127	5	2,060	4,100	210,000	415,000	2P7205	2P7205K	382	508	4
	540	134	5	2,370	4,700	242,000	480,000	23072B	23072BK	382	518	4
	540	180	5	3,100	6,600	320,000	675,000	24072B	24072BK30	382	518	4
	600	192	5	3,750	7,050	385,000	715,000	23172B	23172BK	382	578	4
	600	243	5	4,600	9,150	470,000	935,000	24172B	24172BK30	382	578	4
	610	255	5	4,300	8,300	440,000	845,000	2P7206	2P7206K	382	588	4
	650	232	6	4,850	8,700	495,000	885,000	23272B	23272BK	388	622	5
380	520	106	4	1,560	3,550	159,000	360,000	23976	23976K	398	502	3
	560	135	5	2,510	5,150	256,000	525,000	23076B	23076BK	402	538	4
	560	180	5	3,250	7,100	330,000	725,000	24076B	24076BK30	402	538	4
	620	194	5	3,900	7,500	400,000	765,000	23176B	23176BK	402	598	4
	620	243	5	4,800	9,650	490,000	985,000	24176B	24176BK30	402	598	4

[1] Smallest allowable dimension for chamfer dimension r.
[2] Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.

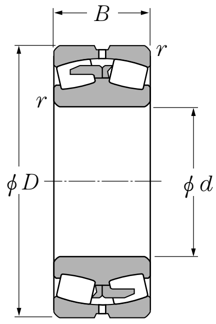


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

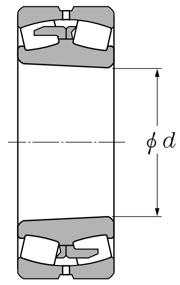
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.32	2.13	3.17	2.08	270	265
0.17	3.90	5.81	3.82	22.8	22.4
0.19	3.50	5.21	3.42	43	41.7
0.25	2.73	4.06	2.67	78.2	75.5
0.33	2.06	3.07	2.02	103	101
0.33	2.06	3.07	2.02	167	162
0.40	1.67	2.48	1.63	207	204
0.26	2.57	3.83	2.51	172	168
0.36	1.86	2.77	1.82	243	236
0.36	1.86	2.77	1.82	241	233
0.34	1.99	2.96	1.94	166	160
0.17	3.91	5.83	3.83	44.7	43.3
0.25	2.68	3.99	2.62	104	100
0.34	1.98	2.95	1.94	140	138
0.33	2.05	3.06	2.01	210	204
0.42	1.61	2.39	1.57	269	265
0.37	1.84	2.75	1.80	300	291
0.37	1.84	2.75	1.80	298	288
0.12	5.78	8.61	5.66	19.2	18.6
0.14	4.94	7.36	4.83	37.1	36.1
0.17	3.99	5.93	3.90	47.2	45.7
0.25	2.69	4.01	2.63	92.8	89.5
0.23	2.92	4.35	2.86	95.3	92.3
0.24	2.78	4.14	2.72	110	106
0.33	2.06	3.07	2.02	147	145
0.32	2.11	3.15	2.07	222	215
0.40	1.67	2.48	1.63	281	277
0.41	1.64	2.44	1.60	290	277
0.36	1.87	2.78	1.83	339	329
0.19	3.54	5.27	3.46	69.9	67.7
0.24	2.87	4.27	2.80	115	111
0.30	2.23	3.32	2.18	153	150
0.31	2.16	3.22	2.12	235	228
0.39	1.73	2.58	1.69	292	287



Cylindrical bore

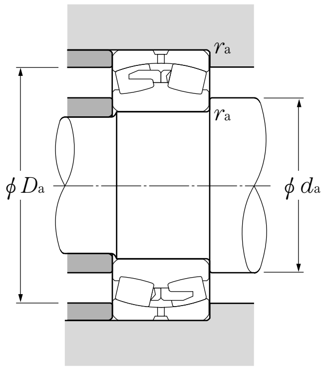


Tapered bore
taper 1:12

d 380～460mm

d	Boundary dimensions (mm) *D*	*B*	$r_{s\,min}$ ❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers Cylindrical bore	tapered❷ bore	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max
380	680	240	6	5,200	9,650	530,000	985,000	23276B	23276BK	408	652	5
	680	245	6	5,200	9,650	536,000	985,000	2P7603	2P7603K	408	652	5
390	510	90	3	1,310	3,050	133,000	310,000	2P7801	2P7801K	404	496	2.5
400	500	100	2.1	1,330	3,500	135,000	360,000	24880	24880K30	412	488	2
	540	106	4	1,580	3,650	161,000	370,000	23980	23980K	418	522	3
	600	148	5	2,980	6,050	305,000	615,000	23080B	23080BK	422	578	4
	600	200	5	3,850	8,400	390,000	855,000	24080B	24080BK30	422	578	4
	650	200	6	4,200	8,050	425,000	820,000	23180B	23180BK	428	622	5
	650	250	6	5,100	10,300	520,000	1,060,000	24180B	24180BK30	428	622	5
	720	256	6	5,850	10,600	595,000	1,080,000	23280B	23280BK	428	692	5
	720	260	6	5,850	10,600	595,000	1,080,000	2P8002	2P8002K	428	692	5
420	520	75	2.1	1,090	2,710	111,000	277,000	23884	23884K	432	508	2
	560	106	4	1,630	3,850	166,000	390,000	23984	23984K	438	542	3
	620	150	5	3,100	6,400	315,000	650,000	23084B	23084BK	442	598	4
	620	200	5	3,850	8,450	395,000	865,000	24084B	24084BK30	442	598	4
	700	224	6	5,200	9,950	530,000	1,020,000	23184B	23184BK	448	672	5
	700	280	6	6,150	12,200	625,000	1,240,000	24184B	24184BK30	448	672	5
	760	272	7.5	6,550	12,000	665,000	1,230,000	23284B	23284BK	456	724	6
440	600	118	4	2,030	4,700	207,000	480,000	23988	23988K	458	582	3
	650	157	6	3,300	6,850	335,000	695,000	23088B	23088BK	468	622	5
	650	212	6	4,300	9,450	440,000	960,000	24088B	24088BK30	468	622	5
	720	226	6	5,200	10,100	530,000	1,030,000	23188B	23188BK	468	692	5
	720	280	6	6,450	13,100	660,000	1,330,000	24188B	24188BK30	468	692	5
	790	280	7.5	6,900	12,800	705,000	1,310,000	23288B	23288BK	476	754	6
	790	285	7.5	6,900	12,800	705,000	1,310,000	2P8802	2P8802K	476	754	6
450	620	190	3	3,050	7,400	315,000	755,000	2P9002	2P9002K	464	606	2.5
460	580	118	3	1,840	4,850	187,000	495,000	24892	24892K30	474	566	2.5
	620	118	4	2,100	4,950	214,000	505,000	23992	23992K	478	602	3
	620	140	4	2,440	6,000	248,000	610,000	2P9203	2P9203K	478	602	3
	680	163	6	3,600	7,450	365,000	760,000	23092B	23092BK	488	652	5
	680	218	6	4,600	10,200	470,000	1,040,000	24092B	24092BK30	488	652	5
	760	240	7.5	5,700	11,400	585,000	1,160,000	23192B	23192BK	496	724	6
	760	300	7.5	7,100	14,500	725,000	1,480,000	24192B	24192BK30	496	724	6

❶ Smallest allowable dimension for chamfer dimension *r*.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.

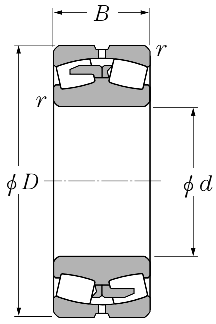


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

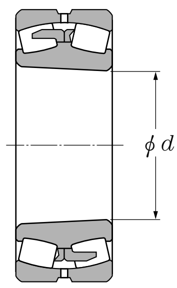
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.36	1.89	2.82	1.85	380	369
0.36	1.89	2.82	1.85	382	370
0.15	4.41	6.57	4.31	47.3	45.7
0.18	3.76	5.59	3.67	45.3	44.5
0.18	3.71	5.53	3.63	73	70.7
0.24	2.80	4.16	2.73	149	144
0.32	2.09	3.11	2.04	202	200
0.31	2.21	3.28	2.16	264	256
0.38	1.77	2.63	1.73	329	324
0.37	1.81	2.69	1.77	457	443
0.37	1.81	2.69	1.77	457	443
0.12	5.42	8.08	5.30	34.8	33.6
0.17	3.95	5.88	3.86	76.2	73.8
0.24	2.85	4.24	2.78	157	152
0.32	2.13	3.18	2.09	210	207
0.32	2.11	3.15	2.07	354	343
0.40	1.69	2.51	1.65	440	433
0.36	1.86	2.77	1.82	544	528
0.18	3.66	5.46	3.58	101	98
0.24	2.85	4.24	2.78	181	175
0.32	2.11	3.15	2.07	245	241
0.31	2.15	3.21	2.11	370	358
0.39	1.75	2.61	1.71	456	449
0.36	1.88	2.80	1.84	600	582
0.36	1.88	2.80	1.84	595	576
0.27	2.49	3.71	2.43	166	157
0.18	3.76	5.59	3.67	73.6	72.3
0.17	3.95	5.88	3.86	107	104
0.21	3.22	4.80	3.15	122	118
0.23	2.88	4.29	2.82	206	200
0.31	2.15	3.21	2.11	276	272
0.31	2.14	3.19	2.10	443	429
0.39	1.71	2.55	1.67	550	541



Cylindrical bore

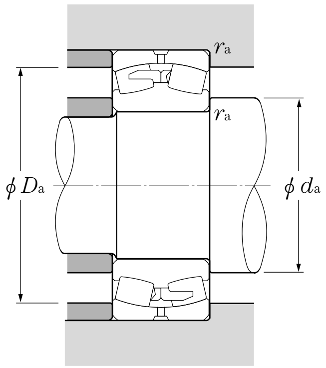


Tapered bore
taper 1:12

d 460～600mm

d	Boundary dimensions (mm) D	B	$r_{s\,min}$ ❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers Cylindrical bore	tapered❷ bore	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max
460	830	296	7.5	7,750	14,500	790,000	1,470,000	23292B	23292BK	496	794	6
480	650	128	5	2,330	5,500	238,000	565,000	23996	23996K	502	628	4
	660	200	3	3,550	8,350	360,000	850,000	2P9602	2P9602K	494	646	2.5
	700	165	6	3,650	7,700	370,000	785,000	23096B	23096BK	508	672	5
	700	218	6	4,650	10,500	475,000	1,070,000	24096B	24096BK30	508	672	5
	790	248	7.5	6,200	12,300	635,000	1,260,000	23196B	23196BK	516	754	6
	790	308	7.5	7,450	15,300	760,000	1,560,000	24196B	24196BK30	516	754	6
	870	310	7.5	8,300	15,500	845,000	1,580,000	23296B	23296BK	516	834	6
490	650	130	5	2,270	5,450	232,000	555,000	2P9801	2P9801K	512	628	4
500	620	90	3	1,550	3,950	158,000	405,000	238/500	238/500K	514	606	2.5
	670	128	5	2,370	5,600	242,000	570,000	239/500	239/500K	522	648	4
	720	167	6	3,850	8,300	390,000	845,000	230/500B	230/500BK	528	692	5
	720	218	6	4,750	10,900	485,000	1,110,000	240/500B	240/500BK30	528	692	5
	830	264	7.5	6,950	13,700	705,000	1,400,000	231/500B	231/500BK	536	794	6
	830	325	7.5	8,050	16,700	825,000	1,700,000	241/500B	241/500BK30	536	794	6
	920	336	7.5	9,400	17,800	960,000	1,820,000	232/500B	232/500BK	536	884	6
530	710	136	5	2,640	6,450	269,000	655,000	239/530	239/530K	552	688	4
	780	185	6	4,400	9,350	445,000	955,000	230/530B	230/530BK	558	752	5
	780	250	6	5,600	12,700	570,000	1,290,000	240/530B	240/530BK30	558	752	5
	870	272	7.5	7,000	14,200	715,000	1,450,000	231/530B	231/530BK	566	834	6
	870	335	7.5	8,300	17,400	850,000	1,770,000	241/530B	241/530BK30	566	834	6
	980	355	9.5	10,400	19,800	1,060,000	2,020,000	232/530B	232/530BK	574	936	8
545	755	230	4	4,550	10,800	460,000	1,100,000	2P10901	2P10901K	563	737	3
560	680	90	3	1,650	4,450	168,000	455,000	238/560	238/560K	574	666	2.5
	750	140	5	2,830	6,700	288,000	680,000	239/560	239/560K	582	728	4
	820	195	6	4,800	10,500	490,000	1,070,000	230/560B	230/560BK	588	792	5
	820	258	6	6,100	14,100	620,000	1,440,000	240/560B	240/560BK30	588	792	5
	920	280	7.5	7,650	15,500	780,000	1,580,000	231/560B	231/560BK	596	884	6
	920	355	7.5	9,950	20,800	1,010,000	2,120,000	241/560B	241/560BK30	596	884	6
	1,030	365	9.5	11,100	21,100	1,130,000	2,150,000	232/560B	232/560BK	604	986	8
600	800	150	5	3,150	7,800	325,000	795,000	239/600	239/600K	622	778	4
	870	200	6	5,250	12,000	535,000	1,220,000	230/600B	230/600BK	628	842	5

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.

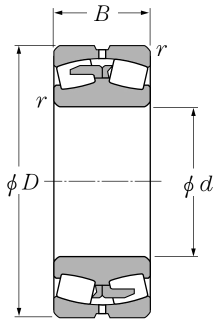


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

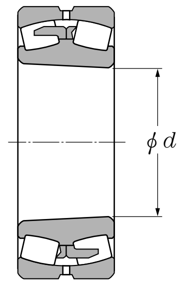
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.36	1.87	2.78	1.83	704	683
0.18	3.85	5.73	3.76	123	119
0.27	2.52	3.75	2.46	195	185
0.23	2.94	4.38	2.88	217	209
0.30	2.22	3.30	2.17	285	280
0.31	2.15	3.21	2.11	492	477
0.39	1.74	2.59	1.70	608	600
0.36	1.87	2.78	1.83	814	790
0.16	4.10	6.10	4.01	114	109
0.13	5.38	8.02	5.26	59.6	57.5
0.17	4.02	5.98	3.93	131	127
0.23	2.98	4.44	2.91	226	218
0.30	2.28	3.40	2.23	295	290
0.32	2.12	3.16	2.08	584	566
0.39	1.72	2.57	1.69	716	705
0.39	1.74	2.59	1.70	1,000	971
0.17	3.94	5.87	3.86	157	152
0.22	3.03	4.52	2.97	306	295
0.30	2.24	3.33	2.19	413	406
0.30	2.22	3.30	2.17	653	633
0.38	1.79	2.67	1.75	800	788
0.39	1.74	2.59	1.70	1,200	1,170
0.28	2.45	3.65	2.40	301	286
0.11	5.97	8.88	5.83	66.1	63.7
0.16	4.09	6.09	4.00	182	176
0.22	3.03	4.51	2.96	353	340
0.30	2.29	3.40	2.24	467	459
0.30	2.27	3.38	2.22	752	729
0.39	1.75	2.61	1.71	948	934
0.36	1.88	2.80	1.84	1,360	1,320
0.18	3.85	5.73	3.76	218	211
0.21	3.17	4.72	3.10	400	386



Cylindrical bore

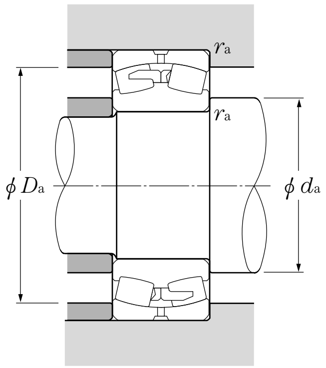


Tapered bore
taper 1:12

d 600～780mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Abutment and fillet dimensions (mm)		
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered❷ bore	d_a min	D_a max	r_{as} max
600	870	272	6	6,450	15,600	655,000	1,590,000	240/600B	240/600BK30	628	842	5
	980	300	7.5	9,000	18,400	920,000	1,880,000	231/600B	231/600BK	636	944	6
	980	375	7.5	10,700	23,200	1,090,000	2,360,000	241/600B	241/600BK30	636	944	6
	1,090	388	9.5	12,200	23,700	1,240,000	2,420,000	232/600B	232/600BK	644	1,046	8
630	780	150	4	3,050	8,800	310,000	895,000	248/630	248/630K30	648	762	3
	850	165	6	3,700	9,250	375,000	945,000	239/630	239/630K	658	822	5
	920	212	7.5	5,900	13,000	600,000	1,330,000	230/630B	230/630BK	666	884	6
	920	290	7.5	7,550	17,900	770,000	1,830,000	240/630B	240/630BK30	666	884	6
	1,030	315	7.5	9,600	19,900	975,000	2,030,000	231/630B	231/630BK	666	994	6
	1,030	400	7.5	11,600	25,000	1,180,000	2,550,000	241/630B	241/630BK30	666	994	6
	1,150	412	12	13,700	26,800	1,400,000	2,740,000	232/630B	232/630BK	684	1,096	10
670	900	170	6	4,100	10,300	420,000	1,050,000	239/670	239/670K	698	872	5
	980	230	7.5	6,550	14,600	665,000	1,490,000	230/670B	230/670BK	706	944	6
	980	308	7.5	8,650	20,600	885,000	2,100,000	240/670B	240/670BK30	706	944	6
	1,090	336	7.5	11,000	22,800	1,120,000	2,330,000	231/670B	231/670BK	706	1,054	6
	1,090	412	7.5	12,700	28,000	1,300,000	2,850,000	241/670B	241/670BK30	706	1,054	6
	1,220	438	12	16,100	32,000	1,640,000	3,250,000	232/670B	232/670BK	724	1,166	10
680	980	220	7.5	6,050	14,000	615,000	1,430,000	2P13601	2P13601K	716	944	6
710	950	180	6	4,450	11,500	450,000	1,170,000	239/710	239/710K	738	922	5
	1,030	236	7.5	7,200	16,200	730,000	1,650,000	230/710B	230/710BK	746	994	6
	1,030	315	7.5	9,300	22,500	945,000	2,300,000	240/710B	240/710BK30	746	994	6
	1,150	345	9.5	11,600	24,900	1,190,000	2,540,000	231/710B	231/710BK	754	1,106	8
	1,150	438	9.5	14,500	32,000	1,470,000	3,250,000	241/710B	241/710BK30	754	1,106	8
	1,280	450	12	16,300	32,500	1,660,000	3,300,000	232/710B	232/710BK	764	1,226	10
750	920	128	5	3,100	8,450	320,000	865,000	238/750	238/750K	772	898	4
	1,000	185	6	5,000	13,000	510,000	1,330,000	239/750	239/750K	778	972	5
	1,090	250	7.5	8,150	18,300	835,000	1,860,000	230/750B	230/750BK	786	1,054	6
	1,090	335	7.5	10,100	24,600	1,030,000	2,500,000	240/750B	240/750BK30	786	1,054	6
	1,220	365	9.5	12,800	27,200	1,310,000	2,780,000	231/750B	231/750BK	794	1,176	8
	1,360	475	15	18,200	36,500	1,860,000	3,750,000	232/750B	232/750BK	814	1,296	12
760	1,140	325	7.5	10,200	23,800	1,040,000	2,430,000	☆2P15203	2P15203K	796	1,104	6
780	1,220	375	9.5	12,800	28,700	1,300,000	2,920,000	2P15605	2P15605K	824	1,176	8

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.

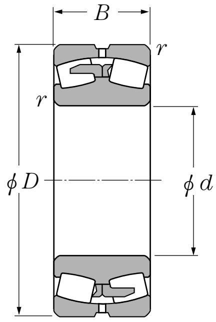


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

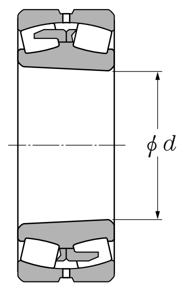
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.29	2.33	3.47	2.28	544	535
0.30	2.22	3.30	2.17	908	880
0.37	1.81	2.70	1.77	1,130	1,110
0.36	1.86	2.77	1.82	1,540	1,490
0.17	4.07	6.06	3.98	158	155
0.18	3.66	5.45	3.58	277	268
0.22	3.14	4.67	3.07	481	464
0.30	2.28	3.40	2.23	657	646
0.30	2.27	3.38	2.22	1,050	1,020
0.38	1.78	2.66	1.74	1,330	1,310
0.36	1.87	2.78	1.83	1,900	1,840
0.18	3.76	5.59	3.67	317	307
0.22	3.07	4.57	3.00	594	573
0.29	2.29	3.41	2.24	794	781
0.30	2.22	3.30	2.17	1,250	1,210
0.37	1.83	2.73	1.79	1,530	1,510
0.36	1.89	2.81	1.85	2,270	2,200
0.21	3.17	4.72	3.10	550	533
0.18	3.85	5.73	3.76	375	363
0.22	3.02	4.50	2.96	663	640
0.29	2.36	3.51	2.31	884	870
0.29	2.32	3.45	2.27	1,420	1,380
0.37	1.80	2.69	1.76	1,800	1,770
0.35	1.91	2.84	1.87	2,540	2,470
0.12	5.72	8.51	5.59	179	173
0.17	3.90	5.81	3.81	412	399
0.21	3.20	4.76	3.13	790	763
0.29	2.35	3.49	2.29	1,060	1,040
0.29	2.32	3.45	2.27	1,700	1,650
0.35	1.92	2.86	1.88	3,050	2,960
0.24	2.79	4.15	2.73	1,100	1,060
0.30	2.25	3.34	2.20	1,610	1,560



Cylindrical bore

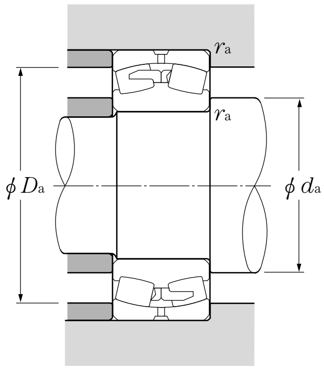


Tapered bore
taper 1:12

d 790～1,060mm

d	Boundary dimensions (mm) D	B	$r_{s\,min}$ ❶	Basic load ratings dynamic (kN) C_r	static (kN) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Bearing numbers Cylindrical bore	tapered❷ bore	Abutment and fillet dimensions (mm) d_a min	D_a max	r_{as} max
790	1,100	310	7.5	8,650	21,000	880,000	2,150,000	2P15802	2P15802K	826	1,064	6
800	1,060	195	6	5,400	13,700	550,000	1,400,000	239/800	239/800K	828	1,032	5
	1,150	258	7.5	8,400	19,500	860,000	1,990,000	230/800B	230/800BK	836	1,114	6
	1,150	345	7.5	11,200	27,800	1,140,000	2,840,000	240/800B	240/800BK30	836	1,114	6
	1,280	375	9.5	14,400	31,000	1,460,000	3,150,000	231/800B	231/800BK	844	1,236	8
850	1,030	136	5	3,600	10,500	365,000	1,070,000	238/850	238/850K	872	1,008	4
	1,120	200	6	5,850	15,100	595,000	1,540,000	239/850	239/850K	878	1,092	5
	1,220	272	7.5	9,750	22,700	995,000	2,310,000	230/850B	230/850BK	886	1,184	6
	1,220	290	7.5	9,150	22,000	935,000	2,240,000	2P17001	2P17001K	886	1,184	6
	1,220	290	7.5	10,500	24,000	1,070,000	2,450,000	☆2P17011	2P17011K	886	1,184	6
	1,220	330	7.5	11,000	26,900	1,120,000	2,740,000	☆2P17012	2P17012K	886	1,184	6
	1,220	365	7.5	12,500	31,500	1,270,000	3,200,000	240/850B	240/850BK30	886	1,184	6
	1,360	400	12	15,500	34,000	1,580,000	3,500,000	231/850B	231/850BK	904	1,306	10
	1,500	515	15	22,300	47,500	2,270,000	4,850,000	232/850B	232/850BK	914	1,436	12
900	1,180	206	6	6,650	17,300	675,000	1,770,000	239/900	239/900K	928	1,152	5
	1,280	280	7.5	10,300	24,700	1,050,000	2,520,000	230/900B	230/900BK	936	1,244	6
	1,280	375	7.5	13,200	33,500	1,350,000	3,450,000	240/900B	240/900BK30	936	1,244	6
	1,420	412	12	16,800	38,000	1,720,000	3,850,000	231/900B	231/900BK	954	1,366	10
950	1,250	224	7.5	7,750	20,500	790,000	2,090,000	239/950	239/950K	986	1,214	6
	1,280	260	7.5	8,650	22,200	885,000	2,270,000	2P19014	2P19014K	986	1,244	6
	1,330	300	7.5	8,400	21,200	855,000	2,170,000	2P19013	2P19013K	986	1,294	6
	1,360	300	7.5	11,500	28,400	1,180,000	2,900,000	230/950B	230/950BK	986	1,324	6
	1,360	320	7.5	11,500	28,000	1,170,000	2,860,000	☆2P19022	2P19022K	986	1,324	6
	1,360	412	7.5	15,500	40,000	1,580,000	4,100,000	240/950B	240/950BK30	986	1,324	6
	1,400	380	7.5	14,100	33,500	1,440,000	3,400,000	2P19019	2P19019K	986	1,364	6
1,000	1,320	236	7.5	8,600	22,700	875,000	2,310,000	239/1000	239/1000K	1,036	1,284	6
	1,320	258	7.5	8,500	22,600	865,000	2,300,000	2P20002	2P20002K	1,036	1,284	6
	1,420	308	7.5	12,400	30,000	1,260,000	3,050,000	230/1000B	230/1000BK	1,036	1,384	6
	1,420	412	7.5	16,000	42,000	1,640,000	4,250,000	240/1000B	240/1000BK30	1,036	1,384	6
1,050	1,500	412	9.5	15,800	42,500	1,600,000	4,350,000	☆2P21001	2P21001K	1,094	1,456	8
1,060	1,400	250	7.5	9,300	24,700	950,000	2,520,000	239/1060	239/1060K	1,096	1,364	6
	1,500	325	9.5	13,600	33,500	1,390,000	3,400,000	230/1060B	230/1060BK	1,104	1,456	8

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

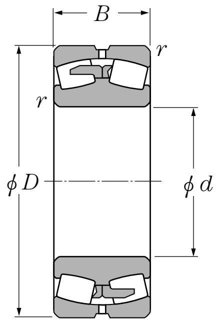
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

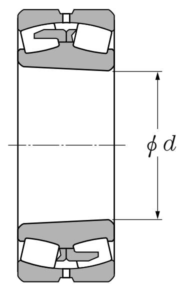
$P_{or} = F_r + Y_o F_a$

For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	Axial load factors			Mass (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.24	2.76	4.11	2.70	857	817
0.17	4.05	6.04	3.96	487	471
0.21	3.15	4.69	3.08	890	859
0.28	2.41	3.59	2.36	1,190	1,170
0.29	2.32	3.45	2.27	1,890	1,830
0.11	6.01	8.94	5.87	232	223
0.16	4.25	6.32	4.15	550	532
0.20	3.32	4.95	3.25	1,050	1,010
0.23	2.98	4.44	2.92	1,100	1,070
0.21	3.28	4.88	3.21	1,060	1,020
0.23	2.90	4.31	2.83	1,200	1,160
0.28	2.42	3.61	2.37	1,410	1,390
0.28	2.37	3.54	2.32	2,270	2,200
0.35	1.94	2.89	1.90	3,890	3,780
0.16	4.32	6.44	4.23	623	603
0.20	3.32	4.95	3.25	1,170	1,130
0.27	2.48	3.70	2.43	1,570	1,540
0.28	2.42	3.60	2.36	2,500	2,420
0.16	4.20	6.26	4.11	774	749
0.17	3.98	5.92	3.89	921	888
0.18	3.66	5.46	3.58	1,210	1,170
0.21	3.26	4.85	3.18	1,430	1,380
0.20	3.33	4.96	3.25	1,450	1,400
0.28	2.39	3.56	2.34	1,970	1,940
0.24	2.77	4.13	2.71	1,940	1,870
0.16	4.21	6.26	4.11	916	887
0.16	4.23	6.30	4.14	911	877
0.20	3.37	5.02	3.29	1,580	1,520
0.27	2.51	3.73	2.45	2,110	2,080
0.24	2.85	4.25	2.79	2,290	2,200
0.16	4.28	6.37	4.19	1,090	1,060
0.20	3.36	5.00	3.28	1,850	1,790



Cylindrical bore

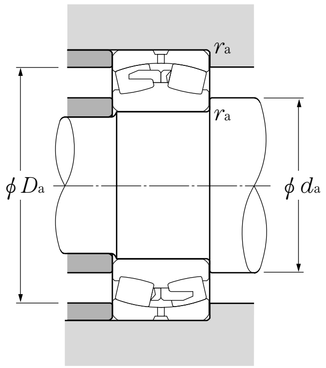


Tapered bore
taper 1:12

d 1,060～1,800mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers		Abutment and fillet dimensions (mm)		
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	tapered❷ bore	d_a min	D_a max	r_{as} max
1,060	1,500	340	9.5	13,100	32,000	1,340,000	3,250,000	**2P21202**	**2P21202K**	1,104	1,456	8
	1,500	438	9.5	17,800	47,000	1,810,000	4,800,000	**240/1060B**	**240/1060BK30**	1,104	1,456	8
1,120	1,360	180	6	6,200	18,700	630,000	1,900,000	**238/1120**	**238/1120K**	1,148	1,332	5
	1,460	250	7.5	9,850	26,700	1,000,000	2,720,000	**239/1120**	**239/1120K**	1,156	1,424	6
	1,580	345	9.5	15,600	39,000	1,590,000	4,000,000	**230/1120B**	**230/1120BK**	1,164	1,536	8
	1,580	462	9.5	19,500	52,500	1,990,000	5,350,000	**240/1120B**	**240/1120BK30**	1,164	1,536	8
1,180	1,420	180	6	6,350	19,700	650,000	2,010,000	**238/1180**	**238/1180K**	1,208	1,392	5
	1,540	272	7.5	11,000	29,800	1,120,000	3,050,000	**239/1180**	**239/1180K**	1,216	1,504	6
	1,540	355	7.5	13,700	40,500	1,390,000	4,150,000	**249/1180**	**249/1180K30**	1,216	1,504	6
	1,660	475	9.5	20,700	55,500	2,110,000	5,650,000	**240/1180B**	**240/1180BK30**	1,224	1,616	8
1,200	1,700	410	9.5	17,600	44,500	1,800,000	4,550,000	**2P24005**	**2P24005K**	1,244	1,656	8
	1,700	410	12	17,800	45,000	1,810,000	4,600,000	☆**2P24007**	**2P24007K**	1,254	1,646	10
1,250	1,630	280	7.5	12,100	33,500	1,230,000	3,400,000	**239/1250**	**239/1250K**	1,286	1,594	6
	1,750	390	9.5	17,200	44,000	1,760,000	4,500,000	**2P25002**	**2P25002K**	1,294	1,706	8
1,320	1,720	300	7.5	13,600	38,000	1,390,000	3,900,000	**239/1320**	**239/1320K**	1,356	1,684	6
	1,850	480	12	22,200	58,500	2,270,000	5,950,000	**2P26402**	**2P26402K**	1,374	1,796	10
	1,850	530	12	25,200	67,500	2,570,000	6,900,000	**240/1320B**	**240/1320BK30**	1,374	1,796	10
1,400	1,820	315	9.5	15,100	43,000	1,540,000	4,400,000	**239/1400**	**239/1400K**	1,444	1,776	8
1,500	1,820	315	7.5	12,300	41,500	1,260,000	4,200,000	**248/1500**	**248/1500K30**	1,536	1,784	6
1,800	2,180	375	9.5	17,500	60,500	1,790,000	6,200,000	**248/1800**	**248/1800K30**	1,844	2,136	8

❶ Smallest allowable dimension for chamfer dimension r.
❷ Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
Remarks: 1. Bearing numbers marked "☆" are C type.

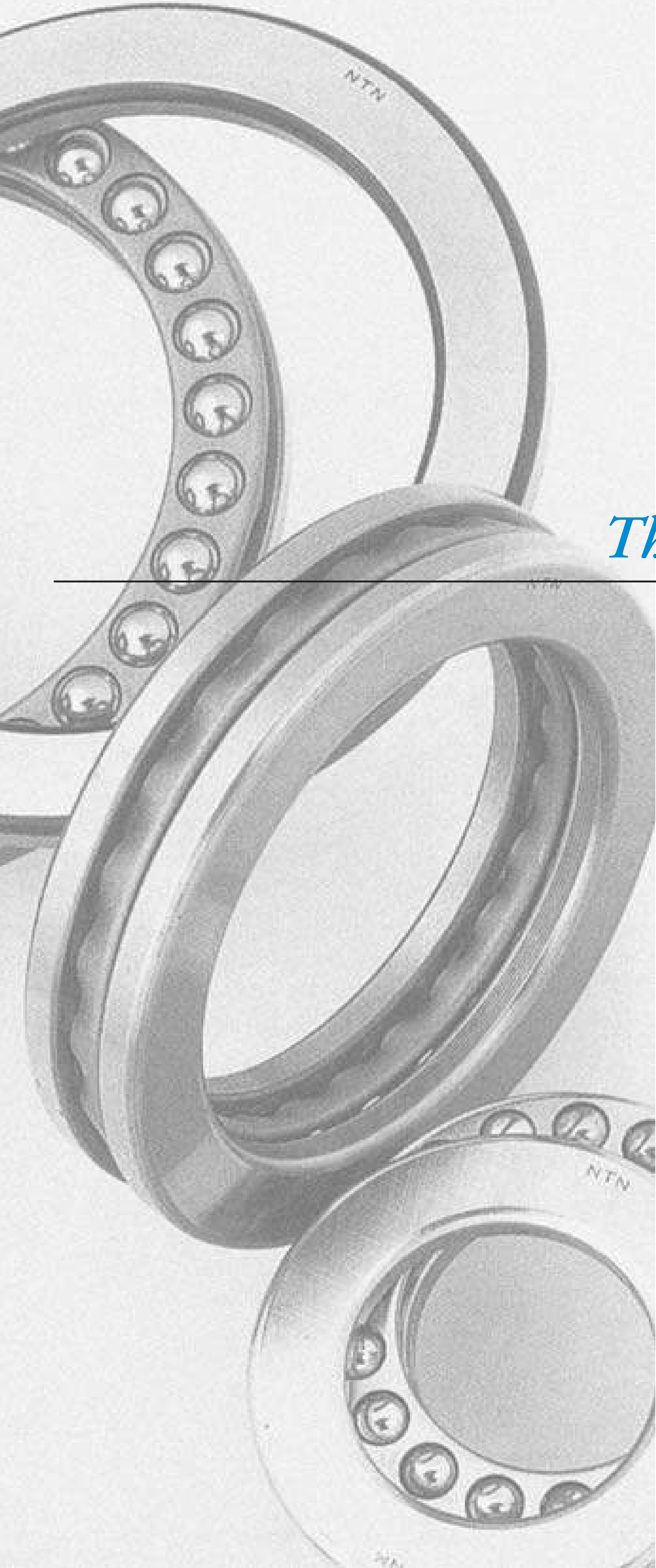


Equivalent bearing load
dynamic
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_1, Y_2 and Y_o see the table below.

Constant	**Axial load factors**			**Mass** (approx.) kg	
e	Y_1	Y_2	Y_o	Cylindrical bore	tapered bore
0.21	3.25	4.83	3.17	1,870	1,810
0.27	2.49	3.71	2.44	2,450	2,140
0.11	5.97	8.89	5.84	536	517
0.15	4.42	6.58	4.32	1,140	1,100
0.21	3.29	4.80	3.21	2,160	2,090
0.27	2.50	3.72	2.44	2,890	2,840
0.11	6.27	9.34	6.13	559	539
0.15	4.40	6.55	4.30	1,390	1,340
0.21	3.28	4.88	3.21	1,740	1,660
0.27	2.54	3.78	2.48	3,220	3,170
0.21	3.19	4.75	3.12	2,860	2,750
0.21	3.21	4.77	3.14	2,830	2,730
0.15	4.42	6.58	4.32	1,600	1,550
0.20	3.31	4.93	3.24	2,880	2,780
0.16	4.34	6.46	4.24	1,900	1,840
0.22	3.12	4.64	3.05	3,830	3,670
0.25	2.65	3.94	2.59	4,320	4,240
0.15	4.39	6.54	4.29	2,230	2,160
0.15	4.54	6.75	4.43	1,660	1,580
0.15	4.47	6.65	4.37	2,830	2,770



Thrust bearings

1. Classification and Features

1. 1 Thrust ball bearings

Balls are arranged between a set of washers (a shaft washer and housing washer) and the contact angle is 90˚. Axial loads can be supported in only one direction and radial loads cannot be supported. These bearings are unsuitable for high speed operation. **Table 1** shows the standard cage models.

Table 1 Standard cage model

Bearing series	511	512	513	514
Press cage	51120 ～51152	51220 ～51224	51320	—
Machined cage	51156 ～511/750	51226 ～51292	51322 ～51340	51420

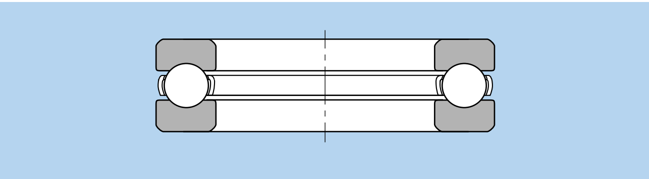


Fig.1 Single type thrust ball bearing (Example of the press cage)

1. 2 Cylindrical roller thrust bearings

These bearings use cylindrical rollers and have single row, double row, 3 row, 4 row, and also duplex types. Bearings can support only axial loads and are suitable to heavy loads. Their axial rigidity is high. Cages are the machined type.

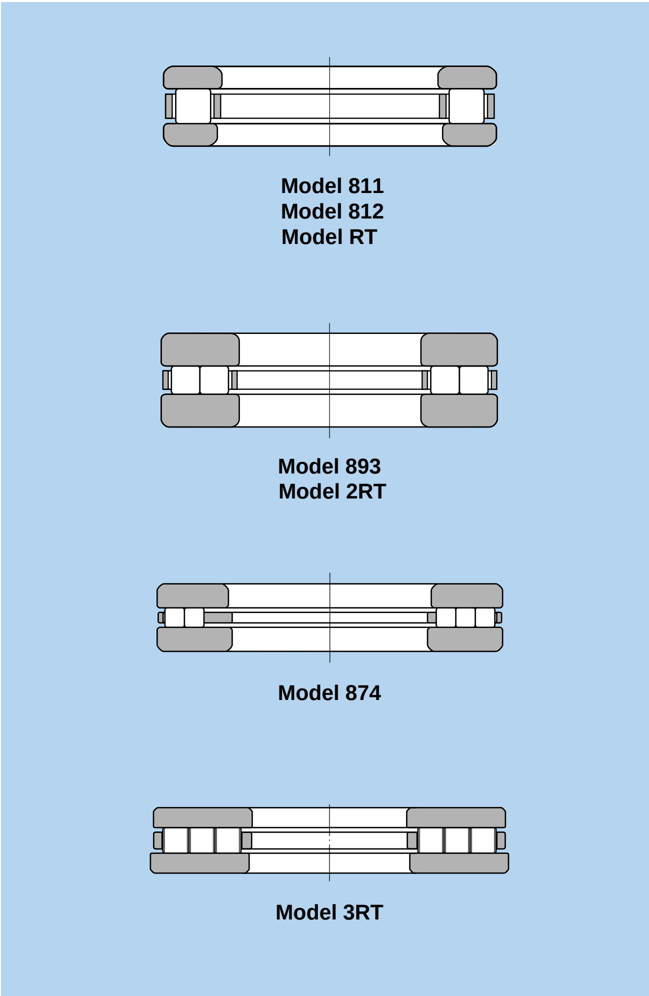
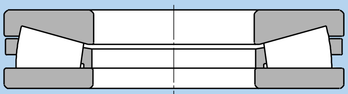


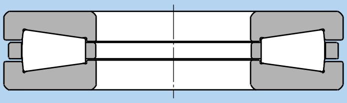
Fig.2 Cylindrical roller thrust bearing

1. 3 Tapered roller thrust bearings

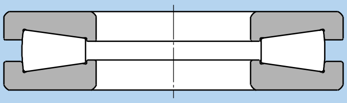
These are thrust bearings using tapered rollers, and the single type bearings have three types of housing washers. One type is the housing raceway with a rib, the other one is without a rib, and the third bearing is the full complement roller type. Double type bearings are mainly used to support axial loads on the roll neck of rolling mill. Machined cages are used for cages.



Drawing 1



Drawing 2



Drawing 3

Fig.3 Tapered roller thrust bearings (Single type)

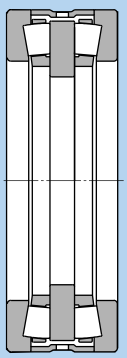


Fig.4 Tapered roller thrust bearings (Double type)

1. 4 Self-aligning thrust roller bearings

These bearings have a self-aligning nature using barrel-shaped rollers. The allowable aligning angle varies depending on the bearing's dimension system, but it is 1˚- 2˚ for normal loads. Cages are machined type and the guide sleeve is on the axial housing raceway. Since the load capacity for axial loads is high, these bearings can support a certain amount of radial load in the instances that axial loads are applied. However, it is necessary to use these bearing where the load conditions meet $F_r/F_a \leqq 0.55$.

These bearings have some spots where lubricant cannot enter such as the gap between the cage and guide sleeve. It is necessary to use oil lubrication even in low speed operation.

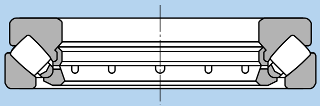


Fig.5 Self-aligning thrust roller bearing

2. Dimensional Accuracy / Rotation Accuracy

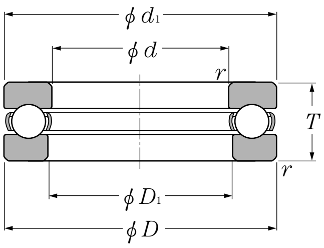
Thrust ball bearings ··················**Table 3.6 (Page A-18)**
Cylindrical roller thrust bearings ······**Table 3.6 (Page A-18)**
Tapered roller thrust bearings······**Table 3.8 (Page A-19)**
Self-aligning thrust roller bearings ······**Table 3.8 (Page A-19)**

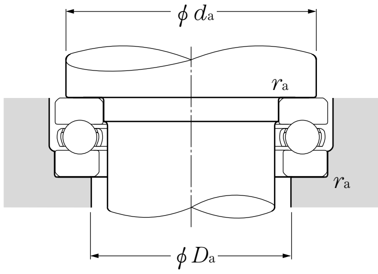
3. Recommended Fitting

Thrust ball bearings
Cylindrical roller thrust bearings
Tapered roller thrust bearings
Self-aligning thrust roller bearings
} **Table 4.3 (Page A-26)**

4. General Operating Cautions

Thrust bearings need to load a certain amount of axial load to prevent sliping between the rolling elements and axial housing raceway. Please consult with **NTN** Engineering for details.





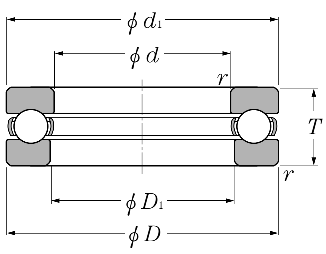
Equivalent bearing load
dynamic
$P_a = F_a$

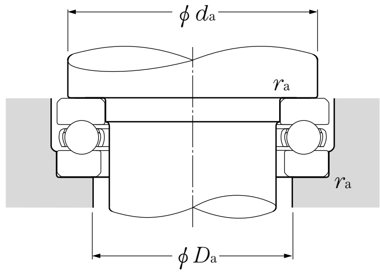
static
$P_{oa} = F_a$

d 100～190mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)		Abutment and fillet dimensions (mm)			Mass kg
d	D	T	$r_{s\,min}$ [1]	C_a	C_{oa}	C_a	C_{oa}		$d_{1s\,max}$ [2]	$D_{1s\,min}$ [3]	d_a min	D_a max	r_{as} max	(approx.)
100	135	25	1	85.0	268	8,700	27,300	51120	135	102	121	114	1	0.987
	150	38	1.1	147	410	14,900	42,000	51220	150	103	130	120	1	2.29
	170	55	1.5	237	595	24,100	60,500	51320	170	103	142	128	1.5	4.88
	210	85	3	370	970	37,500	99,000	*51420	205	103	165	145	2.5	14.7
110	145	25	1	87.0	288	8,900	29,400	51122	145	112	131	124	1	1.07
	160	38	1.1	153	450	15,600	46,000	51222	160	113	140	130	1	2.46
	190	63	2	267	705	27,300	72,000	*51322	187	113	158	142	2	7.67
120	155	25	1	89.0	310	9,100	31,500	51124	155	122	141	134	1	1.11
	170	39	1.1	154	470	15,700	48,000	51224	170	123	150	140	1	2.71
	210	70	2.1	296	805	30,000	82,500	*51324	205	123	173	157	2	10.8
130	170	30	1	104	350	10,600	36,000	51126	170	132	154	146	1	1.73
	190	45	1.5	191	565	19,400	57,500	*51226	187	133	166	154	1.5	4.22
	225	75	2.1	330	960	33,500	97,500	*51326	220	134	186	169	2	12.7
140	180	31	1	107	375	10,900	38,500	*51128	178	142	164	156	1	1.90
	200	46	1.5	193	595	19,700	60,500	*51228	197	143	176	164	1.5	4.77
	240	80	2.1	350	1,050	35,500	107,000	*51328	235	144	199	181	2	15.3
150	190	31	1	109	400	11,100	41,000	*51130	188	152	174	166	1	2.00
	215	50	1.5	220	685	22,400	70,000	*51230	212	153	189	176	1.5	5.87
	250	80	2.1	360	1,130	37,000	115,000	*51330	245	154	209	191	2	16.1
160	200	31	1	112	425	11,400	43,500	*51132	198	162	184	176	1	2.10
	225	51	1.5	223	720	22,800	73,000	*51232	222	163	199	186	1.5	6.32
	270	87	3	450	1,470	45,500	150,000	*51332	265	164	225	205	2.5	20.7
170	215	34	1.1	134	510	13,700	52,000	*51134	213	172	197	188	1	2.77
	240	55	1.5	261	835	26,600	85,000	*51234	237	173	212	198	1.5	7.81
	280	87	3	465	1,570	47,000	160,000	*51334	275	174	235	215	2.5	21.6
180	225	34	1.1	135	525	13,700	54,000	*51136	222	183	207	198	1	2.92
	250	56	1.5	266	875	27,100	89,000	*51236	247	183	222	208	1.5	8.34
	300	95	3	490	1,700	50,000	174,000	*51336	295	184	251	229	2.5	27.5
190	240	37	1.1	170	655	17,400	67,000	*51138	237	193	220	210	1	3.75
	270	62	2	310	1,060	31,500	108,000	*51238	267	194	238	222	2	11.3

[1] Smallest allowable dimension for chamfer dimension r. [2] Maximum allowable dimension for shaft washer outer dimension d_1. [3] Maximum allowable dimension for housing washer inner dimension D_1. Remarks: Bearing numbers marked "*" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.





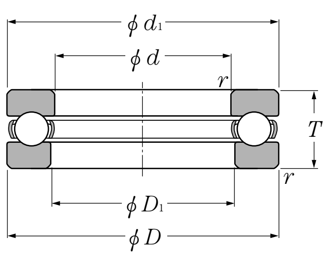
Equivalent bearing load
dynamic
$P_a = F_a$

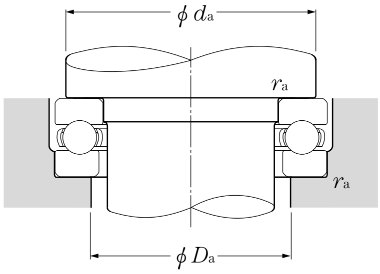
static
$P_{oa} = F_a$

d 190～420mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Dimensions mm		Abutment and fillet dimensions mm			Mass kg
d	D	T	$r_{s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}		$d_{1s\,max}$ ❷	$D_{1s\,min}$ ❸	d_a min	D_a max	r_{as} max	(approx.)
190	320	105	4	545	1,950	55,500	199,000	*51338	315	195	266	244	3	35.0
200	250	37	1.1	172	675	17,500	69,000	*51140	247	203	230	220	1	3.92
	280	62	2	315	1,110	32,000	113,000	*51240	277	204	248	232	2	11.8
	340	110	4	595	2,220	61,000	227,000	*51340	335	205	282	258	3	41.8
220	270	37	1.1	177	740	18,100	75,500	*51144	267	223	250	240	1	4.27
	300	63	2	325	1,210	33,000	123,000	*51244	297	224	268	252	2	13.0
240	300	45	1.5	228	935	23,200	95,000	*51148	297	243	276	264	1.5	6.87
	340	78	2.1	415	1,650	42,500	168,000	*51248	335	244	299	281	2	22.4
260	320	45	1.5	232	990	23,600	101,000	*51152	317	263	296	284	1.5	7.38
	360	79	2.1	440	1,810	45,000	184,000	*51252	355	264	319	301	2	24.2
280	350	53	1.5	305	1,270	31,000	130,000	*51156	347	283	322	308	1.5	11.8
	380	80	2.1	460	1,970	47,000	201,000	*51256	375	284	339	321	2	26.1
300	380	62	2	355	1,560	36,000	159,000	*51160	376	304	348	332	2	17.2
	420	95	3	590	2,680	60,000	273,000	*51260	415	304	371	349	2.5	40.6
320	400	63	2	365	1,660	37,000	169,000	*51164	396	324	368	352	2	18.4
	440	95	3	595	2,800	61,000	285,000	*51264	435	325	392	368	2.5	44.9
340	420	64	2	375	1,760	38,000	179,000	*51168	416	344	388	372	2	19.7
	460	96	3	605	2,920	61,500	298,000	*51268	455	345	412	388	2.5	47.8
360	440	65	2	380	1,860	39,000	190,000	*51172	436	364	408	392	2	21.1
	500	110	4	720	3,650	73,500	375,000	*51272	495	365	444	416	3	69.0
380	460	65	2	380	1,910	39,000	195,000	*51176	456	384	428	412	2	22.3
	520	112	4	735	3,800	74,500	390,000	*51276	515	385	464	436	3	73.7
400	480	65	2	390	2,010	40,000	205,000	*51180	476	404	448	432	2	23.3
	540	112	4	745	3,950	76,000	405,000	*51280	535	405	484	456	3	76.9
420	500	65	2	395	2,110	40,500	215,000	*51184	495	424	468	452	2	24.4
	580	130	5	865	4,850	88,500	490,000	*51284	575	425	516	484	4	109

❶ Smallest allowable dimension for chamfer dimension r. ❷ Maximum allowable dimension for shaft washer outer dimension d_1. ❸ Maximum allowable dimension for housing washer inner dimension D_1. Remarks: Bearing numbers marked "*" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.





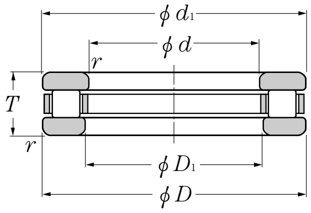
Equivalent bearing load
dynamic
$P_a = F_a$

static
$P_{oa} = F_a$

d 440～750mm

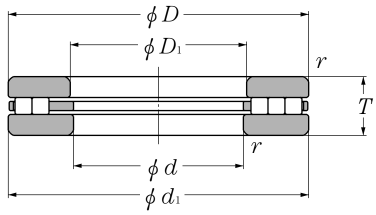
Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Dimensions mm		Abutment and fillet dimensions mm			Mass kg
d	D	T	$r_{s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}		$d_{1s\,max}$ ❷	$D_{1s\,min}$ ❸	d_a min	D_a max	r_{as} max	(approx.)
440	540	80	2.1	515	2,850	52,500	291,000	∗51188	535	444	499	481	2	40.0
	600	130	5	855	4,850	87,500	490,000	∗51288	595	445	536	504	4	113
460	560	80	2.1	525	3,000	53,500	305,000	∗51192	555	464	519	501	2	41.6
	620	130	5	895	5,250	91,000	535,000	∗51292	615	465	556	524	4	118
480	580	80	2.1	525	3,100	54,000	315,000	∗51196	575	484	539	521	2	43.3
500	600	80	2.1	575	3,400	58,500	345,000	∗511/500	595	504	559	541	2	45.0
530	640	85	3	645	4,000	66,000	405,000	∗511/530	635	534	595	575	2.5	55.8
560	670	85	3	595	3,750	60,500	385,000	∗511/560	665	564	625	605	2.5	59.4
600	710	85	3	645	4,200	66,000	430,000	∗511/600	705	604	666	644	2.5	62.6
630	750	95	3	720	4,850	73,500	495,000	∗511/630	745	634	702	678	2.5	82.5
670	800	105	4	825	5,850	84,000	600,000	∗511/670	795	674	748	722	3	105
710	850	112	4	875	6,350	89,000	650,000	∗511/710	845	714	794	766	3	129
750	900	120	4	1,010	7,650	103,000	780,000	∗511/750	895	755	841	809	3	155

❶ Smallest allowable dimension for chamfer dimension r. ❷ Maximum allowable dimension for shaft washer outer dimension d_1. ❸ Maximum allowable dimension for housing washer inner dimension D_1. Remarks: Bearing numbers marked "∗" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.



Type 811
Type 812

Type 893

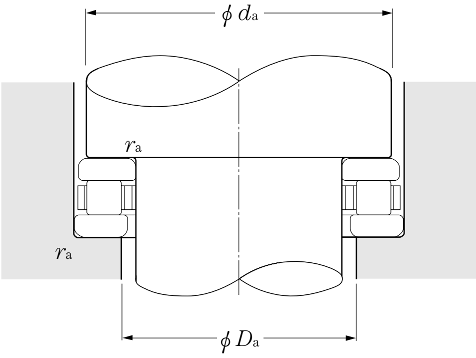


Type 874

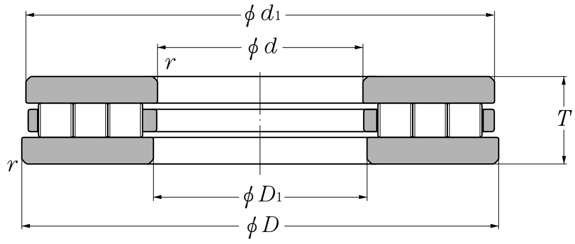
d 100～180mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	T	$r_{s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	
100	135	25	1	158	555	16,100	57,000	81120L1
	150	38	1.1	243	795	24,800	81,000	81220L1
	170	42	1.5	335	1,370	34,500	140,000	89320L1
	210	50	3	580	2,650	59,000	271,000	87420L1
110	145	25	1	165	605	16,800	61,500	81122L1
	160	38	1.1	259	885	26,400	90,000	81222L1
	190	48	2	430	1,770	44,000	180,000	89322L1
	230	54	3	725	3,150	74,000	325,000	87422L1
120	155	25	1	172	655	17,500	66,500	81124L1
	170	39	1.1	264	930	26,900	94,500	81224L1
	210	54	2.1	555	2,300	56,500	235,000	89324L1
	250	58	4	830	3,900	84,500	395,000	87424L1
130	170	30	1	197	755	20,100	77,000	81126L1
	190	45	1.5	360	1,210	36,500	123,000	81226L1
	225	58	2.1	615	2,600	63,000	265,000	89326L1
	270	63	4	895	4,250	91,500	435,000	87426L1
140	180	31	1	206	815	21,000	83,000	81128L1
	200	46	1.5	370	1,280	38,000	130,000	81228L1
	240	60	2.1	695	2,980	71,000	305,000	89328L1
	280	63	4	940	4,600	96,000	470,000	87428L1
150	190	31	1	214	870	21,800	89,000	81130L1
	215	50	1.5	455	1,580	46,000	161,000	81230L1
	250	60	2.1	710	3,130	72,500	320,000	89330L1
160	200	31	1	221	930	22,600	95,000	81132L1
	225	51	1.5	518	1,930	53,000	197,000	81232L1
	270	67	3	835	3,690	85,500	375,000	89332L1

❶ Smallest allowable dimension for chamfer dimension r.



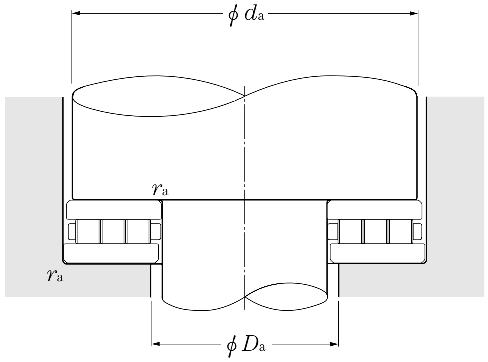
Dimensions mm		Abutment and fillet dimensions mm			Mass
		d_a	D_a	r_{as}	kg
d_1	D_1	min	max	max	(approx.)
135	102	128	106	1	1.220
150	103	139	109	1	2.730
170	103	163	110	1.5	4.500
210	103	203	112	3	9.500
145	112	138	116	1	1.330
160	113	149	119	1	2.980
190	113	183	122	2	6.350
230	113	221	118	3	11.850
155	122	148	126	1	1.410
170	123	159	129	1	3.280
210	123	201	132	2	9.000
250	123	241	132	4	15.690
170	132	162	137	1	2.020
187	133	178	140	1.5	5.050
225	134	216	143	2	10.370
270	134	262	147	4	19.750
178	142	172	147	1	2.250
197	143	188	150	1.5	5.460
240	144	231	154	2	12.600
280	144	273	158	4	20.940
188	152	182	157	1	2.410
212	153	202	160	1.5	6.870
250	154	242	165	2	13.320
198	162	192	167	1	2.500
222	163	216	174	1.5	6.910
270	164	262	177	3	17.250



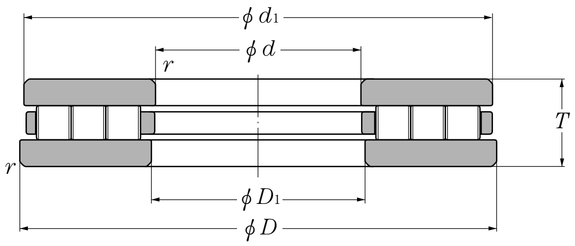
d 180～304.8mm

d	D	T	$r_{s\,min}$ ❷	C_a dynamic (kN)	C_{oa} static (kN)	C_a dynamic (kgf)	C_{oa} static (kgf)	Bearing numbers ❶
180	220	22	1.0	160	715	16,300	72,500	**RT3615**
	300	73	3.0	1,090	4,900	111,000	495,000	**2RT3618**
190	270	62	2.5	745	2,780	76,000	284,000	**RT3812**
	330	70	4.0	1,260	5,900	129,000	600,000	**2RT3811**
200	340	75	5.0	1,320	6,150	134,000	630,000	**2RT4028**
	340	85	5.0	1,260	4,950	128,000	505,000	**2RT4030**
	370	85	4.0	1,760	7,400	179,000	755,000	**2RT4024**
	400	122	5.0	2,230	8,250	227,000	840,000	**2RT4032**
203.2	406.4	76.2	6.0	1,530	7,850	156,000	800,000	**3RT4101**
210	250	25	1.5	133	635	13,600	64,500	**RT4206**
220	270	25	1.0	217	1,060	22,100	109,000	**RT4411**
	360	85	outer 4.0 inner 2.0	1,380	5,950	140,000	610,000	**2RT4416**
	400	80	2.0	1,720	7,750	175,000	790,000	**2RT4425**
	430	88	5.0	1,880	9,100	191,000	930,000	**3RT4406**
222.25	520.7	114.3	4.0	5,100	20,500	520,000	2,090,000	**2RT4426**
	520.7	165	4.0	5,100	20,500	520,000	2,090,000	**2RT4427**
240	320	45	2.0	670	3,350	6,800	340,000	**2RT4814**
	425	90	2.0	1,820	8,850	186,000	905,000	**2RT4803**
254	457.2	95.25	6.0	2,360	12,100	240,000	1,240,000	**3RT5107**
260	340	55	1.5	790	3,350	80,500	340,000	**RT5211**
270	540	105	5.0	3,100	15,800	315,000	1,610,000	**3RT5404**
280	380	55	2.5	645	2,900	65,500	296,000	**RT5606**
	520	109	4.0	2,900	13,200	296,000	1,340,000	**2RT5610**
290	350	35	1.5	345	1,760	35,000	180,000	**RT5805**
304.8	457.2	95.25	6.0	1,770	8,250	181,000	840,000	**2RT6108**

❶ RT: single row, 2RT: double row, 3RT: triple row
❷ Smallest allowable dimension for chamfer dimension r.



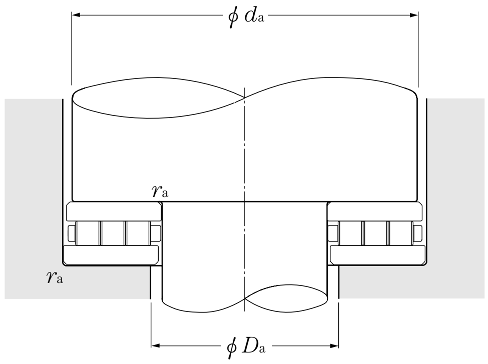
Dimensions mm		Abutment and fillet dimensions mm			Mass kg
d_1	D_1	d_a min	D_a max	r_{as} max	(approx.)
219	181	213	187	1	1.77
300	184	298	188	2.5	23.3
270	195	264	196	2	11.9
329.5	190.5	327	200	3	27.9
340	201	335	204	4	31.4
340	202	332	212	4	35.0
370	200.5	362	210	3	44.3
396	204	388	216	4	80.3
404.038	205.562	389	214	5	52.1
250	210	243	217	1.5	2.51
269	221	262	234	1	3.16
359	221	349	233	outer 3 inner 2	38.1
399	221	382	244	2	48.5
430	222	418	230	4	64.6
514.7	228	511	231	3	135
514.7	228	511	231	3	203
316	244	313	247	2	10.4
425	241	408	254	2	61.6
456	256	453	261	5	76.0
339.5	260.4	328	270	1.5	13.9
530	277	530	282	4	125
375	285	358	302	2	18.0
520	280	501	309	3	113
350	290	338	302	1.5	6.92
454.8	307.2	450	318	5	60.0



d 320～560mm

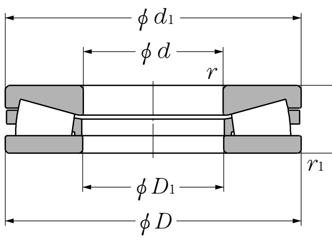
Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers[1]
d	D	T	$r_{s\,min}$[2]	C_a	C_{oa}	C_a	C_{oa}	
320	380	30	1.5	274	1,510	28,000	154,000	RT6405
	440	95	3.0	1,670	7,100	171,000	725,000	RT6406
	600	115	5.0	4,100	20,600	415,000	2,110,000	3RT6404
360	610	120	5.0	3,800	18,200	390,000	1,860,000	2RT7205
380	520	112	4.0	1,900	7,850	194,000	800,000	RT7607
400	500	63	4.0	1,300	6,400	132,000	650,000	RT8009
	540	85	4.0	1,970	10,100	200,000	1,030,000	RT8005
425	650	110	4.0	3,500	19,200	360,000	1,960,000	2RT8502
440	540	45	2.5	755	5,300	77,000	540,000	2RT8807
540	705	100	5.0	2,240	11,700	228,000	1,200,000	RT10802
560	660	50	3.0	1,040	7,850	106,000	800,000	2RT11207
	670	85	3.0	1,850	10,200	188,000	1,040,000	RT11204
	820	113	5.0	4,350	26,000	445,000	2,650,000	2RT11208

1. RT: single row, 2RT: double row, 3RT: triple row
2. Smallest allowable dimension for chamfer dimension r.

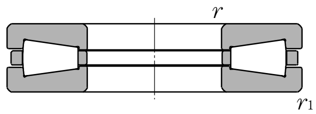


Dimensions mm		Abutment and fillet dimensions mm			Mass kg
d_1	D_1	d_a min	D_a max	r_{as} max	(approx.)
379	321	368	336	1.5	6.64
435	325	428	334	2.5	44.0
600	321	584	336	4	162
605	365	598	378	4	157
515	385	500	404	3	73.8
495	405	488	412	3	27.9
540	403	526	414	3	59.2
650	430	635	443	3	145
539	441	532	460	2	24.2
695	565	682	582	4	99.5
659	561	653	571	2.5	32.9
660	570	657	575	2.5	58.1
810	570	790	590	4	210

Tapered Roller Thrust Bearings (Single Direction Type)



Drawing A

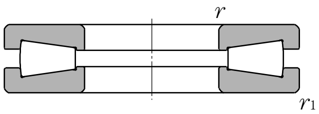


Drawing B

d 101.600～254.000mm

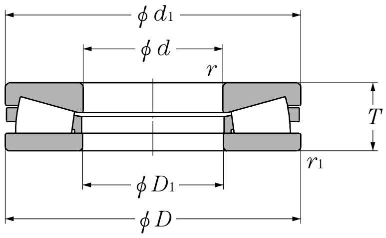
Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	T	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	
101.600	215.900	46.038	3.3	3.3	700	2,730	71,000	279,000	∗CRT2010
	215.900	46.038	1.5	1.5	805	2,920	82,000	297,000	∗CRT2014
107.950	228.600	69.850	2	5.6	1,070	3,100	109,000	320,000	∗CRT2223
114.300	250.825	53.975	4.06	4.06	995	3,750	102,000	380,000	∗CRT2301
127.000	266.700	58.738	4	4	1,130	4,650	115,000	475,000	∗CRT2503
130	225	55	2.1	2.1	640	2,590	65,500	264,000	CRT2615
145	190	31	1	1	216	815	22,000	83,000	CRT2906
152.400	317.500	69.850	6.4	6.4	1,520	6,250	155,000	640,000	∗CRT3018
168.275	304.800	69.850	6.4	6.4	1,250	4,950	127,000	505,000	∗CRT3407
	304.800	69.850	6.4	6.4	1,350	5,100	138,000	520,000	∗CRT3409
170	320	100	6	6	1,620	6,400	166,000	650,000	CRT3410
174.625	358.775	82.550	6.4	6.4	1,720	7,050	175,000	720,000	∗CRT3503
177.800	368.300	82.550	8	8	2,190	8,900	223,000	910,000	∗CRT3617
203.200	419.100	92.075	9.7	9.7	2,400	10,200	244,000	1,040,000	∗CRT4108
	419.100	92.075	9.7	9.7	2,490	10,600	254,000	1,090,000	∗CRT4112
	419.100	120.650	9.7	9.7	2,240	9,450	229,000	965,000	∗CRT4105
220	370	90	4	4	1,690	7,250	172,000	740,000	CRT4405
227	325	50	2	2	610	2,720	62,000	277,000	CRT4502
228.600	482.600	104.775	11.2	11.2	3,450	15,600	350,000	1,590,000	∗CRT4604
	482.600	104.775	11.2	11.2	3,250	14,300	330,000	1,460,000	∗CRT4605
234.950	546.100	127.000	16	16	5,700	27,900	580,000	2,850,000	∗CRT4707V
254.000	539.750	117.475	11.2	11.2	3,850	17,100	395,000	1,740,000	∗CRT5103

❶ Minimal allowable dimension for chamfer dimension r or r_1.
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings.

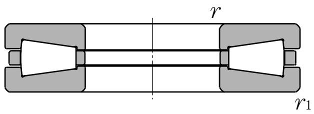


Drawing C

Drawing no.	Dimensions mm D_1	d_1	Mass kg (approx.)
B	101.6	215.9	9.06
A	102.591	215.138	8.23
B	107.95	228.6	14.0
B	114.3	250.825	13.9
B	128.6	265.1	17.7
A	130.3	225	9.14
B	147	188	2.30
B	152.4	317.5	28.5
B	168.275	304.8	24.6
A	168.275	302.5	22.2
A	170.5	320	39.4
B	174.625	358.775	39.9
B	177.8	368.3	45.0
A	203.2	416.7	60.9
B	203.2	419.1	64.9
B	203.2	419.1	79.8
A	221	369	39.2
A	227	325	13.3
B	230.6	480.6	101
A	230.6	480.6	93.2
C	234.95	546.1	160
A	254	539.75	140



Drawing A

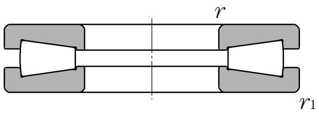


Drawing B

d 260～920mm

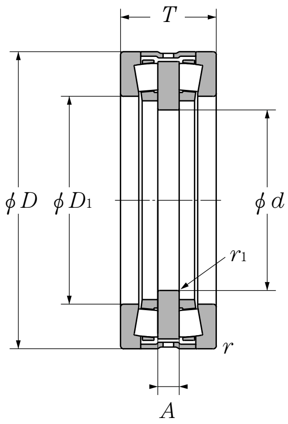
Boundary dimensions mm					Basic load ratings kN		Basic load ratings kgf		Bearing numbers
					dynamic	static	dynamic	static	
d	D	T	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	
260	360	60	2.1	2.1	890	3,950	91,000	400,000	**CRT5207**
279.400	603.250	136.525	11.2	11.2	5,100	23,300	520,000	2,380,000	**∗CRT5613**
290	395	80	3	3	1,330	5,150	136,000	525,000	**CRT5804**
320	580	155	7.5	7.5	4,800	18,900	490,000	1,920,000	**CRT6408**
	710	235	7.5	7.5	8,600	31,000	880,000	3,200,000	**CRT6401**
340	460	96	3	3	1,640	7,300	167,000	745,000	**CRT6803**
350	460	85	3	3	1,390	5,850	142,000	600,000	**CRT7012**
360	600	120	6.9	5.5	3,800	17,500	390,000	1,780,000	**CRT7207**
406.400	711.200	146.050	9.7	9.7	6,100	30,500	620,000	3,150,000	**∗CRT8101**
406.4	711.2	166.5	5	5	8,250	33,500	840,000	3,400,000	**CRT8104**
450	570	100	4	4	1,560	7,750	159,000	790,000	**CRT9002**
	750	145	8	8	6,350	31,500	645,000	3,200,000	**CRT9003**
508.000	990.600	196.850	12.7	12.7	12,100	62,500	1,230,000	6,400,000	**∗CRT10202**
600	745	105	5	5	2,530	13,600	258,000	1,390,000	**CRT12002**
920	1,120	150	7.5	7.5	5,500	32,500	560,000	3,350,000	**CRT18401**

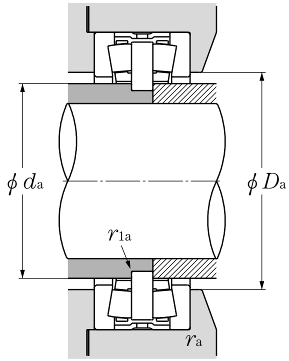
❶ Minimal allowable dimension for chamfer dimension r or r_1.
Remarks: 1. Bearing numbers marked "∗" designate inch system bearings.



Drawing C

Drawing no.	Dimensions mm D_1	d_1	Mass kg (approx.)
A	260.3	360	18.3
B	279.4	603.25	205
A	291	395	27.8
B	320.5	580	179
A	320	708	465
A	340	460	49.9
A	351	450	37.3
A	366	620	136
B	406.4	711.2	245
A	409	709	301
A	452	570	60.3
B	450.5	750	257
B	508	990.6	701
A	600.5	745	101
A	922	1,118	295

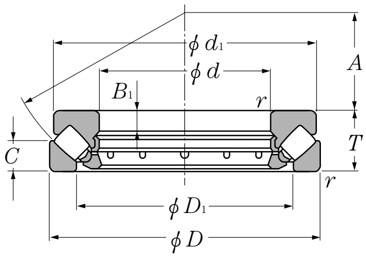




d 170～550mm

Boundary dimensions mm					Basic load ratings dynamic kN	static kgf	Bearing numbers	Abutment and fillet dimensions mm						Mass kg
d	D	T	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_a		D_1	A	d_a	D_a	r_a	r_{1a}	(approx.)
170	240	84	2.5	1	365	37,000	**CRTD3401**	184	20	179	190	2	1	12
180	280	90	2	1	645	65,500	**CRTD3618**	196	20	189	202	2	1	20
200	560	138	3	4	1,630	166,000	**CRTD4013**	430	40	413	438	2.5	3	105
212	300	96	2	1	435	44,000	**CRTD4203**	236	22	228	242	2	1	19.5
220	340	130	2	1.5	860	88,000	**CRTD4401**	250	39	242	256	2	1.5	42.1
240	320	96	2	0.6	405	41,500	**CRTD4802**	256	22	246	262	2	1	21
	380	105	1.5	1.5	840	85,500	**CRTD4803**	270	27	267	274	1.5	1.5	41.5
250	360	96	1.5	0.6	635	64,500	**CRTD5007**	285	24	274	289	1.5	0.6	28
	380	100	2	1	905	92,000	**CRTD5005**	275	22	266	281	2	1	40
260	360	92	2	1	580	59,500	**CRTD5216**	285	20	272	291	2	1	26
	400	120	3	1.5	920	93,500	**CRTD5217**	290	25	276	298	2.5	1.5	51.5
300	420	100	2	2	880	89,500	**CRTD6001**	330	23	320	335	2	2	38
305	530	200	5	1.5	2,500	255,000	**CRTD6104**	345	56	332	357	4	1.5	165
320	440	108	3	2	980	100,000	**CRTD6406**	355	20	344	363	2.5	2	43
	470	130	3	2	1,390	142,000	**CRTD6404**	350	30	335	358	2.5	2	73
350	490	130	3	1.1	1,150	118,000	**CRTD7012**	390	30	375	398	2.5	1.5	72
380	560	130	3	2	1,630	166,000	**CRTD7612**	430	32	410	438	2.5	2	102
410	560	160	5	2	1,660	169,000	**CRTD8201**	440	40	428	446	4	2	111
420	620	170	3	1.1	2,190	223,000	**CRTD8403**	465	35	448	473	2.5	1	155
440	645	167	5	2	2,070	211,000	**CRTD8802**	500	50	470	495	2	2	176
470	720	200	4	4	3,450	355,000	**CRTD9408**	535	40	507	545	3	3	261
550	760	230	4	2	2,910	296,000	**CRTD11002**	610	50	577	622	4	2	296

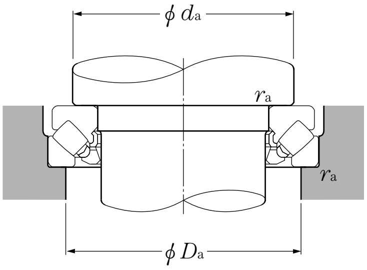
❶ Minimum allowable dimension for chamfer dimension r or r_1.
Remarks: 1. C_a does not means allowable load ratings. Please contact **NTN** Engineering.



d 100～200mm

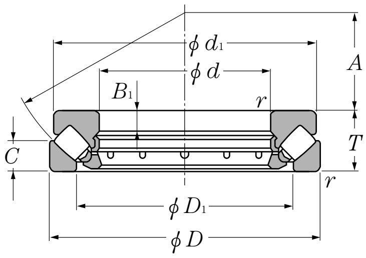
Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)				
d	D	T	$r_{s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}		D_1	d_1	B_1	C	A
100	170	42	1.5	345	1,160	35,500	118,000	29320	129	163	14	20.8	58
	210	67	3	685	2,130	69,500	217,000	29420	146	200	24	32	62
110	190	48	2	445	1,500	45,000	152,000	29322	143	182	16	23	64
	230	73	3	845	2,620	86,500	267,000	29422	162	220	26	35	69
120	210	54	2.1	535	1,770	54,500	181,000	29324	159	200	18	26	70
	250	78	4	975	3,050	99,000	310,000	29424	174	236	29	37	74
130	225	58	2.1	615	2,100	62,500	215,000	29326	171	215	19	28	76
	270	85	4	1,080	3,550	110,000	360,000	29426	189	255	31	41	81
140	240	60	2.1	685	2,360	70,000	241,000	29328	183	230	20	29	82
	280	85	4	1,110	3,750	114,000	385,000	29428	199	268	31	41	86
150	215	39	1.5	340	1,340	34,500	136,000	29230	178	208	14	19	82
	250	60	2.1	675	2,390	68,500	243,000	29330	194	240	20	29	87
	300	90	4	1,280	4,350	131,000	445,000	29430	214	285	32	44	92
160	225	39	1.5	360	1,460	36,500	149,000	29232	188	219	14	19	86
	270	67	3	820	2,860	84,000	292,000	29332	208	260	24	32	92
	320	95	5	1,500	5,150	153,000	525,000	29432	229	306	34	45	99
170	240	42	1.5	425	1,770	43,500	180,000	29234	198	233	15	20	92
	280	67	3	855	3,050	87,000	310,000	29334	216	270	23	32	96
	340	103	5	1,660	5,750	169,000	590,000	29434	243	324	37	50	104
180	250	42	1.5	450	1,920	45,500	196,000	29236	208	243	15	20	97
	300	73	3	995	3,600	102,000	365,000	29336	232	290	25	35	103
	360	109	5	1,840	6,200	188,000	635,000	29436	255	342	39	52	110
190	270	48	2	530	2,230	54,000	227,000	29238	223	262	15	24	104
	320	78	4	1,150	4,250	117,000	430,000	29338	246	308	27	38	110
	380	115	5	2,010	6,800	205,000	695,000	29438	271	360	41	55	117
200	280	48	2	535	2,300	54,500	234,000	29240	236	271	15	24	108
	340	85	4	1,280	4,600	131,000	470,000	29340	261	325	29	41	116
	400	122	5	2,230	7,650	228,000	780,000	29440	286	380	43	59	122

❶ Minimum allowable dimension for chamfer dimension r or r_1.



Equivalent bearing load
dynamic
$P_a = F_a + 1.2F_r$
static
$P_{oa} = F_a + 2.7F_r$
when $\frac{F_r}{F_a} \leqq 0.55$

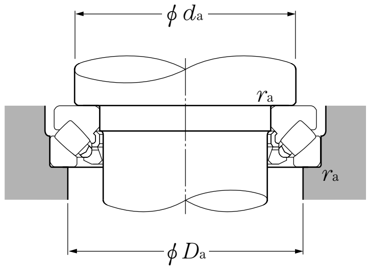
Abutment and fillet dimensions mm			Mass kg
d_a min	D_a max	r_{as} max	(approx.)
130	150	1.5	3.94
150	175	2.5	11.5
145	165	2	5.78
165	190	2.5	15
160	180	2	7.92
180	205	3	18.6
170	195	2	9.76
195	225	3	23.7
185	205	2	11.4
205	235	3	25.2
179	196	1.5	4.56
195	215	2	12
220	250	3	30.5
189	206	1.5	4.88
210	235	2.5	15.9
230	265	4	37
201	218	1.5	6.02
220	245	2.5	16.6
245	285	4	45
211	228	1.5	6.27
235	260	2.5	21.2
260	300	4	52.9
225	245	2	8.8
250	275	3	26
275	320	4	62
235	255	2	9.14
265	295	3	31.9
290	335	4	73.3



d 220～400mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Dimensions mm				
d	D	T	$r_{s\ min}$ ❶	C_a	C_{oa}	C_a	C_{oa}		D_1	d_1	B_1	C	A
220	300	48	2	555	2,480	56,500	253,000	29244	254	292	15	24	117
	360	85	4	1,390	5,200	141,000	530,000	29344	280	345	29	41	125
	420	122	6	2,300	8,100	235,000	825,000	29444	308	400	43	58	132
240	340	60	2.1	825	3,600	84,000	365,000	29248	283	330	19	30	130
	380	85	4	1,380	5,250	140,000	535,000	29348	300	365	29	41	135
	440	122	6	2,400	8,700	245,000	885,000	29448	326	420	43	59	142
260	360	60	2.1	870	3,950	88,500	400,000	29252	302	350	19	30	139
	420	95	5	1,710	6,800	175,000	695,000	29352	329	405	32	45	148
	480	132	6	2,740	10,000	279,000	1,020,000	29452	357	460	48	64	154
280	380	60	2.1	875	4,050	89,000	415,000	29256	323	370	19	30	150
	440	95	5	1,800	7,250	184,000	740,000	29356	348	423	32	46	158
	520	145	6	3,350	12,400	340,000	1,270,000	29456	387	495	52	68	166
300	420	73	3	1,190	5,350	121,000	545,000	29260	353	405	21	38	162
	480	109	5	2,140	8,250	218,000	840,000	29360	379	460	37	50	168
	540	145	6	3,450	13,200	350,000	1,340,000	29460	402	515	52	70	175
320	440	73	3	1,260	5,800	128,000	595,000	29264	372	430	21	38	172
	500	109	5	2,220	8,800	226,000	895,000	29364	399	482	37	53	180
	580	155	7.5	3,700	14,200	375,000	1,440,000	29464	435	555	55	75	191
340	460	73	3	1,240	5,800	126,000	590,000	29268	395	445	21	37	183
	540	122	5	2,650	10,700	270,000	1,090,000	29368	428	520	41	59	192
	620	170	7.5	4,400	17,500	445,000	1,790,000	29468	462	590	61	82	201
360	500	85	4	1,510	7,050	154,000	720,000	29272	423	485	25	44	194
	560	122	5	2,710	11,100	276,000	1,130,000	29372	448	540	41	59	202
	640	170	7.5	4,500	18,500	460,000	1,890,000	29472	480	610	61	82	210
380	520	85	4	1,590	7,650	162,000	780,000	29276	441	505	27	42	202
	600	132	6	3,200	13,300	325,000	1,360,000	29376	477	580	44	63	216
	670	175	7.5	4,900	19,700	500,000	2,010,000	29476	504	640	63	85	230
400	540	85	4	1,620	7,950	165,000	810,000	29280	460	526	27	42	212
	620	132	6	3,400	14,500	345,000	1,480,000	29380	494	596	44	64	225
	710	185	7.5	5,450	22,100	555,000	2,250,000	29480	534	680	67	89	236

❶ Smallest allowable dimension for chamfer dimension r.

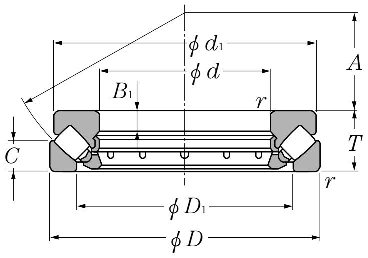


Equivalent bearing load
dynamic
$P_a = F_a + 1.2F_r$

static
$P_{oa} = F_a + 2.7F_r$

when $\frac{F_r}{F_a} \leqq 0.55$

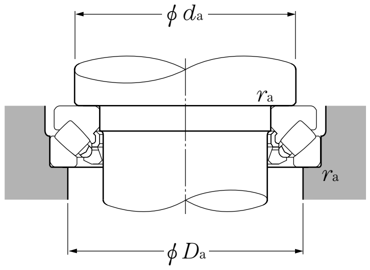
Abutment and fillet dimensions mm			Mass kg
d_a min	D_a max	r_{as} max	(approx.)
260	275	2	9.94
285	315	3	34.5
310	355	5	77.8
285	305	2	17.5
300	330	3	36.6
330	375	5	82.6
305	325	2	18.6
330	365	4	52
360	405	5	108
325	345	2	19.8
350	390	4	54.6
390	440	5	140
355	380	2.5	30.9
380	420	4	75.8
410	460	5	147
375	400	2.5	33.5
400	440	4	79.9
435	495	6	181
395	420	2.5	34.4
430	470	4	107
465	530	6	230
420	455	3	50.5
450	495	4	112
485	550	6	240
440	475	3	53.4
480	525	5	143
510	575	6	267
460	490	3	55.8
500	550	5	148
540	610	6	321



d 420～800mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	Dimensions (mm)				
d	D	T	$r_{s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}		D_1	d_1	B_1	C	A
420	580	95	5	2,100	10,400	214,000	1,060,000	**29284**	489	564	30	46	225
	650	140	6	3,600	15,500	365,000	1,580,000	**29384**	520	626	48	68	235
	730	185	7.5	5,500	22,800	560,000	2,330,000	**29484**	556	700	67	89	244
440	600	95	5	2,150	10,900	219,000	1,110,000	**29288**	508	585	30	49	235
	680	145	6	3,800	16,400	385,000	1,680,000	**29388**	548	655	49	70	245
	780	206	9.5	6,400	26,200	650,000	2,670,000	**29488**	588	745	74	100	260
460	620	95	5	2,150	11,000	219,000	1,120,000	**29292**	530	605	30	46	245
	710	150	6	4,200	18,500	430,000	1,880,000	**29392**	567	685	51	72	257
	800	206	9.5	6,600	27,900	670,000	2,840,000	**29492**	608	765	74	100	272
480	650	103	5	2,400	12,000	245,000	1,220,000	**29296**	556	635	33	55	259
	730	150	6	4,200	18,700	430,000	1,910,000	**29396**	590	705	51	72	270
	850	224	9.5	7,500	31,500	765,000	3,200,000	**29496**	638	810	81	108	280
500	670	103	5	2,540	13,000	259,000	1,330,000	**292/500**	574	654	33	55	268
	750	150	6	4,300	19,300	435,000	1,970,000	**293/500**	611	725	51	74	280
	870	224	9.5	7,850	33,000	805,000	3,350,000	**294/500**	661	830	81	107	290
530	710	109	5	2,720	14,000	278,000	1,430,000	**292/530**	610	692	39	55	288
	800	160	7.5	5,000	23,300	510,000	2,380,000	**293/530**	648	772	54	76	295
	920	236	9.5	8,650	36,000	880,000	3,700,000	**294/530**	697	880	86	115	308
560	750	115	5	3,200	16,600	325,000	1,700,000	**292/560**	642	732	38	61	302
	980	250	12	9,300	40,500	945,000	4,100,000	**294/560**	743	938	90	121	321
600	800	122	5	3,500	18,300	355,000	1,870,000	**292/600**	686	780	40	63	321
	1,030	258	12	10,200	44,500	1,040,000	4,550,000	**294/600**	785	978	90	125	360
630	850	132	6	4,300	22,800	435,000	2,330,000	**292/630**	717	822	44	70	338
	1,090	280	12	11,600	51,000	1,180,000	5,200,000	**294/630**	830	1,040	100	136	365
670	1,150	290	15	12,900	57,000	1,320,000	5,850,000	**294/670**	880	1,105	106	138	387
710	1,060	212	9.5	8,350	40,500	850,000	4,150,000	**293/710**	850	1,030	76	102	393
	1,220	308	15	14,100	63,500	1,440,000	6,450,000	**294/710**	925	1,165	112	150	415
750	1,280	315	15	15,700	69,000	1,600,000	7,000,000	**294/750**	983	1,220	116	152	436
800	1,360	335	15	17,000	79,000	1,730,000	8,050,000	**294/800**	1,040	1,300	120	162	462

❶ Smallest allowable dimension for chamfer dimension r.



Equivalent bearing load
dynamic
$P_a = F_a + 1.2F_r$

static
$P_{oa} = F_a + 2.7F_r$

when $\frac{F_r}{F_a} \leqq 0.55$

Abutment and fillet dimensions mm			Mass kg
d_a min	D_a max	r_{as} max	(approx.)
490	525	4	76.6
525	575	5	172
560	630	6	333
510	545	4	79.6
550	600	5	195
595	670	8	428
530	570	4	82.8
575	630	5	221
615	690	8	443
555	595	4	98.6
595	650	5	228
645	730	8	552
575	615	4	102
615	670	5	235
670	750	8	569
610	650	4	122
655	710	6	288
715	790	8	669
640	690	4	144
755	835	10	815
690	735	4	171
800	885	10	897
725	780	5	213
845	935	10	1,110
895	990	12	1,280
870	930	8	669
950	1,050	12	1,520
995	1,105	12	1,690
1,060	1,175	12	2,040

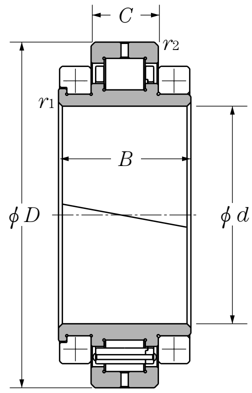
Bearings for special applications

Contents

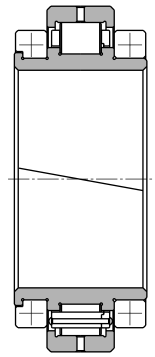
Bearings for special applications

Split Cylindrical Roller Bearings: Double–Fractured

- Since the inner ring, outer ring and cage are split in two parts, it is possible to mount the bearing in places where a united bearing is difficult or impossible to mount. (ie. Places where mounting from the shaft end is impossible, an obstacle exists on the shaft, or the shaft is very long.)
- Inspection and maintenance after mounting is easy.



Drawing A
Fixed side



Drawing B
Free side

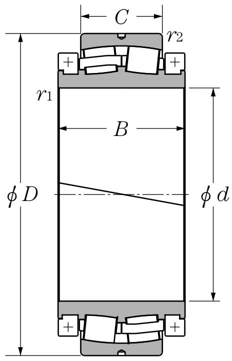
d 120～770mm

Boundary dimensions						Basic load ratings				Bearing[1] numbers	Drawing no.
mm						dynamic kN	static kN	dynamic kgf	static kgf		
d	D	B	C	r_1	r_2	C_r	C_{or}	C_r	C_{or}		
120	R254	125	60	C4	4	450	510	46,000	52,000	∗RE2436 ∗RE2437	B A
127	254	114.3	63.5	C5	C2	555	720	56,500	73,500	RE2512	A
160	240	76	38	C3	C3	238	340	24,200	35,000	RE3220 RE3221	A B
164	240	76	38	C3	C3	238	340	24,200	35,000	RE3308 RE3309	A B
170	R340	120	56	C3.5	3.5	435	565	44,500	57,500	∗RE3420 ∗RE3421	A B
180	285.75	109	55.5	C3.5	C3.5	415	580	42,500	59,000	RE3617	A
190	290	92	46	C3.5	C3.5	350	510	36,500	52,000	RE3812 RE3813	A B
200	311.15	109.5	60.3	C3.2	C3.2	480	760	49,000	77,500	RE4022	A
210	360	92	46	C3	C3	370	595	37,500	60,500	RE4206 RE4207	A B
230	360	92	46	C3	C3	350	550	35,500	56,500	RE4604 RE4605	A B
235	360	92	46	C3	C3	350	550	35,500	56,500	RE4702 RE4703	A B
260	360	92	46	C3	C3	350	550	35,500	56,500	RE5209 RE5210	A B
280	400	92	48	C3	C3	460	755	47,000	77,000	RE5606 RE5607	B A
320	622.3	272	160.4	C12	C6	2,900	4,250	295,000	435,000	RE6405	A
335	480	115	56	C3	C3	545	955	56,000	97,500	RE6702 RE6703	A B
360	R600	200	116	C6	6	1,940	3,250	198,000	330,000	∗RE7203	B
460	740	294	170	C4	C4	3,650	6,150	370,000	625,000	RE9208	B
500	850.9	360	210	C12	C6	5,250	9,050	535,000	525,000	RE10013	B
575	800	180	90	C3	C3	1,370	2,570	140,000	262,000	RE11501 RE11502	A B
640	900	200	103	C3	C3	1,650	3,150	168,000	325,000	RE12801 RE12802	A B
670	900	200	103	C3	C3	1,650	3,150	168,000	325,000	RE13405 RE13406	A B
770	1,070	300	180	C2.5	C6	5,300	12,000	540,000	1,230,000	RE15404 RE15405	A B

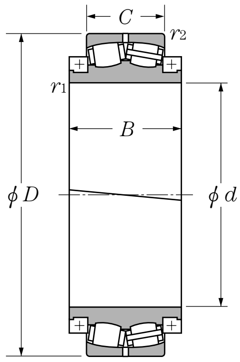
[1] The marked "∗" bearings has a spherical surface of outer rings outside dia.
Remarks: 1. The above drawings are typical examples. Please contact **NTN** Engineering.

Split Spherical Roller Bearings: Double–Fractured

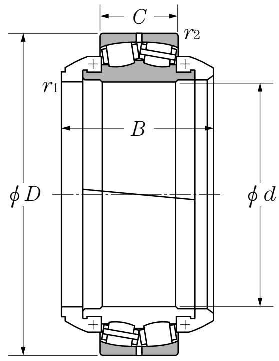
NTN



Drawing A



Drawing B



Drawing C

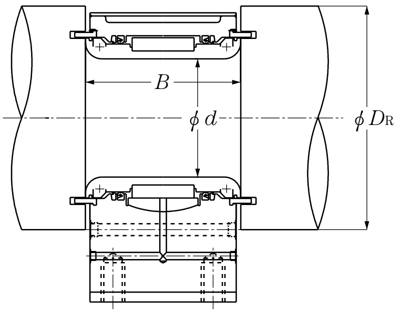
d 150～1,400mm

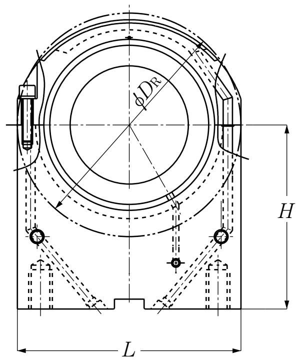
Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing[1] numbers	Drawing no.
d	D	B	C	r_1	r_2	C_r	C_{or}	C_r	C_{or}		
150	260	121	67	2.1	2.1	420	720	43,000	73,500	**2PE3012**	A
190	290	150	90	2.1	2.1	785	1,440	80,000	147,000	**2PE3801**	A
200	340	152	90	3	3	935	1,620	95,000	165,000	**2PE4002**	A
240	400	173	104	4	4	1,070	1,990	109,000	203,000	**2PE4802**	A
315.9	530	210	133	5	5	2,130	4,150	218,000	420,000	**2PE6301**	A
320	480	226	121	7.5	4	1,590	2,930	163,000	299,000	**2PE6401**	A
360	540	212	134	3	5	2,270	4,350	231,000	445,000	**2PE7202**	A
505	750	248	140	5	5	2,680	6,200	273,000	635,000	**2PE10101**	A
530	750	248	140	5	5	2,680	6,200	273,000	633,000	**2PE10601**	A
850	1,280	375	249	12	12	8,800	19,900	895,000	2,020,000	**2PE17009**	A
1 120	1,540	525	355	7.5	7.5	14,200	43,500	1,450,000	4,400,000	**2PE22401**	B
1 200	1,700	790	410	—	9.5	17,200	44,000	1,750,000	4,500,000	**2PE24004**	C
1 200	1,700	695	410	—	9.5	15,600	44,000	1,590,000	4,500,000	**2PE24005**	C
1 400	1,900	880	530	—	12	22,900	65,500	2,340,000	6,650,000	**2PE28001**	C

Double–Fractured Split Cylindrical Roller Bearings: Continuous Casting Equipment

NTN

- These bearings are designed to be a full complement roller type and have high rating load for heavy loads, ultra low speed rotation and space-saving.
- These bearings provide a multi-seal with a labyrinth ring, seal ring and special rubber seal to prevent water from invading.
- The clamping ring of the inner ring is not needed anymore and the structure of direct clamping is applied to make a compact bearing.
- Bearings have a self-aligning nature due to the roll deflection since the outer ring outside diameter and the housing inner diameter are spherical.
- Application of a water cooling jacket type housing controls rising bearing temperatures.





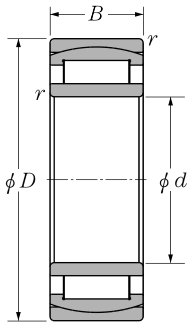
d 100～230mm

Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Housing No.
d	B	H	L	D_R	C_r	C_{or}	C_r	C_{or}		
100	154	145	210	210	355	790	36,000	80,500	**RE2038V**	**SS2020**
	169	132	220	225	475	950	48,500	96,500	**RE2039V**	**SS2021**
110	154	150	230	230	425	1,040	43,500	106,000	**RE2224V**	**SS2228**
	154	180	230	230	390	930	40,000	94,500	**RE2225V**	**SS2230**
		155	230	225						**SS2234**
115	173	220	240	240	505	940	51,500	95,500	**RE2306V**	**SS2304**
120	151	190	240	250	395	970	40,000	99,000	**RE2439V**	**SS2420**
130	154	190	270	270	430	1,110	43,500	113,000	**RE2628**	**SS2637**
140	179	245	270	270	600	1,240	61,500	126,000	**RE2827V**	**SS2835**
	191	250	265	265	525	1,280	53,500	131,000	**RE2824V**	**SS2825**
145	196	260	280	280	630	1,440	64,500	147,000	**RE2906V**	**SS2908**
	208	270	295	295	765	1,780	78,000	182,000	**RE2907V**	**SS2907**
150	169	180	265	300	695	1,700	70,500	173,000	**RE3036V**	**SS3043**
165	228	280	320	320	930	2,210	95,000	225,000	**RE3311V**	**SS3303**
180	169	217.5	335	335	815	2,010	83,000	205,000	**RE3621V**	**SS3616**
	235	280	340	340	1,030	2,580	106,000	263,000	**RE3620V**	**SS3415**
190	233	280	370	370	1,320	3,100	134,000	320,000	**RE3815V**	**SS3804**
230	239	300	450	450	1,590	3,700	162,000	380,000	**RE4606**	**SS4601**

Cylindrical Roller Bearings With Self-Aligning Rings: Continuous Casting Equipment

NTN

- These bearings are designed to be a full complement roller type and have high rating load.
- Bearings have a self-aligning nature since the outer ring outside surface and aligning ring inside surface are spherical.

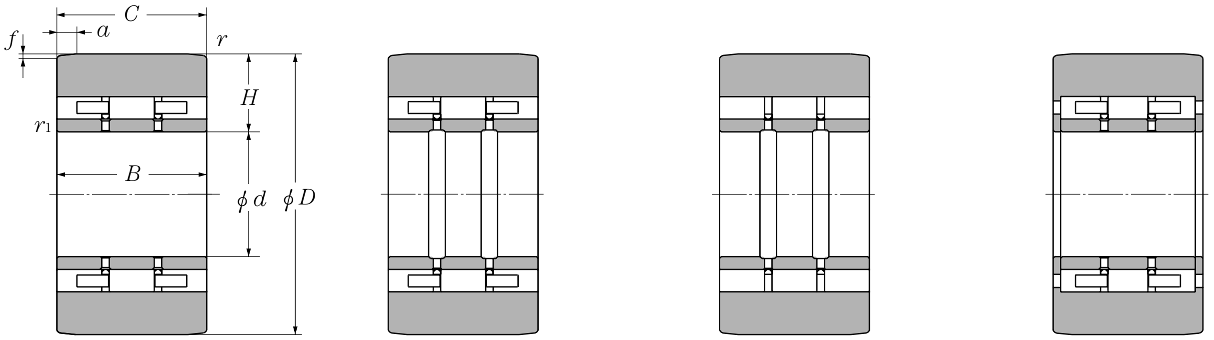


d 55～200mm

Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	
55	90	32	1.1	85	203	8,700	20,700	R11A11V
	100	25	1.5	94.5	146	9,650	14,900	R11A12V
75	130	31	1.5	146	236	14,900	24,100	R1564V
110	170	60	2	297	720	30,500	73,000	R2260V
	180	56	2	325	635	33,000	65,000	R2252V
120	200	80	2	450	980	46,000	100,000	R2481V
130	200	69	2	405	935	41,500	95,500	R2674V
	210	80	2	495	1,090	50,500	112,000	R2677V
140	210	69	2	420	990	42,500	101,000	R2858V
	225	85	2.1	545	1,230	56,000	125,000	R2859V
150	250	100	2.1	710	1,620	72,500	165,000	R3056V
160	270	109	2.1	855	1,830	87,500	186,000	R3261V
170	260	90	2.1	635	1,510	65,000	154,000	R3444V
180	280	100	2.1	785	1,870	80,500	191,000	R3646V
200	340	112	3	1 160	2,470	119,000	252,000	R4051V

❶ Smallest allowable dimension for chamfer dimension r.

- Since bearings are directly used in preparing rolls, the thickness of the outer ring is designed to be thicker than regular bearings.
- Since high accuracy under heavy loads is required, these bearings are designed to have a capacity for heavy loads and high accuracy.
- Several bearings are assembled on one shaft for operation, and the mutual difference of assembled thickness (Dimension H) of bearings on the same shaft is very minimal.
- When the outer ring outside surface is worn, it is possible to recycle it by grinding it to a certain level.

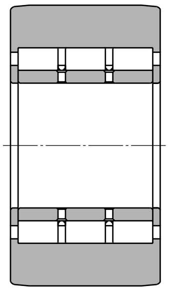


Drawing A Drawing B Drawing C Drawing D

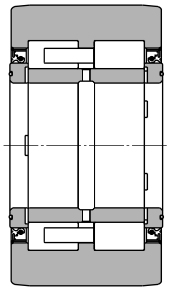
d 70～180mm

Boundary dimensions mm						Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers	Drawing no.
d	D	B	C	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}		
70	160	90	90	1.5	0.6	455	855	46,500	87,000	3RCS1414VUP	C
	160	90	90	1.5	0.6	355	605	36,000	61,500	3RCS1418UP	B
90	220	96	94	3.0	1.1	470	695	48,000	71,000	2R1840LLUP-1	F
	220	120	120	2.0	0.3	775	1,510	79,000	154,000	3R1827VUP	E
	220	120	120	2.0	1.5	650	1,150	66,000	118,000	3R1829UP	D
	200	130	130	2.0	1.5	675	1,260	69,000	128,000	3R1826UP	D
100	255	120	120	1.5	1.0	715	1,350	73,000	138,000	3RCS2035UP	A
130	300	160	159.5	1.5	2.0	1,480	2,700	151,000	275,000	3RCS2659UPV1	A
	300	172.6	172.6	1.5	2.0	1,580	2,930	161,000	299,000	3RCS2629UP	A
180	406.4	171.04	171.04	2.5	4.0	2,060	3,800	210,000	390,000	3RCS3615UP	B
	406.4	224	224	1.45	4.0	2,350	4,500	240,000	460,000	3RCS3618UP	B

❶ Minimal allowable dimension for chamfer dimension r or r_1.



Drawing E

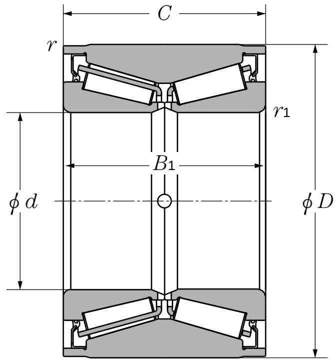


Drawing F

Sloping outer ring mm		Assembled thickness mm	Necessary number	Mass kg
a	*f*	*H*	(P/C)	(approx.)
6	0.035	44.981 (±0.010)	32	10.7
6	0.035	44.981 (±0.010)	32	10.7
21	0.5	64.980 (±0.008)	64	21.7
6	0.035	64.978 (±0.008)	32	27.6
20.6	0.12	64.973 (0～−0.010)	40	27.5
6	0.1	64.960 (±0.008)	40	29.8
10	0.1	62.474 (0.010～0)	32	28.0
10	0.1	84.954 (±0.008)	40	67.4
10	0.1	84.954 (±0.008)	40	73.0
25	0.15	113.150 (±0.010)	56	132
25	0.15	113.150 (±0.010)	40	170

Enclosed–Type Tapered Roller Bearings for Wheels: Sintering Machines

- The double lip contact seal, which has a tight seal, is installed with the bearing side face to prevent dust from entering the bearings.
- Greasing the bearings is possible when a notch is positioned at the central part of inner ring.



d 85～130mm

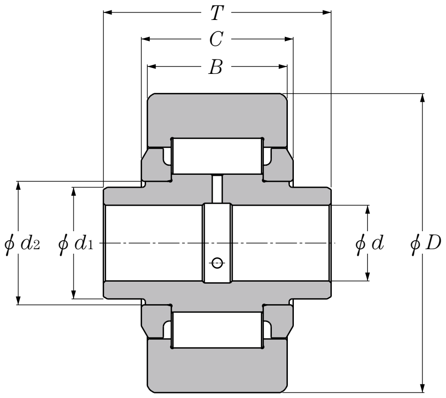
Boundary dimensions (mm)						Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers
d	D	B_1	C	r_{smin} ❶	r_{1smin} ❶	C_r	C_{or}	C_r	C_{or}	
85	180	115	115	2.5	0.6	440	715	45,000	73,000	CRI-1760LL
95	180	100	100	3.0	1.0	530	835	54,500	85,500	CRI-1959LL ∗
100	180	100	100	2.5	0.8	440	675	45,000	68,500	CRI-2070LL
110	200	100	100	3.0	1.0	605	965	61,500	98,500	CRI-2272LL
130	230	138	138	3.0	0.3	820	1,660	83,500	169,000	CRI-2666LL

❶ Minimal allowable dimension for chamfer dimension r or r_1.
Remarks: 1. The marked "∗" bearings are not prepared with oil holes.

Cylindrical Roller Bearings: Chain Conveyors

NTN

- Since the outer ring directly supports heavy loads, the thickness of outer ring is designed to be thicker than regular bearings.
- For operation under heavy loads and extremely low speed rotation, these bearings are designed to be a full complement roller type and have high loads capacity.
- To prevent foreign matter from entering the bearing, a labyrinth structure is applied, which has a narrower clearance between outer ring and rib ring.

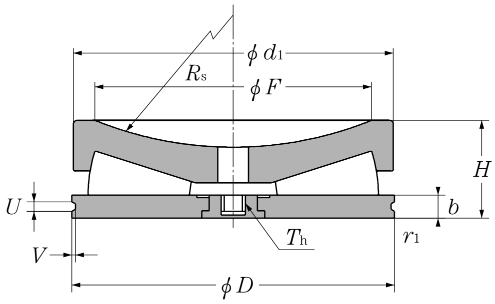


d 28.3～56mm

Boundary dimensions mm							Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	d_1	d_2	D	B	C	T	C	C_0	C	C_0	
28.3	44.05	47	125	55	62	94	197	241	20,100	24,500	R06A31V
38.4	60	66	150	90	99	138	390	585	40,000	59,500	R08A31V
38.7	56	56	150	70	75	112	315	420	32,500	42,500	R08A24V
41.75	64.16	71	175	80	85	125	395	575	40,500	59,000	R08A02V
45	73	73	150	60	60	60	278	405	28,300	41,000	R09A20V
46	73	73	150	60	60	60	278	405	28,300	41,000	R09A21V
50	72	72	156	60	70	70	280	355	28,600	36,500	R1099V
56	74	74	160	51	55	49	261	310	26,600	31,500	R11A01V
	73	73	150	60	60	60	278	405	28,300	41,000	R11A13V

Tapered Roller Thrust Bearings: Screw Down Operations

- These bearings are designed to be a full complement roller type and have high static rating load for large axial load applications.
- Inner ring surface is spherical (convex or concave) to allow its circle center to meet the tip of the pressing screw.
- For hoisting, bearings are designed to have a hole or bushing at the center of the inner ring, and a bushing on the outer ring.



D 149.225～641.350mm

Boundary dimensions mm					Basic load ratings static kN	kgf	Bearing numbers
D	d_1	H	F	$r_{1s\,min}$ ❶	C_{oa}	C_{oa}	
149.225	146.900	47.625	127.000	1.6	2,280	233,000	CRT0402V
174.625	172.300	52.375	152.400	1.6	3,300	335,000	CRT0503V
203.200	200.800	65.075	177.800	1.6	4,550	465,000	CRT0607V
266.700	264.300	80.950	228.600	1.6	7,750	790,000	CRT0701V
320.675	318.300	95.250	279.400	1.6	11,800	1,200,000	CRT0814V
377.825	375.500	111.125	330.200	1.6	16,300	1,660,000	CRT0908V
409.575	407.200	122.225	355.600	3.2	19,300	1,960,000	CRT1006V
438.150	435.800	130.175	381.000	3.2	21,600	2,210,000	CRT1104V
495.300	492.900	146.050	431.800	3.2	27,300	2,780,000	CRT1209V
495.300	492.900	146.050	431.800	3.2	32,000	3,250,000	CRT1212V
523.875	521.500	152.400	457.200	3.2	32,000	3,300,000	CRT1409V
554.000	555.000	190.500	465.430	1.7	36,000	3,700,000	CRT1206V
555.625	553.300	165.100	482.600	3.2	36,000	3,650,000	CRT1516V
581.025	578.700	168.275	508.000	3.2	38,500	3,950,000	CRT1610V
609.600	607.200	177.800	533.400	3.2	44,000	4,500,000	CRT1806V
641.350	639.000	184.150	558.800	3.2	49,000	4,950,000	CRT1807V

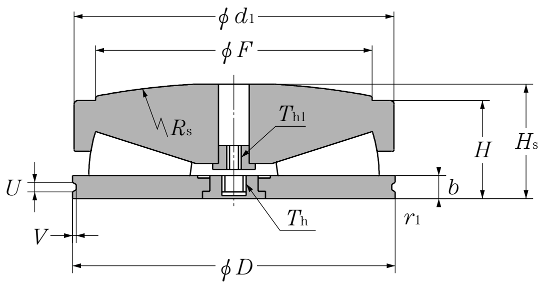
❶ Smallest allowable dimension for chamfer dimension r_1.

Dimensions mm					Mass kg
R_S	b	U	V	T_h	(approx.)
228.6	12.7	4.7	1.2	M12	4.4
228.6	12.7	4.7	1.2	M12	6.7
254	15.875	6.4	1.2	M12	11
304.8	19.05	7.9	2	M20	24.1
381	22.225	10.3	2.4	M20	41.3
457.2	25.4	10.3	2.4	M24	73.7
508	28.575	10.3	2.4	M24	87.2
508	31.75	13.5	3.2	M24	105
558.8	34.925	13.5	3.2	M24	150
1,270	34.925	13.5	3.2	M24	150
635	34.925	13.5	3.2	M24	175
1,270	50	9.5	6	M24	245
635	38.1	13.5	3.2	M24	214
711.2	38.1	13.5	3.2	M24	238
762	38.1	13.5	3.2	M24	277
762	38.1	13.5	3.2	M24	317

Tapered Roller Thrust Bearings: Screw Down Operations

NTN

- These bearings are designed to be a full complement roller type and have high static rating load for large axial load applications.
- Inner ring surface is spherical (convex or concave) to allow its circle center to meet the tip of the pressing screw.
- For hoisting, bearings are designed to have a hole or bushing at the center of the inner ring, and a bushing on the outer ring.



D 149.225～641.350mm

Boundary dimensions (mm)					Basic load ratings static		Bearing numbers
					kN	kgf	
D	d_1	H	F	$r_{1s\,min}$ [1]	C_{oa}	C_{oa}	
149.225	146.900	80	127.000	1.6	2,280	233,000	CRT0401V
174.625	172.300	61.392	152.400	1.6	3,300	335,000	CRT0504V
203.200	200.800	75	177.800	1.6	4,650	475,000	CRT0606V
266.700	264.300	94.412	228.600	1.6	7,750	790,000	CRT0505V
320.675	318.300	110.973	279.400	1.6	11,800	1,200,000	CRT0811V
377.825	375.500	129.007	330.200	1.6	16,300	1,660,000	CRT0909V
409.575	407.200	140.767	355.600	3.2	19,300	1,960,000	CRT1007V
438.150	435.800	150.673	381.000	3.2	21,600	2,210,000	CRT1105V
482.600	480.212	145.542	419.100	3.2	27,200	2,770,000	CRT1307V
495.300	492.900	170.612	431.800	3.2	32,000	3,250,000	CRT1211V
523.875	521.500	174.35	457.200	3.2	32,500	3,350,000	CRT1412V
533.400	533.400	177.8	457.200	1.6	33,500	3,400,000	CRT1411V
555.625	553.300	190.856	482.600	3.2	36,000	3,650,000	CRT1517V
581.025	578.700	193.78	508.000	3.2	39,000	4,000,000	CRT1214V
581.225	578.700	193.777	508.000	3.2	38,500	3,950,000	CRT1601V
609.600	607.240	202.167	533.400	3.2	44,500	4,550,000	CRT1812V
641.350	639.000	212.674	558.800	3.2	49,000	4,950,000	CRT1808V

[1] Smallest allowable dimension for chamfer dimension r_1.

NTN

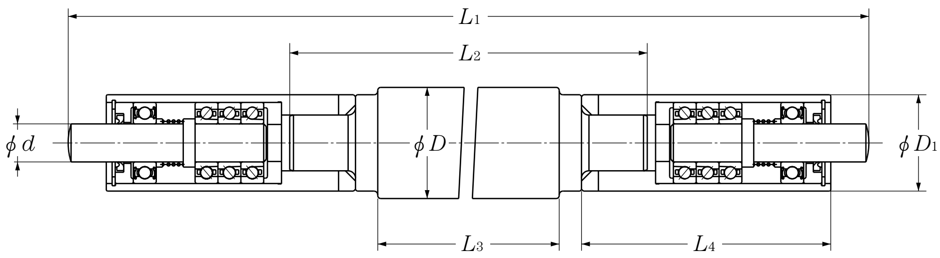
Dimensions mm							Mass kg
R_S	H_s	b	U	V	T_h	T_{h1} ❷	(approx.)
457.2	47.625	12.7	4.7	1.2	M12	—	6.6
457.2	52.375	12.7	4.7	1.2	M12	—	10.1
508	65.075	15.875	6.4	1.2	M12	M16	17
609.6	80.950	19.05	7.9	2	M20	—	36.2
762	95.250	22.225	10.3	2.4	M20	—	61.3
914.4	111.125	25.4	10.3	2.4	M24	—	98.8
1,016	122.225	28.575	10.3	2.4	M24	—	127
1,016	130.175	31.75	13.5	3.2	M24	—	155
1,905	130.175	38.1	13.5	3.2	M24	—	182
1,066.8	146.050	34.925	13.5	3.2	M24	—	215
1,270	152.400	34.925	13.49	3.18	M24	—	259
1,981.2	161.925	31.75	9.5	9.5	M24	—	271
1,270	165.100	38.1	13.5	3.2	M24	—	316
1,320.8	166.880	38.1	13.5	6	M24	M42	350
1,422.4	168.275	38.1	13.5	3.2	M24	—	350
1,524	177.800	38.1	13.5	3.2	M30	M42	388
1,524	184.150	38.1	13.5	3.2	M24	—	469

❷ "—" means that is not prepared with a bush.

Tension Leveler Roll Unit: Cartridge Unit

- This unit has a precision small diameter and a long scaled roll, with the surface roughness of the roll designed to be low.
- Angular ball bearings are assembled in multiple rows in the cartridge to obtain high load capacity in both axial directions and at high speed.
- This unit has established both low torque operation and tight sealing by a labyrinth structure and low-contact seals.

Cartrige Unit

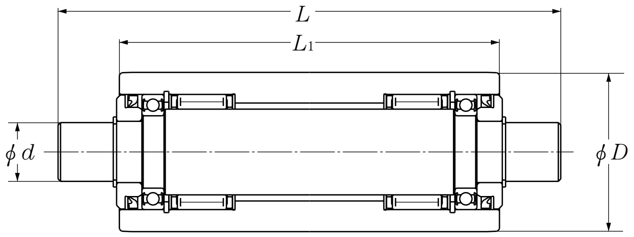


d 8～15mm

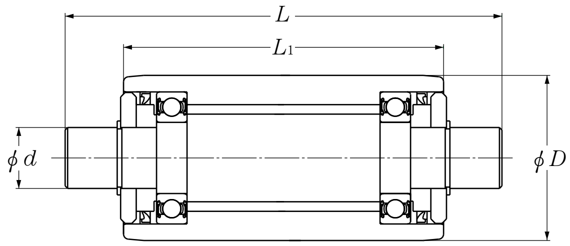
Bearing numbers	Boundary dimensions mm							Allowable axiale load kN	kgf
	d	D	L_1	L_2	L_3	D_1	L_4		
CU8A01W+WK30/150	**8**	30	1,716	1,552	1,500	26	92	1.85	189
CU8A05W+WK50/185	**8**	50	2,066	1,902	1,850	26	92	1.85	189
CU8A05W+IM38/185	**8**	38	2,066	1,902	1,850	26	92	1.85	189
CU10B01W+WK25/220	**10**	25	2,433.5	2,280	2,200	24	80	0.715	73
CU10B01W+WK20/180	**10**	20	2,033.5	1,880	1,800	24	80	0.715	73
CU12B04W+WK40/150	**12**	40	1,716	1,566	1,500	32	92	2.02	206
CU12B07W+WK30/220	**12**	30	2,433.5	2,288	2,200	28	85	1.49	151
CU12B07W+IM38/180	**12**	38	2,033.5	1,888	1,800	28	85	1.49	151
CU12B08W+WK40/210	**12**	40	2,332	2,170	2,100	38	100	2.02	206
CU15A04W+IM60/220	**15**	60	2,433.5	2,270	2,200	38	94	3.78	380

- This unit has established both low torque operation and tight sealing by a labyrinth structure and low-contact seals.
- When further low torque is requested, the roll unit (Model BUB), which uses only the deep groove ball bearings, is available.
- Since the unit is used as a backup roll, the accuracy and its surface roughness are designed to be low.

Backup Unit



Type NKZ



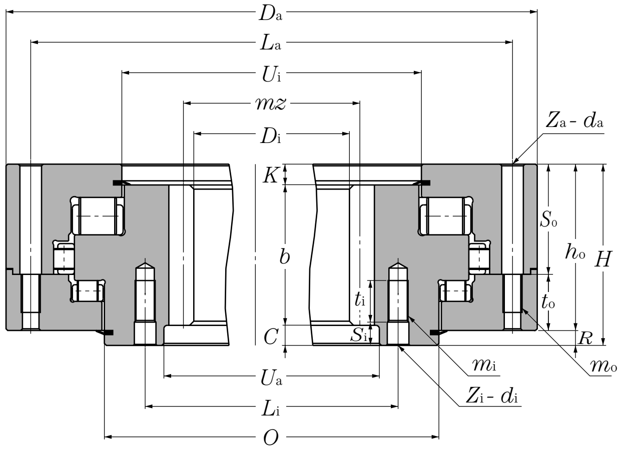
Type BUB

d 13～70mm

Bearing numbers	Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Mass kg
	d	D	L	L_1	C_r	C_{or}	C_r	C_{or}	(approx.)
NKZ 13×34×190-2	**13**	34	190	150	42	68	4,300	6,900	1
NKZ 16×38×192	**16**	38	192	170	35.5	55.5	3,600	5,650	1.4
NKZ 20×50×153-1	**20**	50	153	115	77.5	116	7,900	11,900	1.9
BUB 24×63.5×150-01	**24**	63.5	190	140	26.6	23.4	2,710	2,390	2.4
NKZ 24×65×205-6	**24**	65	205	155	82.5	122	8,450	12,500	3.9
NKZ 24×65×294	**24**	65	294	244	98	153	10,000	15,600	5.8
NKZ 24×65×314-4	**24**	65	314	275	84	150	8,600	15,300	6.5
BUB 24×65×320-03	**24**	65	320	274	19.2	14.8	1,950	1,510	6.5
NKZ 26×75×208-5	**26**	75	208	160	112	163	11,400	16,700	5.1
NKZ 28×75×150	**28**	75	150	108	112	163	11,400	16,700	3.6
NKZ 30×65×196	**30**	65	196	146	114	186	11,600	18,900	3.8
NKZ 30×75×150-24	**30**	75	150	110	125	187	12,700	19,000	3.7
NKZ 30×75×230-19	**30**	75	230	180	151	228	15,400	23,200	5.8
NKZ 30×75×326-12	**30**	75	326	276	151	228	15,400	23,200	8.5
NKZ 40×90×195	**40**	90	195	145	128	214	13,000	21,900	7
NKZ 70×150×345-4	**70**	150	345	250	515	905	52,500	92,500	34.5

Turn Table Bearings: 3–Row Cylindrical Roller Type

- These are compound type bearings which unite the double row thrust roller bearing and the radial roller bearing.
- These bearings are designed so that rollers in each row support axial and moment loads respectively, and high rigidity and long life can be obtained since the rolling parts make line contact.
- They are suitable for tunnel excavating machines or cranes with frequent turns.

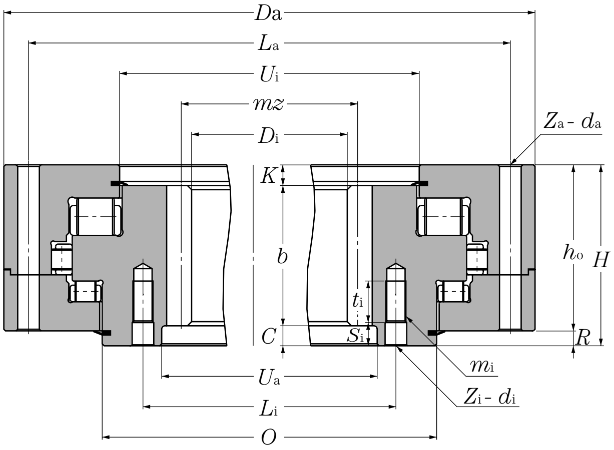


Drawing A

D_i 1,104～4,000mm

Boundary dimensions			Gear spec				Setting holes (inner ring)						Setting holes (outer ring)						
				module	number of gear teeth														
D_i	D_a	H	mz	m	z	b	L_i	z_i (n)	d_i	S_i	m_i	t_i	L_a	z_a (n)	d_a	s_o	t_o	m_o	
1,104	1,510	175	1,128	12	94	140	1,230	36	ϕ26	30	M24X3	45	1,460	36	ϕ26	108	52	M24X3	
1,400	1,850	220	1,428	14	102	120	1,520	48	ϕ26	30	M24X3	50	1,795	48	ϕ26	—	—	—	
1,620	2,180	260	1,656	18	92	180	1,800	40	ϕ33	30	M30X3.5	60	2,115	40❶	ϕ33	—	—	—	
2,172	2,660	230	2,196	12	183	170	2,300	48	ϕ33	35	M30X3.5	60	2,595	48	ϕ33	—	—	—	
2,784	3,305	240	2,808	12	234	140	2,910	42	ϕ33	30	M30X3.5	55	3,240	42	ϕ33	—	—	—	
4,000	4,700	348	4,032	16	252	210	4,175	88	ϕ42	50	M39X4	70	4,615	88	ϕ42	226	80	M39X4	

❶ Disparity positioned



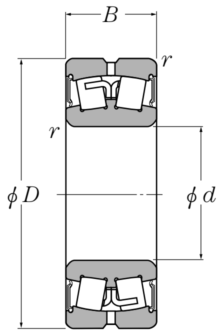
Drawing B

Unit mm

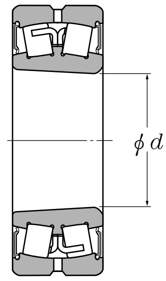
Bearing numbers	Drawing no.	Dimensions						Basic load ratings						Mass
								static kN			static Tonf			kg
		O	U_i	U_a	R	K	C	main thrust line	sub thrust line	radial line	main thrust line	sub thrust line	radial line	(approx.)
K2N-RTD22602PX1	A	1,306	1,284	1,166	15	15	20	11,500	6,700	1,410	1,170	680	143	930
K2N-RTD28601PX1	B	1,618	1,576	1,475	20	15	85	20,500	10,800	2,200	2,100	1,110	225	1,550
K2N-RTD33102PX1	B	1,902	1,844	1,710	20	25	55	28,900	14,600	3,050	2,950	1,490	310	2,650
K2N-RTD43902PX1	B	2,391	2,364	2,235	30	20	40	27,500	18,600	2,280	2,800	1,900	233	2,600
K2N-RTD56205PX1	B	3,034	3,000	2,846	20	15	85	36,500	22,000	4,500	3,700	2,240	460	3,850
K2N-RTD80602PX1	A	4,321	4,219	4,085	20	52	86	114,000	50,500	17,000	11,600	5,150	1,740	10,300

Sealed Spherical Roller Bearings: Model WA

- Special contact type rubber seal prevents foreign matter from entering the bearings.
- Compact design enables bearings to be mounted with the standard type of plummer blocks (SN5, SN2).
- Greasing bearings is possible since lubrication grooves and holes are provided on the outer ring.
- Bearings are prelubricated with grease and can be directly mounted on machines.



Cylindrical bore

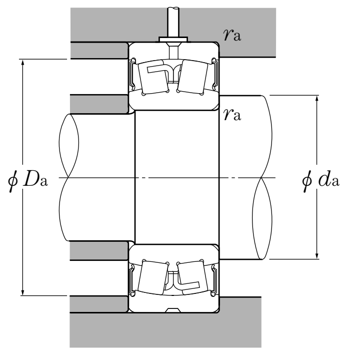


Tapered bore
taper 1:12

d 60～160mm

Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Bearing numbers	
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	Cylindrical bore	Tapered bore ❷
60	110	36	1.5	115	147	11,700	15,000	LH-WA22212BLLS	LH-WA22212BLLSK
65	120	39	1.5	143	179	14,600	18,300	LH-WA22213BLLS	LH-WA22213BLLSK
70	125	39	1.5	154	201	15,700	20,500	LH-WA22214BLLS	LH-WA22214BLLSK
75	130	39	1.5	166	223	16,900	22,800	LH-WA22215BLLS	LH-WA22215BLLSK
80	140	41	2	179	239	18,300	24,400	LH-WA22216BLLS	LH-WA22216BLLSK
85	150	44	2	206	272	21,000	27,800	LH-WA22217BLLS	LH-WA22217BLLSK
90	160	50.4	2	256	345	26,200	35,000	LH-WA22218BLLS	LH-WA22218BLLSK
95	170	51	2.1	294	390	30,000	39,500	WA22219BLLS	WA22219BLLSK
100	180	60.3	2.1	315	415	32,000	42,500	WA22220BLLS	WA22220BLLSK
110	200	69.8	2.1	410	570	42,000	58,000	WA22222BLLS	WA22222BLLSK
120	215	76	2.1	485	700	49,500	71,500	WA22224BLLS	WA22224BLLSK
130	230	80	3	570	790	58,000	80,500	WA22226BLLS	WA22226BLLSK
140	250	88	3	685	975	70,000	99,500	WA22228BLLS	WA22228BLLSK
150	270	96	3	775	1,160	79,000	119,000	WA22230BLLS	WA22230BLLSK
160	290	104	3	870	1,290	88,500	132,000	WA22232BLLS	WA22232BLLSK

❶ Smallest allowable dimension for chamfer dimension *r*. ❷ "**K**" indicates bearings have tapered bore with a taper ratio of 1: 12.



Equivalent bearing load

dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{or} = F_r + Y_o F_a$

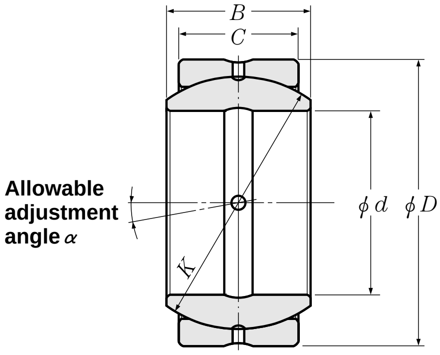
For values of e, Y_2 and Y_o see the table below.

Abutment and fillet dimensions mm				**Constant**	**Axial load factors**			**Mass** (approx.) kg	
d_a min	d_a max	D_a max	r_{as} max	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
68.5	74.5	101.5	1.5	0.27	2.49	3.71	2.44	1.41	1.37
73.5	80	111.5	1.5	0.28	2.42	3.60	2.37	1.80	1.76
78.5	84	116.5	1.5	0.26	2.55	3.80	2.50	1.91	1.86
83.5	89.5	121.5	1.5	0.24	2.81	4.19	2.75	2.06	2.00
90	94.5	130	2	0.26	2.64	3.93	2.58	2.51	2.45
95	101	140	2	0.26	2.60	3.88	2.55	3.08	3.01
100	107	150	2	0.26	2.55	3.80	2.49	4.08	3.97
107	114	158	2	0.26	2.63	3.92	2.57	4.71	4.59
112	119	168	2	0.26	2.55	3.80	2.49	6.01	5.83
122	133	188	2	0.27	2.51	3.74	2.46	8.87	8.60
132	147	203	2	0.27	2.47	3.68	2.42	11.2	10.9
144	154	216	2.5	0.28	2.39	3.56	2.33	12.5	12.1
154	168	236	2.5	0.28	2.39	3.55	2.33	16.9	16.3
164	185	256	2.5	0.27	2.46	3.66	2.40	22.6	21.9
174	197	276	2.5	0.28	2.42	3.60	2.37	28.0	27.2

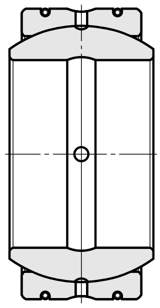
Spherical Surface Slide Bearings

- These are self-aligning sliding bearings: the sliding parts form a spherical surface. The bearings also can support radial loads and axial loads in either direction.
- A lubricant (oil or grease) should be used since the sliding parts are steel on steel.
- These bearings are suitable for swinging and aligning movements, and used in joint-movement parts for industrial and construction machines.

Grease up type



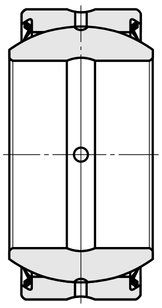
Drawing A
Divided by 1 place (outer ring)



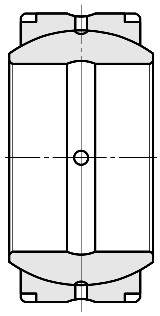
Drawing B
Divided by 2 place (outer ring)

d 110～420mm

Boundary dimensions mm					α	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing numbers
d	D	B	C	K	(deg.)	C_d	C_s	C_d	C_s	
110	180	85	70	160	6	1,100,000	6,600,000	112,000	670,000	W2222
	180	100	75	160	10	1,180,000	7,050,000	120,000	720,000	W2225
180	260	105	60	225	12	1,110,000	6,670,000	113,000	680,000	W3617
200	290	130	120	250	2	2,550,000	15,300,000	260,000	1,560,000	W4029
260	430	215	195	375	3	6,350,000	38,000,000	645,000	3,900,000	W52A07
280	350	69	69	320	—	2,170,000	13,000,000	221,000	1,320,000	W5605
	430	220	140	375	10	4,900,000	29,600,000	500,000	3,010,000	W5613
300	440	190	150	380	6	5,000,000	30,500,000	510,000	3,050,000	W6022
320	440	160	120	380	6	4,200,000	25,300,000	430,000	2,580,000	W6415
380	480	100	100	430	—	4,200,000	25,300,000	430,000	2,580,000	W7601
420	540	120	120	480	—	5,650,000	34,000,000	575,000	3,450,000	W8407



Drawing C
Divided by 1 place (outer ring)
Plastic sealed



Drawing D
Divided by 2 place (outer ring)
Retaining ring (shrinkage fit) type
(D ≧ 500mm)

Drawing no.	Mass kg (approx.)	Remarks
A	9.42	
C	10.3	
A	16.1	Inner ring outside dia. with oil groove
B	33.0	Inner ring outside dia. with oil groove
B	140	Inner ring outside dia. with oil groove
B	18.7	Without oil hole, oil groove
B	106	Inner ring outside dia. with oil groove
B	101	Inner ring outside dia. with oil groove
B	72	Inner ring outside dia. with oil groove
B	52.9	Without oil hole, oil groove
D	85.0	Without oil hole, oil groove

Catalog List & Appendix Table

CATALOG TITLES	CATALOG No.
BALL AND ROLLER BEARINGS	
Ball and Roller Bearings	2202/C/E/I/P/S
Large Bearings	2250/E/P
Miniature and Extra Small Ball Bearings	3013/E
Miniature Molded Rubber Bearings	3014/E
Ball Bearings Shield and Seal Types	3015/E
Care and Maintenance of Bearings	3017/E/S/P
HL Bearings	3020/E
Bearings with Solid Grease	3022/E/S/P
Large Size, Long Operating Life Bearing-EA type	3024/E/P
Tapered Roller Bearings ECO-Top	3026/E/S/C
Self-Aligning Spherical Roller Bearings LH Series	3027/E/S/C
Bearings for Clean Environment	3028/E
Insulated Bearings-Resin Coated Type	3204/E
Type E Spherical Roller Bearings	3701/E
Sealed Self-Aligning Roller Bearings-WA Type	3702/E/S
Spherical Roller Bearings-UA Type	3710/E
HUB BEARINGS	4601/E
Aerospace Bearings	8102/E
Precision Rolling Bearings for Machine Tools	8401/E
Super High-speed Precision Bearings for Main Spindles of Machine Tools	8403/E
NEEDLE ROLLER BEARINGS	
Needle Roller Bearings	2300/E/I/P/S
Miniature Cam Followers	3601/E
CONSTANT VELOCITY JOINTS	
Constant Velocity Joints for Automobiles	5601/JE
TRI-Ball Joint / Constant Velocity Joints	5602/E
Constant Velocity Joints for Industrial Machines	5603/E
BEARING UNITS	
Bearing Units	2400/E/I/S
Bearing Units with Ductile Cast Iron Housing	3901/E
Bearing Units Steel Series	3902/E
Bearing Units Stainless Series	3903/E
Bearing Units Plastic Housing Series	3904/E
Triple-Sealed Bearings for Bearing Units	3905/E

CATALOG TITLES	CATALOG No.
PLUMMER BLOCKS	
Plummer Blocks	2500E/S
PRECISION BALL SCREWS	
Precision Ball Screws	6000/E
Rolled Ball Screws	6206/E
PARTS FEEDER	
Parts Feeder	7018/E
NTN Parts Feeder with Standard Attachments (for Bolts or Washer)	7016/E
CLUTCHES	
One-way Clutches (Overrunning Clutches)	6402/E
PLAIN BEARINGS	
"BEAREE" NTN Engineering Plastics	5100/E
Miniature Plastic Sliding Screws	5112/E
NTN "BEARPHITE" Oil Impregnated Sintered Bearings	5202/E
Spherical Plain Bearings	5301/E
HANDBOOK	
Bearing Units Handbook	9011/E/S
Rolling Bearings Handbook	9012/E
Needle Roller Bearings Handbook	9013/E
GUIDE BOOK	
Parts Feeder Guide Book	7019/E
Automotive Products Guide Book	8021/E/D/F/C
New Products Guide	9208/E/C
Food Machinery Component Guide	9209/E
Product Catalog for Paper Manufacturing Machinery	9210/E
Steel Manufacturing Machinery Product Guide Book	9211/E
ELECTRONIC CATALOG	
NTN Electronic Catalog (CD-ROM for Windows)	7903/E
NTN Autoparts Catalog (CD-ROM for Windows)	7905/E
Reference Kit Program -Bearing Interchange- (CD-ROM for Windows)	7907/E
OTHERS	
Bearing Handling	9103/E/P/S

C:Chinese E:English F:French D:Germany I:Italian
K:Korean S:Spanish T:Thai TC: Taipei Chinese

Note : The above are basic numbers. Renewal of the suffix by a revision.

Appendix table 1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-1

Diameter series 7

Number	Dimension	Nominal outside diameter of bearing D	Dimension series 17	27	37	17~37
Single row radial ball bearings			67			
Double row radial ball bearings						
Cylindrical roller bearings						
Needle roller bearings						
Spherical roller bearings						
Nominal bearing bore diameter d		D	Nominal width B			Chamfer dimension γs min
—	0.6	2	0.8	—	—	0.05
1	1	2.5	1	—	—	0.05
—	1.5	3	1	—	1.8	0.05
2	2	4	1.2	—	2	0.05
—	2.5	5	1.5	—	2.3	0.08
3	3	6	2	2.5	3	0.08
4	4	7	2	2.5	3	0.08
5	5	8	2	2.5	3	0.08
6	6	10	2.5	3	3.5	0.1
7	7	11	2.5	3	3.5	0.1
8	8	12	2.5	—	3.5	0.1
9	9	14	3	—	4.5	0.1
00	10	15	3	—	4.5	0.1
01	12	18	4	—	5	0.2
02	15	21	4	—	5	0.2
03	17	23	4	—	5	0.2
04	20	27	4	—	5	0.2
/22	22	—	—	—	—	—
05	25	32	4	—	5	0.2
/28	28	—	—	—	—	—
06	30	37	4	—	5	0.2
/32	32	—	—	—	—	—
07	35	44	5	—	—	0.3
08	40	—	—	—	—	—
09	45	—	—	—	—	—
10	50	—	—	—	—	—
11	55	—	—	—	—	—
12	60	—	—	—	—	—
13	65	—	—	—	—	—
14	70	—	—	—	—	—
15	75	—	—	—	—	—
16	80	—	—	—	—	—
17	85	—	—	—	—	—
18	90	—	—	—	—	—
19	95	—	—	—	—	—
20	100	—	—	—	—	—
21	105	—	—	—	—	—
22	110	—	—	—	—	—
24	120	—	—	—	—	—
26	130	—	—	—	—	—
28	140	—	—	—	—	—
30	150	—	—	—	—	—
32	160	—	—	—	—	—
34	170	—	—	—	—	—
36	180	—	—	—	—	—
38	190	—	—	—	—	—
40	200	—	—	—	—	—
44	220	—	—	—	—	—
48	240	—	—	—	—	—
52	260	—	—	—	—	—
56	280	—	—	—	—	—
60	300	—	—	—	—	—
64	320	—	—	—	—	—
68	340	—	—	—	—	—
72	360	—	—	—	—	—
76	380	—	—	—	—	—
80	400	—	—	—	—	—
84	420	—	—	—	—	—
88	440	—	—	—	—	—
92	460	—	—	—	—	—
96	480	—	—	—	—	—
/500	500	—	—	—	—	—
/530	530	—	—	—	—	—
/560	560	—	—	—	—	—
/600	600	—	—	—	—	—
/630	630	—	—	—	—	—
/670	670	—	—	—	—	—
/710	710	—	—	—	—	—
/750	750	—	—	—	—	—
/800	800	—	—	—	—	—
/850	850	—	—	—	—	—
/900	900	—	—	—	—	—
/950	950	—	—	—	—	—
/1000	1000	—	—	—	—	—
/1060	1060	—	—	—	—	—
/1120	1120	—	—	—	—	—
/1180	1180	—	—	—	—	—
/1250	1250	—	—	—	—	—
/1320	1320	—	—	—	—	—
/1400	1400	—	—	—	—	—
/1500	1500	—	—	—	—	—
/1600	1600	—	—	—	—	—
/1700	1700	—	—	—	—	—
/1800	1800	—	—	—	—	—
/1900	1900	—	—	—	—	—
/2000	2000	—	—	—	—	—

Diameter series 8

Number	Dimension	Nominal outside diameter of bearing D	Dimension series 08	18	28	38	48	58	68	08	18~68
Single row radial ball bearings				68 78							
Double row radial ball bearings											
Cylindrical roller bearings					N28	N38	NN48				
Needle roller bearings							NA48				
Spherical roller bearings											
Nominal bearing bore diameter d		D	Nominal width B							Chamfer dimension γs min	
—	0.6	2.5	—	1	—	1.4	—	—	—	—	0.05
1	1	3	—	1	—	1.5	—	—	—	—	0.05
—	1.5	4	—	1.2	—	2	—	—	—	—	0.05
2	2	5	—	1.5	—	2.3	—	—	—	—	0.08
—	2.5	6	—	1.8	—	2.6	—	—	—	—	0.08
3	3	7	—	2	—	3	—	—	—	—	0.1
4	4	9	—	2.5	3.5	4	—	—	—	—	0.1
5	5	11	—	3	4	5	—	—	—	—	0.15
6	6	13	—	3.5	5	6	—	—	—	—	0.15
7	7	14	—	3.5	5	6	—	—	—	—	0.15
8	8	16	—	4	5	6	8	—	—	—	0.2
9	9	17	—	4	5	6	8	—	—	—	0.2
00	10	19	—	5	6	7	9	—	—	—	0.3
01	12	21	—	5	6	7	9	—	—	—	0.3
02	15	24	—	5	6	7	9	—	—	—	0.3
03	17	26	—	5	6	7	9	—	—	—	0.3
04	20	32	4	7	8	10	12	16	22	0.3	0.3
/22	22	34	4	7	—	10	—	16	22	0.3	0.3
05	25	37	4	7	8	10	12	16	22	0.3	0.3
/28	28	40	4	7	—	10	—	16	22	0.3	0.3
06	30	42	4	7	8	10	12	16	22	0.3	0.3
/32	32	44	4	7	—	10	—	16	22	0.3	0.3
07	35	47	4	7	8	10	12	16	22	0.3	0.3
08	40	52	4	7	8	10	12	16	22	0.3	0.3
09	45	58	4	7	8	10	13	18	23	0.3	0.3
10	50	65	5	7	10	12	15	20	27	0.3	0.3
11	55	72	7	9	11	13	17	23	30	0.3	0.3
12	60	78	7	10	12	14	18	24	32	0.3	0.3
13	65	85	7	10	13	15	20	27	36	0.3	0.6
14	70	90	8	10	13	15	20	27	36	0.3	0.6
15	75	95	8	10	13	15	20	27	36	0.3	0.6
16	80	100	8	10	13	15	20	27	36	0.3	0.6
17	85	110	9	13	16	19	25	34	45	0.3	1
18	90	115	9	13	16	19	25	34	45	0.3	1
19	95	120	9	13	16	19	25	34	45	0.3	1
20	100	125	9	13	16	19	25	34	45	0.3	1
21	105	130	9	13	16	19	25	34	45	0.3	1
22	110	140	10	16	19	23	30	40	54	0.6	1
24	120	150	10	16	19	23	30	40	54	0.6	1
26	130	165	11	18	22	26	35	46	63	0.6	1.1
28	140	175	11	18	22	26	35	46	63	0.6	1.1
30	150	190	13	20	24	30	40	54	71	0.6	1.1
32	160	200	13	20	24	30	40	54	71	0.6	1.1
34	170	215	14	22	27	34	45	60	80	0.6	1.1
36	180	225	14	22	27	34	45	60	80	0.6	1.1
38	190	240	16	24	30	37	50	67	90	1	1.5
40	200	250	16	24	30	37	50	67	90	1	1.5
44	220	270	16	24	30	37	50	67	90	1	1.5
48	240	300	19	28	36	45	60	80	100	1	2
52	260	320	19	28	36	45	60	80	100	1	2
56	280	350	22	33	42	52	69	95	125	1.1	2
60	300	380	25	38	48	60	80	109	145	1.5	2.1
64	320	400	25	38	48	60	80	109	145	1.5	2.1
68	340	420	25	38	48	60	80	109	145	1.5	2.1
72	360	440	25	38	48	60	80	109	145	1.5	2.1
76	380	480	31	46	60	75	100	136	180	2	2.1
80	400	500	31	46	60	75	100	136	180	2	2.1
84	420	520	31	46	60	75	100	136	180	2	2.1
88	440	540	31	46	60	75	100	136	180	2	2.1
92	460	580	37	56	72	90	118	160	218	2.1	3
96	480	600	37	56	72	90	118	160	218	2.1	3
/500	500	620	37	56	72	90	118	160	218	2.1	3
/530	530	650	37	56	72	90	118	160	218	2.1	3
/560	560	680	37	56	72	90	118	160	218	2.1	3
/600	600	730	42	60	78	98	128	175	236	3	3
/630	630	780	48	69	88	112	150	200	272	3	4
/670	670	820	48	69	88	112	150	200	272	3	4
/710	710	870	50	74	95	118	160	218	290	4	4
/750	750	920	54	78	100	128	170	230	308	4	5
/800	800	980	57	82	106	136	180	243	325	4	5
/850	850	1030	57	82	106	136	180	243	325	4	5
/900	900	1090	60	85	112	140	190	258	345	5	5
/950	950	1150	63	63	118	150	200	272	355	5	5
/1000	1000	1220	71	90	128	165	218	300	400	5	6
/1060	1060	1280	71	100	128	165	218	300	400	5	6
/1120	1120	1360	78	106	140	180	243	325	438	5	6
/1180	1180	1420	78	106	140	180	243	325	438	5	6
/1250	1250	1500	80	112	145	185	250	335	450	6	6
/1320	1320	1600	88	122	165	206	280	375	500	6	6
/1400	1400	1700	95	132	175	224	300	400	545	6	7.5
/1500	1500	1820	—	140	185	243	315	—	—	—	7.5
/1600	1600	1950	—	155	200	265	345	—	—	—	7.5
/1700	1700	2060	—	160	206	272	355	—	—	—	7.5
/1800	1800	2180	—	165	218	290	375	—	—	—	9.5
/1900	1900	2300	—	175	230	300	400	—	—	—	9.5
/2000	2000	2430	—	190	250	325	425	—	—	—	9.5

Diameter series 9

Number	Dimension	Nominal outside diameter of bearing D	Dimension series 09	19	29	39	49	59	69	09	19~39	49~69
Single row radial ball bearings				69 79								
Double row radial ball bearings												
Cylindrical roller bearings				N19	N29	NN39	NN49					
Needle roller bearings							NA49	NA59	NA69			
Spherical roller bearings						239	249					
Nominal bearing bore diameter d		D	Nominal width B							Chamfer dimension γs min		
—	0.6	—	—	—	—	—	—	—	—	—	—	—
1	1	4	—	1.6	—	2.3	—	—	—	—	0.1	—
—	1.5	5	—	2	—	2.6	—	—	—	—	0.15	—
2	2	6	—	2.3	—	3	—	—	—	—	0.15	—
—	2.5	7	—	2.5	—	3.5				—	0.15	
3	3	8	—	3	—	4	—	—	—	—	0.15	—
4	4	11	—	4	—	5	—	—	—	—	0.15	—
5	5	13	—	4	—	6	10	—	—	—	0.2	0.15
6	6	15	—	5	—	7	10	—	—	—	0.2	0.15
7	7	17	—	5	—	7	10	—	—	—	0.3	0.15
8	8	19	—	6	—	9	11	—	—	—	0.3	0.2
9	9	20	—	6	—	9	11	—	—	—	0.3	0.3
00	10	22	—	6	8	10	13	16	22	—	0.3	0.3
01	12	24	—	6	8	10	13	16	22	—	0.3	0.3
02	15	28	—	7	8.5	10	13	18	23	—	0.3	0.3
03	17	30	—	7	8.5	10	13	18	23	—	0.3	0.3
04	20	37	7	9	11	13	17	23	30	0.3	0.3	0.3
/22	22	39	7	9	11	13	17	23	30	0.3	0.3	0.3
05	25	42	7	9	11	13	17	23	30	0.3	0.3	0.3
/28	28	45	7	9	11	13	17	23	30	0.3	0.3	0.3
06	30	47	7	9	11	13	17	23	30	0.3	0.3	0.3
/32	32	52	7	10	13	15	20	27	36	0.3	0.6	0.6
07	35	55	7	10	13	15	20	27	36	0.3	0.6	0.6
08	40	62	8	12	14	16	22	30	40	0.3	0.6	0.6
09	45	68	8	12	14	16	22	30	40	0.3	0.6	0.6
10	50	72	8	12	14	16	22	30	40	0.3	0.6	0.6
11	55	80	9	13	16	19	25	34	45	0.3	1	1
12	60	85	9	13	16	19	25	34	45	0.3	1	1
13	65	90	9	13	16	19	25	34	45	0.6	1	1
14	70	100	10	16	19	23	30	40	54	0.6	1	1
15	75	105	10	16	19	23	30	40	54	0.6	1	1
16	80	110	10	16	19	23	30	40	54	0.6	1	1
17	85	120	11	18	22	26	35	46	63	0.6	1.1	1.1
18	90	125	11	18	22	26	35	46	63	0.6	1.1	1.1
19	95	130	11	18	22	26	35	46	63	0.6	1.1	1.1
20	100	140	13	20	24	30	40	54	71	0.6	1.1	1.1
21	105	145	13	20	24	30	40	54	71	0.6	1.1	1.1
22	110	150	13	20	24	30	40	54	71	0.6	1.1	1.1
24	120	165	14	22	27	34	45	60	80	0.6	1.1	1.1
26	130	180	16	24	30	37	50	67	90	1	1.5	1.5
28	140	190	16	24	30	37	50	67	90	1	1.5	1.5
30	150	210	19	28	36	45	60	80	109	1	2	2
32	160	220	19	28	36	45	60	80	109	1	2	2
34	170	230	19	28	36	45	60	80	109	1	2	2
36	180	250	22	33	42	52	69	95	125	1.1	2	2
38	190	260	22	33	42	52	69	95	125	1.1	2	2
40	200	280	25	38	48	60	80	109	145	1.5	2.1	2.1
44	220	300	25	38	48	60	80	109	145	1.5	2.1	2.1
48	240	320	25	38	48	60	80	109	145	1.5	2.1	2.1
52	260	360	31	46	60	75	100	136	180	2	2.1	2.1
56	280	380	31	46	60	75	100	136	180	2	2.1	2.1
60	300	420	37	56	72	90	118	160	218	2.1	3	3
64	320	440	37	56	72	90	118	160	218	2.1	3	3
68	340	460	37	56	72	90	118	160	218	2.1	3	3
72	360	480	37	56	72	90	118	160	218	2.1	3	3
76	380	520	44	65	82	106	140	190	250	3	4	4
80	400	540	44	65	82	106	140	190	250	3	4	4
84	420	560	44	65	82	106	140	190	250	3	4	4
88	440	600	50	74	95	118	160	218	290	4	4	4
92	460	620	50	74	95	118	160	218	290	4	4	4
96	480	650	54	78	100	128	170	230	308	4	5	5
/500	500	670	54	78	100	128	170	230	308	4	5	5
/530	530	710	57	82	106	136	180	243	325	4	5	5
/560	560	750	60	85	112	140	190	258	355	5	5	5
/600	600	800	63	90	118	150	200	272	355	5	5	5
/630	630	850	71	100	128	165	218	300	400	5	6	6
/670	670	900	73	103	136	170	230	308	412	5	6	6
/710	710	950	78	106	140	180	243	325	438	5	6	6
/750	750	1000	80	112	145	185	250	335	450	6	6	6
/800	800	1060	82	115	150	195	258	355	462	6	6	6
/850	850	1120	85	118	155	200	272	365	488	6	6	6
/900	900	1180	88	122	165	206	280	375	500	6	6	6
/950	950	1250	95	132	175	224	300	400	545	6	7.5	7.5
/1000	1000	1320	103	140	185	236	315	438	580	6	7.5	7.5
/1060	1060	1400	109	150	195	250	335	462	615	7.5	7.5	7.5
/1120	1120	1460	109	150	195	250	335	462	615	7.5	7.5	7.5
/1180	1180	1540	115	160	206	272	355	488	650	7.5	7.5	7.5
/1250	1250	1630	122	170	218	280	375	515	690	7.5	7.5	7.5
/1320	1320	1720	128	175	230	300	400	545	710	7.5	7.5	7.5
/1400	1400	1820	—	185	243	315	425	—	—	—	9.5	9.5
/1500	1500	1950	—	195	258	335	450	—	—	—	9.5	9.5
/1600	1600	2060	—	200	265	345	462	—	—	—	9.5	9.5
/1700	1700	2180	—	212	280	355	475	—	—	—	9.5	9.5
/1800	1800	2300	—	218	290	375	500	—	—	—	12	12
/1900	1900	2430	—	230	308	400	530	—	—	—	12	12
/2000	2000	—	—	—	—	—	—	—	—	—	—	—

Diameter series 0

Number	Dimension	Nominal outside diameter of bearing D	Dimension series 00	10	20	30	40	50	60	00	10~60
Single row radial ball bearings			160	60 70							
Double row radial ball bearings											
Cylindrical roller bearings				N10	N20	NN30	NN40				
Needle roller bearings											
Spherical roller bearings						230	240				
Nominal bearing bore diameter d		D	Nominal width B							Chamfer dimension γs min	
—	0.6	—	—	—	—	—	—	—	—	—	—
1	1	—	—	—	—	—	—	—	—	—	—
—	1.5	6	—	2.5	—	3	—	—	—	—	0.15
2	2	7	—	2.8	—	3.5	—	—	—	—	0.15
—	2.5	8	—	2.8	—	4	—	—	—	—	0.15
3	3	7	—	3	—	5	—	—	—	—	0.15
4	4	12	—	4	—	6	—	—	—	—	0.2
5	5	14	—	5	—	7	—	—	—	—	0.2
6	6	17	—	6	—	9	—	—	—	—	0.3
7	7	19	—	6	8	10	—	—	—	—	0.3
8	8	22	—	7	9	11	14	19	25	—	0.3
9	9	24	—	7	10	12	15	20	27	—	0.3
00	10	26	—	8	10	12	16	21	29	—	0.3
01	12	28	7	8	10	12	16	21	29	0.3	0.3
02	15	32	8	9	11	13	17	23	30	0.3	0.3
03	17	35	8	10	12	14	18	24	32	0.3	0.3
04	20	42	8	12	14	16	22	30	40	0.3	0.6
/22	22	44	8	12	14	16	22	30	40	0.3	0.6
05	25	47	8	12	14	16	22	30	40	0.3	0.6
/28	28	52	8	12	15	18	24	32	43	0.3	0.6
06	30	55	9	13	16	19	25	34	45	0.3	1
/32	32	58	9	13	16	20	26	35	47	0.3	1
07	35	62	9	14	17	20	27	36	48	0.3	1
08	40	68	9	15	18	21	28	38	50	0.3	1
09	45	75	10	16	19	23	30	40	54	0.3	1
10	50	80	10	16	19	23	30	40	54	0.6	1
11	55	90	11	18	22	26	35	46	63	0.6	1.1
12	60	95	11	18	22	26	35	46	63	0.6	1.1
13	65	100	11	18	22	26	35	46	63	0.6	1.1
14	70	110	13	20	24	30	40	54	71	0.6	1.1
15	75	115	13	20	24	30	40	54	71	0.6	1.1
16	80	125	14	22	27	34	45	60	80	0.6	1.1
17	85	130	14	22	27	34	45	60	80	0.6	1.1
18	90	140	16	24	30	37	50	67	90	1	1.5
19	95	145	16	24	30	37	50	67	90	1	1.5
20	100	150	16	24	30	37	50	67	100	1	1.5
21	105	160	18	26	33	41	56	75	109	1	2
22	110	170	19	28	36	45	60	80	109	1	2
24	120	180	19	28	36	46	60	80	109	1	2
26	130	200	22	33	42	52	69	95	125	1.1	2
28	140	210	22	33	42	53	69	65	125	1.1	2
30	150	225	24	35	45	56	75	100	136	1.1	2.1
32	160	240	25	38	48	60	80	109	145	1.5	2.1
34	170	260	28	42	54	67	90	122	160	1.5	2.1
36	180	280	31	46	60	74	100	136	180	2	2.1
38	190	290	31	46	60	75	100	136	180	2	2.1
40	200	310	34	51	66	82	109	150	200	2	2.1
44	220	340	37	56	72	90	118	160	218	2.1	3
48	240	360	37	56	72	92	118	160	218	2.1	3
52	260	400	44	65	82	104	140	190	250	3	4
56	280	420	44	65	82	106	140	190	250	3	4
60	300	460	50	74	95	118	160	218	290	4	4
64	320	480	50	74	95	121	160	218	290	4	4
68	340	520	57	82	106	133	180	243	325	4	5
72	360	540	57	82	106	134	180	243	325	4	5
76	380	560	57	82	106	135	180	243	325	4	5
80	400	600	63	90	118	148	200	272	355	5	5
84	420	620	63	90	118	150	200	272	355	5	5
88	440	650	67	94	122	157	212	280	375	5	6
92	460	680	71	100	128	163	218	300	400	5	6
96	480	700	71	100	128	165	218	300	400	5	6
/500	500	720	71	100	128	167	218	300	400	5	6
/530	530	780	80	112	145	185	250	335	450	6	6
/560	560	820	82	115	150	195	258	355	462	6	6
/600	600	870	85	118	155	200	272	365	488	6	6
/630	630	920	92	128	170	212	290	388	515	6	7.5
/670	670	980	100	136	180	230	308	425	560	6	7.5
/710	710	1030	103	140	185	236	315	438	580	6	7.5
/750	750	1090	109	150	195	250	335	462	615	7.5	7.5
/800	800	1150	112	155	200	258	345	475	630	7.5	7.5
/850	850	1220	118	165	212	272	365	500	670	7.5	7.5
/900	900	1280	122	170	218	280	375	515	690	7.5	7.5
/950	950	1300	132	180	236	300	412	560	730	7.5	7.5
/1000	1000	1420	136	185	243	308	412	560	750	7.5	7.5
/1060	1060	1500	140	195	250	325	438	600	800	9.5	9.5
/1120	1120	1580	145	200	265	345	462	615	825	9.5	9.5
/1180	1180	1660	155	212	272	355	475	650	875	9.5	9.5
/1250	1250	1750	—	218	290	375	500	—	—	—	9.5
/1320	1320	1850	—	230	300	400	530	—	—	—	12
/1400	1400	1950	—	243	315	412	545	—	—	—	12
/1500	1500	2120	—	272	355	462	615	—	—	—	12
/1600	1600	2240	—	280	365	475	630	—	—	—	12
/1700	1700	2360	—	290	375	500	650	—	—	—	15
/1800	1800	2500	—	308	400	530	690	—	—	—	15
/1900	1900	—	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—	—

Appendix table 1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-2

Single row radial ball bearings												62 72		1,22	1,32						63 73		623	633					64 74		
Double row radial ball bearings												12		42 22	52 32						13		43 23	53 33							
Cylindrical roller bearings						NN31						N2		N22	N32						N3		N23	N33					N4		
Needle roller bearings																															
Spherical roller bearings						231	241							222	232						213		223								
Nominal bearing bore diameter d		Diameter series 1								Diameter series 2									Diameter series 3								Diameter series 4			
		Nominal outside diameter of bearing D	Dimension series							Nominal outside diameter of bearing D	Dimension series								Nominal outside diameter of bearing D	Dimension series							Nominal outside diameter of bearing D	Dimension series		
			01	11	21	31	41	01	11~41		82	02	12	22	32	42	82	02~42		83	03	13	23	33	83	03~33		04	24	Chamfer dimension γ s min
Number	Dimension		Nominal width B					Chamfer dimension γ s min			Nominal width B						Chamfer dimension γ s min			Nominal width B					Chamfer dimension γ s min			Nominal width B		
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	3	—	—	—	—	—	—	—	—	10	2.5	4	—	—	5	—	0.1	0.15	13	—	5	—	—	7	—	0.2	—	—	—	—
4	4	—	—	—	—	—	—	—	—	13	3	5	—	—	7	—	0.15	0.2	16	—	5	—	—	9	—	0.3	—	—	—	—
5	5	—	—	—	—	—	—	—	—	16	3.5	5	—	—	8	—	0.15	0.3	19	—	6	—	—	10	—	0.3	—	—	—	—
6	6	—	—	—	—	—	—	—	—	19	4	6	—	—	10	—	0.2	0.3	22	—	7	—	11	13	—	0.3	—	—	—	—
7	7	—	—	—	—	—	—	—	—	22	5	7	—	—	11	—	0.3	0.3	26	—	9	—	13	15	—	0.3	—	—	—	—
8	8	—	—	—	—	—	—	—	—	24	5	8	—	—	12	—	0.3	0.3	28	—	9	—	13	15	—	0.3	30	10	14	0.6
9	9	—	—	—	—	—	—	—	—	26	6	8	—	—	13	—	0.3	0.3	30	—	10	—	14	16	—	0.6	32	11	15	0.6
00	10	—	—	—	—	—	—	—	—	30	7	9	—	14	14.3	—	0.3	0.6	35	9	11	—	17	19	0.3	0.6	37	12	16	0.6
01	12	—	—	—	—	—	—	—	—	32	7	10	—	14	15.9	—	0.3	0.6	37	9	12	—	17	19	0.3	1	42	13	19	1
02	15	—	—	—	—	—	—	—	—	35	8	11	—	14	15.9	20	0.3	0.6	42	9	13	—	17	19	0.3	1	52	15	24	1.1
03	17	—	—	—	—	—	—	—	—	40	8	12	—	16	17.5	22	0.3	0.6	47	10	14	—	19	22.2	0.6	1	62	17	29	1.1
04	20	—	—	—	—	—	—	—	—	47	9	14	—	18	20.6	27	0.3	1	52	10	15	—	21	22.2	0.6	1.1	72	19	33	1.1
/22	22	—	—	—	—	—	—	—	—	50	9	14	—	18	20.6	27	0.3	1	56	11	16	—	21	25	0.6	1.1	—	—	—	—
05	25	—	—	—	—	—	—	—	—	52	10	15	—	18	20.6	27	0.3	1	62	12	17	—	24	25.4	0.6	1.1	80	21	36	1.5
/28	28	—	—	—	—	—	—	—	—	58	10	16	—	19	23	30	0.6	1	68	13	18	—	24	30	0.6	1.1	—	—	—	—
06	30	—	—	—	—	—	—	—	—	62	10	16	—	20	23.8	32	0.6	1	72	13	19	—	27	30.2	0.6	1.1	90	23	40	1.5
/32	32	—	—	—	—	—	—	—	—	65	11	17	—	21	25	33	0.6	1	75	14	20	—	28	32	0.6	1.1	—	—	—	—
07	35	—	—	—	—	—	—	—	—	72	12	17	—	23	27	37	0.6	1.1	80	14	21	—	31	34.9	0.6	1.5	100	25	43	1.5
08	40	—	—	—	—	—	—	—	—	80	13	18	—	23	30.2	40	0.6	1.1	90	16	23	—	33	36.5	1	1.5	110	27	46	2
09	45	—	—	—	—	—	—	—	—	85	13	19	—	23	30.2	40	0.6	1.1	100	17	25	—	36	39.7	1	1.5	120	29	50	2
10	50	—	—	—	—	—	—	—	—	90	13	20	—	23	30.2	40	0.6	1.1	110	19	27	—	40	44.4	1	2	130	31	53	2.1
11	55	—	—	—	—	—	—	—	—	100	14	21	—	25	33.3	45	1	1.5	120	21	29	—	43	49.2	1.1	2	140	33	57	2.1
12	60	—	—	—	—	—	—	—	—	110	16	22	—	28	36.5	50	1	1.5	130	22	31	—	46	54	1.1	2.1	150	35	60	2.1
13	65	—	—	—	—	—	—	—	—	125	18	23	—	31	38.1	56	1	1.5	140	24	33	—	48	58.7	1.1	2.1	160	37	64	2.1
14	70	—	—	—	—	—	—	—	—	125	18	24	—	31	39.7	56	1	1.5	150	25	35	—	51	63.5	1.5	2.1	180	42	74	3
15	75	—	—	—	—	—	—	—	—	130	18	25	—	31	41.3	56	1	1.5	160	27	37	—	55	68.3	1.5	2.1	190	45	77	3
16	80	—	—	—	—	—	—	—	—	140	19	26	—	33	44.4	60	1	2	170	28	39	—	58	68.3	1.5	2.1	200	48	80	3
17	85	—	—	—	—	—	—	—	—	150	21	28	—	36	49.2	65	1.1	2	180	30	41	—	60	73	2	3	210	52	86	4
18	90	150	—	—	—	—	60	—	2	160	22	30	—	40	52.4	69	1.1	2	190	30	43	—	64	73	2	3	225	54	90	4
19	95	160	—	—	—	—	65	—	2	170	24	32	—	43	55.6	75	1.1	2.1	200	33	45	—	67	77.8	2	3	240	55	95	4
20	100	165	21	30	39	52	65	1.1	2	180	25	34	—	46	60.3	80	1.5	2.1	215	36	47	51	73	82.6	2.1	3	250	58	98	4
21	105	175	22	33	42	56	69	1.1	2	190	27	36	—	50	65.1	85	1.5	2.1	225	37	49	53	77	87.3	2.1	3	260	60	100	4
22	110	180	22	33	42	56	69	1.1	2	200	28	38	—	53	69.8	90	1.5	2.1	240	42	50	57	80	92.1	3	3	280	65	108	4
24	120	200	25	38	48	62	80	1.5	2	215	—	40	42	58	76	95	—	2.1	260	44	55	62	86	106	3	3	310	72	118	5
26	130	210	25	38	48	64	80	1.5	2	230	—	40	46	64	80	100	—	3	280	48	58	66	93	112	3	4	340	78	128	5
28	140	225	27	40	50	68	85	1.5	2.1	250	—	42	50	68	88	109	—	3	300	50	62	70	102	118	4	4	360	82	132	5
30	150	250	31	46	60	80	100	2	2.1	270	—	45	54	73	96	118	—	3	320	—	65	75	108	128	—	4	380	85	138	5
32	160	270	34	51	66	86	109	2	2.1	290	—	48	58	80	104	128	—	3	340	—	68	79	114	136	—	4	400	88	142	5
34	170	280	34	51	66	88	109	2	2.1	310	—	52	62	86	110	140	—	4	360	—	72	84	120	140	—	4	420	92	145	5
36	180	300	37	56	72	96	118	2.1	3	320	—	52	62	86	112	140	—	4	380	—	75	88	126	150	—	4	440	95	150	6
38	190	320	42	60	78	104	128	3	3	340	—	55	65	92	120	150	—	4	400	—	78	92	132	155	—	5	460	98	155	6
40	200	340	44	65	82	112	140	3	3	360	—	58	70	98	128	160	—	4	420	—	80	97	138	165	—	5	480	102	160	6
44	220	370	48	69	88	120	150	3	4	400	—	65	78	108	144	180	—	4	460	—	88	106	145	180	—	5	540	115	180	6
48	240	400	50	74	95	128	160	4	4	440	—	72	85	120	160	200	—	4	500	—	95	114	155	195	—	5	580	122	190	6
52	260	440	57	82	106	144	180	4	4	480	—	80	90	130	174	218	—	5	540	—	102	123	165	206	—	6	620	132	206	7.5
56	280	460	57	82	106	146	180	4	5	500	—	80	90	130	176	218	—	5	580	—	108	132	175	224	—	6	670	140	224	7.5
60	300	500	63	90	118	160	200	5	5	540	—	85	98	140	192	243	—	5	620	—	109	140	185	236	—	7.5	710	150	236	7.5
64	320	540	71	100	128	176	218	5	5	580	—	92	105	150	208	258	—	5	670	—	112	155	200	258	—	7.5	750	155	250	9.5
68	340	580	78	106	140	190	243	5	5	620	—	92	118	165	224	280	—	6	710	—	118	165	212	272	—	7.5	800	164	265	9.5
72	360	600	78	106	140	192	243	5	5	650	—	95	122	170	232	290	—	6	750	—	125	170	224	290	—	7.5	850	180	280	9.5
76	380	620	78	106	140	194	243	5	5	680	—	95	132	175	240	300	—	6	780	—	128	175	230	300	—	7.5	900	190	300	9.5
80	400	650	80	112	145	200	250	6	6	720	—	103	140	185	256	315	—	6	820	—	136	185	243	308	—	7.5	950	200	315	12
84	420	700	88	122	165	224	280	6	6	760	—	109	150	195	272	335	—	7.5	850	—	136	190	250	315	—	9.5	980	206	325	12
88	440	720	88	122	165	226	280	6	6	790	—	112	155	200	280	345	—	7.5	900	—	145	200	265	345	—	9.5	1030	212	335	12
92	460	760	95	132	175	240	300	6	7.5	830	—	118	165	212	296	365	—	7.5	950	—	155	212	280	365	—	9.5	1060	218	345	12
96	480	790	100	136	180	248	308	6	7.5	870	—	125	170	224	310	388	—	7.5	980	—	160	218	290	375	—	9.5	1120	230	365	15
/500	500	830	106	145	190	264	325	7.5	7.5	920	—	136	185	243	336	412	—	7.5	1030	—	170	230	300	388	—	12	1150	236	375	15
/530	530	870	109	150	195	272	335	7.5	7.5	980	—	145	200	258	355	450	—	9.5	1090	—	180	243	325	412	—	12	1220	250	400	15
/560	560	920	115	160	206	280	355	7.5	7.5	1030	—	150	206	272	365	475	—	9.5	1150	—	190	258	335	438	—	12	1280	258	412	15
/600	600	980	122	170	218	300	375	7.5	7.5	1090	—	155	212	280	388	488	—	9.5	1220	—	200	272	355	462	—	15	1360	272	438	15
/630	630	1030	128	175	230	315	400	7.5	7.5	1150	—	165	230	300	412	515	—	12	1280	—	206	280	375	488	—	15	1420	280	450	15
/670	670	1090	136	185	243	336	412	7.5	7.5	1220	—	175	243	315	438	545	—	12	1360	—	218	300	400	515	—	15	1500	290	475	15
/710	710	1150	140	195	250	345	438	9.5	9.5	1280	—	180	250	325	450	560	—	12	1420	—	224	308	412	530	—	15	—	—	—	—
/750	750	1220	150	206	272	365	475	9.5	9.5	1360	—	195	265	345	475	615	—	15	1500	—	236	325	438	560	—	15	—	—	—	—
/800	800	1280	155	212	272	375	475	9.5	9.5	1420	—	200	272	355	488	615	—	15	1600	—	258	355	462	600	—	15	—	—	—	—
/850	850	1360	165	224	290	400	500	12	12	1500	—	206	280	375	515	650	—	15	1700	—	272	375	488	630	—	19	—	—	—	—
/900	900	1420	165	230	300	412	515	12	12	1580	—	218	300	388	515	670	—	15	1780	—	280	388	500	650	—	19	—	—	—	—
/950	950	1500	175	243	315	438	545	12	12	1660	—	230	315	412	530	710	—	15	1850	—	290	400	515	670	—	19	—	—	—	—
/1000	1000	1580	185	258	335	462	580	12	12	1750	—	243	330	425	560	750	—	15	1950	—	300	412	545	710	—	19	—	—	—	—
/1060	1060	1660	190	265	345	475	600	12	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1120	1120	1750	—	280	365	475	630	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1180	1180	1850	—	290	388	500	670	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1250	1250	1950	—	308	400	530	710	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1320	1320	2060	—	325	425	560	750	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1400	1400	2180	—	345	450	580	775	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1500	1500	2300	—	355	462	600	800	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table 2: Comparison of SI, CGS and gravity units-1

Unit system \ Quantity	Length L	Mass M	Time T	Acceleration	Force	Stress	Pressure	Energy
SI	m	kg	s	m/s^2	N	Pa	Pa	J
CGS system	cm	g	s	Gal	dyn	dyn/cm^2	dyn/cm^2	erg
Gravitation system	m	kgf · s^2/m	s	m/s^2	kgf	kgf/m^2	kgf/m^2	kgf · m

Appendix table 3: SI-customary unit conversion table-1

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Angle	Degree	°	π/180	Radian	rad
	Minute	′	π/10 800		
	Second	″ (sec)	π/648 000		
Length	Meter	m	1	Meter	m
	Micron	μ	10^{-6}		
	Angstrom	Å	10^{-10}		
Area	Square meter	m^2	1	Square meter	m^2
	Are	a	10^2		
	Hectare	ha	10^4		
Volume	Cubic meter	m^3	1	Cubic meter	m^3
	Liter	R.L	10^{-3}		
Mass	Kilogram	kg	1	Kilogram	kg
	Ton	t	10^3		
	Kilogram force / square second per meter	kgf · s^2/m	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meters per second	m/s	1	Meters per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s^{-1} (pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute (rpm)	rpm (r/min)	1/60	Per second	s^{-1}
Angular speed	Radians per second	rad/s	1	Radians per second	rad/s
Acceleration	Meters per square second	m/s^2	1	Meters per second square	m/s^2
	G	G	9.806 65		
Force	Kilogram force	kgf	9.806 65	Newton	N
	Ton force	tf	9 806.65		
	Dyne	dyn	10^{-5}		
Force moment	Kilogram force / meter	kgf · m	9.806 65	Newton meter	N · m
Inertia moment	Kilogram force / meter / square second	kgf · m · s^2	9.806 65	Kilogram / square meter	kg · m^2
Stress	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal or newton per square meter	Pa or N/m^2
Pressure	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal	Pa
	Meter water column	mH_2O	9 806.65		
	Meter of mercury	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmosphere	atm	101 325		
	Bar	bar	10^5		
Energy	Erg	erg	10^{-7}	Joule	J
	IT calorie	cal_{IT}	4.186 8		
	Kilogram force / meter	kgf · m	9.806 65		
	Kilowatt hour	kW · h	3.600×10^6		
	Metric horsepower per hour	PS · h	$2.647\,79 \times 10^6$		
Power rate and power	Watt	W	1	Watt	W
	Metric horsepower	PS	735.5		
	Kilogram force / meter per second	kgf · m/s	9.806 65		

Appendix table 2: Comparison of SI, CGS and gravity units-2

Quantity / Unit system	Power rate	Temperature	Viscosity	Dynamic viscosity	Magnetic flux	Flux density	Magnetic field strength
SI	W	K	Pa · s	m²/s	Wb	T	A/m
CGS system	erg/s	˚C	P	St	Mx	Gs	Oe
Gravitation system	kgf · m/s	˚C	kgf · s/m²	m²/s	—	—	—

Appendix table 3: SI-customary unit conversion table-2

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Viscosity	Poise	P	10^{-1}	Pascal second	Pa · s
	Centipoise	cP	10^{-3}		
	Kilogram force / square second per meter	kgf · s/m²	9.806 65		
Dynamic viscosity	Stoke	St	10^{-4}	Square meter per second	m²/s
	Centistoke	cSt	10^{-6}		
Temperature	Degree	˚C	+273.15	Kelvin	K
Radioactive	Curie	Ci	3.7×10^{10}	Becquerel	Bq
Dosage	Roentgen	R	2.58×10^{-4}	Coulombs per kilogram	C/kg
Absorption dosage	Rad	rad	10^{-2}	Gray	Gy
Dosage equivalent	Rem	rem	10^{-2}	Sievert	Sv
Magnetic flux	Maxwell	Mx	10^{-8}	Weber	Wb
Flux density	Gamma	γ	10^{-9}	Tesla	T
	Gauss	Gs	10^{-4}		
Magnetic field strength	Oersted	Oe	$10^{3}/4\pi$	Amperes per meter	A/m
Quantity of electricity	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Current	Ampere	A	1	Ampere	A

Appendix table 4: Tenth power multiples of SI unit

Multiples of unit	Prefix		Multiples of unit	Prefix	
	Name	Symbol		Name	Symbol
10^{18}	Exa	E	10^{-1}	Deci	d
10^{15}	Peta	P	10^{-2}	Centi	c
10^{12}	Tera	T	10^{-3}	Mili	m
10^{9}	Giga	G	10^{-6}	Micro	μ
10^{6}	Mega	M	10^{-9}	Nano	n
10^{3}	Kilo	k	10^{-12}	Pico	p
10^{2}	Hecto	h	10^{-15}	Femto	f
10	Deca	da	10^{-18}	Ato	a

Appendix table 5: Dimensional tolerance for shafts

Diameter division mm over	incl.	a13 high	a13 low	c12 high	c12 low	d6 high	d6 low	e6 high	e6 low	e13 high	e13 low	f5 high	f5 low	f6 high	f6 low	g5 high	g5 low	g6 high	g6 low
3	6	-270	-450	-70	-190	-30	-38	-20	-28	-20	-200	-10	-15	-10	-18	-4	-9	-4	-12
6	10	-280	-500	-80	-230	-40	-49	-25	-34	-25	-245	-13	-19	-13	-22	-5	-11	-5	-14
10	18	-290	-560	-95	-275	-50	-61	-32	-43	-32	-302	-16	-24	-16	-27	-6	-14	-6	-17
18	30	-300	-630	-110	-320	-65	-78	-40	-53	-40	-370	-20	-29	-20	-33	-7	-16	-7	-20
30 40	40 50	-310 -320	-700 -710	-120 -130	-370 -380	-80	-96	-50	-66	-50	-440	-25	-36	-25	-41	-9	-20	-9	-25
50 65	65 80	-340 -360	-800 -820	-140 -150	-440 -450	-100	-119	-60	-79	-60	-520	-30	-43	-30	-49	-10	-23	-10	-29
80 100	100 120	-380 -410	-920 -950	-170 -180	-520 -530	-120	-142	-72	-94	-72	-612	-36	-51	-36	-58	-12	-27	-12	-34
120 140 160	140 160 180	-460 -520 -580	-1 090 -1 150 -1 210	-200 -210 -230	-600 -610 -630	-145	-170	-85	-110	-85	-715	-43	-61	-43	-68	-14	-32	-14	-39
180 200 225	200 225 250	-660 -740 -820	-1 380 -1 460 -1 540	-240 -260 -280	-700 -720 -740	-170	-199	-100	-129	-100	-820	-50	-70	-50	-79	-15	-35	-15	-44
250 280	280 315	-920 -1 050	-1 730 -1 860	-300 -330	-820 -850	-190	-222	-110	-142	-110	-920	-56	-79	-56	-88	-17	-40	-17	-49
315 355	355 400	-1 200 -1 350	-2 090 -2 240	-360 -400	-930 -970	-210	-246	-125	-161	-125	-1 015	-62	-87	-62	-98	-18	-43	-18	-54
400 450	450 500	-1 500 -1 650	-2 470 -2 620	-440 -480	-1 070 -1 110	-230	-270	-135	-175	-135	-1 105	-68	-95	-68	-108	-20	-47	-20	-60
500 560	560 630	-	-	-	-	-260	-304	-145	-189	-	-	-	-	-76	-120	-	-	-22	-66
630 710	710 800	-	-	-	-	-290	-340	-160	-210	-	-	-	-	-80	-130	-	-	-24	-74
800 900	900 1 000	-	-	-	-	-320	-376	-170	-226	-	-	-	-	-86	-142	-	-	-26	-82
1 000 1 120	1 120 1 250	-	-	-	-	-350	-416	-195	-261	-	-	-	-	-98	-164	-	-	-28	-94
1 250 1 400	1 400 1 600	-	-	-	-	-390	-468	-220	-298	-	-	-	-	-110	-188	-	-	-30	-108

Diameter division mm over	incl.	j5 high	j5 low	js5 high	js5 low	j6 high	j6 low	js6 high	js6 low	j7 high	j7 low	k4 high	k4 low	k5 high	k5 low	k6 high	k6 low	m5 high	m5 low
3	6	+3	-2	+2.5	-2.5	+6	-2	+4	-4	+8	-4	+5	+1	+6	+1	+9	+1	+9	+4
6	10	+4	-2	+3	-3	+7	-2	+4.5	-4.5	+10	-5	+5	+1	+7	+1	+10	+1	+12	+6
10	18	+5	-3	+4	-4	+8	-3	+5.5	-5.5	+12	-6	+6	+1	+9	+1	+12	+1	+15	+7
18	30	+5	-4	+4.5	-4.5	+9	-4	+6.5	-6.5	+13	-8	+8	+2	+11	+2	+15	+2	+17	+8
30 40	40 50	+6	-5	+5.5	-5.5	+11	-5	+8	-8	+15	-10	+9	+2	+13	+2	+18	+2	+20	+9
50 65	65 80	+6	-7	+6.5	-6.5	+12	-7	+9.5	-9.5	+18	-12	+10	+2	+15	+2	+21	+2	+24	+11
80 100	100 120	+6	-9	+7.5	-7.5	+13	-9	+11	-11	+20	-15	+13	+3	+18	+3	+25	+3	+28	+13
120 140 160	140 160 180	+7	-11	+9	-9	+14	-11	+12.5	-12.5	+22	-18	+15	+3	+21	+3	+28	+3	+33	+15
180 200 225	200 225 250	+7	-13	+10	-10	+16	-13	+14.5	-14.5	+25	-21	+18	+4	+24	+4	+33	+4	+37	+17
250 280	280 315	+7	-16	+11.5	-11.5	+16	-16	+16	-16	+26	-26	+20	+4	+27	+4	+36	+4	+43	+20
315 355	355 400	+7	-18	+12.5	-12.5	+18	-18	+18	-18	+29	-28	+22	+4	+29	+4	+40	+4	+46	+21
400 450	450 500	+7	-20	+13.5	-13.5	+20	-20	+20	-20	+31	-32	+25	+5	+32	+5	+45	+5	+50	+23
500 560	560 630	-	-	-	-	-	-	+22	-22	-	-	-	-	-	-	+44	0	-	-
630 710	710 800	-	-	-	-	-	-	+25	-25	-	-	-	-	-	-	+50	0	-	-
800 900	900 1 000	-	-	-	-	-	-	+28	-28	-	-	-	-	-	-	+56	0	-	-
1 000 1 120	1 120 1 250	-	-	-	-	-	-	+33	-33	-	-	-	-	-	-	+66	0	-	-
1 250 1 400	1 400 1 600	-	-	-	-	-	-	+39	-39	-	-	-	-	-	-	+78	0	-	-

Unit μm

h4 high	h4 low	h5 high	h5 low	h6 high	h6 low	h7 high	h7 low	h8 high	h8 low	h9 high	h9 low	h10 high	h10 low	h11 high	h11 low	h13 high	h13 low	js4 high	js4 low	Diameter division mm over	Diameter division mm incl.
0	−4	0	−5	0	−8	0	−12	0	−18	0	−30	0	−48	0	−75	0	−180	+2	−2	3	6
0	−4	0	−6	0	−9	0	−15	0	−22	0	−36	0	−58	0	−90	0	−220	+2	−2	6	10
0	−5	0	−8	0	−11	0	−18	0	−27	0	−43	0	−70	0	−110	0	−270	+2.5	−2.5	10	18
0	−6	0	−9	0	−13	0	−21	0	−33	0	−52	0	−84	0	−130	0	−330	+3	−3	18	30
0	−7	0	−11	0	−16	0	−25	0	−39	0	−62	0	−100	0	−160	0	−390	+3.5	−3.5	30 40	40 50
0	−8	0	−13	0	−19	0	−30	0	−46	0	−74	0	−120	0	−190	0	−460	+4	−4	50 65	65 80
0	−10	0	−15	0	−22	0	−35	0	−54	0	−87	0	−140	0	−220	0	−540	+5	−5	80 100	100 120
0	−12	0	−18	0	−25	0	−40	0	−63	0	−100	0	−160	0	−250	0	−630	+6	−6	120 140 160	140 160 180
0	−14	0	−20	0	−29	0	−46	0	−72	0	−115	0	−185	0	−290	0	−720	+7	−7	180 200 225	200 225 250
0	−16	0	−23	0	−32	0	−52	0	−81	0	−130	0	−210	0	−320	0	−810	+8	−8	250 280	280 315
0	−18	0	−25	0	−36	0	−57	0	−89	0	−140	0	−230	0	−360	0	−890	+9	−9	315 355	355 400
0	−20	0	−27	0	−40	0	−63	0	−97	0	−155	0	−250	0	−400	0	−970	+10	−10	400 450	450 500
–	–	–	–	0	−44	0	−70	0	−110	0	−175	0	−280	0	−440	0	–	–	–	500 560	560 630
–	–	–	–	0	−50	0	−80	0	−125	0	−200	0	−320	0	−500	0	–	–	–	630 710	710 800
–	–	–	–	0	−56	0	−90	0	−140	0	−230	0	−360	0	−560	0	–	–	–	800 900	900 1 000
–	–	–	–	0	−66	0	−105	0	−165	0	−260	0	−420	0	−660	0	–	–	–	1 000 1 120	1 120 1 250
–	–	–	–	0	−78	0	−125	0	−195	0	−310	0	−500	0	−780	0	–	–	–	1 250 1 400	1 400 1 600

Unit μm

m6 high	m6 low	n5 high	n5 low	n6 high	n6 low	p5 high	p5 low	p6 high	p6 low	r6 high	r6 low	r7 high	r7 low	Basic tolerance IT2	Basic tolerance IT3	Basic tolerance IT5	Basic tolerance IT7	Diameter division mm over	Diameter division mm incl.
+12	+4	+13	+8	+16	+8	+17	+12	+20	+12	+23	+15	+27	+15	1.5	2.5	5	12	3	6
+15	+6	+16	+10	+19	+10	+21	+15	+24	+15	+28	+19	+34	+19	1.5	2.5	6	15	6	10
+18	+7	+20	+12	+23	+12	+26	+18	+29	+18	+34	+23	+41	+23	2	3	8	18	10	18
+21	+8	+24	+15	+28	+15	+31	+22	+35	+22	+41	+28	+49	+28	2.5	4	9	21	18	30
+25	+9	+28	+17	+33	+17	+37	+26	+42	+26	+50	+34	+59	+34	2.5	4	11	25	30 40	40 50
+30	+11	+33	+20	+39	+20	+45	+32	+51	+32	+60 +62	+41 +43	+71 +73	+41 +43	3	5	13	30	50 65	65 80
+35	+13	+38	+23	+45	+23	+52	+37	+59	+37	+73 +76	+51 +54	+86 +89	+51 +54	4	6	15	35	80 100	100 120
+40	+15	+45	+27	+52	+27	+61	+43	+68	+43	+88 +90 +93	+63 +65 +68	+103 +105 +108	+63 +65 +68	5	8	18	40	120 140 160	140 160 180
+46	+17	+51	+31	+60	+31	+70	+50	+79	+50	+106 +109 +113	+77 +80 +84	+123 +126 +130	+77 +80 +84	7	10	20	46	180 200 225	200 225 250
+52	+20	+57	+34	+66	+34	+79	+56	+88	+56	+126 +130	+94 +98	+146 +150	+94 +98	8	12	23	52	250 280	280 315
+57	+21	+62	+37	+73	+37	+87	+62	+98	+62	+144 +150	+108 +114	+165 +171	+108 +114	9	13	25	57	315 355	355 400
+63	+23	+67	+40	+80	+40	+95	+68	+108	+68	+166 +172	+126 +132	+189 +195	+126 +132	10	15	27	63	400 450	450 500
+70	+26	–	–	+88	+44	–	–	+122	+78	+194 +199	+150 +155	+220 +225	+150 +155	–	–	–	70	500 560	560 630
+80	+30	–	–	+100	+50	–	–	+138	+88	+225 +235	+175 +185	+255 +265	+175 +185	–	–	–	80	630 710	710 800
+90	+34	–	–	+112	+56	–	–	+156	+100	+266 +276	+210 +220	+300 +310	+210 +220	–	–	–	90	800 900	900 1 000
+106	+40	–	–	+132	+66	–	–	+186	+120	+316 +326	+250 +260	+355 +365	+250 +260	–	–	–	105	1 000 1 120	1 120 1 250
+126	+48	–	–	+156	+78	–	–	+218	+140	+378 +408	+300 +330	+425 +455	+300 +330	–	–	–	125	1 250 1 400	1 400 1 600

Appendix table 6: Dimensional tolerance for housing bore

Diameter division mm		E7		E10		E11		E12		F6		F7		F8		G6		G7		H6	
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
3 6 10 18	6 10 18 30	+32 +40 +50 +61	+20 +25 +32 +40	+68 +83 +102 +124	+20 +25 +32 +40	+95 +115 +142 +170	+20 +25 +32 +40	+140 +175 +212 +250	+20 +25 +32 +40	+18 +22 +27 +33	+10 +13 +16 +20	+22 +28 +34 +41	+10 +13 +16 +20	+28 +35 +43 +53	+10 +13 +16 +20	+12 +14 +17 +20	+4 +5 +6 +7	+16 +20 +24 +28	+4 +5 +6 +7	+8 +9 +11 +13	0 0 0 0
30 40	40 50	+75	+50	+150	+50	+210	+50	+300	+50	+41	+25	+50	+25	+64	+25	+25	+9	+34	+9	+16	0
50 65	65 80	+90	+60	+180	+60	+250	+60	+360	+60	+49	+30	+60	+30	+76	+30	+29	+10	+40	+10	+19	0
80 100	100 120	+107	+72	+212	+72	+292	+72	+422	+72	+58	+36	+71	+36	+90	+36	+34	+12	+47	+12	+22	0
120 140 160	140 160 180	+125	+85	+245	+85	+335	+85	+485	+85	+68	+43	+83	+43	+106	+43	+39	+14	+54	+14	+25	0
180 200 225	200 225 250	+146	+100	+285	+100	+390	+100	+560	+100	+79	+50	+96	+50	+122	+50	+44	+15	+61	+15	+29	0
250 280	280 315	+162	+110	+320	+110	+430	+110	+630	+110	+88	+56	+108	+56	+137	+56	+49	+17	+69	+17	+32	0
315 355	355 400	+182	+125	+355	+125	+485	+125	+695	+125	+98	+62	+119	+62	+151	+62	+54	+18	+75	+18	+36	0
400 450	450 500	+198	+135	+385	+135	+535	+135	+765	+135	+108	+68	+131	+68	+165	+68	+60	+20	+83	+20	+40	0
500 560	560 630	+215	+145	–	–	–	–	–	–	+120	+76	+146	+76	+186	+76	+66	+22	+92	+22	+44	0
630 710	710 800	+240	+160	–	–	–	–	–	–	+130	+80	+160	+80	+205	+80	+74	+24	+104	+24	+50	0
800 900	900 1 000	+260	+170	–	–	–	–	–	–	+142	+86	+176	+86	+226	+86	+82	+26	+116	+26	+56	0
1 000 1 120	1 120 1 250	+300	+195	–	–	–	–	–	–	+164	+98	+203	+98	+263	+98	+94	+28	+133	+28	+66	0
1 250 1 400	1 400 1 600	+345	+220	–	–	–	–	–	–	+188	+110	+235	+110	+305	+110	+108	+30	+155	+30	+78	0
1 600 1 800	1 800 2 000	+390	+240	–	–	–	–	–	–	+212	+120	+270	+120	+350	+120	+124	+32	+182	+32	+92	0

Unit μm

Diameter division mm		K6		K7		M6		M7		N6		N7		P6		P7		R6		R7	
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
3 6 10 18	6 10 18 30	+2 +2 +2 +2	-6 -7 -9 -11	+3 +5 +6 +6	-9 -10 -12 -15	-1 -3 -4 -4	-9 -12 -15 -17	0 0 0 0	-12 -15 -18 -21	-5 -7 -9 -11	-13 -16 -20 -24	-4 -4 -5 -7	-16 -19 -23 -28	-9 -12 -15 -18	-17 -21 -26 -31	-8 -9 -11 -14	-20 -24 -29 -35	-12 -16 -20 -24	-20 -25 -31 -37	-11 -13 -16 -20	-23 -28 -34 -41
30 40	40 50	+3	-13	+7	-18	-4	-20	0	-25	-12	-28	-8	-33	-21	-37	-17	-42	-29	-42	-25	-50
50 65	65 80	+4	-15	+9	-21	-5	-24	0	-30	-14	-33	-9	-39	-26	-45	-21	-51	-35 -37	-54 -56	-30 -32	-60 -62
80 100	100 120	+4	-18	+10	-25	-6	-28	0	-35	-16	-38	-10	-45	-30	-52	-24	-59	-44 -47	-66 -69	-38 -41	-73 -76
120 140 160	140 160 180	+4	-21	+12	-28	-8	-33	0	-40	-20	-45	-12	-52	-36	-61	-28	-68	-56 -58 -61	-81 -83 -86	-48 -50 -53	-88 -90 -93
180 200 225	200 225 250	+5	-24	+13	-33	-8	-37	0	-46	-22	-51	-14	-60	-41	-70	-33	-79	-68 -71 -75	-97 -100 -104	-60 -63 -67	-106 -109 -113
250 280	280 315	+5	-27	+16	-36	-9	-41	0	-52	-25	-57	-14	-66	-47	-79	-36	-88	-85 -89	-117 -121	-74 -78	-126 -130
315 355	355 400	+7	-29	+17	-40	-10	-46	0	-57	-26	-62	-16	-73	-51	-87	-41	-98	-97 -103	-133 -139	-87 -93	-144 -150
400 450	450 500	+8	-32	+18	-45	-10	-50	0	-63	-27	-67	-17	-80	-55	-95	-45	-108	-113 -119	-153 -159	-103 -109	-166 -172
500 560	560 630	0	-44	0	-70	-26	-70	-26	-96	-44	-88	-44	-114	-78	-122	-78	-148	-150 -155	-194 -199	-150 -155	-220 -225
630 710	710 800	0	-50	0	-80	-30	-80	-30	-100	-50	-100	-50	-130	-88	-138	-88	-168	-175 -185	-225 -235	-175 -185	-225 -265
800 900	900 1 000	0	-56	0	-90	-34	-90	-34	-124	-56	-112	-56	-146	-100	-156	-100	-190	-210 -220	-266 -276	-210 -220	-300 -310
1 000 1 120	1 120 1 250	0	-66	0	-105	-40	-106	-40	-145	-66	-132	-66	-171	-120	-186	-120	-225	-250 -260	-316 -326	-250 -260	-355 -365
1 250 1 400	1 400 1 600	0	-78	0	-125	-48	-126	-48	-173	-78	-156	-78	-203	-140	-218	-140	-265	-300 -330	-378 -408	-300 -330	-425 -455
1 600 1 800	1 800 2 000	0	-92	0	-150	-58	-150	-58	-208	-92	-184	-92	-242	-170	-262	-170	-320	-370 -400	-462 -492	-370 -400	-520 -550

Unit μm

H7		H8		H9		H10		H11		H13		J6		Js6		J7		Js7		K5		Diameter division mm	
high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	over	incl.
+12	0	+18	0	+30	0	+48	0	+75	0	+180	0	+5	−3	+4	−4	+6	−6	+6	−6	0	−5	3	6
+15	0	+22	0	+36	0	+58	0	+90	0	+220	0	+5	−4	+4.5	−4.5	+8	−7	+7.5	−7.5	+1	−5	6	10
+18	0	+27	0	+43	0	+70	0	+110	0	+270	0	+6	−5	+5.5	−5.5	+10	−8	+9	−9	+2	−6	10	18
+21	0	+33	0	+52	0	+84	0	+130	0	+330	0	+8	−5	+6.5	−6.5	+12	−9	+10.5	−10.5	+1	−8	18	30
+25	0	+39	0	+62	0	+100	0	+160	0	+390	0	+10	−6	+8	−8	+14	−11	+12.5	−12.5	+2	−9	30 40	40 50
+30	0	+46	0	+74	0	+120	0	+190	0	+460	0	+13	−6	+9.5	−9.5	+18	−12	+15	−15	+3	−10	50 65	65 80
+35	0	+54	0	+87	0	+140	0	+220	0	+540	0	+16	−6	+11	−11	+22	−13	+17.5	−17.5	+2	−13	80 100	100 120
+40	0	+63	0	+100	0	+160	0	+250	0	+630	0	+18	−7	+12.5	−12.5	+26	−14	+20	−20	+3	−15	120 140 160	140 160 180
+46	0	+72	0	+115	0	+185	0	+290	0	+720	0	+22	−7	+14.5	−14.5	+30	−16	+23	−23	+2	−18	180 200 225	200 225 250
+52	0	+81	0	+130	0	+210	0	+320	0	+810	0	+25	−7	+16	−16	+36	−16	+26	−26	+3	−20	250 280	280 315
+57	0	+89	0	+140	0	+230	0	+360	0	+890	0	+29	−7	+18	−18	+39	−18	+28.5	−28.5	+3	−22	315 355	355 400
+63	0	+97	0	+155	0	+250	0	+400	0	+970	0	+33	−7	+20	−20	+43	−20	+31.5	−31.5	+2	−25	400 450	450 500
+70	0	+110	0	+175	0	+280	0	+440	0	−	0	−	−	+22	−22	−	−	+35	−35	−	−	500 560	560 630
+80	0	+125	0	+200	0	+320	0	+500	0	−	0	−	−	+25	−25	−	−	+40	−40	−	−	630 710	710 800
+90	0	+140	0	+230	0	+360	0	+560	0	−	0	−	−	+28	−28	−	−	+45	−45	−	−	800 900	900 1 000
+105	0	+165	0	+260	0	+420	0	+660	0	−	0	−	−	+33	−33	−	−	+52.5	−52.5	−	−	1 000 1 120	1 120 1 250
+125	0	+195	0	+310	0	+500	0	+780	0	−	0	−	−	+39	−39	−	−	+62.5	−62.5	−	−	1 250 1 400	1 400 1 600
+150	0	+230	0	+370	0	+600	0	+920	0	−	0	−	−	+46	−46	−	−	+75	−75	−	−	1 600 1 800	1 800 2 000

Appendix table 7: Basic tolerance

Unit μm

Diameter division mm		IT basic tolerance class									
over	incl.	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10
—	3	0.8	1.2	2	3	4	6	10	14	25	40
3	6	1	1.5	2.5	4	5	8	12	18	30	48
6	10	1	1.5	2.5	4	6	9	15	22	36	58
10	18	1.2	2	3	5	8	11	18	27	43	70
18	30	1.5	2.5	4	6	9	13	21	33	52	84
30	50	1.5	2.5	4	7	11	16	25	39	62	100
50	80	2	3	5	8	13	19	30	46	74	120
80	120	2.5	4	6	10	15	22	35	54	87	140
120	180	3.5	5	8	12	18	25	40	63	100	160
180	250	4.5	7	10	14	20	29	46	72	115	185
250	315	6	8	12	16	23	32	52	81	130	210
315	400	7	9	13	18	25	36	57	89	140	230
400	500	8	10	15	20	27	40	63	97	155	250
500	630	9	11	16	22	30	44	70	110	175	280
630	800	10	13	18	25	35	50	80	125	200	320
800	1 000	11	15	21	29	40	56	90	140	230	360
1 000	1 250	13	18	24	34	46	66	105	165	260	420
1 250	1 600	15	21	29	40	54	78	125	195	310	500
1 600	2 000	18	25	35	48	65	92	150	230	370	600
2 000	2 500	22	30	41	57	77	110	175	280	440	700
2 500	3 150	26	36	50	69	93	135	210	330	540	860

Appendix table 8: Viscosity conversion table

Kinematic viscosity mm²/s	Saybolt SUS (second)	Redwood R"(second)	Engler E (degree)
2.7	35	32.2	1.18
4.3	40	36.2	1.32
5.9	45	40.6	1.46
7.4	50	44.9	1.60
8.9	55	49.1	1.75
10.4	60	53.5	1.88
11.8	65	57.9	2.02
13.1	70	62.3	2.15
14.5	75	67.6	2.31
15.8	80	71.0	2.42
17.0	85	75.1	2.55
18.2	90	79.6	2.68
19.4	95	84.2	2.81
20.6	100	88.4	2.95
23.0	110	97.1	3.21
25.0	120	105.9	3.49
27.5	130	114.8	3.77
29.8	140	123.6	4.04
32.1	150	132.4	4.32
34.3	160	141.1	4.59
36.5	170	150.0	4.88
38.8	180	158.8	5.15
41.0	190	167.5	5.44
43.2	200	176.4	5.72
47.5	220	194.0	6.28
51.9	240	212	6.85
56.5	260	229	7.38
60.5	280	247	7.95
64.9	300	265	8.51
70.3	325	287	9.24
75.8	350	309	9.95
81.2	375	331	10.7
86.8	400	353	11.4
92.0	425	375	12.1
97.4	450	397	12.8

Kinematic viscosity mm²/s	Saybolt SUS (second)	Redwood R"(second)	Engler E (degree)
103	475	419	13.5
108	500	441	14.2
119	550	485	15.6
130	600	529	17.0
141	650	573	18.5
152	700	617	19.9
163	750	661	21.3
173	800	705	22.7
184	850	749	24.2
195	900	793	25.6
206	950	837	27.0
217	1 000	882	28.4
260	1 200	1 058	34.1
302	1 400	1 234	39.8
347	1 600	1 411	45.5
390	1 800	1 587	51
433	2 000	1 763	57
542	2 500	2 204	71
650	3 000	2 646	85
758	3 500	3 087	99
867	4 000	3 526	114
974	4 500	3 967	128
1 082	5 000	4 408	142
1 150	5 500	4 849	156
1 300	6 000	5 290	170
1 400	6 500	5 730	185
1 510	7 000	6 171	199
1 630	7 500	6 612	213
1 740	8 000	7 053	227
1 850	8 500	7 494	242
1 960	9 000	7 934	256
2 070	9 500	8 375	270
2 200	10 000	8 816	284

Appendix table 9: Kgf to N conversion table

kgf		N	kgf		N	kgf		N
0.1020	**1**	9.8066	3.4670	**34**	333.43	6.8321	**67**	657.04
0.2039	**2**	19.613	3.5690	**35**	343.23	6.9341	**68**	666.85
0.3059	**3**	29.420	3.6710	**36**	353.04	7.0361	**69**	676.66
0.4079	**4**	39.227	3.7730	**37**	362.85	7.1380	**70**	686.46
0.5099	**5**	49.033	3.8749	**38**	372.65	7.2400	**71**	696.27
0.6118	**6**	58.840	3.9769	**39**	382.46	7.3420	**72**	706.08
0.7138	**7**	68.646	4.0789	**40**	392.27	7.4440	**73**	715.88
0.8158	**8**	78.453	4.1808	**41**	402.07	7.5459	**74**	725.69
0.9177	**9**	88.260	4.2828	**42**	411.88	7.6479	**75**	735.50
1.0197	**10**	98.066	4.3848	**43**	421.68	7.7499	**76**	745.30
1.1217	**11**	107.87	4.4868	**44**	431.49	7.8518	**77**	755.11
1.2237	**12**	117.68	4.5887	**45**	441.30	7.9538	**78**	764.92
1.3256	**13**	127.49	4.6907	**46**	451.10	8.0558	**79**	774.72
1.4276	**14**	137.29	4.7927	**47**	460.91	8.1578	**80**	784.53
1.5296	**15**	147.10	4.8946	**48**	470.72	8.2597	**81**	794.34
1.6316	**16**	156.91	4.9966	**49**	480.52	8.3617	**82**	804.14
1.7335	**17**	166.71	5.0986	**50**	490.33	8.4637	**83**	813.95
1.8355	**18**	176.52	5.2006	**51**	500.14	8.5656	**84**	823.76
1.9375	**19**	186.33	5.3025	**52**	509.94	8.6676	**85**	833.56
2.0394	**20**	196.13	5.4045	**53**	519.75	8.7696	**86**	843.37
2.1414	**21**	205.94	5.5065	**54**	529.56	8.8716	**87**	853.18
2.2434	**22**	215.75	5.6085	**55**	539.36	8.9735	**88**	862.98
2.3454	**23**	225.55	5.7104	**56**	549.17	9.0755	**89**	872.79
2.4473	**24**	235.36	5.8124	**57**	558.98	9.1775	**90**	882.60
2.5493	**25**	245.17	5.9144	**58**	568.78	9.2794	**91**	892.40
2.6513	**26**	254.97	6.0163	**59**	578.59	9.3814	**92**	902.21
2.7532	**27**	264.78	6.1183	**60**	588.40	9.4834	**93**	912.02
2.8552	**28**	274.59	6.2203	**61**	598.20	9.5854	**94**	921.82
2.9572	**29**	284.39	6.3223	**62**	608.01	9.6873	**95**	931.63
3.0592	**30**	294.20	6.4242	**63**	617.82	9.7893	**96**	941.44
3.1611	**31**	304.01	6.5262	**64**	627.62	9.8913	**97**	951.24
3.2631	**32**	313.81	6.6282	**65**	637.43	9.9932	**98**	961.05
3.3651	**33**	323.62	6.7302	**66**	647.24	10.0952	**99**	970.86

〔How to read the table〕 If for example you want to convert 10 kgf to N, find "10" in the middle column of the first set of columns on the right. Look in the N column directly to the right of "10," and you will see that 10 kgf equals 98.066 N. Oppositely, to convert 10 N to kgf, look in the kgf column to the right of "10" and you will see that 10 N equals 1.0197 kgf.

1kgf＝9.80665N
1N＝0.101972kgf

Appendix table 10: Inch-millimetre conversion table

inch		0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
fraction	decimal										
			25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791
1/16	0.062500	1.588	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584
3/32	0.093750	2.381	27.781	53.181	48.581	103.981	129.381	154.781	180.181	205.581	230.981
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378
1/ 8	0.125000	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966
3/16	0.187500	4.762	30.162	55.562	80.962	106.362	131.762	157.162	182.562	207.962	233.362
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553
1/ 4	0.250000	6.350	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141
5/16	0.312500	7.938	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728
3/ 8	0.375000	9.525	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125
25/64	0.390625	9.922	35.322	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316
7/16	0.437500	11.112	36.512	61.912	87.312	112.721	138.112	163.512	188.912	214.312	239.712
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903
1/ 2	0.500000	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491
9/16	0.562500	14.288	39.688	65.088	90.488	115.888	141.283	166.688	192.088	217.488	242.888
37/64	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284
19/32	0.593750	15.081	40.481	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078
5/ 8	0.625000	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666
11/16	0.687500	17.462	42.862	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.056	246.459
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253
3/ 4	0.750000	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841
13/16	0.812500	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428
7/ 8	0.875000	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222
39/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016
15/16	0.937500	23.812	49.212	74.612	100.012	125.412	150.812	176.212	201.612	227.012	252.412
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809
31/32	0.968750	24.606	50.006	75406	100.806	126.206	151.606	177.006	202.406	227.806	253.206
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603

NTN®

EV/HEV用
グリース潤滑高速深溝玉軸受

Grease Lubrication Type High Speed
Deep Groove Ball Bearing for EV/HEV

CAT.No.3040/JE

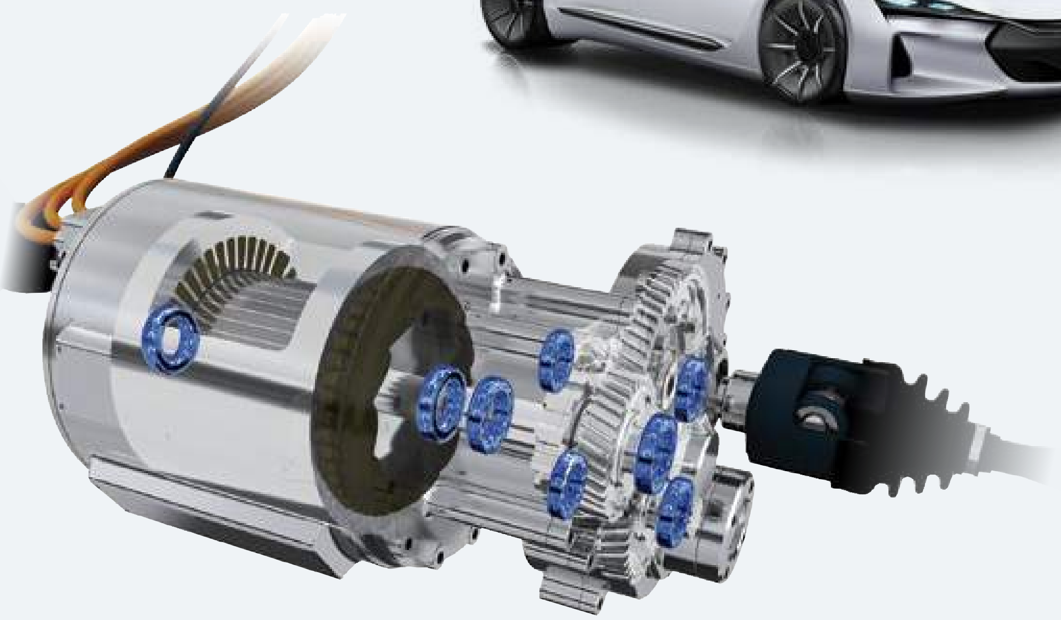
高速性能を向上させた
EV/HEV用高速深溝玉軸受
標準軸受の2倍の許容回転速度を実現

High speed deep groove ball bearing for EV/HEV with improved high speed performance.
Achieves 2X the allowable speed of standard bearings.

軽量高強度樹脂保持器
Lightweight and high strength resin cage

×

高速潤滑性能向上グリース
High speed lubricating performance improved grease



従来のグリース潤滑では、グリースが高速回転により飛び散り、軌道面への供給が不足し、
本来のグリース性能が発揮できません。
EV/HEV用グリース潤滑高速深溝玉軸受は、高速回転用に開発した樹脂保持器とグリースを組み合わせ、
最適なパフォーマンスをご提供します。

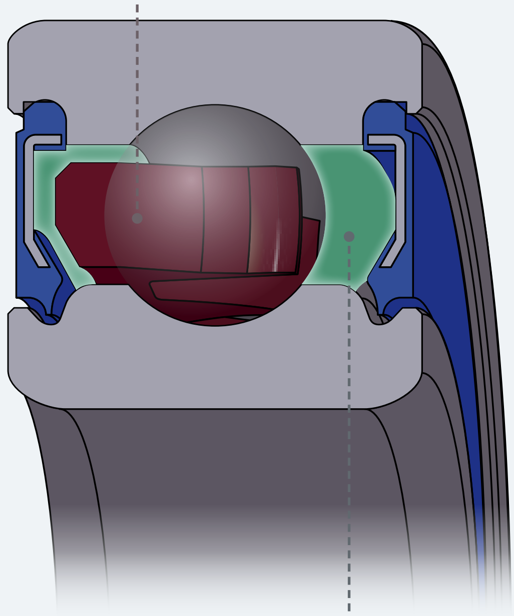
With conventional grease lubrication, high speed rotation causes grease spattering resulting in an insufficient supply of grease to the raceway surface so that the grease is unable to perform as it was originally intended.
Grease Lubrication Type High Speed Deep Groove Ball Bearing for EV/HEV combines a resin cage and grease developed for high speed rotation to provide optimal performance.

特 長　Feature

軽量高強度樹脂保持器
Lightweight and high strength resin cage

高速性・耐熱性・潤滑性を向上させた樹脂材料・形状の採用

Uses a resin material and design with high-speed, heat-resistant and high-lubrication properties



慣性力の低減
Reduced inertial force
- 保持器の軽量化
- Lightweight cage

遠心力変形の低減
Reduced centrifugal force deformation
- 材質と形状の最適化
- Optimized material and design

潤滑性の改善
Improved lubricity
- ポケット形状の改良（グリース溝）グリースを保持し、軌道面への潤滑剤供給を確保
- Improved pocket design (Grease groove) Retains grease and ensures lubricant is supplied to the raceway surface

回転トルク（温度上昇）の低減
Reduced rotational torque (temperature increase)
- 摩擦損失を低減させる形状
- Reduced friction loss design

耐熱性※1 Heat-resistant	材料強度※1 Material strength	遠心力変形※2 Centrifugal force deformation
30 ℃向上 30 ℃ improvement	1.6倍 1.6X	1/8

※1 標準樹脂保持器材料比　Compared with standard resin cage material
※2 標準樹脂保持器比　Comparison with standard resin cage

高速潤滑性能向上グリース
High speed lubricating performance improved grease

広い温度範囲で高い潤滑性と低発熱を発揮するグリースを採用

Uses grease providing high lubricating and low heat generating properties over a wide range of temperatures

潤滑性の改善
Improved lubricity
- グリース成分の最適化により、高速回転時の潤滑性を改善
- Optimization of grease composition improves lubricity during high speed rotation

性 能　Performance

軽量高強度樹脂保持器

高速回転時の遠心力変形を抑制し、高潤滑性、トルク低減、低昇温を可能にする形状と樹脂材料を採用

Lightweight and high strength resin cage

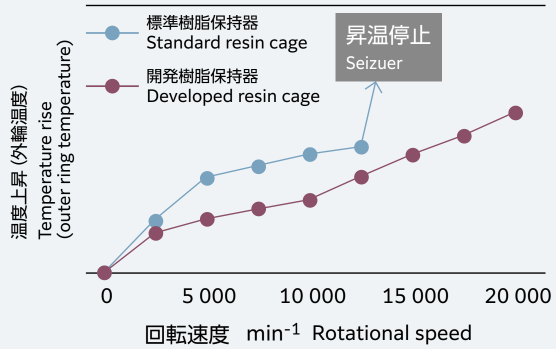
A resin cage is used with a design and resin material that suppress centrifugal force deformation during high speed rotation, which enables high lubricity, torque reduction and low temperature rises

[温度上昇の低減]　[Reduction in temperature rises]

軸受温度上昇比較（樹脂保持器比較）

Comparison of bearing temperature rise for resin cage

軸受寸法 Bearing dimensions	ϕ40×ϕ68×15
雰囲気温度 Ambient temperature	室温 Room temperature

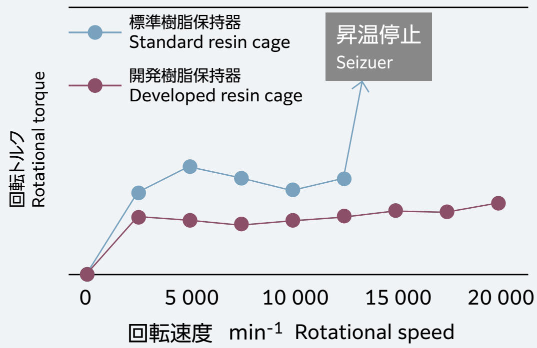


[回転トルクの低減]　[Reduction in rotational torque]

軸受回転トルク比較（樹脂保持器比較）

Comparison of bearing rotational torque for resin cage

軸受寸法 Bearing dimensions	ϕ40×ϕ68×15
雰囲気温度 Ambient temperature	室温 Room temperature

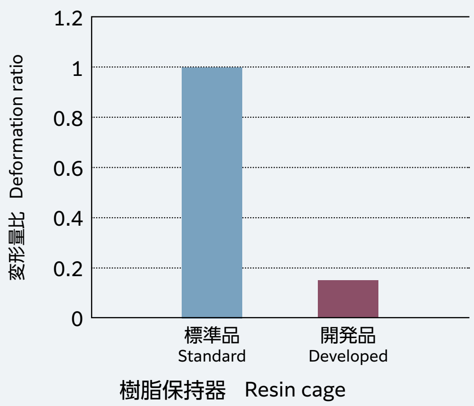


[遠心力変形量の低減]　[Reduction in amount of centrifugal force deformation]

樹脂保持器のポケット先端変形量比較（解析）

Deformation amount comparison of pocket tip on resin cage (Analysis)

軸受寸法 Bearing dimensions	ϕ40×ϕ68×15
回転速度 Rotational speed	20 000min^{-1}
温度 Temperature	120 ℃

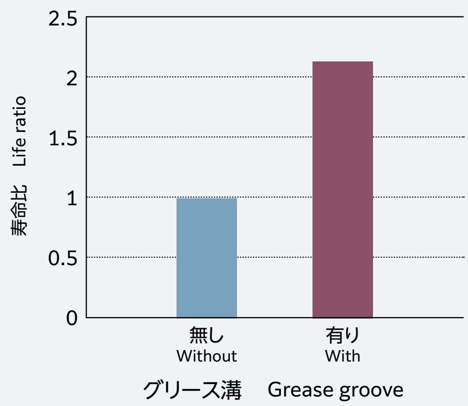


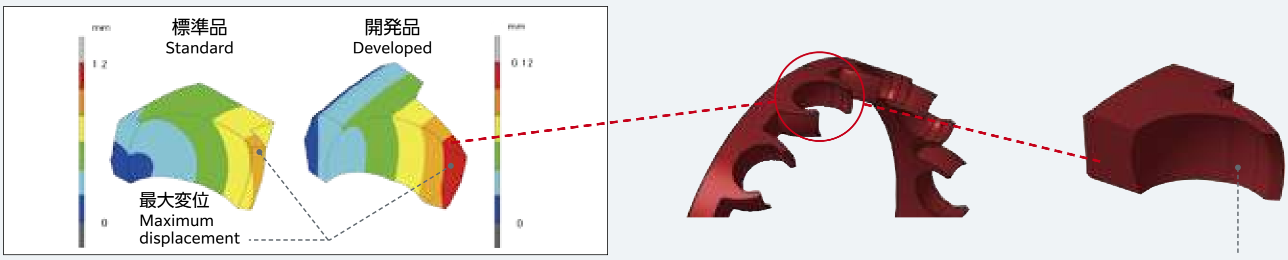
[潤滑性の改善]　[Improvement in lubrication]

グリース溝有無によるグリース寿命比較

Grease life comparison with and without grease groove

軸受寸法 Bearing dimensions	ϕ40×ϕ68×15
回転速度 Rotational speed	20 000min^{-1}
温度 Temperature	120 ℃





保持器ポケット　Cage pocket　　樹脂保持器　Resin cage　　グリース溝　Grease groove

高速潤滑性向上グリース

高速回転時の潤滑性を考慮した組成
高速回転時にもグリース本来の性能を発揮

High speed lubricating performance improved grease

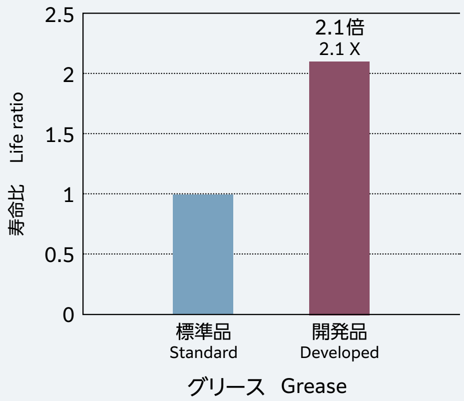
Composition that considers lubricity during high speed rotation
Ensures the original grease performance even during high speed rotation

[潤滑性の改善] [Improvement in lubrication]

グリースの寿命比較（開発樹脂保持器）

Comparison of grease life
(Developed resin cage)

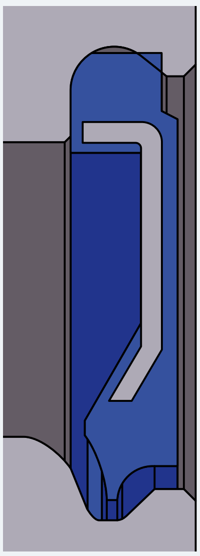
軸受寸法 Bearing dimensions	ϕ40×ϕ68×15
回転速度 Rotational speed	20 000min^{-1}
温度 Temperature	120 ℃



シール

シールは、標準の非接触ゴムシールを採用

標準シール形状を適用しましたが、使用環境や温度によって材質を選定します。



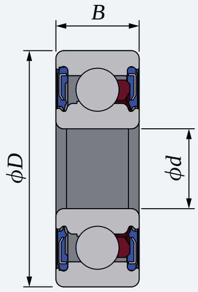
Seal

Uses a standard non-contact rubber seal

This bearing is fitted with a standard-shaped seal. However, NTN selects the material that best suits the environment and temperature in which the bearing is to be used.

※ZZシールドの適用については、**NTN**にご照会ください。

*Please contact **NTN** for ZZ shield applications.



ラインアップ

Product lineup

基本番号[1)] Basic number[1)]	主要寸法 Boundary dimensions [mm]			基本定格荷重 Basic load rating [kN]		疲労限荷重[2)] Fatigue load limit[2)] [kN]	許容回転速度[3)] Allowable speed[3)]
	d	*D*	*B*	*Cr*	*Cor*	*Cu*	[min^{-1}]
6900	10	22	6	2.99	1.27	0.099	67 500
6000		26	8	5.05	1.96	0.138	60 500
6202	15	35	11	8.60	3.60	0.279	43 000
6004C	20	42	12	11.8	5.40	0.500	34 500
63/22	22	56	16	20.4	9.25	0.725	27 500
6206	30	62	16	21.6	11.3	0.795	23 000
6306		72	19	29.5	15.0	1.14	21 000
6007	35	62	14	17.7	10.3	0.805	22 000
6207		72	17	28.4	15.3	1.09	20 000
6307		80	21	37.0	19.1	1.47	19 000
6008	40	68	15	18.6	11.5	0.890	20 000
6208		80	18	32.5	17.8	1.24	18 000
6308		90	23	45.0	24.0	1.83	16 500
6909	45	68	12	14.5	10.4	0.730	19 000
6009		75	16	23.2	15.1	1.16	18 000
6209		85	19	36.0	20.4	1.60	16 500
6309		100	25	58.5	32.0	2.50	14 500
6910	50	72	12	14.9	11.2	0.765	17 500
6010		80	16	24.2	16.6	1.24	16 500
6210		90	20	39.0	23.2	1.82	15 500
6310		110	27	68.5	38.5	2.99	13 000
6011	55	90	18	31.5	21.2	1.62	14 500
6211		100	21	48.0	29.2	2.29	13 500
6311		120	29	79.5	45.0	3.50	12 000

1)ラインアップにない基本番号・主要寸法についても対応可能です。詳細は、**NTN**にご照会ください。
2)疲労限荷重（*Cu*）とは、軌道の最大荷重接触部で疲労限応力となる、軸受にかかる荷重です。軸受の形式、内部諸元、品質、材料強度に依存し、ISO 281:2007では、高清浄度の軸受鋼製軸受において、*Cu*に相当する接触応力として1.5GPaを推奨しています。**NTN**では、標準的な熱処理を施した軸受鋼製軸受について、各呼び番号に対する疲労限荷重の値を寸法表に記載し、寿命修正係数a_{ISO}を適用した修正定格寿命を算出可能としています。詳細については「転がり軸受総合カタログ（CAT.No.2203/J）3.4 修正定格寿命」項をご参照ください。
3)許容回転速度は、軸受温度120 ℃、ラジアル荷重0.05 *Cr*時の目安です。特殊環境下での使用については、**NTN**にご照会ください。

1) We can support basic numbers and boundary dimensions not listed in the product lineup. Please contact **NTN** for details.
2) The fatigue load limit is the applied load on a bearing that results in just reaching the fatigue stress limit at the maximum loaded raceway contact. This depends on the bearing type, internal specifications, quality, and material strength. In ISO 281:2007, 1.5GPa is recommended as the fatigue stress limit corresponding to *Cu* for bearings made of commonly used high quality material and good manufacturing quality. Values for the fatigue load limit with respect to the **NTN** bearing numbers are provided in the dimensional table. The life modification factor, a_{ISO}, should be evaluated considering the fatigue load limit. For details see catalog “Ball and Roller Bearings (CAT.No.2203/E) section 3.4 Modified rating life”.
3) Allowable speed is an estimate when the bearing temperature is 120 ℃ and the radial load is 0.05 *Cr*. Please contact **NTN** for usage in special environments.

減速機などでの使用を目的としたオイル潤滑の適用については、**NTN**にご照会ください。
絶縁を目的としたセラミック玉軸受の適用については、**NTN**にご照会ください。

Please contact **NTN** for oil lubrication applications for use in speed reducers and such items.
Please contact **NTN** for ceramic ball bearing applications for insulation.

呼び番号の例

Bearing number examples

6008 HSGT2 LLB CM / L542

- 6008 — 基本番号　Basic number
- HSGT2 — 開発保持器　Developed cage
- LLB — シール形式　Seal type
- CM — ラジアルすきま　Radial clearance
- L542 — 開発グリース　Developed grease

耐クリープオプション

Creep resistant option

耐クリープ性を向上させた、AC軸受とEC軸受の2種類の対応が可能

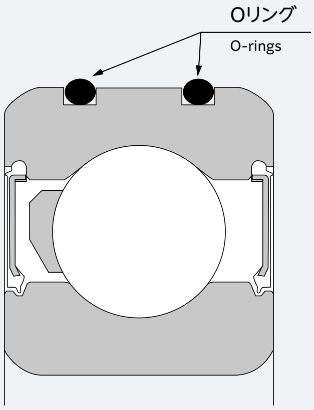
Can support two types, an AC bearing and EC bearing, to improve the creep resistance

【AC軸受】

[AC bearing]

標準の軸受と同じ主要寸法で、外輪外径に設けた二本の溝にOリングを装着した軸受

It has the same boundary dimensions as standard bearings with the addition of two O-ring imbedded on the outside surface of the outer ring

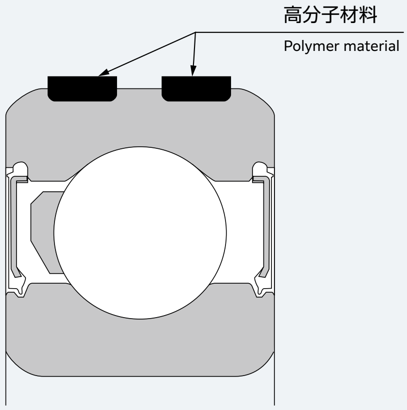


【EC軸受】

[EC bearing]

標準の軸受と同じ主要寸法で、外輪外径に設けた溝に熱膨張率の大きい高分子材料を成形した軸受

Boundary dimensions are same as for standard bearings, but formed polymer material with a high expansion rate is provided in the groove on the outer circumference of the outer ring



技術・価格・納期等のご照会・相談は最寄りの支社・営業所にお申し付けください。

営業拠点情報はこちら

▼

NTN株式会社

お問い合わせは

- カタログの内容については，技術的進歩および改良に対応するため製品の外観や仕様などは予告なしに変更することがあります。また，内容の正確さを維持するため，細心の注意を払っておりますが，万が一，誤記および製本上の落丁を起因とする損害が発生した場合の保証責任については負いかねます。
- The appearance and specifications may be changed without prior notice if required to improve performance. Although care has been taken to assure the accuracy of the data compiled in this catalog, **NTN** does not assume any liability to any company or person for errors or omissions.

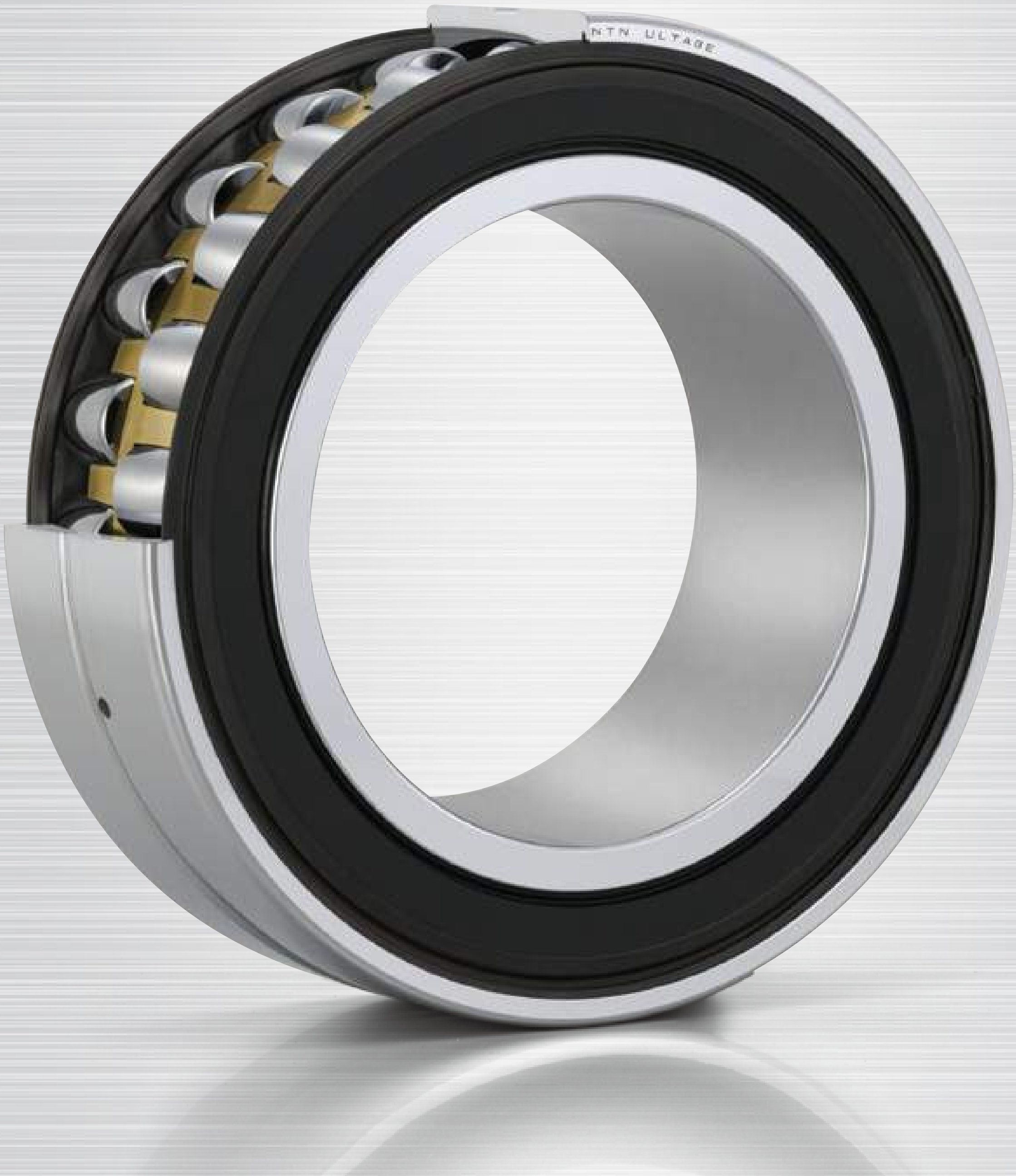
NTN®

UD FONT

CAT.No.3040/JE 22.02.01 DS/DS

Sealed Spherical Roller Bearings
[EMLLX Type]

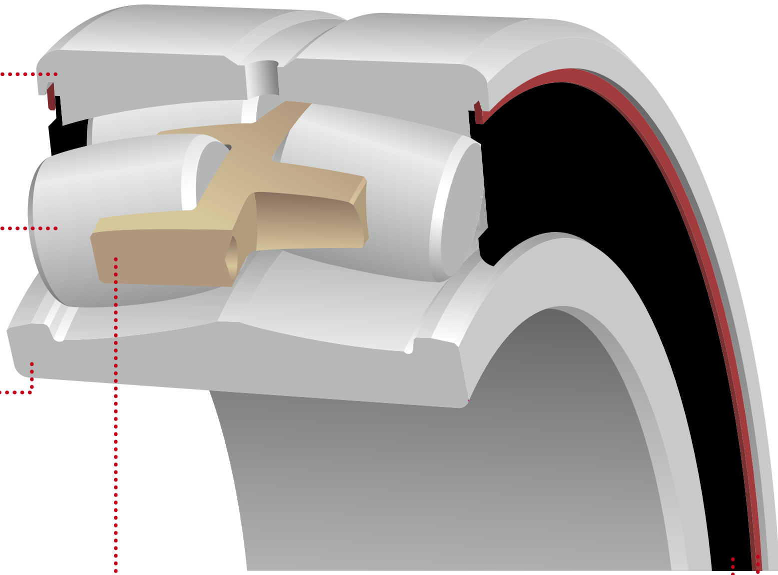
CAT.No.3039-2/E



ULTAGE™

Sealed Spherical Roller Bearings [EMLLX Type]

ULTAGE™ Series Sealed Spherical Roller Bearings (EMLLX Type) are new innovative standard products specifically developed to provide "long life", "higher reliability", and "improved ease-of-use" required for all industrial machineries.



Long Life

- Larger rollers provide the industry's highest load capacity
- Extended maintenance intervals
- Lighter and more compact design

Higher Reliability

- Seals prevent intrusion of foreign matter
- Prolonged relubrication interval

Improved Ease-of-Use

- Uses removable seals
- Complies with ISO dimensions

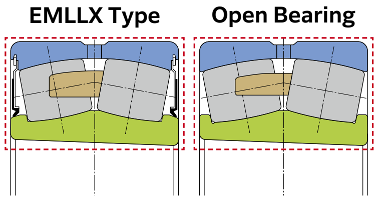
ULTAGE™

"ULTAGE™" (a name created from the combination of "ultimate," signifying refinement, and "stage," signifying NTN's intention that this series of products be employed in diverse applications) is the general name for NTN's new generation of bearings that are noted for their industry-leading performance.

Features

1. Fully Compatible with Open Bearings

The dimensions are the same as open bearings complying with ISO dimensions, so they can replace open bearings without changing the dimensions of the surrounding parts. The allowable misalignment angle of 0.5˚ is also the same between sealed and open spherical roller bearings. (**Fig. 1**)



EMLLX type and open bearings have the same dimensions

Fig. 1

2. Use of Removable Seals

Seals can be removed as they are held in place with a retaining ring. (**Fig. 2**)

- When installing the bearing, the radial internal clearance can be accurately measured with a feeler gauge, and adjusted. (**Fig. 3**)
- The retaining rings can be installed without the use of a special tool, and removed by inserting a flathead screwdriver into the retaining ring notch. (**Fig. 4**)

3. Adoption of Special Thin Seals

- Ensures uniform contact pressure of the seal lip during self-alignment of the bearing, prevention of ingress of foreign matter, and stable sealing.
- Provides sealed spherical roller bearings with the world's largest load capacity.

4. Lubrication Specification in Accordance with Requirements

Either grease-filled type or grease-free type can be selected.

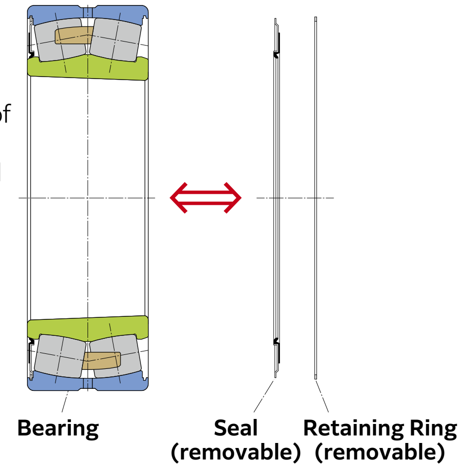
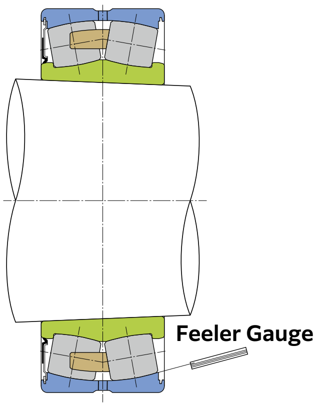
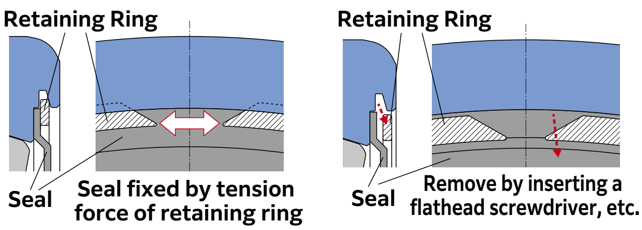


Fig. 2



Measurement of radial internal clearance

Fig. 3



Seal fixing　　Seal removal

Fig. 4

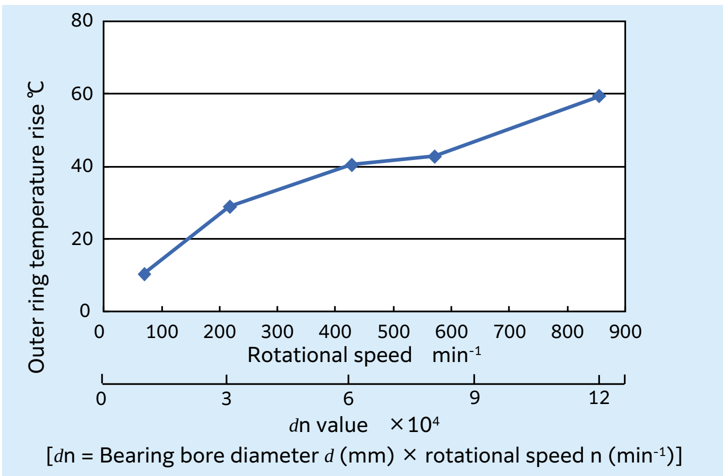
Performance Test Data

● Temperature rise Test

[Test Conditions]

Bearing	: 22228EMLLXKD1
Load	: radial load 47.2 kN
Rotational speed	: 70 to 857 min^{-1}
Lubrication	: Shell Alvania EP Grease 2 (8A)
Amount of grease	: 30 % of free space
Operating time	: 12 h at each rotational speed

[Test Results]



Outer Ring Temperature Rise

Bearing Internal Clearance

1) Cylindrical Bore — Unit: μm

Nominal Bore Diameter d mm		CN		C3		C4	
over	incl.	min	max	min	max	min	max
120	140	95	145	145	190	190	240
140	160	110	170	170	220	220	280
160	180	120	180	180	240	240	310
180	200	130	200	200	260	260	340
200	225	140	220	220	290	290	380
225	250	150	240	240	320	320	420

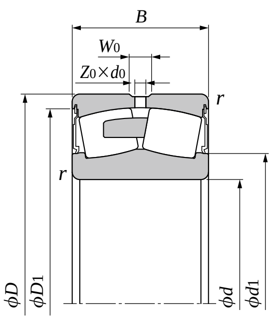
2) Tapered Bore — Unit: μm

Nominal Bore Diameter d mm		CN		C3		C4	
over	incl.	min	max	min	max	min	max
120	140	120	160	160	200	200	260
140	160	130	180	180	230	230	300
160	180	140	200	200	260	260	340
180	200	160	220	220	290	290	370
200	225	180	250	250	320	320	410
225	250	200	270	270	350	350	450

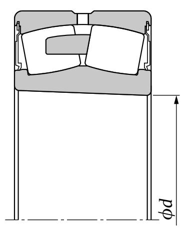
Fatigue Load Limit (C_u)

The fatigue load limit is the applied load on a bearing that results in just reaching the fatigue stress limit at the maximum loaded raceway contact. This depends on the bearing type, internal specifications, quality, and material strength. In ISO 281:2007, 1.5 GPa is recommended as the fatigue stress limit corresponding to C_u for bearings made of commonly used high quality material and good manufacturing quality. Values for the fatigue load limit with respect to the **NTN** bearing numbers are provided in the dimensional table. The life modification factor, a_{ISO}, should be evaluated considering the fatigue load limit. For details see catalog "Ball and Roller Bearings (CAT. No.2203/E) section 3.4 Modified rating life".

Dimension Table



Cylindrical Bore



Tapered Bore

Number of oil inlets

Norminal Outside Diameter mm		Number of Lubrication Holes Z_0
≥	<	
-	320	4
320	-	8

Boundary Dimensions mm						Basic Dynamic Load Rating kN	Basic Static Load Rating kN	Fatigue Load Limit kN	Bearing Number	
d	D	B	$r_{s\,min}$ ❷	W_0	d_0	C_r	C_{0r}	C_u	Cylindrical Bore	Tapered Bore ❶
140	250	68	3	14	7	866	944	65.9	**22228EMLLXD1**	**22228EMLLXKD1**
150	270	73	3	15	7	990	1 090	74.5	**22230EMLLXD1**	**22230EMLLXKD1**
160	290	80	3	17	8	1 170	1 320	84.1	**22232EMLLXD1**	**22232EMLLXKD1**
170	310	86	4	18	8	1 180	1 420	88.1	**22234EMLLXD1**	**22234EMLLXKD1**
170	280	88	2.1	14	6	1 170	1 540	77.6	**23134EMLLXD1**	**23134EMLLXKD1**
180	300	96	3	15	7	1 390	1 800	88.9	**23136EMLLXD1**	**23136EMLLXKD1**
190	320	104	3	17	8	1 590	2 120	100	**23138EMLLXD1**	**23138EMLLXKD1**
200	340	112	3	18	8	1 800	2 380	111	**23140EMLLXD1**	**23140EMLLXKD1**
220	370	120	4	19	9	2 070	2 730	128	**23144EMLLXD1**	**23144EMLLXKD1**
220	400	108	4	21	11	1 930	2 410	136	**22244EMLLXD1**	**22244EMLLXKD1**
240	360	92	3	15	8	1 400	2 120	113	**23048EMLLXD1**	**23048EMLLXKD1**
240	400	128	4	20	9	2 360	3 240	148	**23148EMLLXD1**	**23148EMLLXKD1**

❶ Tapered bore ratio 1:12.
❷ Allowable minimum radius for chamfer r.
* For bearing numbers not shown on the 231 Series dimension table (ϕ240 and larger and ϕ420 and smaller), contact **NTN** Engineering.

NTN Standard Grease

- Brand name: Shell Alvania EP Grease 2 (8A)
  High performance grease for heavy duty containing extreme pressure additives.
- Amount of grease: 25 to 35 % of internal free space of the bearing.

Allowable Misalignment

- 0.009 rad (0.5°)

Allowable Rotational Speeds

- dn value ≦6×10[4]
  [dn = Bearing bore diameter d (mm) × rotational speed n (min[-1])]

Allowable Temperature Range

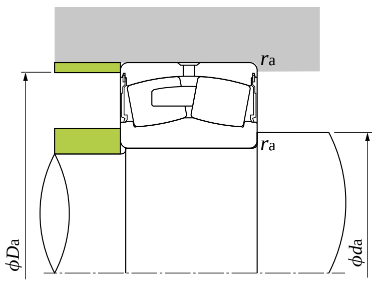
- Bearing temperature: -20 to 110 ℃

Bearing Number

231 36 EM LLX K D1 C3 / 0G V11

- Dimension Series Code — 231
- Bore Diameter Code — 36
- Type Code EM: One-piece Machined High-Tension Brass Cage — EM
- Contact Seal on Both Sides — LLX
- Bore Configuration Code No Code: Cylindrical Bore K: Tapered Bore — K
- Oil Groove/Inlets Code D1: With Oil Groove/Inlets — D1
- Internal Clearance Code — C3
- Lubricant Code /8A: Shell Alvania EP Grease 2
  /0G: No grease — /0G
- Product Specification Code V10: Installed seals for both sides
  V11: Installed a seal for one side only
  Seal for opposite side (on the side with smaller diameter for tapered bore) is not installed but packed with product. — V11

*The lubricant code and the product specification code have the following combinations /8AV10 or /0GV11



Dynamic Equivalent Radial Load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static Equivalent Radial Load

$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2, and Y_0, see the table below.

Abutment and Fillet Dimensions mm					Constant	Axial Load Factor			Mass (approx.) kg		Amount of Grease (approx.) g	Internal Free Space (approx.) cm³	Seal Part No.	Retaining Ring Part No.
d_1	d_a min	D_a max	D_1	r_{as} max	e	Y_1	Y_2	Y_0	Cylindrical Bore	Tapered Bore	*For /8AV10			
168	154	236	235	3	0.23	2.92	4.35	2.86	13.7	13.4	99.5~139	442	**F1#22228EMLX**	**HH#22228EMLX**
181	164	256	254	3	0.23	2.90	4.31	2.83	17.3	17.0	126~176	559	**F1#22230EMLX**	**HH#22230EMLX**
194	174	276	271	3	0.24	2.81	4.19	2.75	22.3	21.8	158~221	703	**F1#22232EMLX**	**HH#22232EMLX**
211	187	293	281	4	0.25	2.69	4.00	2.63	28.3	27.7	171~240	762	**F1#22234EMLX**	**HH#22234EMLX**
203	182	268	263	2.1	0.26	2.60	3.87	2.54	21.0	20.4	137~192	610	**F1#23134EMLX**	**HH#23134EMLX**
213	194	286	280	3	0.27	2.49	3.71	2.43	26.6	25.8	180~252	800	**F1#23136EMLX**	**HH#23136EMLX**
228	204	306	298	3	0.28	2.43	3.61	2.37	33.8	32.7	216~302	960	**F1#23138EMLX**	**HH#23138EMLX**
240	214	326	315	3	0.29	2.35	3.50	2.30	41.2	39.9	273~382	1 214	**F1#23140EMLX**	**HH#23140EMLX**
259	237	353	345	4	0.28	2.43	3.61	2.37	51.4	49.8	339~474	1 506	**F1#23144EMLX**	**HH#23144EMLX**
271	237	383	365	4	0.24	2.84	4.23	2.78	59.6	58.4	342~479	1 520	**F1#22244EMLX**	**HH#22244EMLX**
276	253	347	342	3	0.20	3.34	4.98	3.27	31.8	31.5	182~255	811	**F1#23048EMLX**	**HH#23048EMLX**
286	257	383	373	4	0.27	2.47	3.67	2.41	63.9	61.9	410~574	1 823	**F1#23148EMLX**	**HH#23148EMLX**

Handling Precautions

1.When assembling tapered bore bearings, maintain the reduction in radial internal clearance shown in **Table 1**.
The reduction in radial internal clearance is the difference in the initial clearance and the clearance after assembly.
Note that the axial displacement drive-up in **Table 1** should be taken to be a reference value.

2.During assembly, if misalignment exceeding the allowable misalignment angle (±0.5˚) is applied to the bearing, rollers may come in direct contact with seals causing seal deformation.
Furthermore, if additional force is applied under these conditions, the seals and retaining rings may separate from the bearing, so caution is advised.

3.If a shrink fit is to be used for assembly, do not exceed a bearing temperature of 100 ℃. However, the method of shrink fit by immersion in a hot oil bath cannot be used.

4.The retaining ring can be installed without the use of special tools.
Fit it to the groove in the outer ring sequentially from one end. (**Photo 1**)

5.There is a possibility that the seals or retaining rings will fall out during operation or handling of the bearing, so it is necessary to properly fit the seals and retaining rings.
Confirm the seal and retaining ring are securely fit.

6.After assembly of the bearing, check that there is no slack in the retaining rings.

7.Remove the retaining ring by inserting a flathead screwdriver or similar into the notch of the retaining ring and remove it. (**Photo 2**)

8.When fitting or removing the seals or retaining rings, wear protective glasses for safety, and use caution when handling the retaining rings.
Also, wear gloves during operations with the retaining rings so as not to injure your hand or finger with the tip of the retaining ring.

9.When fitting or removing the seals or retaining rings, be careful not to damage the seals or retaining rings.

10.When supplying grease, the guideline for grease supply pressure is about 0.1 MPa.
If pressure is applied suddenly, there is a possibility that the seals or retaining rings could be dislodged.

11.For the 8AV10 specification, use lithium mineral grease for filling and replenishment. If other types of grease are to be used, please contact **NTN** Engineering.

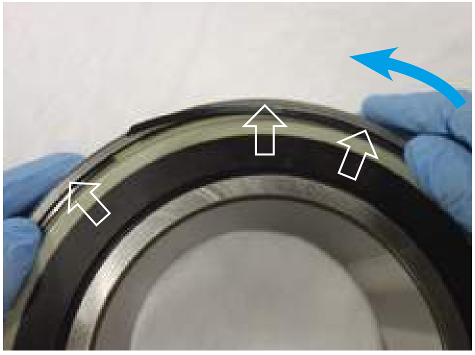


Photo 1

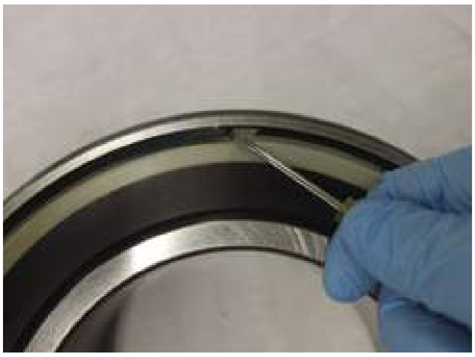


Photo 2

Table 1 Assembling sealed tapered bore spherical roller bearings EMLLX type

Unit: mm

Nominal bore diameter *d*	Bearing No.	Reduction in radial internal clearance		Axial displacement drive-up (reference)		Minimum residual internal clearance		
		min	max	min	max	CN	C3	C4
140	**22228EMLLXKD1**	0.065	0.075	1.0	1.1	0.045	0.085	0.125
150	**22230EMLLXKD1**	0.070	0.085	1.0	1.2	0.045	0.095	0.145
160	**22232EMLLXKD1**	0.065	0.085	1.0	1.2	0.045	0.095	0.145
170	**22234EMLLXKD1**	0.075	0.095	1.1	1.4	0.045	0.105	0.165
170	**23134EMLLXKD1**	0.075	0.095	1.1	1.4	0.045	0.105	0.165
180	**23136EMLLXKD1**	0.075	0.095	1.1	1.4	0.045	0.105	0.165
190	**23138EMLLXKD1**	0.085	0.105	1.2	1.5	0.055	0.115	0.185
200	**23140EMLLXKD1**	0.085	0.105	1.2	1.5	0.055	0.115	0.185
220	**23144EMLLXKD1**	0.105	0.125	1.5	1.8	0.055	0.125	0.195
220	**22244EMLLXKD1**	0.100	0.120	1.5	1.8	0.060	0.130	0.200
240	**23048EMLLXKD1**	0.115	0.135	1.6	1.9	0.065	0.135	0.215
240	**23148EMLLXKD1**	0.110	0.130	1.6	1.9	0.070	0.140	0.220

Minimum residual internal clearance: Standard value of radial internal clearance (min) - reduction in radial internal clearance (max)
* For models not shown on the table, contact **NTN** Engineering.

CAT.No.3039-2/E 21.04.005 DS/DS

NTN®

Sealed Spherical Roller Bearings

[WA Type]

ULTAGE

ULTAGE®

Note: Markings on the seal are not white in actual bearings.

CAT. No. 3703-Ⅱ/E

ULTAGE®

Up to five times longer service life

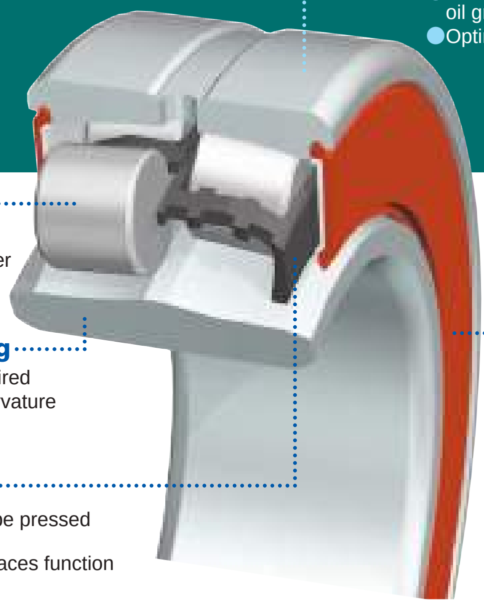
Sealed Spherical Roller Bearings 【WA Type】

ULTAGE Series Sealed Spherical Roller Bearings (WA Type) are new innovative standard products specifically developed to provide “longer service life”, “higher reliability” and “improved ease of use” required for all industrial machineries.

Longer Service Life
- Larger rollers provide the industry’s highest load capacity.
- Extended maintenance intervals
- Lighter and more compact design

Higher reliability
- Prevent from intrusion of foreign matters
- Prolonged relubrication interval

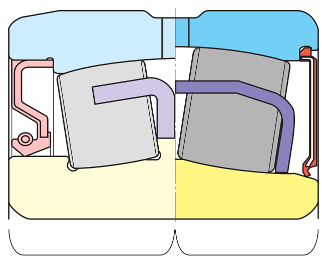
Improved Ease-of-Use
- Unique structure readily accepts lubricant
- Pre-lubricated as standard with long life grease



Features

1. The industry’s highest load capacity

Both a high load capacity and a longer service life are achieved by adopting the internal design of EA type spherical roller bearing which has a significantly increased roller diameter and the maximum number of rollers guided with the window-type pressed steel cage.

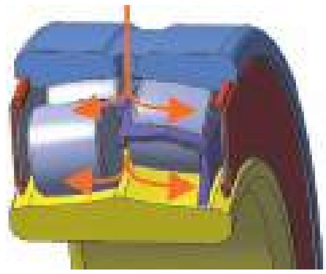


2. Compact design with minimized volume of seals

Adopt the contact type dust-proof seal with minimized volume.
① Prevent from intrusion of foreign matters with uniquely designed contact type rubber seals.
② Secure the dust-proof capability by maintaining the constant contact pressure of seals even under aligned conditions.

3. Prelubricated with a long life grease as standard

Barings are prelubricated with a long life grease.
No cleaning nor greasing are required when being mounted.



4. Oil groove and holes are adopted as standard

Adequate greasing into the inside of the bearing is secured with a lubrication groove and holes on the outside diameter of the outer ring.

ULTAGE®

"ULTAGE®" (a name created from the combination of **"ultimate,"** signifying refinement,and **"stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

Bearing Internal Clearance

1) Cylindrical bore

Unit：μm

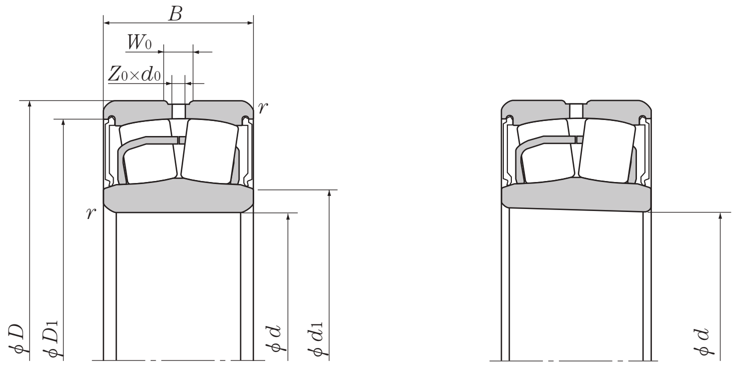
Nominal bore diameter d mm over	incl.	C2 min	C2 max	CN min	CN max	C3 min	C3 max	C4 min	C4 max
—	30	15	25	25	40	40	55	55	75
30	40	15	30	30	45	45	60	60	80
40	50	20	35	35	55	55	75	75	100
50	65	20	40	40	65	65	90	90	120
65	80	30	50	50	80	80	110	110	145
80	100	35	60	60	100	100	135	135	180
100	120	40	75	75	120	120	160	160	210
120	140	50	95	95	145	145	190	190	240
140	160	60	110	110	170	170	220	220	280
160	180	65	120	120	180	180	240	240	310
180	200	70	130	130	200	200	260	260	340
200	225	80	140	140	220	220	290	290	380
225	250	90	150	150	240	240	320	320	420

2) Tapered bore

Unit：μm

Nominal bore diameter d mm over	incl.	C2 min	C2 max	CN min	CN max	C3 min	C3 max	C4 min	C4 max
—	30	20	30	30	40	40	55	55	75
30	40	25	35	35	50	50	65	65	85
40	50	30	45	45	60	60	80	80	100
50	65	40	55	55	75	75	95	95	120
65	80	50	70	70	95	95	120	120	150
80	100	55	80	80	110	110	140	140	180
100	120	65	100	100	135	135	170	170	220
120	140	80	120	120	160	160	200	200	260
140	160	90	130	130	180	180	230	230	300
160	180	100	140	140	200	200	260	260	340
180	200	110	160	160	220	220	290	290	370
200	225	120	180	180	250	250	320	320	410
225	250	140	200	200	270	270	350	350	450

Dimension Table



Oil inlet number

Z_0	
D1	W33
4	3

Bearing numbers Cylindrical bore	Tapered bore❶	Boundary dimensions mm d	D	B	r_s min❷	W_0	d_0	Basic load ratings dynamic kN C_r	static kN C_{0r}	dynamic kgf C_r	static kgf C_{0r}
WA22205EALLSW33	—	25	52	23	1	3	1.5	57.3	46.1	5,840	4,700
WA22206EALLSW33	—	30	62	25	1	4	2	75.7	64.5	7,720	6,580
WA22207EALLSW33	WA22207EALLSKW33	35	72	28	1.1	5	2	100	92	10,200	9,380
WA22208EALLSD1	WA22208EALLSKD1	40	80	28	1.1	5	2.5	116	105	11,800	10,700
WA22209EALLSD1	WA22209EALLSKD1	45	85	28	1.1	6	2.5	121	113	12,300	11,500
WA22210EALLSD1	WA22210EALLSKD1	50	90	28	1.1	6	2.5	130	124	13,300	12,600
WA22211EALLSD1	WA22211EALLSKD1	55	100	31	1.5	6	3	155	148	15,800	15,100
WA22212EALLSD1	WA22212EALLSKD1	60	110	34	1.5	7	3	187	181	19,100	18,400
WA22213EALLSD1	WA22213EALLSKD1	65	120	38	1.5	8	3.5	226	224	23,100	22,900
WA22214EALLSD1	WA22214EALLSKD1	70	125	38	1.5	7	3.5	235	240	24,000	24,400
WA22215EALLSD1	WA22215EALLSKD1	75	130	38	1.5	7	3.5	244	249	24,800	25,400
WA22216EALLSD1	WA22216EALLSKD1	80	140	40	2	8	3.5	278	287	28,400	29,300
WA22217EALLSD1	WA22217EALLSKD1	85	150	44	2	8	3.5	324	330	33,000	33,600
WA22218EALLSD1	WA22218EALLSKD1	90	160	48	2	10	4.5	384	398	39,200	40,600
WA22220EALLSD1	WA22220EALLSKD1	100	180	55	2.1	11	5	472	495	48,100	50,500
WA22222EALLSD1	WA22222EALLSKD1	110	200	63	2.1	12	6	602	643	61,400	65,600
WA22224EALLSD1	WA22224EALLSKD1	120	215	69	2.1	12	6	688	753	70,100	76,800
WA22226EALLSD1	WA22226EALLSKD1	130	230	75	3	13	6	808	898	82,400	91,600

❶ Tapered bore ratio of 1:12. ❷ Smallest allowable dimension for chamfer dimension r.

NTN Standard Grease

- Brand name: Shell Alvania EP grease No.2
  High performance grease for heavy duty containing extreme pressure additives.
- Amount of grease: 15～25% of inside free space of the bearing.

Allowable Speed

- With relubrication : $dn \leqq 6\times10^4$
- Without relubrication : $dn \leqq 8\times10^4$

(d= inner bore diameter dimension, mm) × (n= operating speed, min^{-1})

Allowable Misalignment

- 0.009 rad (0.5˚)

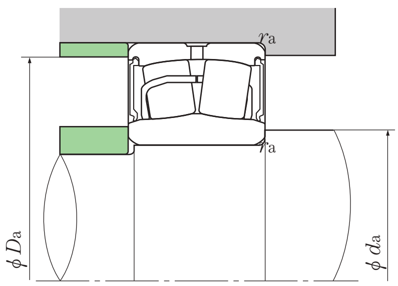
Allowable Temperature Range

- Bearing temperature : -20～+110"

Bearing Number

WA 222 20 EA LLS K D1 C3

- **Seal type code** — WA
- **Dimension series code** — 222
- **Bore diameter code** — 20
- **Type code** — EA — **EA:** Window-type presed steel cage
- **Contact seal on both sides** — LLS
- **Bore configuration code** — K — No code: Cylindrical bore K: Tapered bore
- **Lubrication hole / lubrication groove code** — D1
  - **D1 :** With oil inlet/oil groove (D1 specication only)
  - **W33:** With oil inlet/oil groove (European market specication)
- **Internal clearance code** — C3



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_1, Y_2 and Y_o see the table below.

Abutment and fillet dimensions					Constant	Axial load factor			Mass (approx.)		Amount of grease (approx.) g
d_1	d_a min	D_a max	D_1	r_s max	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore	
29	29	47	47	1	0.34	2.00	2.98	1.96	0.19	—	1.4～2.4
36	36	56	56	1	0.31	2.15	3.20	2.10	0.30	—	2.0～3.3
43	42	65	65	1.1	0.31	2.21	3.29	2.16	0.50	0.49	2.3～3.9
48	47	73	73	1.1	0.27	2.47	3.67	2.41	0.58	0.57	3.1～5.2
53	52	78	78	1.1	0.26	2.64	3.93	2.58	0.63	0.61	3.4～5.7
58	57	83	83	1.1	0.24	2.84	4.23	2.78	0.70	0.68	3.4～5.6
64	64	93	93	1.5	0.23	2.95	4.40	2.89	0.94	0.91	5.2～7.9
70	69	102	102	1.5	0.24	2.84	4.23	2.78	1.25	1.22	6.6～11.0
76	74	111	110	1.5	0.24	2.79	4.15	2.73	1.72	1.67	8.5～14.2
82	79	116	116	1.5	0.22	3.01	4.48	2.94	1.78	1.73	9.6～16.0
86	84	121	121	1.5	0.22	3.14	4.67	3.07	1.88	1.83	9.9～16.4
93	91	131	131	2	0.22	3.14	4.67	3.07	2.32	2.27	12.2～20.3
98	96	140	140	2	0.22	3.07	4.57	3.00	2.90	2.83	16.9～28.1
103	101	149	147	2	0.23	2.90	4.31	2.83	3.68	3.59	20.4～34.1
115	112	168	165	2.1	0.24	2.84	4.23	2.78	5.40	5.25	28.8～48.0
127	122	188	183	2.1	0.25	2.69	4.00	2.63	7.79	7.58	41.6～69.3
138	132	203	197	2.1	0.25	2.74	4.08	2.68	9.76	9.48	52.8～88.0
148	144	216	211	3	0.25	2.69	4.00	2.63	11.9	11.6	62.6～104.4

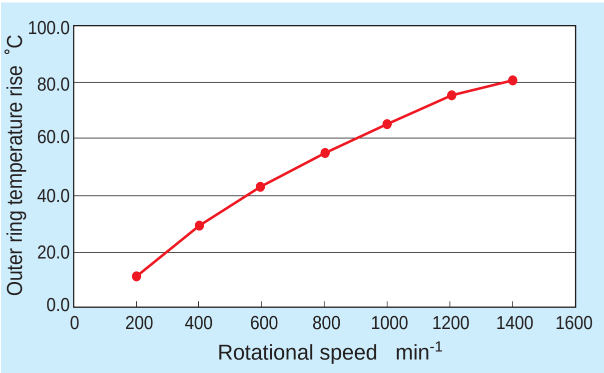
Performance Test Data

Heat Run Test

[Test conditions]

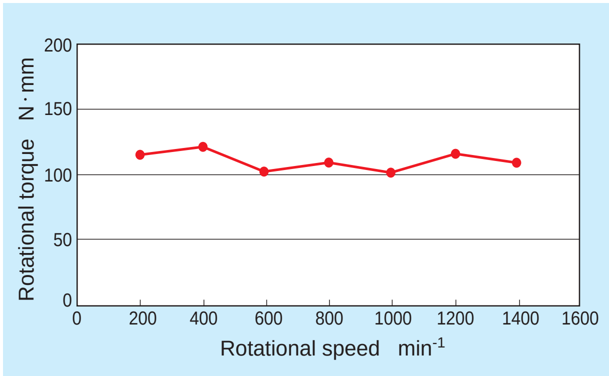
Bearing	: WA22218EALLSD1
Load	: Radial load 294N {30kgf}
Speed	: 200～1400min^{-1}
Lubrication	: Shell Alvania EP grease No.2 (**NTN** code 8A)
Amount of grease	: 20% of free space
Operating time	: Until temperature rise stabilizes

[Test results]



Outer ring temperature rise

[Test results]



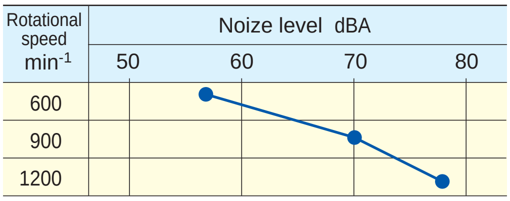
Rotational torque

Noise Test

[Test conditions]

Bearing	: WA22218EALLSD1
Load	: Radial load 980N {100kgf}
Speed	: 600, 900, 1200min^{-1}
Lubrication	: Shell Alvania EP grease No.2 (**NTN** code 8A)
Amount of grease	: 20% of free space

[Test results]



Grease Leakage Test

[Test conditions]

Bearing	: WA22218EALLSD1
Load	: Radial load 1960N {200kgf}
Speed	: 1000min^{-1}
Lubrication	: Shell Alvania EP grease No.2 (**NTN** code 8A)
Amount of grease	: 20% of free space
Operating time	: 100 hours

[Test results]

Accumulated total amount of grease leakage		
25h	50h	100h
0.47g	0.58g	0.63g

Handling Precautions

1. Because the internal radial clearance of "ULTAGE Series Sealed Spherical Roller Bearings" with tapered bores cannot be measured with a thickness gauge, please monitor clearances by measuring the axial movement of the inner ring as shown in **Table 1**.
2. **During assembly, if misalignment exceeding the allowable misalignment angle of ±0.5˚ is applied to the bearing, rollers may come in direct contact with seals causing seal deformation. Furthermore, if additional force is applied under these conditions, seals may separate from the bearing entirely. Therefore, caution is advised.**
3. Please use Lithium mineral grease. In case other types of grease are to be used, please consult **NTN**.
4. **If a shrink fit is to be applied, please do not exceed a bearing temperature of 100˚C. However, these bearing cannot be shrink fit via immersion in a hot oil bath.**

Table 1 Installing sealed tapered bore bearings

Nominal bore diameter *d* mm		Reduction in radial internal clearance		Axial displacement drive-up		Minimum residual internal clearance		
over	incl.	min	max	min	max	CN	C3	C4
24	30	0.010	0.015	0.15	0.20	0.015	0.025	0.040
30	40	0.015	0.020	0.25	0.30	0.015	0.030	0.045
40	50	0.020	0.025	0.35	0.40	0.020	0.035	0.055
50	65	0.025	0.030	0.40	0.45	0.025	0.045	0.065
65	80	0.035	0.040	0.50	0.60	0.030	0.055	0.080
80	100	0.040	0.050	0.60	0.70	0.030	0.060	0.090
100	120	0.055	0.065	0.80	0.90	0.035	0.070	0.105
120	130	0.065	0.075	0.90	1.00	0.045	0.085	0.125

HK-F Type Drawn Cup Needle Roller Bearings

プレミアムシェル™軸受

CAT.No.3029-2/JE

CAT.No.3029-2/JE 23.01.005 DS/DS

The Next Generation of Drawn Cup Needle Roller Bearings

HK-F type drawn cup needle roller bearings

次世代のシェル形針状ころ軸受 プレミアムシェル™ 軸受

Advantages of HK-F type drawn cup needle roller bearings

(Compared with current standard drawn cup needle roller bearings)

プレミアムシェル™ 軸受の特長

〈現行標準仕様 シェル形軸受との比較において〉

■Service life: Three times longer

■寿命向上：3倍

■Allowable static load: 1.5 times greater

(Safety factor: current products, $S_0≧3$; HK-F type, $S_0≧2$)

■静的許容荷重向上：1.5倍

（安全率　現行標準品：$S_0≧3$　プレミアムシェル™ 軸受：$S_0≧2$）

■Reduction and stabilization of press fit force

Bearings can be press fit from either side thanks to manufacturing by the "Pre-bent"production method

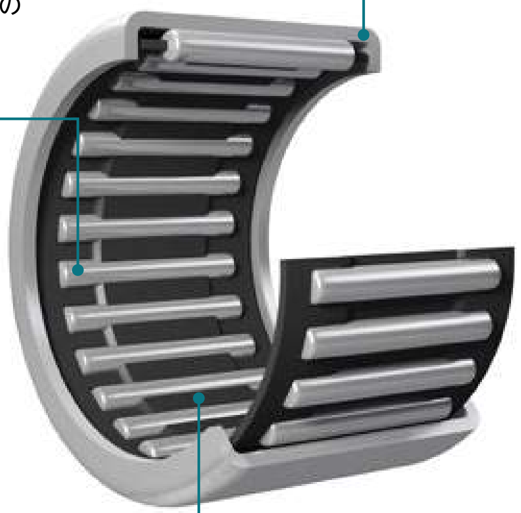
■圧入力低減と安定化

プリ・ベント仕様品については組込方向性なし

1. Bearing specifications 軸受仕様

NTN optimized the specifications of every bearing component in order to develop a new series of long-life drawn cup needle roller bearings.

すべての部品に対する最適仕様を追求し、長寿命化ニーズに対応したシェル形針状ころ軸受の新シリーズが誕生しました。



Rollers ころ

Special heat treatment

NTN has adopted a special heat treatment (specialized carbonitriding) as its new standard.
This special heat treatment provides proven results in extending service life.

特殊熱処理の採用

長寿命化において多くの実績を持つ、特殊熱処理（特殊浸炭窒化処理）を標準仕様としています。

Crowning

Stress concentration at the roller ends (edge load) caused by assembly misalignment and heavy load is reduced.
This innovation contributes to extended bearing life.

クラウニングの採用

取付誤差、重荷重により生ずるころ端部の応力集中（エッジロード）を緩和し、寿命向上に貢献します。

Cage 保持器

V-form cage

The flow of lubricant to and from the inside of the bearing has been improved. At the same time, NTN has adopted a V-form cage design to ensure roller stability, thus extending bearing life.

V形状を採用

軸受内部への潤滑油の流入・流出を向上させ、さらに運転中のころの安定挙動が可能となるV形状を採用することで寿命向上に貢献します。

Case-hardened and tempered or soft-nitrided

The cage is case-hardened and tempered or soft-nitrided to enhance wear resistance and mechanical strength.

浸炭焼入れ または 軟窒化

保持器の耐摩耗性と強度の向上を図っています。

Outer ring 外輪

Carburized chrome molybdenum steel

The higher internal hardness resists permanent deformation from static load. As a result, HK-F type drawn cup needle roller bearings can be used under static load conditions with a safety factor of $S_0≧2$, a significant improvement over the $S_0≧3$ safety factor of current standard drawn cup needle roller bearings.

クロムモリブデン鋼の浸炭焼入れ

内部硬度の向上により静的荷重による永久変形を抑えることで従来の安全率 $S_0≧3$に対して $S_0≧2$の静的重荷重条件下での使用を可能にしました。

Optimal outer ring shape including optimized chamfers and outer diameter surface

The optimized shape contributes to smooth press-fitting of the bearing into the housing.
This arrangement greatly simplifies the press-fitting process on an automatic assembly line.

外径母線形状の最適化、チャンファ形状の最適化

形状の最適化でスムーズなハウジングへの圧入を実現しました。自動組立ライン等での圧入作業の効率化に貢献します。

Redesigned rib

NTN has introduced a rib with a larger bore diameter to promote the flow of lubricant into the bearing from outside.

鍔内径寸法の変更

軸受外部からの潤滑油の流入を容易にするため、鍔内径寸法を大きくすることで、軸と鍔内径間のすきまを十分に確保しました。

Other features その他

"Pre-bent" production method (Only for some HK-F type drawn cup needle roller bearings)

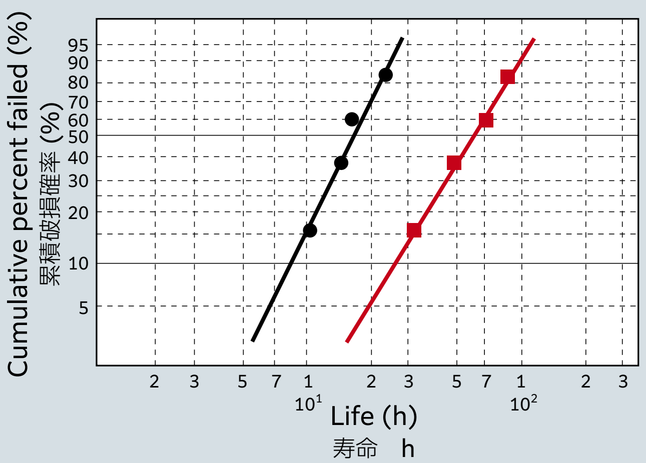
The "Pre-bent" production method results from an unconventional manufacturing process. In this process, the rollers and cage are first assembled into the outer ring and the bent edge rib is bent prior to heat treatment. This gives the rib (at the bent edge side) the same hardness as the remainder of the outer ring.
At the same time, this development eliminates the conventional limitation that the bearing must be press-fit with a jig placed on the marked side face.
This allows the bearing to be press-fit in either direction.
Additionally, optimal heat-treatment contributes to longer bearing life.

プリ・ベント仕様の採用（一部対象外）

プリ・ベント仕様とは、従来と異なる製造方法です。
外輪の熱処理前に保持器付き針状ころを挿入して、外輪の縁曲げを行ったあとに熱処理を実施するため、両側の外輪鍔硬さが確保されます。このことで、刻印側、非刻印側のいずれの方向からでも圧入が可能となりました（従来品は、鍔硬さが確保されている刻印側から治具を当てて圧入）。さらに、熱処理の最適化で寿命向上にも貢献します。

2. Test data 試験データ

1) Life test 寿命試験

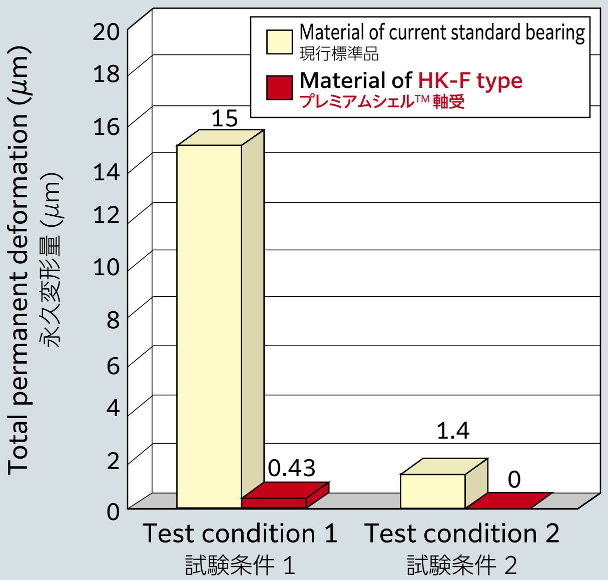


● Current standard product 現行標準品
■ HK-F type プレミアムシェル™ 軸受

Test bearing: (Current) HK2216C (HK-F type) HK2216F
Test load: 6.82 kN《approx. 0.5 C》
Rotating speed: 10 000 min^{-1}
Lubricating oil: Turbine oil 46
Lubrication system: Circulating oil

試験軸受：(現行) HK2216C (プレミアムシェル™ 軸受) HK2216F
試験荷重：6.82 kN《約 0.5C》
回転速度：10 000 min^{-1}
潤　　滑：タービン#46
潤滑方法：循環給油

2) Static load test of outer ring material 外輪材質の静的強度試験



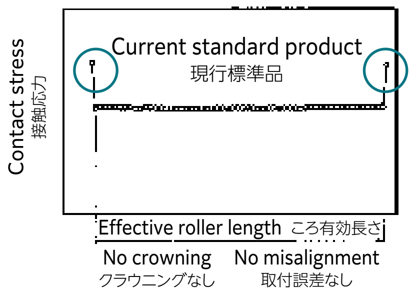
Test condition	1	2
Contact stress GPa	3.9	3.4
Equivalent safety factor S_0	1.5	2
Test plate	t = 1 mm flat	
Rollers	ϕ3×7.8, crowning	

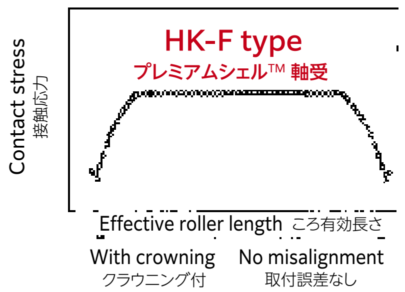
試験条件	1	2
接触応力 GPa	3.9	3.4
安全率 S_0 換算	1.5	2
試験片	t = 1 mm 平板	
使用ころ	ϕ3×7.8, クラウニング付き	

3. Effect of crowned rollers (calculated values) ころクラウニングの効果(計算値)

The HK-F type drawn cup needle roller bearing has crowned rollers. Crowning reduces the stress concentration at the roller ends (indicated by round symbols within the diagram at right) caused by heavy load.

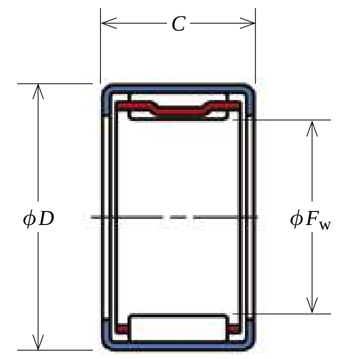
プレミアムシェル™ 軸受ではころへのクラウニング加工を標準仕様とすることで、重荷重条件下で現行標準品使用時に発生するころエッジ部の応力集中(右図丸印部)を緩和しています。



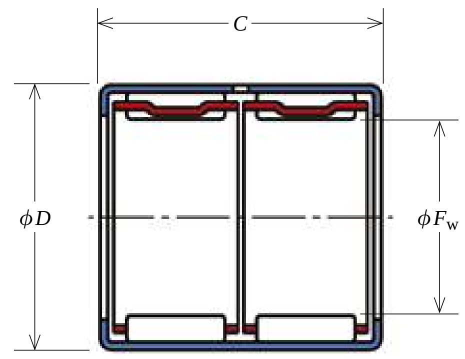


4. Dimension table for HK-F type drawn cup needle roller bearings

プレミアムシェル™ 軸受寸法表



Type HK-F、Type HMK-F
HK-F形、HMK-F形



Type HK-ZWFD
HK-ZWFD形

Boundary dimensions 主要寸法 mm			Basic load ratings N dynamic 基本動定格荷重	static 基本静定格荷重	Fatigue load limit 疲労限荷重 N	Limiting speeds 許容回転速度 min^{-1} Grease グリース潤滑	Oil 油潤滑	Bearing numbers 呼び番号
F_w	D	C	C_r	C_{0r}	C_u			
3	6.5	6	925	565	69	33 000	50 000	**HK0306FT2**
4	8	8	1 770	1 270	155	30 000	45 000	**HK0408FT2**
5	9	9	2 450	1 990	243	27 000	41 000	**HK0509FM**
6	10	9	2 920	2 590	315	25 000	39 000	**HK0609FM**
7	11	9	3 150	2 930	355	23 000	38 000	**HK0709FM**
8	12	10	3 850	3 950	480	20 000	37 000	**HK0810FM**
9	13	10	4 300	4 650	570	18 000	36 000	**HK0910FM**
	13	12	5 400	6 250	765	18 000	36 000	**HK0912F**
10	14	10	4 500	5 100	620	16 000	35 000	**HK1010FM**
	14	12	5 650	6 800	830	16 000	35 000	**HK1012F**
	14	15	7 250	9 400	1 140	16 000	35 000	**HK1015F**
12	16	10	5 050	6 250	760	13 000	29 000	**HK1210FM**
	18	12	6 600	7 300	890	13 000	29 000	**HK1212FM**
13	19	12	6 950	7 900	965	12 000	27 000	**HK1312FM**
14	20	12	7 200	8 500	1 040	11 000	25 000	**HK1412FM**
	20	16	10 300	13 400	1 640	11 000	25 000	**HK1416F**
15	21	12	7 500	9 100	1 110	11 000	23 000	**HK1512FM**
	21	16	10 700	14 400	1 750	11 000	23 000	**HK1516F**
	21	22	12 900	18 200	2 220	11 000	23 000	**HK1522ZWFD**
16	22	12	7 750	9 700	1 180	10 000	22 000	**HK1612FM**
	22	16	11 100	15 300	1 870	10 000	22 000	**HK1616F**
	22	22	13 300	19 400	2 370	10 000	22 000	**HK1622ZWFD**
17	23	12	8 050	10 300	1 260	9 500	21 000	**HK1712FM**
18	24	12	8 300	10 900	1 330	8 500	19 000	**HK1812FM**
	24	16	11 800	17 300	2 110	8 500	19 000	**HK1816F**
20	26	12	8 750	12 100	1 480	8 000	18 000	**HK2012FM**
	26	16	12 500	19 200	2 340	8 000	18 000	**HK2016F**
	26	20	16 000	26 200	3 200	8 000	18 000	**HK2020F**
	26	30	21 500	38 500	4 700	8 000	18 000	**HK2030ZWFD**
22	28	12	9 200	13 400	1 630	7 500	16 000	**HK2212FM**
	28	16	13 200	21 100	2 570	7 500	16 000	**HK2216F**
	28	20	16 800	28 800	3 500	7 500	16 000	**HK2220F**
24	31	20	18 300	28 200	3 450	6 500	15 000	**HMK2420F**
25	32	12	11 100	15 200	1 850	6 500	14 000	**HK2512F**
	32	16	15 900	24 000	2 920	6 500	14 000	**HK2516F**
	32	26	26 400	46 000	5 600	6 500	14 000	**HK2526F**
	33	15	15 200	19 900	2 430	6 500	14 000	**HMK2515F**
28	35	16	16 700	26 400	3 200	5 500	13 000	**HK2816F**
30	37	12	12 300	18 200	2 220	5 500	12 000	**HK3012F**
	37	20	22 300	39 500	4 800	5 500	12 000	**HK3020F**
	37	26	28 500	54 000	6 550	5 500	12 000	**HK3026F**
35	42	12	13 300	21 300	2 600	4 700	10 000	**HK3512F**
	42	16	19 000	33 500	4 100	4 700	10 000	**HK3516F**
40	47	16	20 300	38 500	4 700	4 000	9 000	**HK4016F**

Auxiliary symbols 補助記号
T2：Polyamide resin cage ポリアミド樹脂製保持器
M："Pre-bent" production method プリ・ベント仕様品

Inquiry お問い合わせ

For inquiries and consultations on technology, prices and delivery dates, please contact your local sales office.

技術相談・価格・納期のご照会・相談等は、最寄りの支社・営業所にお申し付けください。

Sales Network

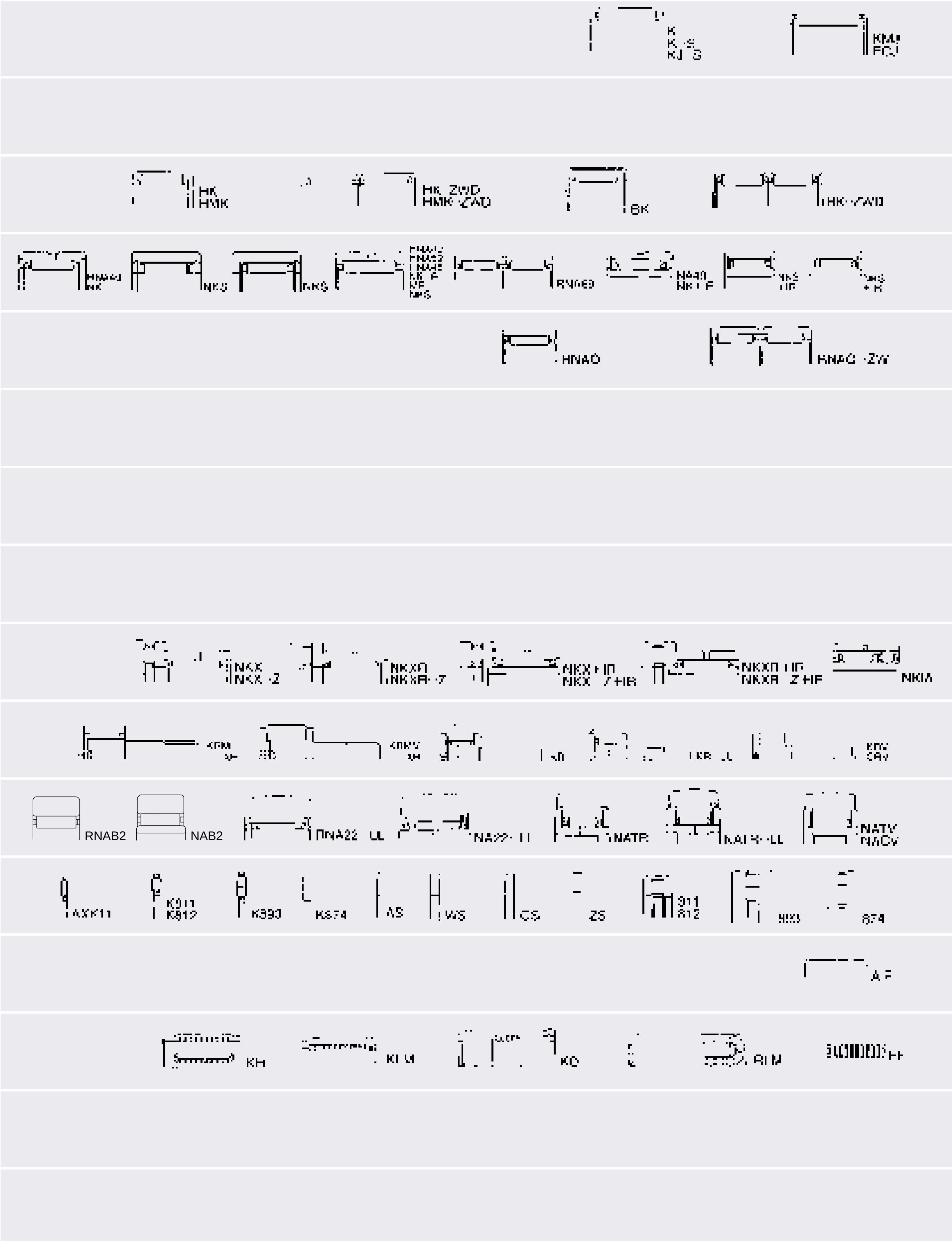
営業拠点情報はこちら

NTN®

Needle Roller Bearings

CAT. NO. 2300-X/E

CONTENTS



Warranty

NTN warrants, to the original purchaser only, that the delivered product which is the subject of this sale (a) will conform to drawings and specifications mutually established in writing as applicable to the contract, and (b) be free from defects in material or fabrication. The duration of this warranty is one year from date of delivery. If the buyer discovers within this period a failure of the product to conform to drawings or specifications, or a defect in material or fabrication, it must promptly notify **NTN** in writing. In no event shall such notification be received by **NTN** later than 13 months from the date of delivery. Within a reasonable time after such notification, **NTN** will, at its option, (a) correct any failure of the product to conform to drawings, specifications or any defect in material or workmanship, with either replacement or repair of the product, or (b) refund, in part or in whole, the purchase price. Such replacement and repair, excluding charges for labor, is at **NTN**'s expense. All warranty service will be performed at service centers designated by **NTN**. These remedies are the purchaser's exclusive remedies for breach of warranty.

NTN does not warrant (a) any product, components or parts not manufactured by **NTN**, (b) defects caused by failure to provide a suitable installation environment for the product, (c) damage caused by use of the product for purposes other than those for which it was designed, (d) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, or (g) any other abuse or misuse by the purchaser.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

In no case shall **NTN** be liable for any special, incidental, or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory,and in no case shall total liability of **NTN** exceed the purchase price of the part upon which such liability is based. Such damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the product or any associated equipment, cost of capital, cost of any substitute equipment, facilities or services, downtime, the claims of third parties including customers, and injury to property. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, the limits in this paragraph and in paragraph (2) shall apply to the extent allowable under case law and statutes in such states.

Any action for breach of warranty or any other legal theory must be commenced within 15 months following delivery of the goods.

Unless modified in a writing signed by both parties, this agreement is understood to be the complete and exclusive agreement between the parties, superceding all prior agreements, oral or written, and all other communications between the parties relating to the subject matter of this agreement. No employee of **NTN** or any other party is authorized to make any warranty in addition to those made in this agreement.

This agreement allocates the risks of product failure between **NTN** and the purchaser. This allocation is recognized by both parties and is reflected in the price of the goods. The purchaser acknowledges that it has read this agreement, understands it, and is bound by its terms.

NTN

Needle Roller Bearings

TECHNICAL DATA CONTENTS

DIMENSIONAL DATA CONTENTS

1. Classification and Characteristics of Needle Bearings

Needle roller bearings have relatively small diameter cylindrical rolling elements whose length is much larger than their diameter.

Compared with other types of rolling bearings, needle roller bearings have a small cross-sectional height and significant load-bearing capacity and rigidity relative to their volume. Also, because the inertial forces acting on them is limited, they are an ideal choice for applications with oscillating motion. Needle roller bearings also work well in compact and lightweight machine designs and they serve as a ready replacement for sliding bearings.

NTN offers several different types of needle roller bearings.

Needle roller and cage assembly

A needle roller and cage assembly includes needle rollers and a cage that guides and retains the rollers.

- These assemblies use both the shaft and housing as raceway surfaces. Consequently, the cross-sectional thickness of the assembly is small, roughly equivalent to the diameter of the needle rollers.
- Because this bearing type has no inner or outer rings, the installation is much easier.
- These assemblies are available in both single-row and double-row configurations.
- As long as the tolerance limits of the shaft and housing are satisfied, the bearing radial internal clearance can be adjusted.

Needle roller and cage assembly for connecting rods

A needle roller and cage assembly for connecting rods includes needle rollers and a cage that guides and retains rollers. This bearing type is used for connecting rods in compact and mid-sized internal combustion engines (e.g. outl engines and multipurpose engines), as well as reciprocating compressors.

Needle roller and cage assembly for large end

- This product boasts a unique light-weight high-strength design to cope with crank motion involving the simultaneous rotation and revolution on the large-end side of connecting rod. At the same time, the outer diameter of the cage surface is precision-finished so that the assembly maintains the appropriate cage-riding clearance.
- The cage is made of high-tensile special steel with a surface hardened treatment.
- The assembly uses an outer diameter-guided system.
- If an application has poor lubrication, the cage can be protected with a surface treatment using a non-ferrous metal.
- For applications with a one-piece crank shaft, split-type cage design is also available.

Needle roller and cage assembly for small end connecting rods

- The small end of connecting rods are subjected to high impact loads and high-speed oscillation. To address this condition, these bearings boast a unique light-weight high-strength design. In addition the cage bore surface is precision-finished so that the assembly maintains an appropriate cage-riding clearance.
- The cage is made from high tensile special steel and the cage surface is hardened.
- The cage is bore-guided and the guide surface is designed to be as long as possible to minimize surface pressure.
- Rollers with the longest possible length are used, At the same time, the maximum number of smaller diameter rollers are incorporated in order to reduce the contract pressure on the rollers.

Drawn-cup needle roller bearing

This bearing type includes an outer ring and needle rollers, which are both drawn from special thin steel plate by precision deep drawing, and a cage which guides the needle rollers precisely.

- This bearing product comprises an outer ring formed through precision deep-drawing process from a thin special steel blank; needle rollers; and cage that guides the rollers.
- A hardened and ground shaft or inner ring (IR Series) is used as the raceway.
- This bearing needs no axial clamping due to easy installation and a press-fit in the housing.
- Both a closed end type to close around the end of the shaft and an open end type are available.
- Furthermore, a type with a seal installed on a single side or on both sides is also available.
- The standard type includes a needle roller and cage assembly. In addition to this type, a special type with full complement rollers is available as an option.

Machined-ring needle roller bearings

This product mainly includes machined components — an outer ring and inner ring, needle rollers and a cage that guides the rollers. In this bearing, the cage or needle rollers are guided by the rib or side plate of the outer ring. Consequently, the roller and cage assembly cannot be separated from the outer ring. When the user wants to use the shaft as the raceway surface, NTN can offer a variant without an inner ring.

- Available in both metric dimensions and inch dimensions.
- This product is best-suited to a space-saving design due to its low section height,and large load capacity.
- Another advantage is high rigidity and high bearing accuracy due to the machined outer ring
- This bearing can be used with a housing made of light metal, because of its highly rigid outer ring. (Other than NKS small size products)
- The outer ring has a lubrication hole and lubrication groove.
- Both single-row and double-row types are available.
- A type with seal a installed on a single side or on both sides is also available.

Machined-ring needle roller bearing separable type

This product is essentially comprised of a machined outer ring, inner ring, and, needle rollers with a cage to guide the rollers. With this bearing, the roller and cage assembly can be separated from the outer ring. If the user wants to use the shaft directly as a raceway surface, NTN offers a variant that lacks inner ring.

- Easy to install: The following components can be mounted independently: cage and roller assembly, and the inner and outer rings.
- Radial Internal Clearance: Radial internal clearance is selected by combining individual independent components with the desired clearance.
- Space Saving Design: Best-suited to save space because of its low section height and large load capacity.
- High Rigidity: The machined (precut) outer ring allows the bearing to have high rigidity and high bearing.
- Housing Material: This bearing can be mounted in light alloy metal housings because of the outer ring high rigidity.
- Single and double row types bearings available. The outer ring of the double row bearing has a lubrication hole and groove.

Inner ring

Most needle roller bearings lack an inner ring and use the shaft as raceway surface. However, there may be cases where the shaft surface cannot be changed on the machine to the required hardness and/or roughness so in this case an inner ring may be used. NTN inner rings are made of high carbon chromium bearing steel blank that is heat-treated, and then fInish-ground to higher precision.

- Can also be used as a bushing.
- Available in both metric and inch series.
- Lubrication hole type at the raceway center is also available.

Clearance-adjustable needle roller bearing

This product is essentially comprised of a machined outer ring, inner ring, and, needle rollers with a cage to guide the rollers. This product features an outer ring with a unique cross-sections shape machined from a solid blank material. With this bearing, the roller and cage assembly cannot be separated from the outer ring. If the user wants to use the shaft directly as a raceway surface, NTN offers a variant that lacks inner ring.

- Clearance Reduction: The outer ring raceway diameter is reduced by clamping the outer ring axially,which then reduces the roller assembly bore diameter.
- Clearance Adjustment: Axial clamping force on the bearing can be adjusted to alter the reduction on outer ring raceway diameter.
- Application: This bearing is used on machine tools main spindle and other similar applications which require high speed rotational accuracy of JIS Grade-4.

Thrust roller bearing

The product is comprised of needle or cylindrical rollers, a cage that guides and retains the rollers, and a disk shaped bearing ring, and is capable of holding an axial load in one direction. The mounting surface can be used as raceway surface when the mounting surface are beat-treated and finished. As a result, the bearing can be supplied without bearing ring raceways.

- Space Saving Design: Best-suited to save space because of its small section height and large load capacity.
- Bearing Types: Current available bearing ring types are AS, WS, GS, and ZS. The AS type consists of a thin steel disk having undergone surface-hardening, while the WS, GS and ZS types are machined.

Complex needle roller bearings — Needle roller bearing with thrust bearing —

This complex bearing is comprised of a needle roller bearing for supporting radial load and a thrust bearing for supporting axial load which are assembled integrally. Both thrust ball bearing and thrust roller bearing type are available to support axial load.

- A variant of thrust bearing are equipped with a dust cover that positively prevents outward release of oil splash and protects the bearing against ingress of dust.

Complex needle roller bearings
— Needle roller bearing with angular contact ball bearing, needle roller bearing with three-point contact ball

This complex bearing is comprised of a needle roller bearing for supporting radial load, a ball bearing for supporting comparatively small axial load and machined inner and outer rings which are all assembled integrally. Both angular contact ball bearing and three-point contact ball bearing are available to support the axial load.

- The complex needle roller bearings (NKIA Series) use an angular contact ball bearing as the thrust bearing to support a one-directional axial load.
- The complex needle roller bearings (NKIB Series) use a three-point contact ball bearing as the thrust bearing to support a double-directional axial load in addition the position in axial direction can be fixed.

Needle roller bearing with double thrust roller bearing

This is a complex bearing wherein a thrust needle roller bearing or a thrust cylindrical roller bearing intends to support an axial load is configured at the double sides of a radial needle roller bearing for supporting radial load.

- Bi-Direction Axial Loading: This bearing can support large axial loads from both sides.
- Application: This complex bearing is designed to support a machine tool precision ball screw.

The track roller bearing is a needle roller bearing with thick outer ring, which is applied to cam roller, guide roller, eccentric roller or rocker arm.

The track roller bearings are mainly categorized into a stud type track roller bearing (cam follower) and a yoke typ roller bearing (roller follower). Various types of the roller follower and the cam follower are available.

Cam follower Needle roller type —

This is a bearing designed for rotation of the outer ring. A needle roller and cage assembly and a stud instead of inner ring are fitted in the thick-walled outer ring. The stud is threaded to be mounted easily. This cam follower (bearing) uses needle rollers as its rolling element and it is available with cage or full complement roller bearing type without cage.

- The bearing type with cage is suitable to comparatively high speed running because its rollers are guided by the cage.
- Having more rollers relative to a given size, a full complement roller type boasts greater load capacity.
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- This cam follower (bearing) is selectively available is both metric and inch sizes.
- A seal built-in type is also available.
- The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

Cam follower —Cylindrical roller type —

This is a full complement roller bearing designed for rotation of the outer ring. Double-row cylindrical rollers and a stud instead of inner ring are fitted in the thick-walled outer ring. The stud is threaded be mounted easily.

- Compared with needle roller type of a given size, cylindrical roller type of a similar size boasts greater load capacity.
- A steel plate is press-fitted in the outer ring and a labyrinth seal is formed between the face ring and the outer ring.
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

Cam follower Eccentric type —

This is a cam follower (bearing) where the studs of the needle roller type and cylindrical roller type a prescribed are made eccentric. It can then be adjusted by making eccentric the outer ring relative position against the raceway.

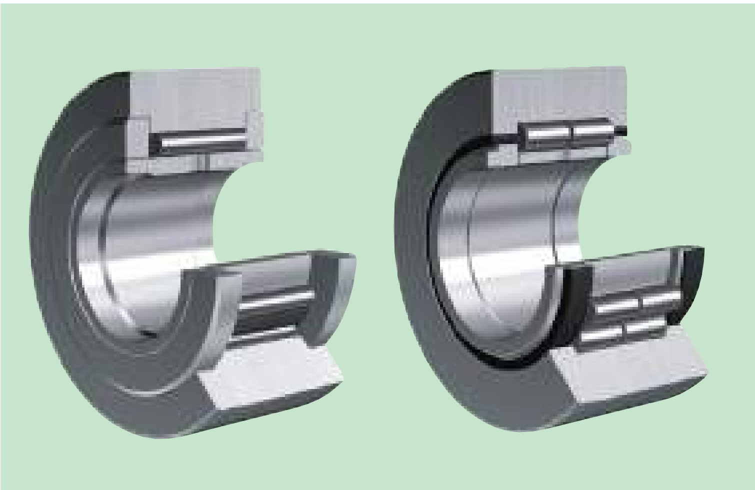
- Load distribution is easily adjustable in configuring two or more cam followers in linear form.
- Preload can be applied by adjustment of load distribution.
- Alignment is possible even when the mounting hole is not processed in high accuracy.
- The outer surface is selectively available in both spherical (crowning) profile and cylindrical profile.
- The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

Roller follower —Without axial guide—

This roller follower is a bearing designed for rotation of the outer ring. A needle roller and cage assembly and a synthetic rubber seal reinforced with steel plate are assembled in a thick-walled outer ring.

- The outer ring, the needle roller and cage assembly, and the rubber seal are non-separable from each other.
- The outer ring is thick-walled type so that it is resistible to high load and impact load.
- **A shaft must be provided with a thrust washer and a flange, because the outer ring has no ribs (or face ring) and no axial guide function.**
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- The spherical outer ring is effective in damping offset load which is caused by deviation in installing.
- The bearing with cylindrical outer ring is suitable for cases of large load and low-hardness track surface,due to its large area of contact with the mating track surface.

Roller follower —With axial guide—



This roller follower is a bearing designed for rotation of the outer ring. A needle roller and cage assembly, an inner ring, and a face ring are assembled in a thick-walled outer ring.

This bearing uses needle rollers as its rolling element. It is available with a cage or full complement roller bearing without cage. The outer ring is guided axially by a face ring which is press-fitted in the inner ring.

- The outer ring is thick-walled type so that it is resistible to high load and impact load.
- The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- The spherical outer ring is effective in damping offset load which is caused by deviation in installing.
- The bearing with cylindrical outer ring is suitable for cases of large load and low-hardness track surface,due to its large area of contact with the mating track surface.
- This bearing is easier to handle because it needs no mounting of a guide (thrust washer, etc.) on the shaft unlike other types without axial guide (RNA22, NA22).

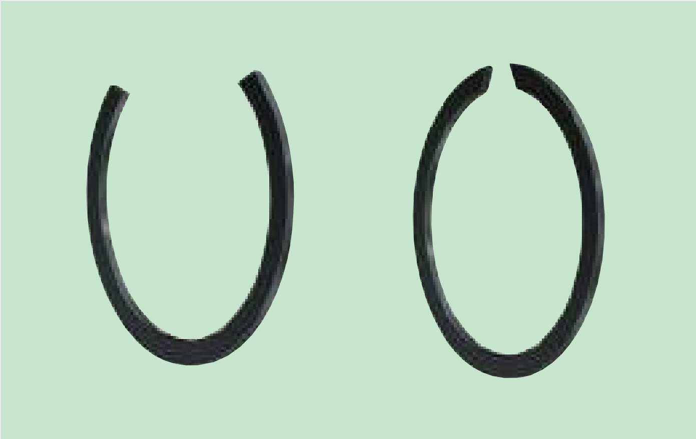
The components described below are for needle roller bearing.

Needle rollers

The needle rollers with flat end round end faces are standard. These rollers are made of high-carbon chrome bearing steel, surface-finished by grinding and buffing after heat-treatment.

- A-Inter-diameter tolerance of the needle rollers is 2mm maximum.
- Rollers with crowned rolling surfaces are also available, which can reduce edge load.
- These needle rollers are supplied individually for applications (pin, shaft).

Snap rings



These are special-purposed rings used for axially positioning, guiding the inner and outer rings, or the needle roller and cage assembly in needle roller bearing.

- Two types are available, for either shaft and/or housing use.
- The snap ring product range cover smaller cross-sectional height products for use in needle roller bearings. The product range also covers snap rings of smaller dimensional range.
- For the axial guide it is recommended to provide a spacer between the cage and the snap ring.

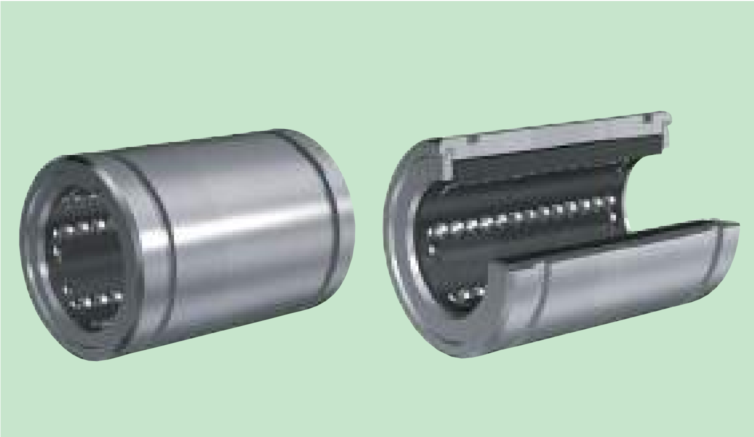
Seals

This product line covers special seals that have been designed for use with low profile needle roller bearings. The product prevents ingress of contamination and help retain grease.

- G-type seal with one lip and GD-type seal with two lips are selectively available on application.
- These seals consist of a ring section formed from steel sheet as well as synthetic rubber material. Their operating temperature ranges from -25 to 120˚C. They are capable of continuous range at a maximum temperature of 100˚C.
- These seals act to prevent the ingress of contamination and over-consumption of lubrication grease.
- The radial section height of each seal is designed to match the drawn-cup needle roller bearings. Hence, these seals require no additional finishing of the housing. This facilitates handling.

This catalogue describes the following ones of linear motion bearings.

Linear ball bearing —Machined ring type—



The product assembly includes a machined outer ring, side plate, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision linear motion bearing develops infinite linear motion on the shaft.

- Standard type, clearance-adjustable type and open type are selectively available on application.
- Some bearings of these types are provided with a synthetic rubber seal at single side or double sides to prevent invasion of foreign matter.
- The steel balls in this product are reliably guided by the cage. Consequently, this product develops stable linear motion on the shaft with minimum frictional resistance.
- **No rotational motion is available.**

Linear ball bearing —Drawn cup type—

The product assembly includes an outer ring formed through precision deep-drawing of thin sheet steel material, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision linear motion bearing develops infinite linear motion on the shaft.

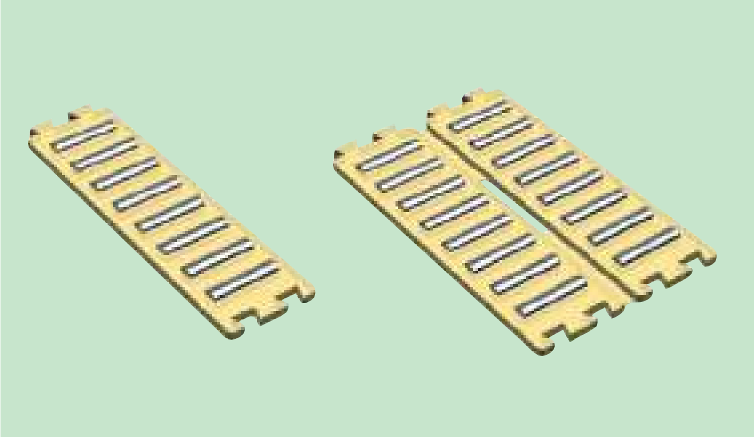
- The outer ring made of thin steel plate creates a smaller section height and allows for a move compact linear motion system.
- Easy to install —This bearing is press-fitted in the housing so that it requires no axial fixing.
- **No rotational motion available.**
- Some bearings of this type are provided with a synthetic rubber seal at double sides to prevent invasion of foreign matter therein.

Linear ball bearing —Stroking type—

The product assembly includes a machined outer ring, side plate, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision bearing rotates and develops finite linear motion on the shaft. The outer ring is provided with a snap ring on both sides and a wavy spring washer is provided between the snap ring and the cage to damp on the impact acting on the cage and to prevent wear of the cage.

- Some bearings of this type are provided with a synthetic rubber seal on each side to prevent invasion of foreign matter.
- The outer ring is grooved so that the snap ring can be fitted and fixed easily.

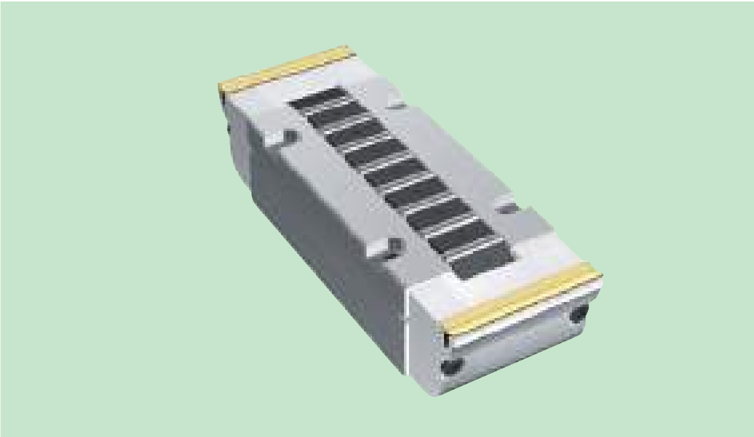
Linear flat roller



This flat roller bearing,comprised of a flat cage and needle rollers, reciprocates on a flat raceway by motion of linear movable components.

- Two material types are available for the cage—synthetic resin and pressed sheet steel.
- FF type molded resin cage – Multiple cages may be joined together in a serial configuration.
- Press-formed steel plate cage – Cage to cage jointing is unavailable, but it can be supplied at any specified length.
- double-row synthetic resin cage has an elastic seam along its center line. When immersed in a hot oil bath heated to 70 to 90˚C the cage can be "folded" to any desired cross-sectional angle so that it can be fitted to a V-sectioned face.

Linear roller bearing

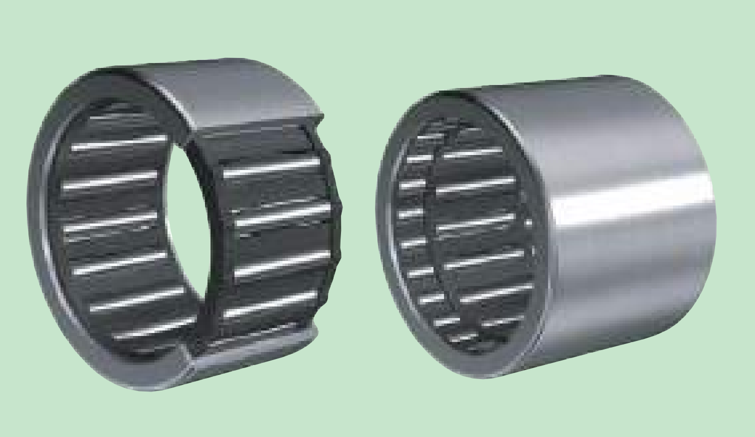


This type has the function of enabling cylindrical rollers to circulate within a track frame and ensures infinite linear motion on a plane.

- Low friction factor due to the cage assembly preventing neighboring rollers from touching each other.
- High load rating due to use of cylindrical rollers

This catalogue describes the following products, too.

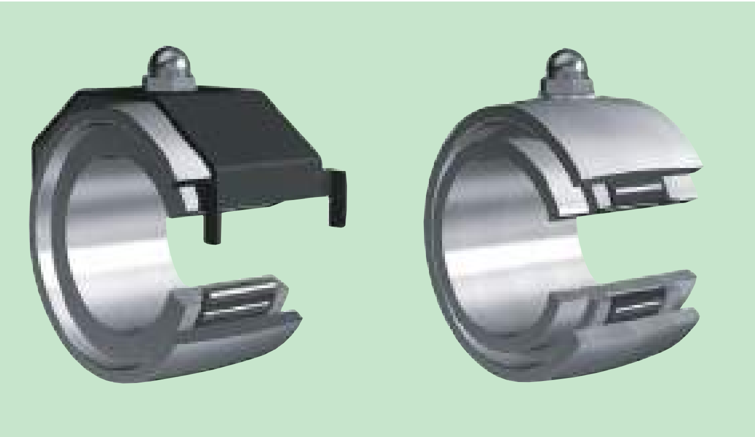
One-way clutch



Comprised of an outer ring drawn from thin special steel plate by precision deep drawing, a spring, needle rollers and a cage, the one-way clutch can transmit torque in only one direction.

- Boasting low frictional torque during over-running, this one-way clutch also features high transmittable torque despite its small cross-sectional height.
- A certain one-way clutch variant has a built-in bearing that supports radial loading. Another variant has a plated outer ring for improved corrosion resistance.
- HF HFL types can be retained axially by merely press-fitting into a housing.
- These one-way clutches use the outer ring drawn by precision deep drawing, which requires a housing with wall thickness of a specified value or more.
- The HF type unit alone is not capable of bearing radial loads, and both ends must be supported with external radial bearings. (On the other hand, HFL type includes integrated radial bearings on each side.)

Bottom roller bearing ~~For~~ textile machinery —



This product has a built-in needle roller bearing pre-filled with grease and is used to support bottom rollers. The spherical outer surface of the outer ring can allow a degree of bottom roller installation error. In order to prevent fiber entry into the bearing, tight clearances are maintained between the outer ring and double-ribbed inner ring, and the rib outer diameter surfaces are knurled.

Tension Pulley ~~For~~ Textile Machinery —

These pulleys are used to guide and tension the tapes and belts driving the spindles of a fine spinning machine, a roving frame, a false twister, etc. The structure is comprised of a precision deep-drawn plate steel pulley which is press-fitted to the outer ring of a bearing.

2. Load Rating and Life

2.1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceways and rolling elements are constantly subjected to repeated compressive stresses which causes **flaking** of these surfaces to occur. This flaking is due to material fatigue and will eventually cause the bearing to fail. The effective life of a bearing is usually defined in terms of **the total number of revolutions a bearing can undergo before flaking of either the raceway surface or the rolling element surfaces occur.**

Other causes of bearing failure are often attributed to problems such as seizing, abrasions, cracking, chipping, scuffing, rust, etc. However these so called "causes" of bearing failure are usually themselves caused by improper lubrication, faulty sealing or inaccurate bearing selection. Since the above mentioned "causes" of bearing failure can be avoided by taking the proper precautions, and are not simply caused by material fatigue, they are considered separately from fatigue or flaking.

2.2 Basic rated life and basic dynamic load rating

A group of seemingly identical bearings, when subjected to identical operating conditions will exhibit a wide diversity in their durability. This disparity in lives can be accounted for by differences in the fatigue of the bearing material itself. This disparity is considered statistically when calculating bearing life.

The basic rated life is based on a 90% statistical model. In this model 90% of an identical group of bearings subjected to identical operating conditions will attain or surpass the stated number of revolutions without any flaking due to rolling fatigue. For bearings operating at fixed constant speeds, the basic operating life (90% reliability) is expressed in the total number of hours of operation.

Basic dynamic load rating expressed a rolling bearing's capacity to support a dynamic load. The basic dynamic load rating is the load under which the basic rating life of the bearing is 1 million revolutions. This is expressed as pure radial load for radial bearings and pure axial load for thrust bearings. These are referred to as **basic dynamic radial load rating** (C_r) and **Basic dynamic axial load rating** (C_a).

The basic dynamic load ratings given in the tables of this catalog are for bearings constructed of NTN standard bearing materials using standard manufacturing technologies. For information about the basic dynamic load rating for a bearing using non-standard material and/or manufacturing techniques, contact NTN Engineering.

The relationship between the basic rated life, the basic dynamic load rating and the bearing load can be expressed in formula (2.1).

Basic Rated Life specified in ISO 281.

$$L_{10} = \left(\frac{C}{P}\right)^p \quad \cdots\cdots (2.1)$$

where,

p= 10/3 ··············For roller bearing

p= 3. ··················For ball bearings

L_{10} : Basic rated life (10^6 revolutions)

C : Basic dynamic rated load, (N) (kgf)
(radial bearings: C_r, thrust bearings: C_a)

P : Bearing load, (N) (kgf)
(radial bearings: P_r, thrust bearings: P_a)

Furthermore, the basic rated life can be expressed in hours using **formula (2.2)**

$$L_{10h} = 500 f_h{}^p \quad \cdots\cdots (2.2)$$

$$f_h = f_n \frac{C}{P} \quad \cdots\cdots (2.3)$$

$$f_n = \left(\frac{33.3}{n}\right)^{1/p} \quad \cdots\cdots (2.4)$$

where,

L_{10h} : Basic rated life, h

f_h : Life factor

f_n : Speed factor

n : Rotational speed, r/ min

Formula (2.2) can also be expressed as **formula (2.5).**

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^p \quad \cdots\cdots (2.5)$$

When several bearings are incorporated into a piece of equipment it is possible to calculate the bearing life of the whole system by way of **formula (2.6)**

$$L = \frac{1}{\left(\frac{1}{L_1^e} + \frac{1}{L_2^e} + \cdots \frac{1}{L_n^e}\right)^{1/e}} \quad \cdots\cdots (2.6)$$

where,

e = 9/8 ………For roller bearings

e = 10/9 ………For ball bearings

L : Total basic rated life of bearing as a whole, h

L_1 , L_2 ···L_n : Individual basic rated life of bearings, 1, 2,···n, h

2.3 Required bearing life for a give application

When selecting a bearing, it is essential to determine the required life of the bearing under the intended operating conditions. The life requirement is usually determined by the durability and reliability required for the particular application. General guidelines for required life are shown in **Table 2.1**.

While the fatigue life of bearing is an important factor to consider when sizing the bearing it is also important to consider the strengths and rigidities of shaft and housing.

Table 2.1 Operating conditions and required life (reference information)

Operation profile	Life Requirement L_{10h} ×10³ hrs.				
	~4	4~12	12~30	30~60	60~
Machine to be run for a short time or only occasionally.	Home electric appliances Power tools	Agricultural machinery Office equipment			
Machine to be run for a short time or only occasionally; however, the machine needs to perform reliably.	Medical equipment Measuring instruments	Home air-conditioner Construction machinery Elevator Cranes	Cranes (sheave)		
Machine to be run for a prolonged time (but not continuous).	Passenger cars Motor cycles	Compact electric motors Buses and trucks General gearing equipment Woodworking machinery	Spindle on machine tool Multi-purpose electric motor for production plant Crusher Vibration screen	Critical gearing equipment Calender rolls for rubber or plastic materials Offset printing press	
Machine to be always run at least 8 hours a day.		Roll neck on steel rolling machinery Escalator Conveyor Centrifugal separator	Axles on rolling stocks Air-conditioning equipment Large electric motor Compressor and pump	Axles on locomotives Traction motors Hoist for mines Press flywheels	Pulp or paper making machinery Propulsion system for ships
Machine to be run 24 hours a day, and must continue operating even in the event of accident.					City water facility Drain and ventilation system for mines Electric power station equipment

2.4 Adjusted rating life

While the basic rating life (90% reliability) for a given bearing can be calculated with the formulas in Subsection 2.2 a number of factors may be present which adjust that life. In some applications it may be necessary to calculate bearing life at greater than 90% reliability. Special materials or manufacturing processes may be applied to the bearing in an effort to increase life. Furthermore, bearing life may be affected by the operating conditions (lubrication, temperature, running speed, etc.).

The basic rating life can be adjusted to consider these factors. The resultant basic rating life is called the **adjusted rating life**, and can be determined by **formula (2.7)**:

$$L_{na} = a_1 \cdot a_2 \cdot a_3 \ (C/P)^p \quad \cdots\cdots\cdots\cdots \textbf{(2.7)}$$

where,

L_{na} : Adjusted life rating 10^6 revolutions
a_1 : Reliability adjustment factor
a_2 : Bearing material adjustment factor
a_3 : Operating condition adjustment factor

2.4.1 Reliability adjustment factor a_1

The reliability adjustment factor a_1, is used when a reliability higher than 90% is required. Values are shown in **Table 2.2**.

2.4.2 Bearing material adjustment factor a_2 for

When non-standard bearing materials or manufacturing processes are used , the life-related bearing characteristics are inevitably changed. In this case, the bearing life is adjusted using the life adjustment factor, a_2.

The basic dynamic load ratings found in the "Bearing Dimensions Table" of the catalog assume the use of standard **NTN** materials and manufacturing processes / techniques. In this case a_2=1.

When special materials or manufacturing techniques are used in the manufacture of the bearing a_2≠1 will need to be applied. In such a case, feel free to contact **NTN** for further information.

When bearings made of high carbon chrome bearing steel are used at temperatures greater than 120°C for a significant period of time significant dimensional changes will occur in the bearing. To limit these changes and their effect on bearing life a special dimension-stabilizing heat-treatment **(TS treatment)** is used. The specific treatment is determined according to the maximum operating temperature. However, this dimension-stabilizing treatment results in lower bearing hardness which reduces bearing life. To account for this, the bearing life is adjusted using the a_2 factor shown in **Table 2.3**.

Table 2.2 Values of reliability adjustment factor a_1

Reliability %	L_n	Reliability adjustment factor a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

Table 2.3 Life adjustment values (a_2) for dimension-stabilizing heat-treated (TS-treated) bearings

Code	Maximum operating temperature	Life adjustment factor for bearing material a_2
TS2-	160°C	1.00
TS3-	200°C	0.73
TS4-	250°C	0.48

2.4.3 Life adjustment factor for operating conditions a_3

The life adjustment factor for operating conditions (a_3) is used to adjust the bearing life when operating under non-ideal conditions such as deteriorated lubricated, the ingress of foreign matter (contamination) or excessively high the rotational speeds.

Generally the life adjustment factor in the case of optimum lubrication and no contamination a_3=1. When the bearing operates under particularly good conditions it is possible to have a_3>1. However, a_3<1 is applied in the following cases.

- **Low dynamic viscosity of grease or oil at bearing operating temperature**
  Radial needle roller bearing 13mm²/s and less
  Thrust needle roller bearing 20mm²/s and less
- **Particularly low rotational speed**
  (The product of rotational speed n min⁻¹ by pitch circle diameter (D_{pw} mm) of rolling element is $D_{pw} \cdot n$<10000.)
- **High operating temperature of bearing**
  When standard bearings operate at high temperatures hardness of the raceway hardness is reduced, impacting bearing life, In such cases the bearing life is adjusted by multiplying the value shown in **Fig.2.1**. **However, this does not apply to bearings having undergone dimension-stabilizing (TS) treatment**.
- **Ingress of foreign matter (contamination) and/or moisture into lubricant**
  When using a bearing operating under suboptimal conditions please feel free to NTN for assistance in applying the adjustment factors.
  If the lubricating conditions are not favorable a factor of $a_2 \times a_3$<1 is usually applied. This is true even if special materials and manufacturing techniques are used that would result in a life adjustment factor>1.

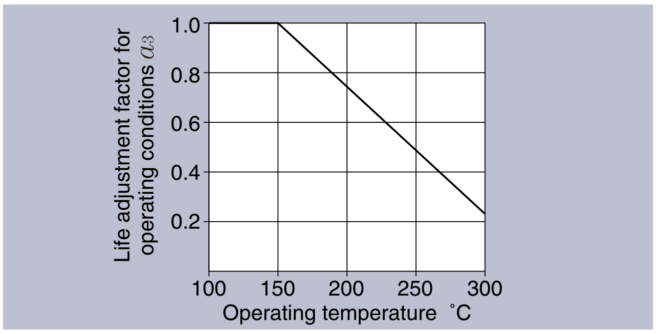


Fig. 2.1 Life adjustment factor for operating conditions depending on operating temperature

2.5 Effect of surface hardness on basic dynamic load rating

It is possible to use the shaft or housing surface as the raceway surface. Under these conditions the surface layer of the shaft/housing must be hardened to HRC58 to 64 and a proper hardening depth must be achieved.

Methods such as ordinary quenching, carburizing or induction quenching can be used to harden the shaft/housing. If it is not possible to sufficiently harden the surface the load rating of the bearing will need to be reduced. The basic load rating must be adjusted by multiplying the hardness factor shown in **Fig.2.2**.

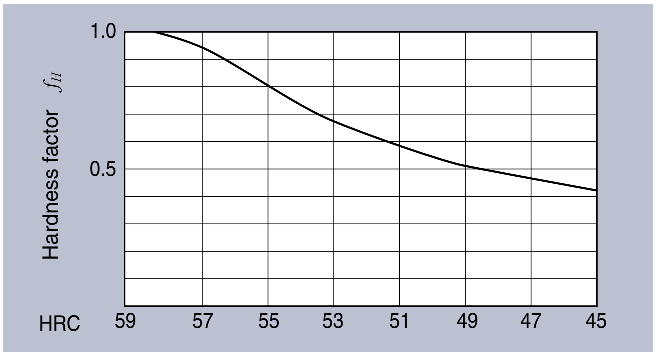


Fig. 2.2 Hardness factor

2.6 Bearing life under oscillating motion

The life of a bearing under oscillating motion can be determined by **formula (2.8)**.

$$L_{osc} = \Omega L_{Rot} \quad \text{(2.8)}$$

where,

L_{osc} : Life of bearing with oscillating motion
L_{Rot} : Life of bearing subject to rotational speed min⁻¹ identical to oscillation frequency cpm
Ex.) Rating life determined from 90 min⁻¹ that is equivalent to cyclic rate of 90 cpm.
Ω : Oscillation factor (showing the relation with half angle β of oscillation angle per **Fig.2.3**).

Generally, **Fig.2.3** applies to cases where the critical oscillation angle 2β is greater than the critical oscillation angle $2\beta_C$. Critical oscillation angle is principally governed by the internal design of the bearing; in particular, the number of rolling elements included in one row.

There may be a case where the bearing needs to be used at an angle smaller than its critical oscillation angle: however, the bearing life will be shorter than the

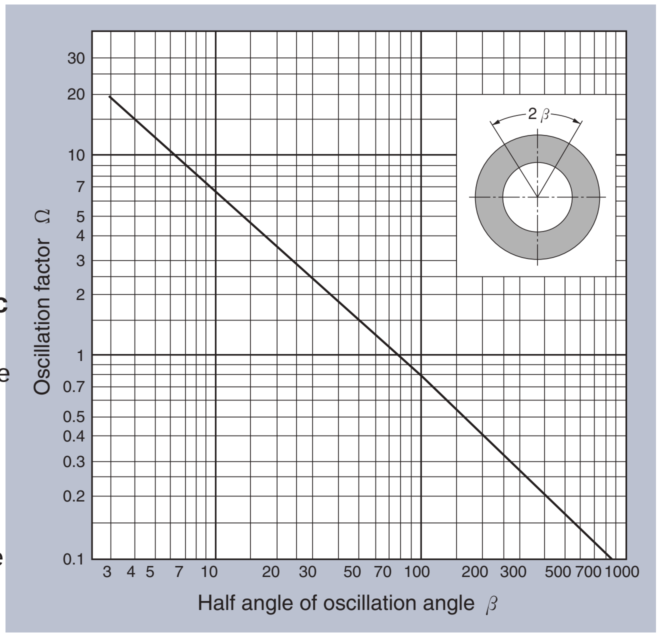


Fig. 2.3 Relationship of oscillation angle β and factor Ω

calculated life determined using the data in **Fig.2.3**. If the oscillation angle of the bearing is unknown, determine Ω, assuming that $\beta = \beta_2$. For the data about an intended bearing, contact **NTN** Engineering.

When the oscillation angle 2β is very small, difficulty in forming an oil film on the contact surface of rolling ring to rolling element could result in **fretting** corrosion.

In the case of inner ring oscillation, the critical oscillation angle is expressed in **formula (2.9)**.

$$\text{Critical oscillation angle } 2\beta_c \geqq \frac{360°}{Z} \cdot \frac{D_{pw}}{D_{pw} - D_w \cos\alpha} \quad \cdots\textbf{(2.9)}$$

Where,

Z : Number of rolling elements (per row)
d_p: Pitch circle diameter (PCD) of rolling element
D_p: Rolling element diameter
e : Contact angle

(In the case of outer ring oscillation, the right side denominator is $D_{pw} + D_w \cos\alpha$.)

2.7 Life of bearing with linear motion

In the case of bearings with linear motion such as linear ball bearing, linear flat roller bearing, etc., the relationship among axial travel distance, bearing load and load rating can be expressed in **formulas (2.10)**, **(2.11)**.

When the rolling elements are balls;

$$L = 50 \times \left(\frac{C_r}{P_r}\right)^3 \quad \cdots\cdots\textbf{(2.10)}$$

When the rolling elements are rollers;

$$L = 100 \times \left(\frac{C_r}{P_r}\right)^{10/3} \quad \cdots\cdots\textbf{(2.11)}$$

where,

L : Load rating km
C_r : Basic dynamic load rating N (kgf)
P_r : Bearing load N (kgf)

Fig.2.4 shows the relationship of C_r/P_r to L.

Furthermore, when the travel motion frequency and travel distance remain unchanged, the lifetime of bearing can be determined by **formulas (2.12)**, **(2.13)**.

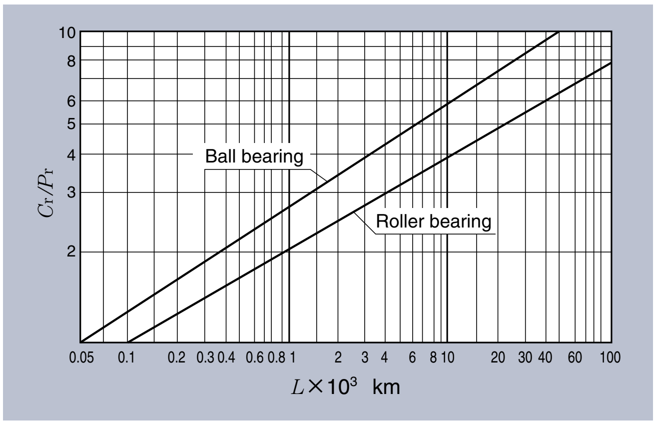


Fig. 2.4 Life of bearing with axial motion

When the rolling elements are balls;

$$L_h = \frac{50 \times 10^3}{60 \cdot S}\left(\frac{C_r}{P_r}\right)^3 \quad \cdots\cdots\textbf{(2.12)}$$

When the rolling elements are rollers;

$$L_h = \frac{100 \times 10^3}{60 \cdot S}\left(\frac{C_r}{P_r}\right)^{10/3} \quad \cdots\cdots\textbf{(2.13)}$$

where,

L_h: Travel life h
S : Travel distance per minute m/min
$S = 2 \cdot L \cdot n$
L : Stroke length m
n : Stroke cycle cpm

2.8 Fitting misalignment and crowning

Generally it is well known that stress concentrations at the edge portion of the roller (so called, edge load) arising from fitting misalignment could result in rapid reduction of bearing lifetime. "Crowning" is adopted as a countermeasure against such rapid reduction of bearing lifetime. In that case, however, unless it is designed properly this crowning would cause the effective contact length of the roller to be reduced, which could then lead to shorter bearing life. It is therefore necessary to calculate a proper crowning based on the extent of fitting misalignment and load condition.

For Reference purposes, **Figs. 2.5** to **2.7** show computer generated examples of contact surface pressure profiles for various scenarios. These profiles demonstrate how crowning can reduce edge surface contact pressure in conditions of misalignment.

Fig. 2.8 shows an example of a computer generated relationship between allowable fitting misalignment and bearing life. It is possible to see from this Figure how the bearing lifetime is influenced by fitting misalignment.

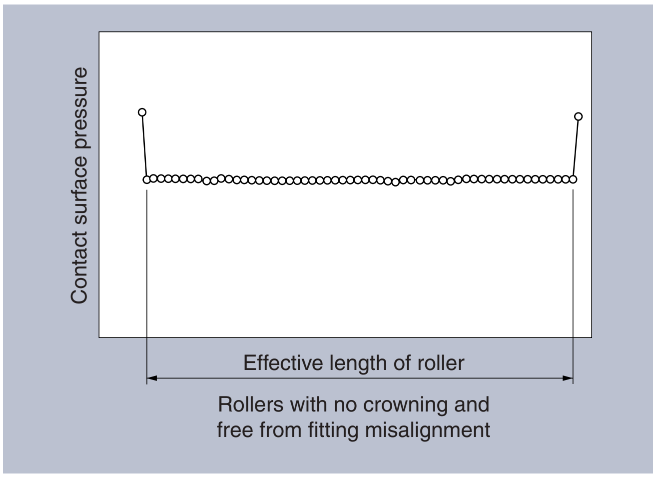


Fig. 2.5

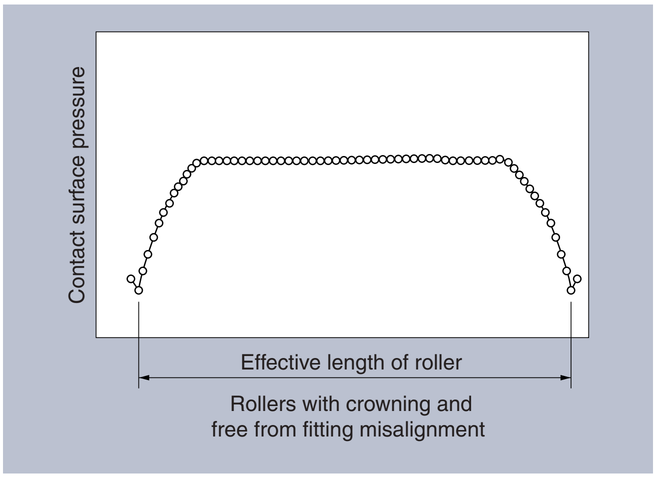


Fig. 2.7

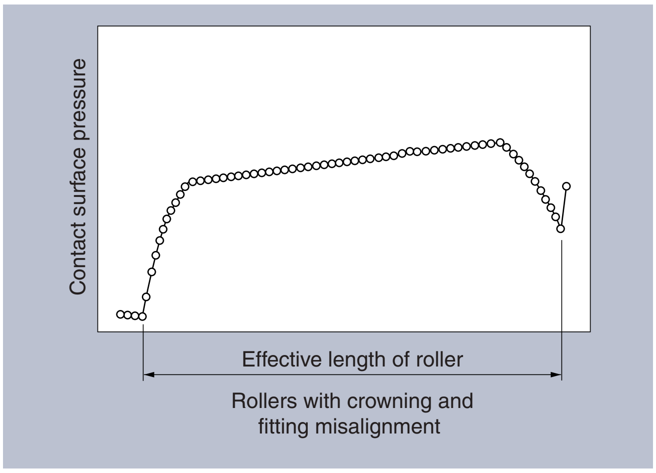


Fig. 2.6

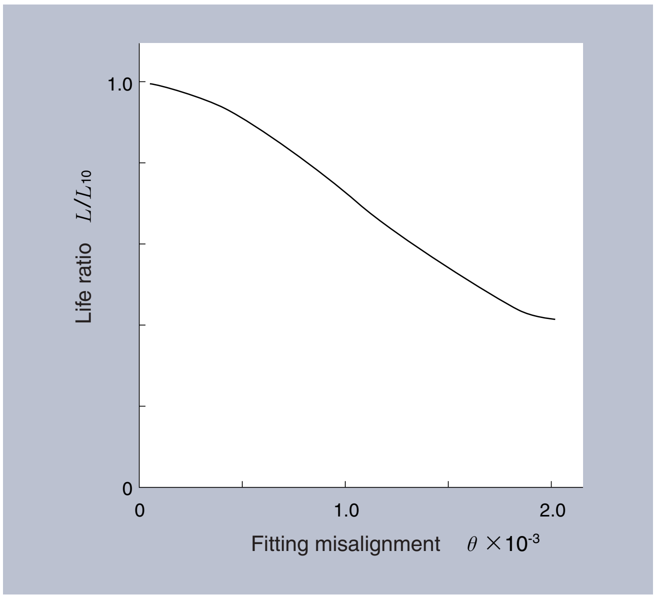


Fig. 2.8 Relationship of fitting misalignment to bearing lifetime

2.9 Basic static load rating

"Basic static load rating" is defined as the minimum static load acting on the center of a rolling element which results in a calculated contact stress value of:

4,000 MPa (408kgf/mm^2) for Roller bearings.

4,200 MPa (428kgf/mm^2) for Ball Bearings.

It has been empirically shown that the resulting permanent deformation on the rolling element and raceway caused by these magnitudes of contact stress is approximately 0.0001 time as great as the diameter of rolling element, and that this deformation level is maximum allowable deformation for smooth running of the bearing.

Basic static load rating for radial bearings is known as **"basic static radial load rating"**, and that for axial thrust bearing as **"basic static axial load rating"**. The bearing dimension tables in this catalog provide data for these load rating types under the parameter names C_{0r} and C_{0a}.

2.10 Allowable static bearing load

The basic static load rating described in **Subsection 2.9** is generally deemed as an allowable static bearing limit load, but in some cases this allowable limit load is set up larger than the basic static load rating and in some other cases it is set up smaller, according to the requirements for revolving smoothness and friction.

Generally this allowable limit load is decided considering the safety factor So in the following **formula (2.14)** and **Table 2.4**.

$$S_0 = C_0 / P_0 \cdots\cdots \textbf{(2.14)}$$

where,

S_0 : Safety factor

C_0 : Basic static rated load, N (kgf)
(For radial bearings: C_{0r},
For thrust bearings: C_{0a})

$P_{0\,max}$: Maximum static bearing load, N (kgf)
(For radial bearings: P_{0r}max,
For thrust bearings: P_{0a}max)

Table 2.4 Lower limit value of safety factor S_0

Operating conditions	Roller bearings	Ball bearings
Requirement for high revolving accuracy	3	2
Requirement for ordinal revolving accuracy (ordinary-purposed)	1.5	1
Where minor deterioration of revolving accuracy is allowed (Ex. Low speed revolution, duty load application, etc.)	1	0.5

Remarks: 1. The lower limit of S_0 for drawn cup needle roller bearings is set at 3; for Premium Shell Product, the limit is set at 2.
2. The lower limit of S_0 is set at 3 for an application where the AS type raceway is used in an axial thrust bearing.
3. Where vibration and shock load act on bearing, P_0 max shall be determined considering the shock load factor.

3. Calculation of Bearing Loads

To compute bearing roads, the forces which act on the shaft being supported by the bearing must be determined. These forces include the inherent dead weight of the rotating body (the weight of the shafts and components themselves), loads generated by the working forces of the machine, and loads arising from transmitted power.

It is possible to calculate theoretical values for these loads; however, there are many instances where the load acting on the bearing is usually determined by the nature of the load acting on the main power transmission shaft.

3.1 Load acting on shafts

3.1.1 Load factors

The actual shaft loads on a machine that uses a bearing are usually greater than the theoretically determined values owing to vibration and impact occurring on the machine. For this reason, loads actually acting on a shaft system are often determined through multiplication by an appropriate load factors listed in **Table 3.1** and **Table 3.2**.

$$K = f_w \cdot f_z \cdot K_c \quad \cdots\cdots \textbf{(3.1)}$$

where

K : Actual load acting on shaft N (kgf)
K_c : Theoretically calculated value N (kgf)
f_w : Load factor **(Table 3.1)**
f_z : Gear factor **(Table 3.2)**

Table 3.1 Load factor f_w

Extent of shock	f_w	Application
Nearly no shock	1.0–1.2	Electrical machines, machine tools, measuring instruments
Light shock	1.2–1.5	Railway vehicles, automobiles, rolling mills, metal working machines, paper making machines, rubber mixing machines, printing machines, aircraft, textile machines, electrical units, office equipment
Heavy shock	1.5–3.0	Crushers, agricultural machines, construction machines, cranes

Table 3.2 Gear factor f_z

Types of gear	f_z
Precision ground gears (Pitch and profile errors of less than 0.02mm)	1.05–1.1
Ordinary machined gears (Pitch and profile errors of less than 0.1mm)	1.1–1.3

3.1.2 Load acting on gears

The loads acting on gears can be divided into tangential load (K_t), radial load (K_s), and axial load (K_a). The magnitude and acting direction of each load differ depending on the types of gear. This paragraph describes how to calculate the loads acting on parallel shaft gears and cross shaft gears for general use.

(1) Load acting on parallel shaft gear

Figs. 3.1 to **3.3** illustrate the loads acting on spur gear and helical gear which are used with a parallel shaft. The magnitude of each load can be determined using the **formulas (3.2)** to **(3.5)**.

$$\left.\begin{aligned} K_t &= \frac{19.1\times10^6 \cdot H}{D_p \cdot n} \quad \text{N} \\ K_t &= \frac{1.95\times10^6 \cdot H}{D_p \cdot n} \quad \text{(kgf)} \end{aligned}\right\} \quad \cdots\cdots \textbf{(3.2)}$$

$$K_s = K_t \cdot \tan\alpha \ \text{(Spur gear)} \quad \cdots\cdots \textbf{(3.3a)}$$

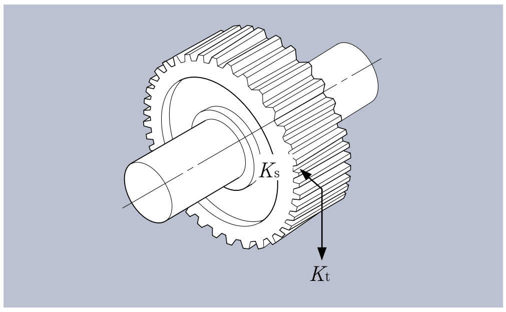


Fig. 3.1 Load acting on spur gear

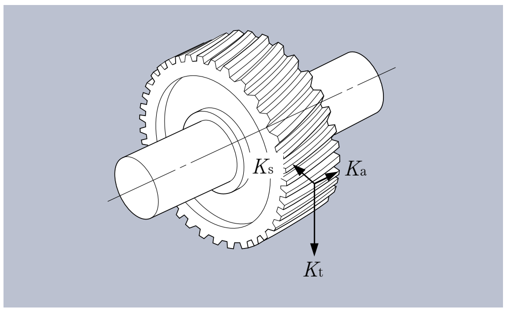


Fig. 3.2 Load acting on helical gear

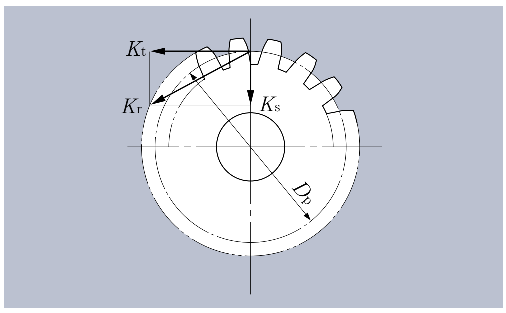


Fig. 3.3 Composite radial force acting on gear

$$=K_t \cdot \frac{\tan\alpha}{\cos\beta} \text{ (for helical gear)} \cdots\cdots \textbf{(3.3b)}$$

$$K_r = \sqrt{K_t^2 + K_s^2} \cdots\cdots \textbf{(3.4a)}$$

$$K_a = K_t \cdot \tan\beta \text{ (for helical gear)} \cdots\cdots \textbf{(3.5)}$$

where,

K_t : Tangential load acting on gear (Tangential force) N (kgf)
K_s : Radial load acting on gear (separating force) N (kgf)
K_r : Load acting perpendicularly on gear shaft (composite force of tangential force and separating force) N (kgf)
K_a : Parallel load acting on gear shaft N (kgf)
H : Transmission power kw
n : Rotational speed min^{-1}
D_p : Pitch circle diameter of gear mm
α : Gear pressure angle deg
β : Gear helix angle deg

(2) Loads acting on cross shaft gears

Figs. 3.4 and **3.5** illustrate the loads acting on straight-tooth bevel gears and spiral bevel gears which are used with cross shafts.

The calculation methods for these gear loads are shown in **Table 3.3**. Herein, to calculate gear loads for straight bevel gears, the helix angle (β) is 0.

K_t : Tangential load acting on gear (Tangential force) N (kgf)
K_s : Radial load acting on gear (separating force) N (kgf)
K_a : Parallel load acting on gear shaft (axial load) N (kgf)
H : Transmission power kw
n : Rotational speed min^{-1}
D_{pm} : Mean pitch circle diameter mm
α : Gear pressure angle deg
β : Gear helix angle deg
δ : Pitch cone angle of gear deg

In general, the relationship between the loads acting on pinion and pinion gear can be expressed as follows, due to the perpendicular intersection of two shafts.

$$K_{sp} = K_{ag} \cdots\cdots \textbf{(3.6)}$$

$$K_{ap} = K_{sg} \cdots\cdots \textbf{(3.7)}$$

where,

K_{sp}, K_{sg} : Pinion and pinion gear separating force N (kgf)
K_{ap}, K_{ag} : Axial load acting on pinion and pinion gear N (kgf)

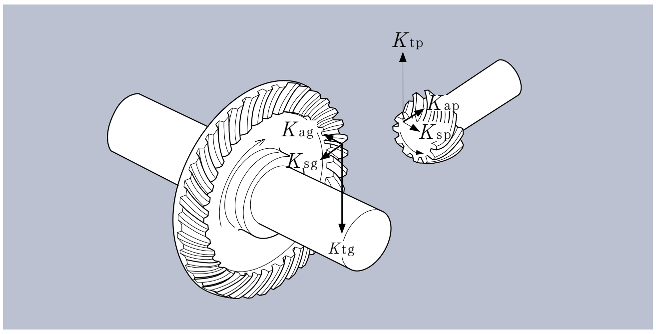


Fig. 3.4 Load acting on bevel gears

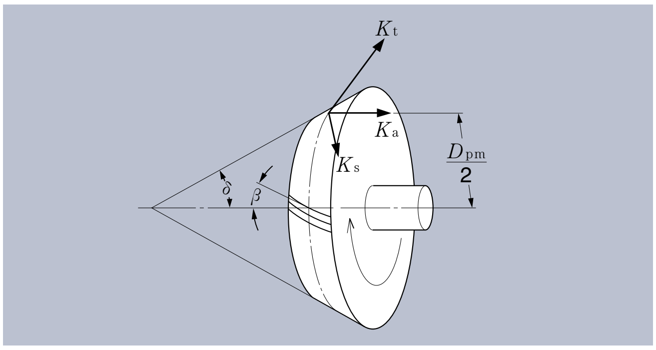


Fig.3.5 Bevel gear diagram

Table 3.3 Calculation formulas for determining loads acting on bevel gears

Unit N

Type of load	Rotational direction	Clockwise	Counter clockwise	Clockwise	Counter clockwise
	Helix angle	To right	To left	To left	To right
Tangential load (tangential force) K_t		$K_t = \frac{19.1\times10^6 \cdot H}{D_{pm}\cdot n}$, $\left\{\frac{1.95\times10^6 \cdot H}{D_{pm}\cdot n}\right\}$			
Radial load (separating force) K_s	Drive side	$K_s = K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta} + \tan\beta\sin\delta\right]$		$K_s = K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta} - \tan\beta\sin\delta\right]$	
	Driven side	$K_s = K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta} - \tan\beta\sin\delta\right]$		$K_s = K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta} + \tan\beta\sin\delta\right]$	
Load parallel to gear train (Axial load) K_a	Drive side	$K_a = K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta} - \tan\beta\cos\delta\right]$		$K_a = K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta} + \tan\beta\cos\delta\right]$	
	Driven side	$K_a = K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta} + \tan\beta\cos\delta\right]$		$K_a = K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta} - \tan\beta\cos\delta\right]$	

The orientation of loading on a spiral bevel gear will vary depending on the direction of the helix angle, the direction of rotation and whether the gear is a driving or driven gear.

The separating force (K_r) and the axial load (K_a) are shown in the positive direction in **Fig. 3.5**. The direction of rotation and the helix direction are defined as viewed from the large end of the gear. For the gear illustrated in **Fig. 3.5** these directions are clockwise and to the right.

3.1.3 Loads acting on chain and belt shafts

When power is transmitted by means of a chain or belt as illustrated in **Fig. 3.6**, the loads acting on the sprocket or pulley can be determined by **formula (3.8).**

$$K_t = \frac{19.1\times10^6 \cdot H}{D_p \cdot n} \left(\frac{1.95\times10^6 \cdot H}{D_p \cdot n}\right) \quad \cdots\cdots\cdots(3.8)$$

where,

K_t : Load acting on sprocket or pulley N (kgf)

HP : Transmission power kW

D_p : Pitch circle diameter of sprocket or pulley mm

For belt drives, an initial tension is applied to ensure sufficient normal force between the belt and pulley during operation.

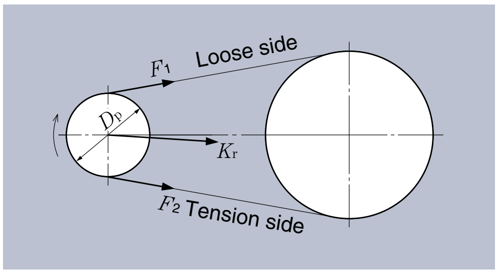


Fig. 3.6 Loads acting on chain/ belt

Taking into account the initial tension, the radial load acting on the pulley can be determined by **formula (3.9)**. For chain drives, the radial load can be expressed using the same formula, if vibration and shock are taken into consideration.

$$K_r = f_b \cdot K_t \quad \cdots\cdots\cdots(3.9)$$

where,

K_r : Radial load acting on sprocket or pulley N (kgf)

f_b : Chain/belt factor **(Table 3.4)**

Table 3.4 Chain/belt factor f_b

Type of chain / belt	f_b
Chain (single row type)	1.2–1.5
Vee-belt	1.5–2.0
Timing belt	1.1–1.3
Flat belt (with tension pulley)	2.5–3.0
Flat belt	3.0–4.0

3.2 Bearing load distribution

Any loads acting on shafts are distributed to the bearings. The bearing load distribution is determined by considering the shaft to be a static beam supported by the bearings.

For example, the loads acting on the bearings supporting the gear shaft illustrated in **Fig. 3.7** can be expressed using **formulas (3.10)** and **(3.11)**.

$$F_{rA} = K_{rI}\frac{b}{l} - K_{rII}\frac{c}{l} - K_a\frac{D_p}{2l} \quad \cdots\cdots\cdots(3.10)$$

$$F_{rB} = K_{rI}\frac{a}{l} + K_{rII}\frac{a+b+c}{l} + K_a\frac{D_p}{2l} \quad \cdots\cdots\cdots(3.11)$$

where,

F_{rA} : Radial load acting on bearing-A N (kgf)

F_{rB} : Radial load acting on bearing-B N (kgf)

K_{rI} : Radial load acting on gear-I N (kgf)

K_a : Axial load acting on gear-I N (kgf)

K_{rII} : Axial load acting on gear-II N (kgf)

D_p : Pitch circle diameter of gear-I mm

l : Bearing to bearing distance mm

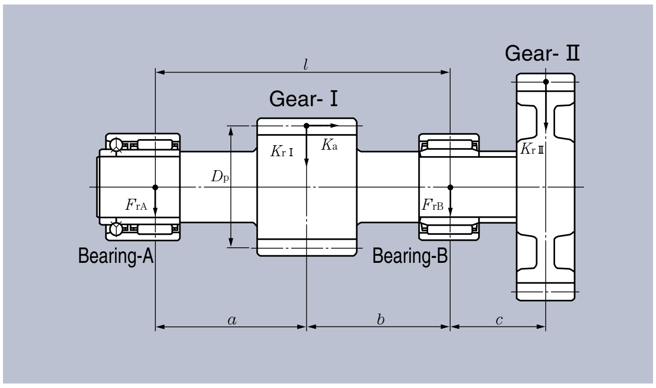


Fig. 3.7 Gear shaft

3.3 Mean load

The load on bearings used in machines will often fluctuate according to a fixed duty cycle. The load on bearings operating under such conditions can be converted to a mean load (F_m). The mean load is a load which gives the bearings the same life they would have under constant operating conditions.

(1) Stepped fluctuating load

The mean bearing load, F_m, for stepped loads is calculated using **formula (3.12)**. where F_1, F_2 .... F_n are the bearing loads, and the rotational speed and running time are n_1, n_2.......n_n and t_1, t_2....... t_n respectively.

$$F_m=\left(\frac{\Sigma\,(F_i^{\,p}\,n_i\,t_i)}{\Sigma\,(n_i\,t_i)}\right)^{1/p} \cdots\cdots(3.12)$$

where:
p=10/3 for roller bearing
p=3 for ball bearing

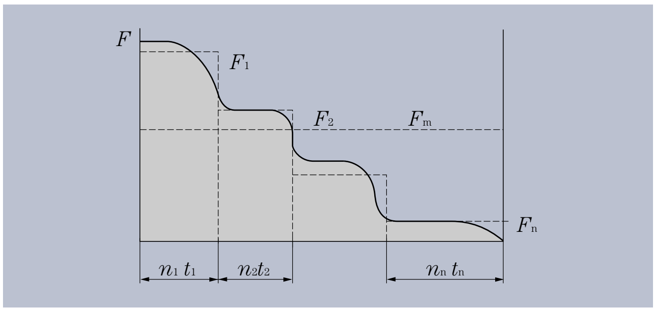


Fig. 3.8 Stepped fluctuating load

(2) Cyclical load

Where the bearing load can be expressed as a function of time $F(t)$, repeating with cycle time t_0, the mean load can be expressed **formula (3.13)**.

$$F_m=\left(\frac{1}{t_0}\int_0^{t_0} F\,(t)^p\,dt\right)^{1/p} \cdots\cdots(3.13)$$

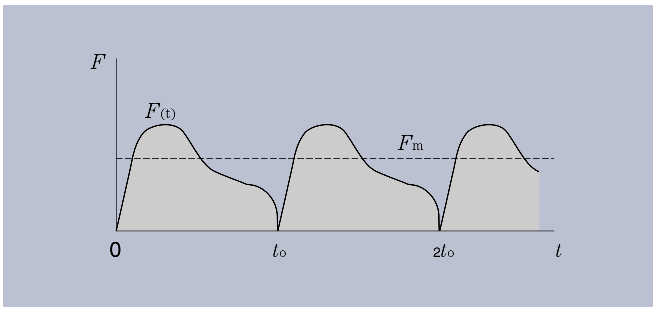


Fig. 3.9 Load fluctuating as cyclical function of time

(3) Linearly fluctuating load

The mean load F_m can be approximated by **formula (3.14)**.

$$F_m=\frac{F_{min}+2F_{max}}{3} \cdots\cdots(3.14)$$

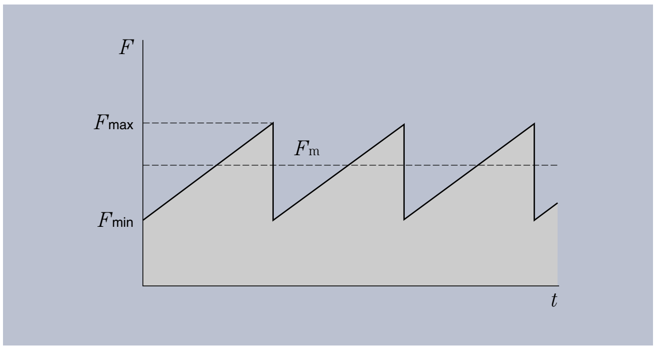


Fig. 3.10 Linearly fluctuating load

(4) Sinusoidal load

The mean load F_m can be approximated by **formulas (3.15)**, and **(3.16)**.

case of (a) $F_m=0.75F_{max}$ ··········**(3.15)**
case of (b) $F_m=0.65F_{max}$ ··········**(3.16)**

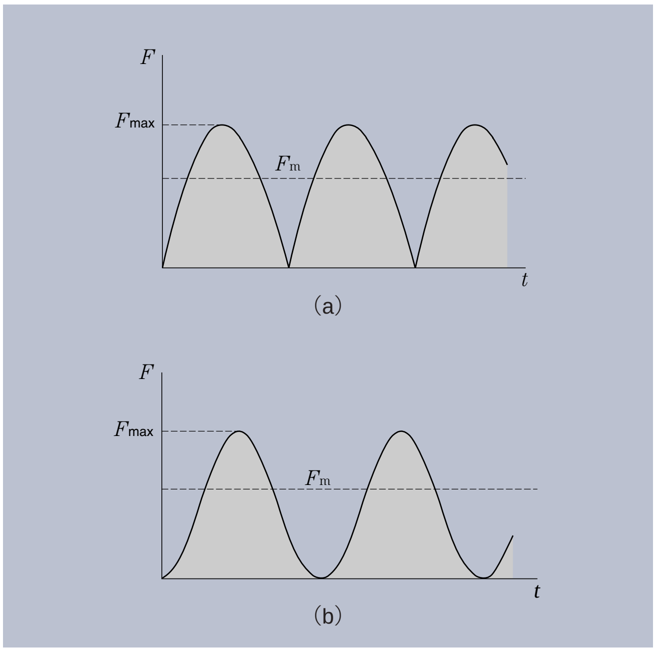


Fig. 3.11 Sinusoidal load

4. Bearing Accuracy

The dimensional, profile and running accuracies of rolling bearings are specified in ISO Standard as applicable and JIS B 1514 (Accuracy of Rolling Bearings).

"**Dimensional accuracy**" and "**Profile accuracy**" are the items indispensable in installing the rolling bearings on a shaft and in a bearing housing, and allowable bearing run-out in running is specified as the running accuracy.

Dimensional accuracy:

Dimensional accuracy means the respective allowable values for bore diameter, outer diameter, width or height (limited to thrust bearing) and chamfering dimension.

Profile accuracy:

Profile accuracy relates to tolerances for inside diameter variation, mean inside diameter variation, outside diameter variation, mean outside diameter variation, and ring width variation.

Running accuracy:

Running accuracy relates to tolerances for radial runout and axial runout with inner ring and outer ring, perpendicularity of ring face, perpendicularity of outside surface, and raceway thickness variation (thrust bearing).

Regarding the accuracy class of the machined ring needle roller bearings, class-0 is equivalent to bearings of the normal precision class, and precision becomes progressively higher as the class number becomes smaller; i.e. Class 6 is less precise than Class 5, which is less precise than Class 4, and so on.

Bearings of Class-0 are mostly used for general applications while bearings of Class-5 or Class-4 are used where the required running accuracies and revolutions are high or less friction and less fluctuation are required for bearings.

Various bearing types are available for NTN needle roller bearings and the representative types and the accuracy classes applicable to them are as shown in **Table 4.1**.

Dimensional item symbols used in the accuracy standard are given in **Table 4.2**, the radial bearing accuracy specified every accuracy class given in **Table 4.3**, the thrust bearing accuracy specified every accuracy class given in **Table 4.4**, and the allowable values for chamfering dimension given in **Table 4.5**.

Table 4.2 Dimensional item symbols used in applicable standards

●**Radial bearings**

Classification	Symbols	Symbol representation	Symbols under JIS B 0021 (Reference)
Dimensional accuracy	Δd_{mp}	Dimensional tolerance for in-plane mean bore diameter	—
	Δd_s	Dimensional tolerance for bore diameter	—
	ΔD_{mp}	Dimensional tolerance for in-plane mean outer diameter	—
	ΔD_s	Dimensional tolerance for outer diameter	—
	ΔB_s	Dimensional tolerance for inner ring width	—
	ΔC_s	Dimensional tolerance for outer ring width	—
Profile accuracy	V_{dp}	Variation of in-plane bore diameter	Roundness ○ 1)
	V_{dmp}	Variation of in-plane mean bore diameter	Cylindricity ⌭ 2)
	V_{Dp}	Variation of in-plane outer diameter	Roundness ○ 1)
	V_{Dmp}	Variation of in-plane mean outer diameter	Cylindricity ⌭ 2)
	V_{Bs}	Variation of inner ring width	Parallelism //
	V_{Cs}	Variation of outer ring width	Parallelism //
Running accuracy	K_{ia}	Radial run-out of inner ring	Run-out ↗
	K_{ea}	Radial run-out of outer ring	Run-out ↗
	S_{ia}	Axial run-out of inner ring	—
	S_{ea}	Axial run-out of outer ring	—
	S_d	Perpendicularity of face (inner ring)	Perpendicularity ⊥
	S_D	Perpendicularity of outside surface (outer ring)	Perpendicularity ⊥

●**Thrust bearings**

Classification	Symbols	Symbol representation	Symbols under JIS B 0021 (Reference)
Dimensional accuracy	Δd_{mp}	Single plane mean bore diameter deviation on single-direction bearing	—
	Δd_{2mp}	Single plane mean bore diameter deviation on central washer	—
	ΔD_{mp}	Dimensional tolerance for in-plane mean outer diameter	—
Profile accuracy	V_{dp}	Bore diameter variation in a single radial plane on single-direction bearing	Roundness ○ 1)
	V_{d2p}	Bore diameter variation in a single radial plane on central washer	Roundness ○ 1)
	V_{Dp}	Variation of in-plane outer diameter	Roundness ○ 1)
Running accuracy	S_i	Raceway thickness variation on shaft washer	Run-out ↗
	S_e	Raceway thickness variation on housing washer	Run-out ↗

1) The roundness specified in JIS B 0021 is applicable to the tolerance V_{dp} for variation of radial in-plane bore diameter or nearly half of V_{Dp}.

2) The cylindricity specified in JIS B 0021 is applicable to the tolerance V_{dmp} for in-uniformity of radial in-plane mean diameter or nearly half of V_{Dmp}.

Table 4.1 Bearing types and corresponding accuracy classes

Bearing type		Applicable accuracy class				Applicable table
Needle roller bearing, Clearance-adjustable needle roller bearing		JIS Class-0 —	JIS Class-6 —	JIS Class-5 —	JIS class-4 JIS class-4	**Table 4.3** **Table 4.3**
Complex bearing	Radial bearing Thrust bearing	JIS Class-0 NTN Class 0	JIS Class-6 NTN Class 6	JIS Class-5 NTN Class 5	— NTN Class 4	**Table 4.3** **Table 4.4**
Needle roller bearing with double-direction thrust roller bearing	Radial bearing Thrust bearing	— —	— —	JIS Class-5 NTN Class 5	JIS Class-4 NTN Class 4	**Table 4.3** **Table 4.4**
Thrust roller bearing Roller follower/cam follower		NTN Class 0 JIS Class-0	NTN Class 6 —	NTN Class 5 —	NTN Class 4 —	**Table 4.4** **Table 4.3**

Table 4.3 Tolerances for radial bearings
Table 4.3(1) Inner rings

Nominal bore diameter d mm		Dimensional tolerance for mean bore diameter Δ_{dmp}								Variation of mean bore diameter V_{dp}				Allowable variation of bore diameter V_{dmp}			
		Class 0		Class 6		Class 5		Class 4		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	high	low	high	low	max				max			
2.5❶	10	0	−8	0	−7	0	−5	0	−4	10	9	5	4	6	5	3	2
10	18	0	−8	0	−7	0	−5	0	−4	10	9	5	4	6	5	3	2
18	30	0	−10	0	−8	0	−6	0	−5	13	10	6	5	8	6	3	2.5
30	50	0	−12	0	−10	0	−8	0	−6	15	13	8	6	9	8	4	3
50	80	0	−15	0	−12	0	−9	0	−7	19	15	9	7	11	9	5	3.5
80	120	0	−20	0	−15	0	−10	0	−8	25	19	10	8	15	11	5	4
120	150	0	−25	0	−18	0	−13	0	−10	31	23	13	10	19	14	7	5
150	180	0	−25	0	−18	0	−13	0	−10	31	23	13	10	19	14	7	5
180	250	0	−30	0	−22	0	−15	0	−12	38	28	15	12	23	17	8	6
250	315	0	−35	0	−25	0	−18	—	—	44	31	18	—	26	19	9	—
315	400	0	−40	0	−30	0	−23	—	—	50	38	23	—	30	23	12	—
400	500	0	−45	0	−35	—	—	—	—	56	44	—	—	34	26	—	—

❶ 2.5mm is included in this dimensional category.
❷ This table is applied to the ball bearings.

Table 4.3 (2) Outer rings

Nominal outer diameter D mm		Dimensional tolerance for mean outer diameter Δ_{Dmp}								Allowable variation of outer diameter V_{Dp}				Allowable variation of mean outer diameter V_{Dmp}			
		Class 0		Class 6		Class 5		Class 4		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	high	low	high	low	max.				max.			
6❶	18	0	−8	0	−7	0	−5	0	−4	10	9	5	4	6	5	3	2
18	30	0	−9	0	−8	0	−6	0	−5	12	10	6	5	7	6	3	2.5
30	50	0	−11	0	−9	0	−7	0	−6	14	11	7	6	8	7	4	3
50	80	0	−13	0	−11	0	−9	0	−7	16	14	9	7	10	8	5	3.5
80	120	0	−15	0	−13	0	−10	0	−8	19	16	10	8	11	10	5	4
120	150	0	−18	0	−15	0	−11	0	−9	23	19	11	9	14	11	6	5
150	180	0	−25	0	−18	0	−13	0	−10	31	23	13	10	19	14	7	5
180	250	0	−30	0	−20	0	−15	0	−11	38	25	15	11	23	15	8	6
250	315	0	−35	0	−25	0	−18	0	−13	44	31	18	13	26	19	9	7
315	400	0	−40	0	−28	0	−20	0	−15	50	35	20	15	30	21	10	8
400	500	0	−45	0	−33	0	−23	—	—	56	41	23	—	34	25	12	—
500	630	0	−50	0	−38	0	−28	—	—	63	48	28	—	38	29	14	—

❶ 6mm is included in this dimensional category.
❷ This table is applied to the ball bearings.

Unit μm

Radial run-out K_{ia}				Perpendicularity of face S_d		Axial run-out S_{ia} [2]		Allowable width deviation Δ_{Bs}				Allowable width variation V_{Bs}				Nominal bore diameter d mm	
Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 0,6		Class 5,4		Class 0	Class 6	Class 5	Class 4		
max				max		max		high	low	high	low	max				over	incl.
10	6	4	2.5	7	3	7	3	0	−120	0	−40	15	15	5	2.5	2.5 [1]	10
10	7	4	2.5	7	3	7	3	0	−120	0	−80	20	20	5	2.5	10	18
13	8	4	3	8	4	8	4	0	−120	0	−120	20	20	5	2.5	18	30
15	10	5	4	8	4	8	4	0	−120	0	−120	20	20	5	3	30	50
20	10	5	4	8	5	8	5	0	−150	0	−150	25	25	6	4	50	80
25	13	6	5	9	5	9	5	0	−200	0	−200	25	25	7	4	80	120
30	18	8	6	10	6	10	7	0	−250	0	−250	30	30	8	5	120	150
30	18	8	6	10	6	10	7	0	−250	0	−250	30	30	8	5	150	180
40	20	10	8	11	7	13	8	0	−300	0	−300	30	30	10	6	180	250
50	25	13	—	13	—	15	—	0	−350	0	−350	35	35	13	—	250	315
60	30	15	—	15	—	20	—	0	−400	0	−400	40	40	15	—	315	400
65	35	—	—	—	—	—	—	0	−450	—	—	50	45	—	—	400	500

Unit μm

Radial run-out K_{ea}				Perpendicularity of outside surface S_D		Axial run-out S_{ea} [2]		Allowable width deviation Δ_{Cs}	Allowable width variation V_{Cs}				Nominal outer diameter D mm	
Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 0,6,5,4	Class 0	Class 6	Class 5	Class 4		
max				max		max			max				over	incl.
15	8	5	3	8	4	8	5	Depending on the tolerance of Δ_{Bs} for d of same bearing.	Depending on the applicable allowable value of V_{Bs} for d of same bearing.		5	2.5	6 [1]	18
15	9	6	4	8	4	8	5				5	2.5	18	30
20	10	7	5	8	4	8	5				5	2.5	30	50
25	13	8	5	8	4	10	5				6	3	50	80
35	18	10	6	9	5	11	6				8	4	80	120
40	20	11	7	10	5	13	7				8	5	120	150
45	23	13	8	10	5	14	8				8	5	150	180
50	25	15	10	11	7	15	10				10	7	180	250
60	30	18	11	13	8	18	10				11	7	250	315
70	35	20	13	13	10	20	13				13	8	315	400
80	40	23	—	15	—	23	—				15	—	400	500
100	50	25	—	18	—	25	—				18	—	500	630

Table 4.4 Tolerances of thrust roller bearings
Table 4.4 (1) Inner rings and center rings

Unit μm

Nominal bore diameter d or d_2 mm		Allowable deviation of mean diameter Δ_{dmp} or Δ_{d2mp}				Allowable variation of bore diameter V_{dp} or V_{d2p}		Allowable variation of raceway thickness ❶ S_i			
		Class 0, 6, 5		Class 4		Class 0, 6, 5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	max		max			
—	18	0	−8	0	−7	6	5	10	5	3	2
18	30	0	−10	0	−8	8	6	10	5	3	2
30	50	0	−12	0	−10	9	8	10	6	3	2
50	80	0	−15	0	−12	11	9	10	7	4	3
80	120	0	−20	0	−15	15	11	15	8	4	3
120	180	0	−25	0	−18	19	14	15	9	5	4
180	250	0	−30	0	−22	23	17	20	10	5	4
250	315	0	−35	0	−25	26	19	25	13	7	5
315	400	0	−40	0	−30	30	23	30	15	7	5
400	500	0	−45	0	−35	34	26	30	18	9	6
500	630	0	−50	0	−40	38	30	35	21	11	7

❶ The complex bearings are applicable to the category of single plane bearing d which corresponds to the same nominal outer diameter of same diameter series, without being applicable to d_2 category.

Table 4.4 (2) Outer rings

Unit μm

Nominal outer diameter D mm		Allowable deviation of mean outer diameter Δ_{Dmp}				Allowable variation of outer diameter V_{Dp}		Allowable variation of raceway thickness S_e
		Class 0,6,5		Class 4		Class 0,6,5	Class 4	Class 0,6,5,4
over	incl.	high	low	high	low	max		max
10	18	0	−11	0	−7	8	5	Depending on the applicable allowable value of S_1 for d or d_2 of same bearing.
18	30	0	−13	0	−8	10	6	
30	50	0	−16	0	−9	12	7	
50	80	0	−19	0	−11	14	8	
80	120	0	−22	0	−13	17	10	
120	180	0	−25	0	−15	19	11	
180	250	0	−30	0	−20	23	15	
250	315	0	−35	0	−25	26	19	
315	400	0	−40	0	−28	30	21	
400	500	0	−45	0	−33	34	25	
500	630	0	−50	0	−38	38	29	
630	800	0	−75	0	−45	55	34	

Table 4.5 Allowable critical value for chamfering dimension

Table 4.5 (1) Radial bearings

Unit mm

$r_{s\,min}$ ❶	Nominal bore diameter d over	Nominal bore diameter d incl.	Radial direction $r_{s\,max}$	Axial direction $r_{s\,max}$
0.15	—	—	0.3	0.6
0.2	—	—	0.5	0.8
0.3	—	40	0.6	1
	40	—	0.8	1
0.6	—	40	1	2
	40	—	1.3	2
1	—	50	1.5	3
	50	—	1.9	3
1.1	—	120	2	3.5
	120	—	2.5	4
1.5	—	120	2.3	4
	120	—	3	5
2	—	80	3	4.5
	80	220	3.5	5
	220	—	3.8	6
2.1	—	280	4	6.5
	280	—	4.5	7
2.5	—	100	3.8	6
	100	280	4.5	6
	280	—	5	7
3	—	280	5	8
	280	—	5.5	8
4	—	—	6.5	9

❶ Allowable minimum values for the chamfering dimension "r" .

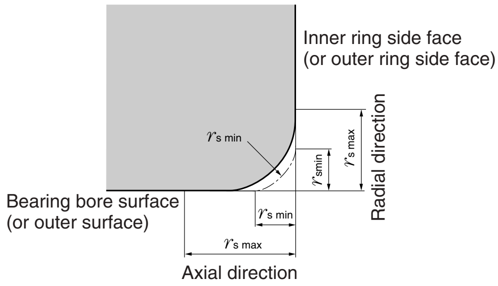


Table 4.5 (2) Thrust bearings

Unit mm

$r_{s\,min}$ ❶	Radial and axial directions $r_{s\,max}$
0.3	0.8
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5

❶ Allowable minimum values for the chamfering dimension "r" .

Table 4.6 Basic tolerances

Unit μm

Basic dimension (mm) over	Basic dimension (mm) incl.	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10
	3	0.8	1.2	2	3	4	6	10	14	25	40
3	6	1	1.5	2.5	4	5	8	12	18	30	48
6	10	1	1.5	2.5	4	6	9	15	22	36	58
10	18	1.2	2	3	5	8	11	18	27	43	70
18	30	1.5	2.5	4	6	9	13	21	33	52	84
30	50	1.5	2.5	4	7	11	16	25	39	62	100
50	80	2	3	5	8	13	19	30	46	74	120
80	120	2.5	4	6	10	15	22	35	54	87	140
120	180	3.5	5	8	12	18	25	40	63	100	160
180	250	4.5	7	10	14	20	29	46	72	115	185
250	315	6	8	12	16	23	32	52	81	130	210
315	400	7	9	13	18	25	36	57	89	140	230
400	500	8	10	15	20	27	40	63	97	155	250
500	630	9	11	16	22	30	44	70	110	175	280
630	800	10	13	18	25	35	50	80	125	200	320
800	1 000	11	15	21	29	40	56	90	140	230	360
1 000	1 250	13	18	24	34	46	66	105	165	260	420
1 250	1 600	15	21	29	40	54	78	125	195	310	500
1 600	2 000	18	25	35	48	65	92	150	230	370	600
2 000	2 500	22	30	41	57	77	110	175	280	440	700
2 500	3 150	26	36	50	69	93	135	210	330	540	860

5. Bearing Internal Clearance

5.1 Bearing internal clearance

Bearing radial internal clearance (free clearance) is the amount of internal clearance a bearing has before being installed on a shaft or into a housing. When either the inner ring or the outer ring is fixed and the other ring is free to move, displacement takes place in the radial direction. This amount of displacement is called the radial internal clearance.

The radial internal clearance values of NTN machined ring needle roller bearings are listed in **Table 5.1**. **Table 5.1 (1)** shows the interchangeable clearances, which remain unchanged even if inner or outer ring are switched with those from different bearings. **Table 5.1 (2)** shows non-interchangeable clearances, which are supplied as matched sets due to the tighter clearance ranges. Bearing clearances are represented by the symbols C2, normal, C3, and C4 in increasing order from smallest to largest. Non-interchangeable clearances symbols are followed by "NA" for identification.

For radial clearance values for bearings other than machined ring needle roller bearings, refer to "Commentary" provided with the appropriate dimension tables.

5.2 Running clearance

5.2.1 Running clearance selection

The internal clearance of a bearing under operating conditions (**running clearance**) is usually smaller than the same bearing's free clearance. This is due to several factors including bearing fit, the difference in temperature between the inner and outer rings, etc. As a bearing's operating clearance has an effect on bearing life, heat generation, vibration, noise, etc.; care must be taken in selecting the most suitable operating clearance.

Theoretically, regarding bearing life, the optimum operating internal clearance of any bearing would be a slight negative clearance after the bearing has reached normal operating temperature.

Unfortunately, under actual operating conditions, maintaining such optimum tolerances is often difficult at best. Due to various fluctuating operating conditions this slight minus clearance can quickly become a large minus, greatly lowering the life of the bearing and causing excessive heat to be generated. Therefore, an initial internal clearance that will result in a slightly greater than minus internal operating clearance should be selected.

Under normal operating conditions (e.g. normal load, fit, speed, temperature, etc.), a standard internal clearance will give a very satisfactory operating clearance.

Table 5.1 Radial internal clearance in machined ring needle roller bearing

Table 5.1 (1) Interchangeable bearings

Unit μm

Nominal bore diameter *d* (mm)		Radial internal clearance							
		C2		Normal ❶		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
—	10	0	30	10	40	25	55	35	65
10	18	0	30	10	40	25	55	35	65
18	24	0	30	10	40	25	55	35	65
24	30	0	30	10	45	30	65	40	70
30	40	0	35	15	50	35	70	45	80
40	50	5	40	20	55	40	75	55	90
50	65	5	45	20	65	45	90	65	105
65	80	5	55	25	75	55	105	75	125
80	100	10	60	30	80	65	115	90	140
100	120	10	65	35	90	80	135	105	160
120	140	10	75	40	105	90	155	115	180
140	160	15	80	50	115	100	165	130	195
160	180	20	85	60	125	110	175	150	215
180	200	25	95	65	135	125	195	165	235
200	225	30	105	75	150	140	215	180	255
225	250	40	115	90	165	155	230	205	280
250	280	45	125	100	180	175	255	230	310
280	315	50	135	110	195	195	280	255	340
315	355	55	145	125	215	215	305	280	370
355	400	65	160	140	235	245	340	320	415
400	450	70	190	155	275	270	390	355	465

❶ Supplementary suffix codes of clearance is not added to bearing numbers.

Table 5.1 (2) Non-interchangeable bearings

Unit μm

Nominal bore diameter *d* (mm)		Radial internal clearance							
		C2NA		NA ❷		C3NA		C4NA	
over	incl.	min	max	min	max	min	max	min	max
—	10	10	20	20	30	35	45	45	55
10	18	10	20	20	30	35	45	45	55
18	24	10	20	20	30	35	45	45	55
24	30	10	25	25	35	40	50	50	60
30	40	12	25	25	40	45	55	55	70
40	50	15	30	30	45	50	65	65	80
50	65	15	35	35	50	55	75	75	90
65	80	20	40	40	60	70	90	90	110
80	100	25	45	45	70	80	105	105	125
100	120	25	50	50	80	95	120	120	145
120	140	30	60	60	90	105	135	135	160
140	60	35	65	65	100	115	150	150	180
160	180	35	75	75	110	125	165	165	200
180	200	40	80	80	120	140	180	180	220
200	225	45	90	90	135	155	200	200	240
225	250	50	100	100	150	170	215	215	265
250	280	55	110	110	165	185	240	240	295
280	315	60	120	120	180	205	265	265	325
315	355	65	135	135	200	225	295	295	360
355	400	75	150	150	225	255	330	330	405
400	450	85	170	170	255	285	370	370	455

❷ For bearing with normal clearance, only NA is added to bearing numbers. EX. NA4920NA

5.2.2 Calculation of running clearance

The internal clearance differential between the free clearance and the operating (running) clearance (the amount of clearance reduction caused by interference fits, or clearance variation due to the temperature difference between the inner and outer rings) can be calculated by the following formula:

$$\delta_{eff} = \delta_o - (\delta_f + \delta_t) \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\textbf{(5.1)}$$

where,

δ_{eff} : Running clearance mm

δ_o : Free clearance mm

δ_f : Reduction in internal clearance by interference mm

δ_t : Reduction in internal clearance due to inner/outer ring temperature difference mm

(1) Reduction in radial clearance by interference

When bearings are installed with interference fits on shafts and in housings, the inner ring will expand and the outer ring will contract; thus reducing the bearing' s internal clearance. The amount of expansion or contraction varies depending on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. The differential is approximately 85% of the effective interference. For details, refer to **Table 6.4** on page A-35.

$$\delta_f \approx 0.85 \cdot \Delta d_{eff} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\textbf{(5.2)}$$

where,

δ_f : Reduction in internal clearance by interference mm

Δd_{eff} : Effective interference mm

(2) Reduction in radial clearance due to inner/outer ring temperature difference

During operation, normally the outer ring will be from 5 to l0°C cooler than the inner ring or rolling elements. However, if the cooling effect of the housing is large, the shaft is connected to a heat source, or a heat substance is conducted through a hollow shaft; the temperature difference between the two rings can be even greater. The amount of internal clearance is thus further reduced by the differential expansion of the two rings.

$$\delta_t = \alpha \cdot \Delta_T \cdot D_o \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\textbf{(5.3)}$$

where,

δ_t : Reduction in internal clearance due to inner/outer ringtemperature difference mm

α : Linear expansion coefficient of bearing steel 12.5×10^{-6}/°C

Δ_T : Inner ring – outer ring temperature difference ℃

D_o : Outer ring raceway diameter mm

When a shaft or housing is directly used as a raceway, the temperature difference(Δ_t) can be determined, treating the shaft as an inner ring and the housing as an outer ring.

5.3 Fits and bearing radial internal clearance

Once the dimensional tolerances for the shaft outside diameter and the housing bore diameter have been determined, a simple nomogram such as a one in **Fig. 5.1** may be used as a guide to determine the initial radial internal clearance for the bearing that will later lead to an appropriate internal clearance of the installed bearing. The nomogram in **Fig. 5.1** is used as the guideline as stated above. For details feel free to contact **NTN**.

For example, where the fit condition of a needle roller bearing with an inner ring is already given as J7 m6, **Fig.5.1** shows that clearance C3 must be used to get the standard running clearance after installation.

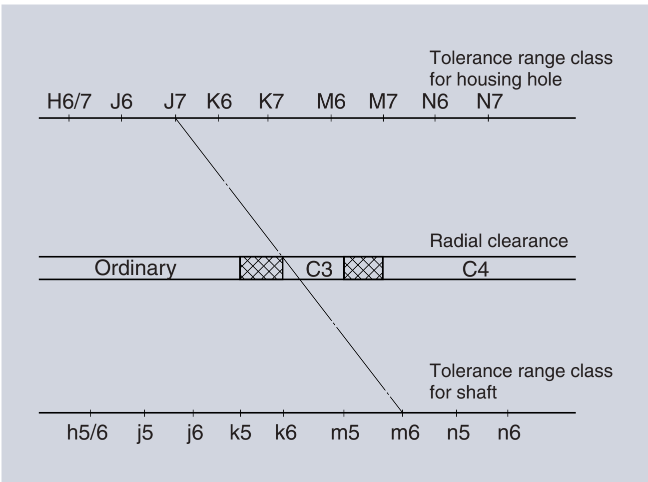


Fig. 5.1 Relationship between bearing fits and radial clearance

6. Bearing Fits

6.1 About bearing fits

For rolling bearings, the inner ring and outer ring are fixed on the shaft or in the housing so that relative movement does not occur between the fitted surfaces of the bearing ring and the shaft or housing in radial, axial and rotational directions when a load acts on the bearing. Depending on presence/absence of interference, fit modes can be categorized into **"interference fit"**, **"transition fit"**, and **"loose fit"**.

The most effective practice to position a bearing is to provide an interference on the fit surfaces between the bearing ring and shaft or housing. Furthermore, as its advantage this tight fit method supports the thin-walled bearing ring with uniform load throughout its entire circumference without any loss of load carrying capacity.

The needle roller bearing is a bearing type which allows separation of the inner ring and the outer ring from one another and, therefore, it can be installed on a shaft or in a housing with an interference applied to both. In the case of "tight fit", the ease of bearing installation and removal. The bearing ring subjected to stationary load can be "loose-fitted". In contrast, tight fitting may not apply to all bearing applications because ease of mounting or removal of the bearing will be jeopardized.

6.2 Necessity of proper fit

Improper fit could lead to damage and shorter life of the bearing. Therefore, advance careful analysis is needed for selection of proper fit. Representative examples of bearing defects caused by improper fit are as described below.

- Fracture of bearing ring, and displacement of bearing ring
- Wear of bearing ring, shaft and housing caused by creep and fretting corrosion
- Seizure caused by insufficient internal clearance
- Insufficient running accuracy and abnormal noise caused by deformed raceway surface

6.3 Fit selection

Fit selection is generally done in accordance with the rule specified hereunder.

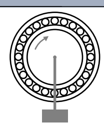
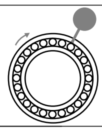
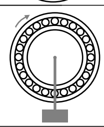
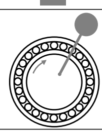
The loads acting on each bearing ring are divided into running load, stationary load and directionally unstable load according to the direction and characteristic of loads acting on the bearing.

A bearing ring that carries both running load and indeterminate direction load is provided with tight fit while a bearing ring that carries static load may be provided with either transition fit or loose fit (refer to **Table 6.1**).

Where load of high magnitude or vibration and shock loads act on a bearing or if a light alloy/plastic housing is used, it is necessary to secure a large interference. **However, if this type of practice is applied, it is necessary to consider the rigidity of housing in order avoid problems including deformation or fracture of the housing, deformation of the bearing, galling on fit surfaces, as well as resultant poor fit accuracy.**

For an application subjected to high running accuracy, bearings of high accuracy must be used with a shaft and a housing of higher dimensional accuracy so as not to require a large interference Applying a large interference would cause the shaft or housing profile to be transferred to the bearing track, which could then interfere with the bearing running accuracy.

Table 6.1 Radial load and bearing fit

Bearing running conditions	Sketch	Load characteristic	Bearing fit	
			Inner ring	Outer ring
Inner ring : Rotation Outer ring: static Load direction: constant		Rotating inner ring load	Needs to be tight fit	May be loose fit
Inner ring: static Outer ring: rotation Load direction: rotating with outer ring		Static outer ring load		
Inner ring: static Outer ring: rotation Load direction: constant		Rotating inner ring load	May be loose fit	Needs to be tight fit
Inner ring: rotation Outer ring: static Load direction : rotating with inner ring		Static outer ring load		
Inner ring: rotation or static Outer ring: rotation or static Load direction: The direction can not be fixed.	Load direction is non-constant due to directional fluctuation, unbalanced load, etc.	Directionally unstable load	Needs to be tight fit	Needs to be tight fit

6.4 Recommended fits

The dimensional tolerances for the diameter of a shaft and the bore diameter of a bearing housing, on/in which a bearing is installed, are standardized under the metric system in ISO 286 and JIS B 0401 (Bases of tolerances, deviations and fits). Hence, bearing fits are determined by selection of the dimensional tolerances for shaft diameter and housing bore diameter as applicable.

Table 6.2 shows the recommended fits for the machined ring needle roller bearings (with inner ring) that are generally selected based on the dimensional and load conditions. **Table 6.3** shows the numerical fit values.

For the recommended fits for others than the machined ring needle roller bearings, refer to "Commentary" described in the respective Dimension Tables.

Table 6.2 General standards for fits of machined ring needle roller bearing (JIS Class 0, Class 6)

Table 6.2 (1) Tolerance range classes for shaft (recommended)

Conditions			Tolerance range class
Load characteristic	Load magnitude	Shaft diameter d mm	
Rotating inner ring load or directionally unstable load	Light load	— 50	j5
	Ordinary load	— 50	k5
		50 — 150	m5
		150 —	m6
	Heavy load and shock load	— 150	m6
		150 —	n6
Inner ring static load	Medium- and low-speed rotation, light load	All dimensions	g6
	General application		h6
	When high rotational accuracy is required		h5

Table 6.2 (2) Tolerance range classes for housing bore (recommended)

Conditions		Tolerance range class
Outer ring static load	Ordinary and heavy load	J7
	Two-split housing, ordinary load	H7
Rotating outer ring load	Light load	M7
	Ordinary load	N7
	Heavy load and shock load	P7
Directionally unstable load	Light load	J7
	Ordinary load	K7
	Heavy load and shock load	M7
When high rotational accuracy under light load is required		K6

Remarks: Light load, ordinary load and heavy load are classified per the following criteria.
Light load : $P_r \leqq 0.06C_r$
Ordinary load : $0.06C_r < P_r \leqq 0.12C_r$
Heavy load : $P_r > 0.12C_r$

6.5 Lower limit and upper limit of interference

When an intended bearing application requires an interference on the bearing, determine the appropriate interference taking into account the following considerations:

- Determine the lower limit taking into account the following factors:
  (1) Reduction in interference due to radial load
  (2) Reduction in interference due to temperature difference
  (3) Reduction in interference due to poor roughness on fit surfaces
- Recommended upper limit is 1/1000 as large as the shaft diameter or smaller.

The formulas for calculating the required interference are presented below:

(1) Radial load and required interference

When a radial load acts on a bearing, the interference between the inner ring and shaft will decrease. The interference required to maintain an effective interference can be determined by **formulas (6.1)** and **(6.2)** below:

For $F_r \leqq 0.3\ C_{0r}$,

$$\Delta d_F = 0.08\sqrt{\frac{d \cdot F_r}{B}}\ \left(0.25\sqrt{\frac{d \cdot F_r}{B}}\right) \cdots\cdots\cdots \textbf{(6.1)}$$

For $F_r > 0.3\ C_{0r}$,

$$\Delta d_F = 0.02\frac{F_r}{B}\ \left(0.2\frac{F_r}{B}\right) \cdots\cdots\cdots \textbf{(6.2)}$$

Where,
Δd_F : Required effective interference mm
d : Bearing bore diameter mm
B : Inner ring width mm
F_r : Radial load N (kgf)
C_{0r} : Basic static load rating N (kgf)

Table 6.3 Numerical fit values for radial bearing (JIS Class-0)
Table 6.3(1) Bearing fits on shaft

Unit μm

Nominal bore diameter *d* mm over	incl.	Allowable deviation of mean bore diameter Δ_{dmp} high	low	g6 Bearing / Shaft	h5 Bearing / Shaft	h6 Bearing / Shaft	j5 Bearing / Shaft	k5 Bearing / Shaft	m5 Bearing / Shaft	m6 Bearing / Shaft	n6 Bearing / Shaft
3	6	0	−8	4T〜12L	8T〜 5L	8T〜 8L	11T〜 2L	14T〜1T	17T〜 4T	20T〜 4T	24T〜 8T
6	10	0	−8	3T〜14L	8T〜 6L	8T〜 9L	12T〜 2L	15T〜1T	20T〜 6T	23T〜 6T	27T〜10T
10	18	0	−8	2T〜17L	8T〜 8L	8T〜11L	13T〜 3L	17T〜1T	23T〜 7T	26T〜 7T	31T〜12T
18	30	0	−10	3T〜20L	10T〜 9L	10T〜13L	15T〜 4L	21T〜2T	27T〜 8T	31T〜 8T	38T〜15T
30	50	0	−12	3T〜25L	12T〜11L	12T〜16L	18T〜 5L	25T〜2T	32T〜 9T	37T〜 9T	45T〜17T
50	80	0	−15	5T〜29L	15T〜13L	15T〜19L	21T〜 7L	30T〜2T	39T〜11T	45T〜11T	54T〜20T
80	120	0	−20	8T〜34L	20T〜15L	20T〜22L	26T〜 9L	38T〜3T	48T〜13T	55T〜13T	65T〜23T
120 140 160	140 160 180	0	−25	11T〜39L	25T〜18L	25T〜25L	32T〜11L	46T〜3T	58T〜15T	65T〜15T	77T〜27T
180 200 225	200 225 250	0	−30	15T〜44L	30T〜20L	30T〜29L	37T〜13L	54T〜4T	67T〜17T	76T〜17T	90T〜31T
250 280	280 315	0	−35	18T〜49L	35T〜23L	35T〜32L	42T〜16L	62T〜4T	78T〜20T	87T〜20T	101T〜34T
315 355	355 400	0	−40	22T〜54L	40T〜25L	40T〜36L	47T〜18L	69T〜4T	86T〜21T	97T〜21T	113T〜37T
400 450	450 500	0	−45	25T〜60L	45T〜27L	45T〜40L	52T〜20L	77T〜5T	95T〜23T	108T〜23T	125T〜40T

Table 6.3 (2) Bearing fits in housing hole

Unit μm

Nominal outer diameter *D* mm over	incl.	Allowable deviation of mean outer diameter Δ_{Dmp} high	low	H7 Housing / Bearing	J7 Housing / Bearing	K6 Housing / Bearing	K7 Housing / Bearing	M7 Housing / Bearing	N7 Housing / Bearing	P7 Housing / Bearing
6	10	0	−8	0〜 23L	7T〜16L	7T〜10L	10T〜13L	15T〜 8L	19T〜 4L	24T〜 1T
10	18	0	−8	0〜 26L	8T〜18L	9T〜10L	12T〜14L	18T〜 8L	23T〜 3L	29T〜 3T
18	30	0	−9	0〜 30L	9T〜21L	11T〜11L	15T〜15L	21T〜 9L	28T〜 2L	35T〜 5T
30	50	0	−11	0〜 36L	11T〜25L	13T〜14L	18T〜18L	25T〜11L	33T〜 3L	42T〜 6T
50	80	0	−13	0〜 43L	12T〜31L	15T〜17L	21T〜22L	30T〜13L	39T〜 4L	52T〜 8T
80	120	0	−15	0〜 50L	13T〜37L	18T〜19L	25T〜25L	35T〜15L	45T〜 5L	59T〜 9T
120	150	0	−18	0〜 58L	14T〜44L	21T〜22L	28T〜30L	40T〜18L	52T〜 6L	68T〜10T
150	180	0	−25	0〜 65L	14T〜51L	21T〜29L	28T〜37L	40T〜25L	52T〜13L	68T〜 3T
180	250	0	−30	0〜 76L	16T〜60L	24T〜35L	33T〜43L	46T〜30L	60T〜16L	79T〜 3T
250	315	0	−35	0〜 87L	16T〜71L	27T〜40L	36T〜51L	52T〜35L	66T〜21L	88T〜 1T
315	400	0	−40	0〜 97L	18T〜79L	29T〜47L	40T〜57L	57T〜40L	73T〜24L	98T〜 1T
400	500	0	−45	0〜108L	20T〜88L	32T〜53L	45T〜63L	63T〜45L	80T〜28L	108T〜 0

Remarks: Fit symbols “L” and “T” represent bearing clearance and interference respectively.

(2) Temperature difference and required interference

Heat is generated in a running bearing, and temperature difference occurs across the inner ring and outer ring: as a result, the interference between the inner ring and shaft will decrease. When the difference between bearing temperature and ambient temperature is taken as ΔT, the interference needed for maintaining an effective interference can be determined by **formula (6.3)**:

$$\Delta d_F = 0.0015 \cdot d \cdot \Delta T \quad \cdots\cdots \textbf{(6.3)}$$

Where,
- Δd_T : Required effective interference for temperature difference μm
- ΔT : Difference between bearing temperature and ambient temperature ˚C
- d : Bearing bore diameter mm

(3) Fitting surface roughness and required interference

The fitting surface is smoothed (surface roughness is made less) by bearing fits so that the interference reduces correspondingly. The interference reduction differs depending on the fitting surface roughness and generally the following reduction values must be used.

For ground shafts : 1.0 to 2.5mm
For lathe-turned shafts : 5.0 to 7.0 mm

(4) Maximum interference

Tensile stress or compressive stress occurs on a bearing ring that has been installed to a shaft or housing with possible interference between these members. Excessively large interference can cause the bearing ring to fracture or shorten the fatigue life of the bearing. Therefore, usually **set the maximum allowable interference at 1/1000 as large as the shaft diameter or smaller; or such that the maximum circumferential tensile stress occurring on the fitting surfaces is not greater than 130 MPa** (refer to **Table 6.4**).

(5) Stress and deformation caused by interference

When bearing ring (solid) is fitted with interference, it deforms elastically and this elastic deformation results in stress.(See **Fig.6.1**) The fitting surface pressure of bearing ring, circumferential tensile stress (inner ring), compressive stress (outer ring) and radial expansion of raceway (inner ring), and shrinkage(outer ring) can be calculated from **Table 6.4**.

Table 6.4 Deformation and stress caused by bearing fit

Item	Inner ring	Outer ring
Surface pressure p MPa	$p_i = \frac{E}{2}\,\frac{\Delta d_{eff}}{d}\,\frac{(1-k^2)(1-k_0^2)}{1-k^2k_0^2}$	$p_e = \frac{E}{2}\,\frac{\Delta D_{eff}}{D}\,\frac{(1-h^2)(1-h_0^2)}{1-h^2h_0^2}$
Circumferential maximum stress σ MPa	$\sigma_i = p_i\,\frac{1+k^2}{1-k^2}$ (Tensile stress)	$\sigma_e = p_e\,\frac{2}{1-h^2}$ (Compressive stress)
Radial elastic deformation of raceway Δ	$\Delta_i = \Delta d_{eff}\cdot k\,\frac{1-k_0^2}{1-k^2k_0^2}$ (Expansion)	$\Delta_e = \Delta D_{eff}\cdot h\,\frac{1-h_0^2}{1-h^2h_0^2}$ (Shrinkage)

Where,

$$k = \frac{d}{d_i},\quad k_0 = \frac{d_0}{d},\quad h = \frac{D_e}{D},\quad h_0 = \frac{D}{D_0}$$

Remarks (Symbol representation)
- d : Inner ring bore diameter (shaft diameter) mm
- d_0 : Hollow shaft bore diameter (For solid shaft, $d_0 = 0$) mm
- d_i : Inner ring raceway diameter mm
- Δd_{eff} : Effective interference for inner ring mm
- D : Outer ring outer diameter (housing hole diameter) mm
- D_0 : Housing outer diameter (For sufficient housing size, $D_0 = \infty$) mm
- D_e : Outer ring raceway diameter mm
- ΔD_{eff} : Effective interference for outer ring mm
- E : Modulus of elasticity (Young factor) 2.07×10^6 (21200) MPa (kgf/mm²)

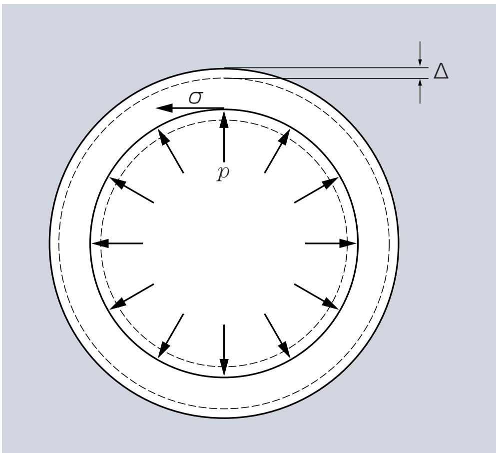


Fig.6.1

7. Limiting Speeds

At a higher bearing running speed, the bearing temperature will be higher due to frictional heat generated inside the bearing, possibly leading to failures such as seizure. As a result, the bearing will fail to continue stable operation. A maximum running speed that allows a bearing to run without developing such a problem heat buildup is known as **limiting speed** (min^{-1}) and can vary depending on the bearing type, dimensions, cage type, load, acceleration/deceleration conditions, lubrication conditions and cooling conditions.

As a guideline, each bearing dimension table contains data about limiting bearing speeds obtained from grease lubrication and oil lubrication. However, it should be noted that these values are based on the following assumptions:

- Bearing that has been manufactured per NTN standard design specification and is provided with an appropriate internal clearance has been correctly mounted.
- Bearing is lubricated with a good quality lubricant, which is resupplied and replaced at correct intervals.
- Bearing is operated under ordinary loading conditions ($P \leqq 0.09\ C_r$) and at an ordinary operating temperature.

If the user is thinking of a bearing application whose running speed exceeds the limiting speed in the relevant dimension table, the user has to adopt a bearing that satisfies stricter requirements for cage specification, internal clearance, bearing accuracy, etc. and make special considerations which typically include adoption of forced circulating lubrication system.

8. Shaft and Housing Design

Even if the bearing to be used is selected correctly, it can not fulfill its specific function unless the shaft/housing on/in which it is installed is designed correctly. For needle roller bearings, special attention must be paid to shaft and housing designs, since the bearing ring thickness is thinner compared to other rolling bearing types.

8.1 Design of bearing installing portions

For needle roller and cage assemblies, attention must be paid to the axial guidance surface, such as a shaft shoulder. This guiding surface should be smooth and free from burrs. Under challenging load and/or speed conditions, a hardened and ground surface is required.

In cases where a snap ring is used as a locating shoulder (**Fig. 8.1**), a thrust ring should be used between the snap ring and bearing cage to prevent the cut section of the snap ring from contacting the cage directly. **NTN** offers WR type snap rings that are customdesigned for axial retention of needle roller & cage assemblies. (Refer to the Dimensions Table on page B-267.)

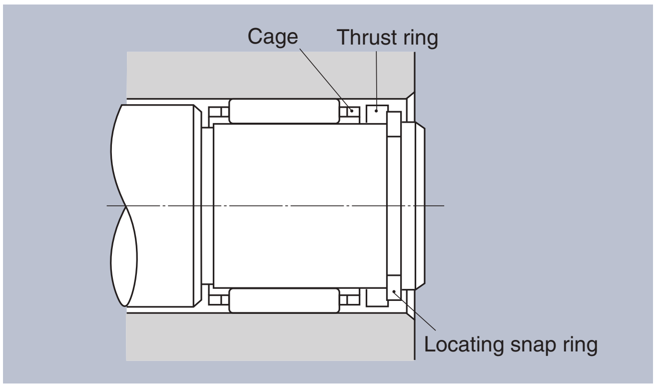


Fig. 8.1 Bearing fixing by thrust ring

Since a radial needle roller bearing can move freely on the shaft along the axial direction, a ball bearing or thrust bearing is used on the side opposite to the radial needle roller bearing in order to locate the shaft in the axial direction. With an application where the axial load is low and the running speed is not high (for example, an idle gear in gearbox), a thrust ring may be installed to a shaft as shown in **Fig. 8.2** to form a sliding bearing between the thrust ring and the housing end face in order to axially position the bearing. **Fig.8.3** illustrates an example of the above thrust ring with oil groove on its guide surface. The boundary between this oil groove and the plane area must be chamfered for deburring.

In general, for proper installation of needle roller bearing the inner ring and outer ring are both positioned in axial direction so that the bearing displaces in axial direction while running.

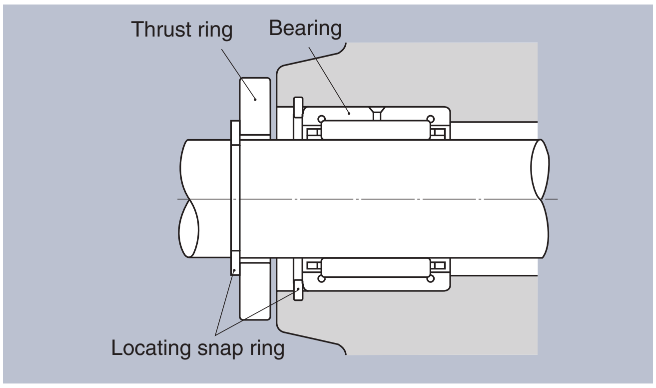


Fig. 8.2 Bearing fixing in axial direction

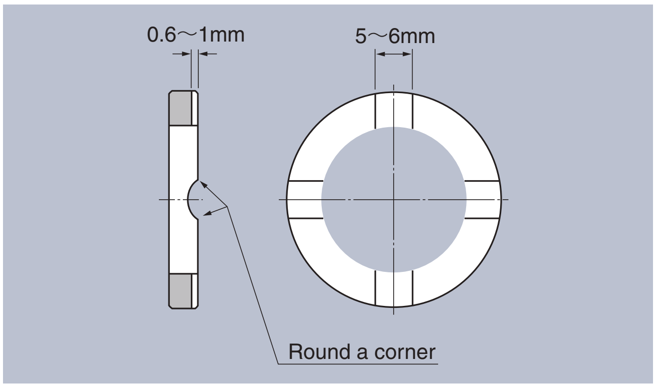


Fig. 8.3 Design of thrust ring guide surface

(1) Inner ring

For fixing inner ring correctly on a shaft, the shaft shoulder face is finished at the right angle against the shaft axial center and, in addition, the shaft corner radius must be smaller than the inner ring chamfer dimension.

To simplify inner ring extraction work, cutout grooves for engagement with jaws of an extraction jig are formed at the shoulder of the shaft as shown in **Fig. 8.4**, and the inner ring is extracted with the extraction jig according to a method illustrated in **Fig. 8.5**. Furthermore, for facilitating inner ring pull-out work the shaft shoulder is provided with a notched groove,as illustrated in **Fig. 8.5**, to accept an inner ring pull-out jig (puller).

NTN snap ring WR type for shaft use (Refer to Dimensions Table on page B-267) can be used for simply fixing inner ring in axial direction. (**Fig. 8.6**) Moreover,

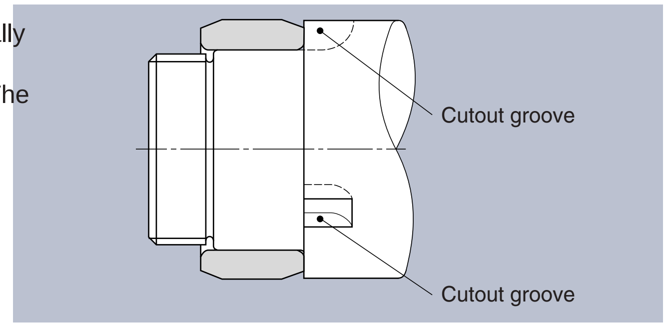


Fig. 8.4 Cutout groove for inner ring extraction

inner ring can be fixed in axial direction using an end plate or a side ring as illustrated in **Figs. 8.7** and **8.8**.

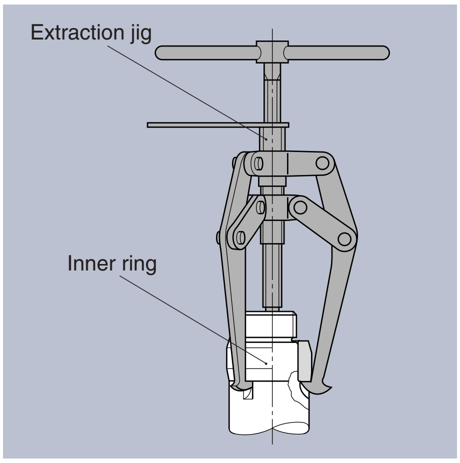


Fig. 8.5 Inner ring extraction with extraction jig

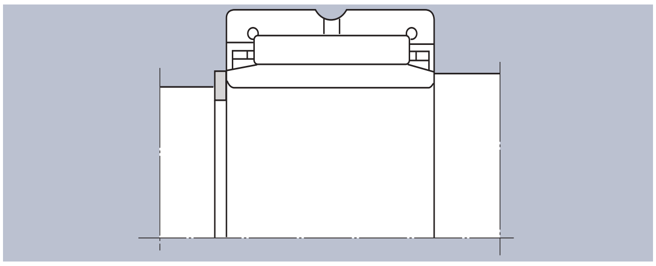


Fig. 8.6 Inner ring fixing method with snap ring

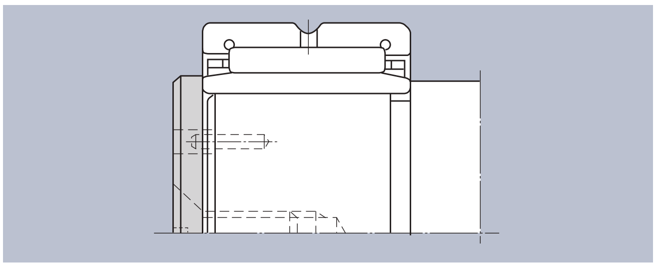


Fig. 8.7 Inner ring fixing method with end plate

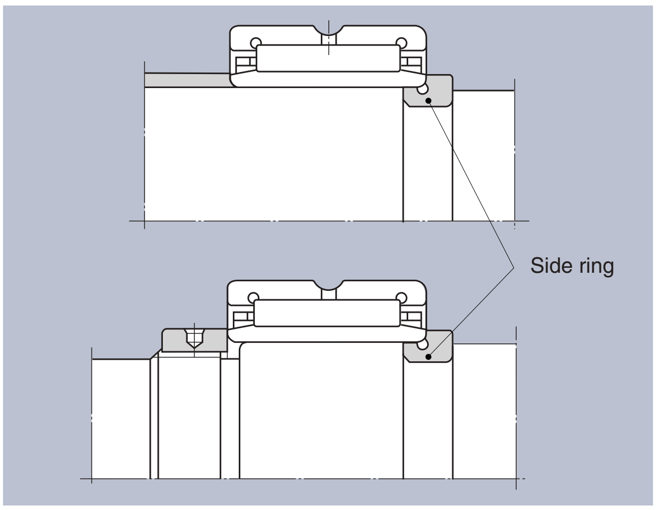


Fig.8.8 Inner ring fixing method with side ring

(2) Outer ring

Similarly to Para. 8.1(1) "Inner Ring", good care must be exercised of the shoulder profile of bearing housing for fixing outer ring in axial direction.

Figs. 8.9 and **8.10** illustrate the methods of fixing outer ring in axial direction.

For the outer ring also, the **NTN** snap ring type BR for housing (refer to the dimension table in page B-269) can be used. **NTN** BR type snap rings are designed to the dimensions adaptable to the needle roller bearings with low section height. However, commercially available snap rings conforming to JIS standard as applicable can also be used for the same bearings with adequately high section height.

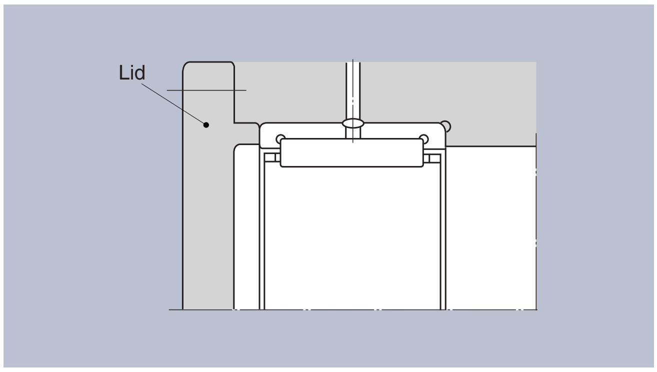


Fig. 8.9 Outer ring fixing by lid

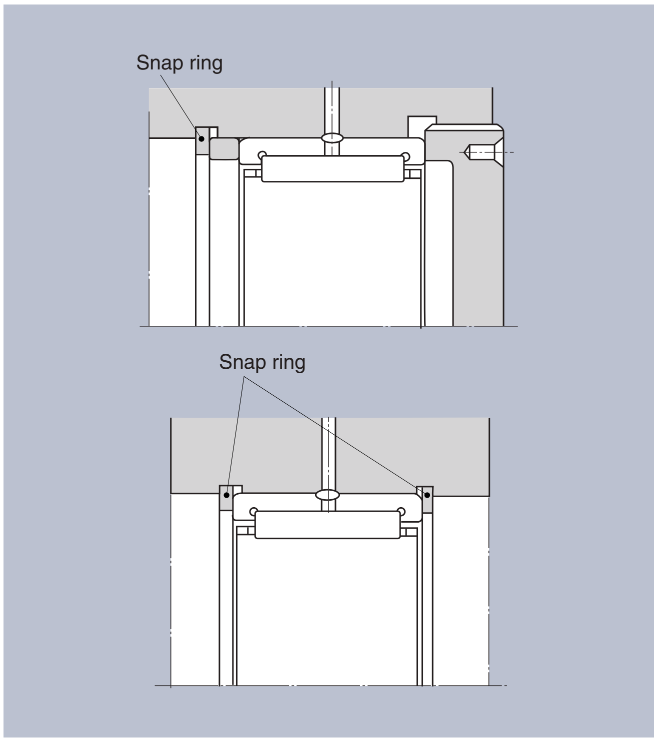


Fig. 8.10 Outer ring fixing method with snap ring

8.2 Bearing fitting dimensions

8.2.1 Shoulder height and corner roundness

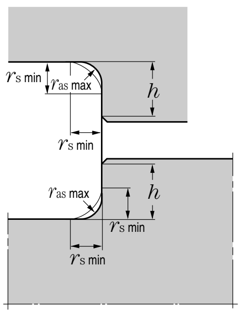
The respective shoulder heights "h", of the shaft and housing are designed to be larger than the maximum bearing chamfer dimension $r_{s\,max}$, so the bearing end face comes in contact with the flat zone. The corner roundness "r_{as}" is designed to be smaller than the minimum bearing chamfer dimension "$r_{s\,min}$" so as not to interfere with the bearing. Generally the radius of the shaft and housing corner roundness shown in **Table 8.1** is used as the shoulder heights of the shaft and housing.

The dimensions of the shafts and housings related to bearing installation are as described in the dimensions table for each bearing type. The shoulder diameter shown in this table means the effective shoulder diameter which comes in contact with the side face of bearing excluding the chamfered portion of the shoulder.

Table 8.1 Radius of shaft /housing corner roundness and shoulder height

Unit mm

$r_{s\,min}$	$r_{as\,max}$	h (min)
0.15	0.15	0.6
0.2	0.2	0.8
0.3	0.3	1
0.6	0.6	2
1	1	2.5
1.1	1	3.25
1.5	1.5	4
2	2	4.5
2.1	2	5.5
2.5	2	5.5
3	2.5	6.5
4	3	8



8.2.2 Applications of spacer and relief grinding

There may be cases where corner roundness $r_{as\,max}$ needs to be greater than the chamfering dimension on the bearing in order to mitigate stress concentration and enhance shaft strength (**Fig. 8.11a**), or where sufficiently large contact area is not available because of a low shaft shoulder (**Fig. 8.11b**). Then, a spacer can be inserted between the shaft shoulder and bearing.

Dimensions of ground-finished fit surfaces on shafts and housings are listed in **Table 8.2**.

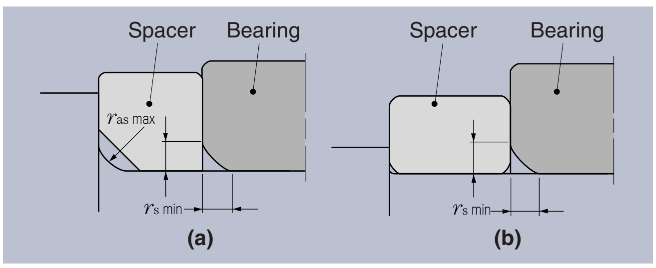
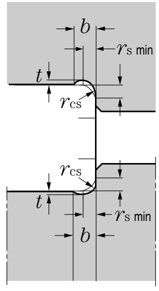


Fig. 8.11 Spacer applications

Table 8.2 Relief grinding dimension for shaft and housing corners

Unit mm

$r_{s\,min}$	b	t	r_{cs}
1	2	0.2	1.3
1.1	2.4	0.3	1.5
1.5	3.2	0.4	2
2	4	0.5	2.5
2.1	4	0.5	2.5
3	4.7	0.5	3
4	5.9	0.5	4



8.2.3 Mounting dimensions for thrust bearings

To be able to satisfy requirements for load capacity and rigidity, the surface of bearing ring on any thrust bearing needs to be sufficiently large. Therefore, the mounting dimensions in the dimension table for the intended bearing needs to be satisfied (**Fig. 8.12**).

Because of this, shoulder heights for thrust bearings have to be greater compared to radial bearings. (For the mounting dimensions of a particular thrust bearing, refer to the dimension table for that bearing.)

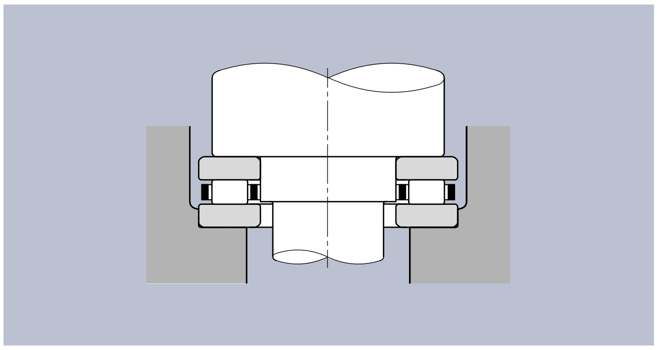


Fig. 8.12

8.3 Shaft and housing accuracy

The bearing ring of a needle roller bearings is thin-walled. Consequently, degree of physical accuracy of the raceway surface of the bearing ring is governed by physical accuracy of the fit surface of the shaft or housing to which the intended bearing is installed.

Table 8.3 summarizes recommended physical accuracy (tolerances) on the fit surfaces of the shaft and housing under ordinary bearing operating conditions: the characteristics in question are dimensional accuracy, shape accuracy, surface roughness, and runout of the shaft shoulder relative to fit surface.

For an application that adopts a double-split housing, the bore side of each housing half may be relieved: consequently, when the housing halves are joined together and the mating surfaces are forced together, resultant deformation on the outer ring is minimal.

Table 8.3 Shaft and housing accuracy (recommended)

Characteristic item	Shaft	Housing
Dimensional accuracy	IT6 (IT5)	IT7 (IT6)
Roundness cylindricality (max)	IT3	IT4
Shoulder perpendicularity (max)	IT3	IT3
Fitting surface roughness	0.8a	1.6a

Remarks: The parenthesized values are applied to the bearings of accuracy class 5 and higher.

8.4 Raceway surface accuracy

For needle roller bearings, the shaft and housing are used as the raceway surface on applications. The raceway dimensional accuracy, profile accuracy and surface roughness of the shaft/housing must be equivalent to the raceway accuracy of the bearing itself. **Table 8.4** shows the specified surface accuracy and surface roughness of the shaft/housing raceway.

Table 8.4 Raceway surface accuracy (recommendation)

Characteristic item	Shaft	Housing
Dimensional accuracy	IT5 (IT4)	IT6 (IT5)
Roundness cylindricality (max)	IT3 (IT2)	IT4 (IT3)
Shoulder perpendicularity (max)	IT3	IT3
Surface roughness	For shaft diameter of φ80 and less :0.2a For shaft diameter of over φ80 to 120 :0.3a For shaft diameter of over φ120 :0.4a	

Note) The parenthesized values are applied where high rotational accuracy is required.

8.5 Material and hardness of raceway surface

When the outer surface or bore surface of the shaft(hollowed) or housing is used as raceway, it must be hardened to HRC58 to 64 in order to obtain sufficient load capacity. For that, the materials shown in **Table 8.5** are used after heat-treated properly.

Table 8.5 Materials used for raceway

Kinds of steel	Representative example	Related standards
High carbon chrome bearing steel	SUJ2	JIS G 4805
Carbon tool steel	SK85 (previously: SK5)	JIS G 4401
Nickel chrome molybdenum steel	SNCM420	JIS G 4053 (previously: JIS G 4103)
Chrome steel	SCr420	JIS G 4053 (previously: JIS G 4104)
Chrome molybdenum steel	SCM420	JIS G 4053 (previously: JIS G 4105)
Stainless steel	SUSU440C	JIS G 4303

When steel is surface-hardened by carburizing or carbonitriding, JIS Standard defines the depth from surface up to HV550 as an effective hardened layer. The minimum value of effective hardened layer depth is approximately expressed in **formula (8.1)**.

$$E_{ht\ min} \geqq 0.8D_w (0.1+0.002D_w) \quad \cdots\cdots\cdots\cdots \textbf{(8.1)}$$

Where,

$E_{ht\ min}$: Minimum effective hardened layer depth mm

D_w : Roller diameter mm

8.6 Allowable bearing inclination

The inner ring and outer ring of the bearing incline a little eventually against one another depending on shaft deflection, shaft /housing machining accuracy, fitting deviation, etc. Although this allowable inclination differs depending on bearing type, bearing load, internal clearance, etc., the inclination degree shown in **Table 8.6** must be used as a guideline in the case of general applications because even minor inclination of the inner and outer ring could cause a reduction of bearing life and damage the cage.

Table 8.6

Bearing type	Allowable inclination
Radial needle roller bearing	1/2 000
Thrust bearing	1/10 000

9. Lubrication

9.1 Purpose of lubrication

When a bearing is lubricated, its rolling and sliding surfaces are covered with a thin oil film that prevents the occurrence of metal-to-metal contact. Lubrication of rolling bearings offers the following benefits:

(1) Reduction of friction and wear
(2) Discharge of friction heat
(3) Further extension of bearing life
(4) Rust prevention
(5) Prevention of foreign matter invasion

To fully realize these benefits developed, the bearing user has to adopt a lubrication system that best suits the projected bearing operating conditions, select quality lubricant, and adopt a relevant sealing design that helps regulate the amount of lubricant retained, prevent the ingress of foreign materials and leakage of the lubricant.

9.2 Lubrication systems and characteristics

In general, bearing lubrication systems usually available as grease lubrication and oil lubrication, each featuring unique advantages and disadvantages. The user needs to select an appropriate lubrication system that best suits the user's bearing performance requirements.

Table 9.1 summarizes the different features of grease and oil lubrication.

Table 9.1 Characteristic comparison of grease and oil lubrication

Lubrication method / Comparative items	Grease lubrication	Oil lubrication
Handling	◎	△
Reliability	○	◎
Cooling effect	×	○ (Recirculation needed)
Seal structure	○	△
Power loss	○	○
Environmental pollution	○	△
High speed operation of bearing	×	○

◎ : Extraordinarily advantageous ○ : Advantageous
△ : Fairly advantageous × : Disadvantageous

9.3 Grease lubrication

Grease lubrication is the simplest lubrication method. This method enables a simplified design of the seal structure, and is broadly used.

Important points for this lubrication method are to select an optimum grease and to fill it securely in the bearing. Particularly where the cage is guided by the inner ring or outer ring of bearing, care must be exercised so the guide surface is fully greased throughout its entire area.

If requiring refilling of grease, the bearing should be provided with grease sectors as a refilling means and a grease valve or an equivalent as a means of discharge.

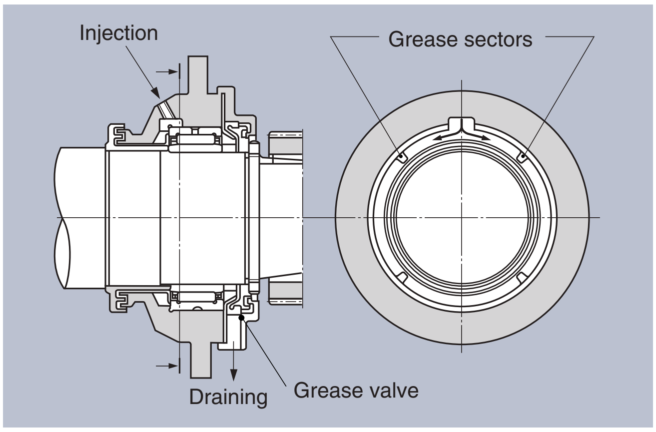


Fig. 9.1 An example of bearing unit with grease sector and grease valve

Fig. 9.1 illustrates an example of bearing unit with grease sector and a grease valve. An amount of grease injected through a port, such as a grease nipple, is blocked by the grease sectors, then fills the space and the excess fluid flows into the bearing. Grease is circulated through the interior of bearing, and excess amount of grease pushed out of the bearing is allowed to drain through the grease valve.

9.3.1 About grease

Grease lubrication is **composed of a lubrication base oil (ex. mineral oil base or a synthetic oil base) held with a thickener, and various additives added thereto.** The properties of grease are determined by the kinds and combination of base oil, thickener, and additives.

Commons grease types and their characteristics are summarized in **Table 9.2**. Characteristics of greases of a similar type can vary greatly depending on the brands. Therefore, **to be able to select an optimal grease brand, it is necessary to check grease characteristic data, available from grease manufacturers.**

(1) Base oil

Base oils used in grease are **mineral oil**, or synthetic oils such as **ester** and **ether oil**.

Lubricating performance of a given lubricant is mainly governed by lubricating performance of the base oil. Generally, greases comprising a low-viscosity base oil excel in low-temperature characteristics and high-speed performance, while greases with a high-viscosity base oil boast excellent high-temperature, high-load characteristics.

(2) Thickener

Thickeners are blended and diffused in base oil to hold grease in a semi-solid form. Commonly used thickeners include: metal soaps derived from **lithium**, **sodium** and **calcium**; non-metal soap thickeners made from inorganic materials such as **silica gel** and **bentonite**, and organic materials such as **urea** and **fluoro carbon**. The grease characteristics such as **critical operating temperature, mechanical stability, durability**, etc. are mainly

Table 9.2 Grease varieties and characteristics

Grease name	Lithium grease			Sodium grease (Fiber grease)	Calcium compound base grease	Aluminum grease	Non-soap grease	
Thickener	Li soap			Na soap	Ca+Na soap Ca+Li soap	Al soap	Bentone, silica gel, urea, carbon black, etc.	
Base oil	Mineral oil	Diester oil	Silicone oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Synthetic oil
Dropping point ˚C	170〜190	170〜190	200〜250	150〜180	150〜180	70〜90	250 or more	250 or more
Operating temperature range ˚C	−30〜+130	−50〜+130	−50〜+160	−20〜+130	−20〜+120	−10〜+80	−10〜+130	−50〜+200
Mechanical stability	Excellent	Good	Good	Excellent to good	Excellent to good	Good to poor	Good	Good
Pressure resistance	Good	Good	Poor	Good	Excellent to good	Good	Good	Good
Water resistance	Good	Good	Good	Good to poor	Good to poor	Good	Good	Good
Applications	Broadest application. Grease for universal type rolling bearings.	Excellent in low temperature characteristic and anti-friction characteristic.	suited to high temperature and low temperature. Low oil film strength and unsuitable for high load application.	emulsified by inclusion of water content. Comparatively excellent in high temperature characteristic.	Excellent in water resistance and mechanical stability. Suitable for bearing subjected to shock load.	Excellent in viscosity characteristic. Suitable for bearing subjected to vibration.	Available for use in wide temperature range from low to high temperature. Some of non-soap base greases are excellent in heat resistance, cold resistance, chemical resistance, etc. subject to proper combination of base oil and thickener. Grease for universal type rolling bearings.	

Remarks: The operating temperature range in this table is the general characteristic value, not the guaranteed value.

determined by the kind of thickener used. Generally, water resistance of sodium soap grease is poor. Non-soap thickeners made from bentone and urea feature excellent high-temperature characteristics.

(3) Additives

Any greases contain various additives to improve the performance. For example: **oxidation inhibitors, extreme pressure additives** (EP additives), **rust inhibitors, corrosion inhibitors,** etc.

A grease containing extreme pressure additives is used for bearings subjected to high load or shock load. A grease containing oxidation stabilizer is used for bearing applications wherein the operating temperature is comparatively high and the grease is not replenished for a long time.

(4) Consistency

"Consistency" is an index showing the hardness or fluidity of grease. **The higher the numerical value, the harder the consistency.** Lubricants commonly used for lubrication of rolling bearings are those having NLGI consistency number 1, 2 or 3.

Table 9.3 shows the general relationship of grease consistency to application.

Table 9.3 Grease consistency

NLGI consistency No.		JIS (ASTM) 60-cycle mixed grease consistency	Application
0	Soft	355–385	For centralized greasing
1	↑	310–340	For centralized greasing
2		265–295	For general application, for tight-sealed bearing
3	↓	220–250	For general application, for high temperature
4	Hard	175–205	Special application

(5) Grease mixing

Mixing dissimilar greases will alter the characteristics of grease: for example, consistency will vary (usually, the grease mixture will be softer compared with original greases) and the permissible operating temperature will be lower. **Therefore, in principle, do not mix greases other than mixing of portions of same grease brand.**

Where mixing of different greases is inevitable, greases composed of the same thickener and similar base oil must be selected. Even when greases of the same kind are mixed together, the properties of the mixed grease could vary depending on difference in additives, etc. It is therefore necessary to check the property variation in advance.

9.3.2 Grease fill amount

Grease fill amount differs depending on housing design, available volume, rotational speed, kind of grease, etc.

As a guideline, approximately 50% to 80% of the static volume within a bearing and housing is filled with grease. When intending higher running speed, or wanting to limit temperature rise, fill grease sparingly. **Too much grease fill would cause the grease temperature to rise, which would then lead to reduction of the specific lubrication performance due to leak of the softened grease, or quality change such as oxidation, etc.**

9.3.3 Grease replenishment

A bearings grease must be replenished at proper intervals because its lubrication performance deteriorates with running time. This replenishing interval differs depending on bearing type, dimension, rotational speed, bearing temperature, kind of grease used, etc.

Fig.9.2 gives the replenishing interval chart as a guideline. This chart is subject to use of a grease for ordinary rolling bearings under usual operating conditions.

Needless to say, the grease replenishing interval must be shortened as the bearing temperature gets higher. As an approximate guideline, when the bearing temperature is 80˚C or more, the replenishing interval shall be shortened by 1/1.5 whenever the bearing temperature rises by 10˚C.

[Ex.] Let us determine grease replenishment intervals for NA4910R that is run at a speed of n=1600 min^{-1}. From the dimension table for **NA4910R**, the shaft diameter (bearing bore diameter)=d 50 mm, limiting speed no = 4700 min^{-1}

Accordingly,

$$\frac{n_0}{n} = \frac{4700}{1600} \fallingdotseq 2.9$$

Plot a line horizontally from d=50 point in **Fig. 9.2** and deem the intersection point with the vertical line Ⅰ as A. Thereafter, connect n_0/n=3 point B on the vertical line Ⅱ and said A point together, with a straight line, and determine the intersection point C with the vertical line Ⅲ.

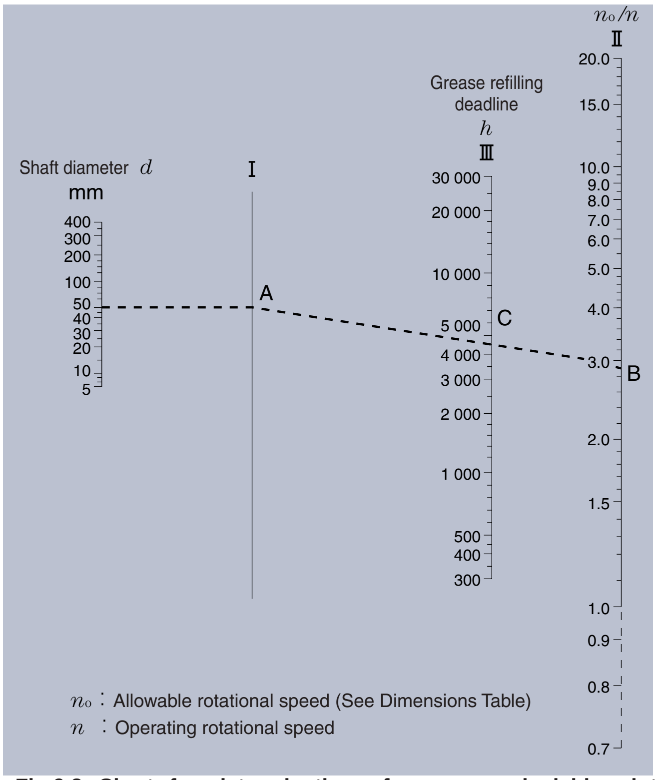


Fig.9.2 Chart for determination of grease replenishing interval

The grease replenishing interval of approximately 4600 hours can be read from the intersection point C.

9.3.4 Solid grease (lubricant for special "Polylube" bearings)

This unique solid grease consists of lubricating grease and ultra heavy molecular weight polyethylene (UHMW-PE) as main components. For more detailed information, refer to page A-54 in this document or the special catalog (Japanese only) "Polylube Needle Bearings" (NTN CAT. NO. 3605).

9.4 Oil lubrication

In general, oil lubrication is more suitable for high speed or high temperature applications than grease lubrication. Oil lubrication is suitable for the cases where heat generated in a bearing or heat transferred to a bearing must be discharged outside the bearing.

9.4.1 Lubrication method

(1) Oil bath lubrication

Oil bath lubrication is the most common lubrication scheme among various oil lubrication systems. It is used for low-speed and medium-speed bearing applications. An important point in this method is control of oil level in an oil bath.

For that, when bearings are installed on a horizontal shaft, it is common that a point close to the center of the rolling element in the lowest position should be deemed as the oil level to be secured during shutdown. In this case, the housing must be designed with such a profile as to minimize variation in oil level therein. Furthermore, it is desirable to provide the housing with an oil gauge to facilitate level check during running as well as shutdown.

When bearings are installed on a vertical shaft, it is okay if 50 to 80% of the rolling elements are dipped in an oil bath under low speed running, but in the cases of high speed running and bearings used in multiple rows it is desirable to adopt the drip lubrication and circulating lubrication methods, or others described hereunder.

(2) Spray lubrication

This method sprays lubrication oil by an impeller of simple structure, which is mounted on the shaft, without directly dipping a bearing in an oil batch. This can be applied to bearings running at considerably high speed.

(3) Drip lubrication

This lubrication method is used where bearing runs at comparatively high speed with medium and less loads act thereon. In this method, oil drips from an oiler on the top of a bearing unit, striking the rolling elements for atomizing lubrication (**Fig. 9.3**) and a small amount of oil passes through the bearing. In many cases the bearing is lubricated with several drips per minute though the number of oil drips per specific unit differs depending on bearing type and dimension.

(4) Circulating lubrication

This circulating lubrication method is adopted to cool down bearings or to lubricate by a centralized lubrication system. As added features with this method the oil feed line is equipped with a cooler to cool down the lubrication oil and an oil filter to purify the lubrication oil.

Under this circulating lubrication system, the lubrication oil must be discharged from each bearing after having passed through it. For that, it is important to provide an oil inlet and an oil outlet on each bearing in opposite position and to make the oil discharge port size as large as possible or otherwise to discharge the oil compulsorily. (**Fig.9.4**)

(5) Others

Jet lubrication, oil mist lubrication, air-operated oil lubrication, etc. are available as other lubrication methods.

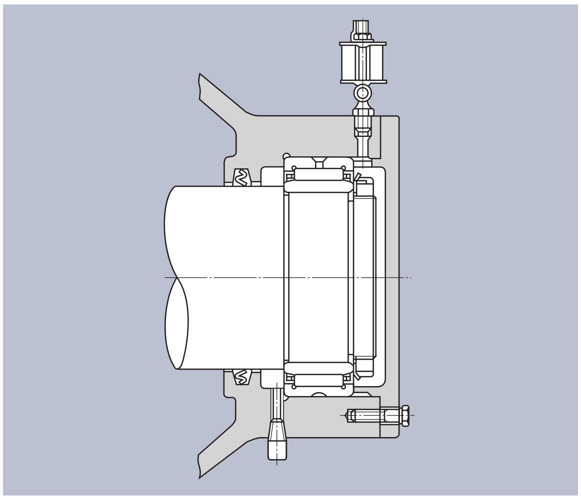


Fig. 9.3 Drip lubrication

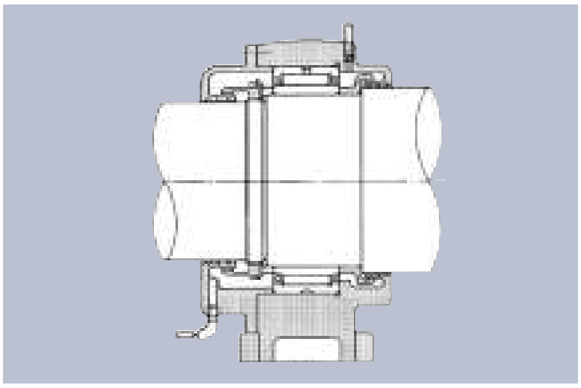


Fig.9.4 Circulating lubrication

9.4.2 Lubrication oil

To lubricate rolling bearings, mineral oil lubricants are often used, the examples of which include **spindle oil, machine oil** and **turbine oil**. When a rolling bearing is used in a demanding operating environment where the ambient temperature can be **not lower than 150˚C** or **not higher than -30˚C**, a rolling bearing should be lubricated with **synthetic oil** such as **diester oil, silicone oil** and **fluoro carbon oil.**

With lubrication oil, its viscosity is one of the important characteristics that determine the lubrication performance. Too low viscosity of lubrication oil causes imperfect forming of an oil film reading to damage of bearing surface, while too high viscosity of lubrication oil causes great viscosity resistance, which then leads to temperature rise and increase of friction loss.

Generally lubrication oil of lower viscosity is used for the faster rotational speed of bearing, while lubrication oil of higher viscosity is used for the heavier bearing loads.

A lubricant for a rolling bearing has to satisfy viscosity listed in **Table 9.4** at the operating temperature of that rolling bearing. **Fig. 9.5** shows the lubrication oil viscosity - temperature characteristic chart, which should be referred to when selecting a lubrication oil of optimal viscosity under actual operating temperature.

Furthermore, **Table 9.5** shows the criterion for selection of the lubrication oil viscosity according to the actual bearing operating conditions.

Table 9.4 Oil viscosity required for each bearing type

Bearing type	Required viscosity mm²/s
Radial needle roller bearing	13
Thrust needle roller bearing	20

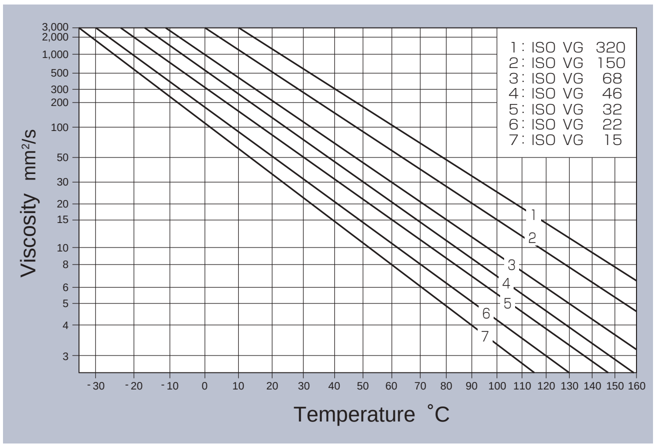


Fig. 9.5 Lubrication oil viscosity - temperature characteristic chart

Table 9.5 Criteria for selection of lubrication oil (Reference)

Bearing operating temperature ˚C	dn value	ISO viscosity grades for lubrication oil (VG)	
		Ordinary load	Heavy load or shock load
−30～0	up to allowable rotational speed	22 32	46
0～60	up to 15000	46 68	100
	15 000～80 000	32 46	68
	80 000～150 000	22 32	32
60～100	up to 15000	150	220
	15 000～80 000	100	150
	80 000～150 000	68	100 150
100～150	up to allowable rotational speed	320	

Remarks:
1. Subject to oil bath lubrication or circulating lubrication.
2. Apply to **NTN** for other operating conditions other than those specified in this Table.

9.4.3 Oil supply rate

When lubricating oil is force-fed into a bearing, the amount of heat generated in the bearing is equal to a sum of amount of heat diffused from the housing and amount of heat removed by lubricating oil.

A standard oil supply rate to be used as a guideline when using an ordinary housing can be determined by **formula (9.1)**. The amount of heat diffused can vary depending on the shape of housing. Therefore, for bearing operation on an actual machine, begin with an oil supply rate approximately 1.5 to 2 times as much as the value determined by **formula (9.1)**, and determine an optimal supply rate through a series of adjustment efforts. It may be convenient to perform calculations with an assumption that there is no heat radiation from the housing and all the heat generated is removed with the lubricating oil. In such a case, take the shaft diameter d = 0 and then determine the oil supply rate q.

$$Q = K \cdot q \quad \text{……………………………………………} \textbf{(9.2)}$$

Where,

Q: Oil supply rate per bearing assembly cm³/min

K: Coefficient governed by temperature rise with lubricating oil in operating mode (**Table 9.6**)

q: Oil supply rate determined from the chart cm³/min (**Fig. 9.6**)

9.4.4 Guideline for lubricating oil change

How often the lubricating oil needs to be changed varies depending on the factors including bearing operating conditions, amount of oil in the lubrication system, and lubricating oil type. As a guideline, perform oil change for an oil bath lubrication system approximately once a year if the oil temperature in the bath is regulated at 50˚C or lower, or at least every three months if the oil temperature in the bath reaches a range from 80 to 100˚C.

For a critical machine involving needle roller bearings, the user is recommended to monitor current lubrication performance of the lubricating oil and deterioration in oil cleanness at regular intervals to establish the user's unique oil change schedule.

Table 9.6 K value

Temperature of discharged oil – Temperature of supply oil ˚C	K
10	1.5
15	1
20	0.75
25	0.6

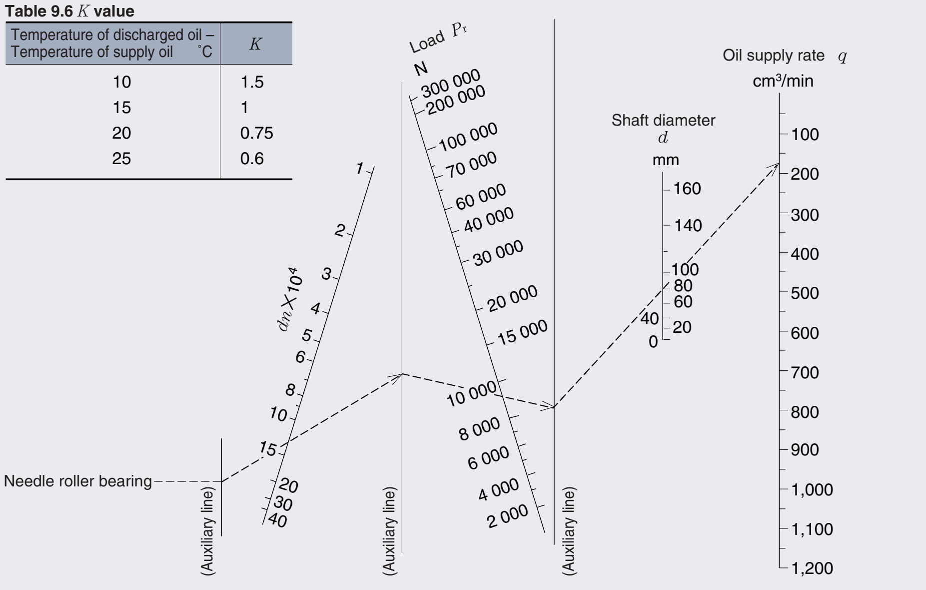


Fig. 9.6 Chart for determining oil supply rate

10. Sealing Devices

10.1 Non-contact seal and contact seal

The purpose of using a seal is to prevent a lubricant held in a bearing from leaking outside the bearing and to prevent powder, water content, etc. from invading into the bearing from outside.

It is very important to design a sealing device with full consideration of the operating conditions, lubricating condition, environmental condition, economical merit, etc., so that the bearing is not adversely affected by the sealing device during operation.

The bearing seals are mainly classified into non-contact seal, contact seal types. as shown in **Tables 10.1** and **10.2**, which must then be selected correctly according to each application,under full consideration of the characteristics of each sealing type.

Table 10.1 Seals (Non-contact seals)

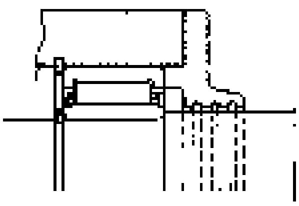
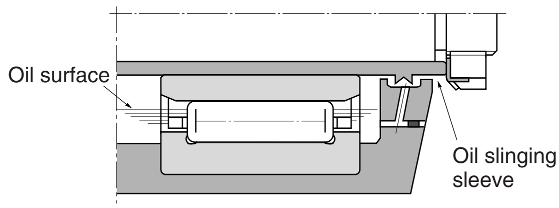
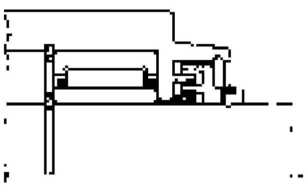
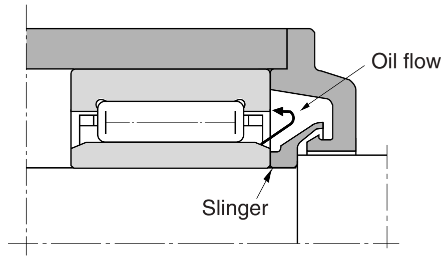
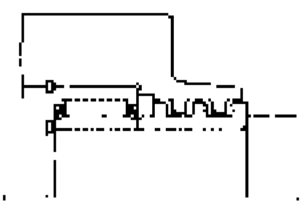
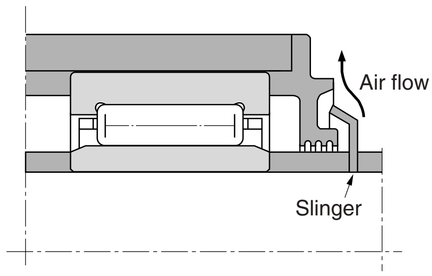
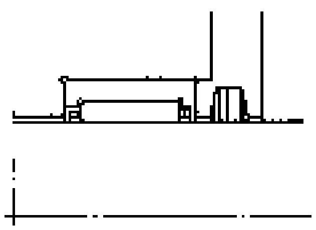
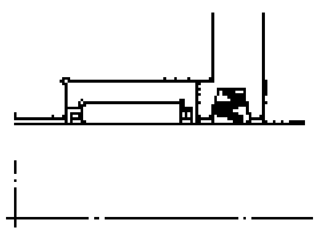
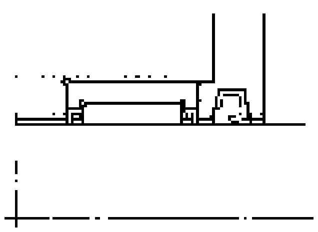
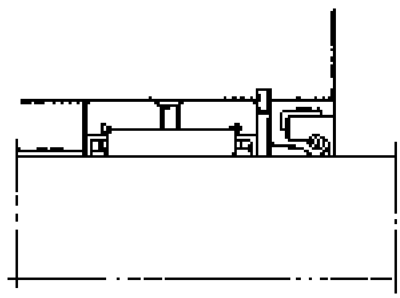
	Non-contact seals		
Seal name	Oil groove seal Labyrinth seal (axial, radial)	Slinger seal	Air seal
Features	**<Oil groove seal>** This seal is fitted at either one side of a housing or a shaft, or fitted at the both sides for sealing In this case, this seal has an effect in preventing invasion of foreign matter from outside by retaining grease in the oil grooves. **< Labyrinth seal >** This seal having a high sealing effect due to its multiple labyrinths and long passage is mainly used for grease lubrication. Generally it is suited to a high speed bearing, but it has a dust-proofing effect even under low speed running if the seal grooves are filled up with grease. It is convenient if this seal is provided with a grease nipple.	In oil lubrication, this seal has an effect in slinging and returning the oil thrown out along its sleeve by centrifugal force if its sleeve is provided with projections. A seal example illustrated in **Fig. 10.6** prevents invasion of foreign matter from outside.	—
Application examples	 **Fig. 10.1 Oil groove seal**	 **Fig. 10.4 Slinger with projections**	
	 **Fig. 10.2 Axial labyrinth seal**	 **Fig. 10.5 Slinger intended for back flow of flown-out oil by centrifuge**	
	 **Fig. 10.3 Radial labyrinth seal**	 **Fig. 10.6 Slinger provided at outer side**	

Table 10.2 Seals (Contact seals)

	Contact seals	
Seal name	Seal ring (felt seal, etc.) O-ring, piston ring	Oil seal, V-shaped ring seal, mechanical seal
Features	**<O-ring seal>** This seal type seals a fluid by pressing its elastic body onto the sliding surface with a constant contact pressure. Generally the contact seals are better in sealing performance than the non-contact seals, but the friction torque and temperature rise are greater than those of the non-contact seals. **<Felt seal>** This is the simplest of the contact seals, which is mainly used for grease lubrication and suited to prevention of fine dust, but oil penetration and purging are occasionally unavoidable to some extent.	**< Oil seal >** This seal type intended to seal lubricant at the sliding portion between its lip and a shaft. The oil seal ia an effective seal and is the most frequently used. The lip must be oriented outward to prevent invasion of water content and foreign matter from outside and oriented inward to prevent lubricant from leaking out of the housing. Furthermore, another seal type with two or more lips is also available for preventing lubricant purge and dust contamination.
Application examples	 **Fig. 10. 7 Felt seal**  **Fig.10. 8 Z type grease seal**  **Fig. 10. 9 GS type grease seal**	 **Fig. 10.10 Oil seal**

10.2 Combined seals

Several seal types are used in combination for an application in an environment where dust, water components, etc. exist as well as for mechanical portions which cannot to be contaminated by lubricant leak.

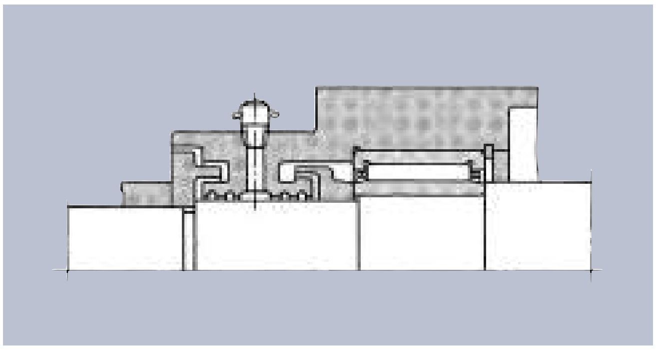


Fig. 10.11 Combined non-contact seal
Combination of labyrinth seal and oil groove seal

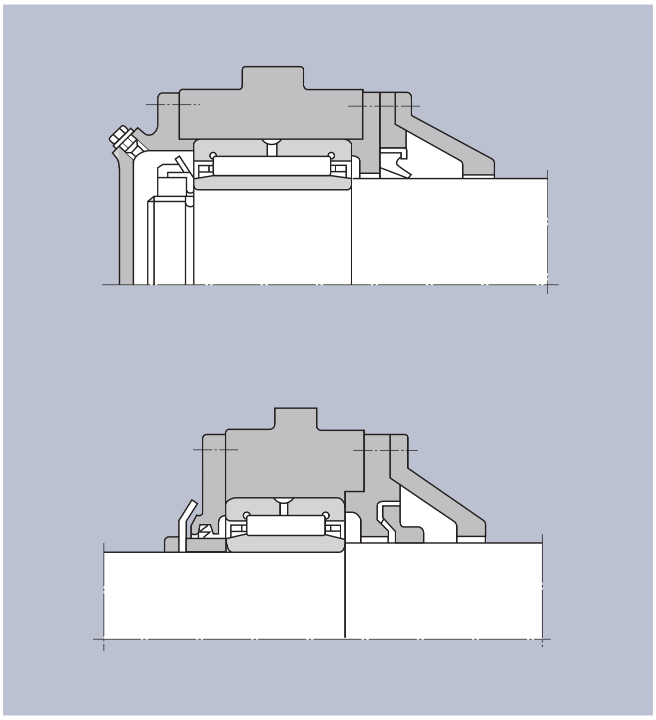


Fig. 10.12 Combined seal
Combination of contact seal and non-contact seal

10.3 Clearance setting

Oil groove seals and labyrinth seals have better sealing effects as the shaft - housing clearance gets smaller, but the actual clearance is generally selected from the following clearance values, under consideration of machining and assembling conditions, shaft deformation, etc.

Table 10.3 Clearances (Optional)

Seal type	Shaft diameter	Radial clearance	Axial clearance
Oil groove seal	50 or less	0.2～0.4	———
	Over 50 to 200	0.5～1.0	
Labyrinth seal	50 or less	0.2～0.4	1.0～2.0
	Over 50 to 200	0.5～1.0	3.0～5.0

10.4 NTN seals

Special-purposed **NTN** seals are available for needle roller bearings.(Refer to **Table 10.4** on page A-49.) For the more detailed information refer to the "Dimensions Table" on page B-273.

10.5 Seal materials and corresponding operating temperature ranges

The oil seal lip is ordinarily made of nitrile rubber, but acrylic rubber, silicone rubber and fluoro-rubber are used as the lip material depending on operating temperature, sealing objective, etc. **Table 10.5** shows the allowable operating temperature ranges available for the respective materials.

Table 10.5 Seal materials and corresponding operating temperature ranges (Reference)

Seal materials	Operating temperature ranges ˚C
Nitrile rubber	−25～+100
Acrylic rubber	−15～+130
Silicone rubber	−70～+150
Fluoro-rubber	−30～+180

10.6 Seal types and allowable speed

The allowable speed for the contact seal type depends on the surface roughness, accuracy and lubrication properties of sliding surface, operating temperature, etc. **Table 10.6** shows the allowable speed for each seal type, as a guideline.

Table 10.6 Seal types and corresponding allowable speed (Reference)

Seal types	Allowable speed m/s
Oil seal (nitrile rubber)	16 or less
Oil seal (acrylic rubber)	26 or less
Oil seal (fluoro-rubber)	32 or less
Z-grease seal (nitrile rubber)	6 or less
V-ring seal (nitrile rubber)	40 or less

Table 10.4 Seals (NTN contact seals)

Seal type	Contact seals (G type, GD type)
	Seal using mainly direct contact
Features	This seal type is a special-purposed seal for needle roller bearings which was designed for smaller section height. This is a synthetic rubber contact seal reinforced with steel plate, for use in the operating temperature range of -25 to +120˚C and, under continuous running condition, used at 100˚C or less. For applications under special operating conditions of greater than 120˚C, please contact contact **NTN** engineering.
Application examples	(see Fig. 10.13)

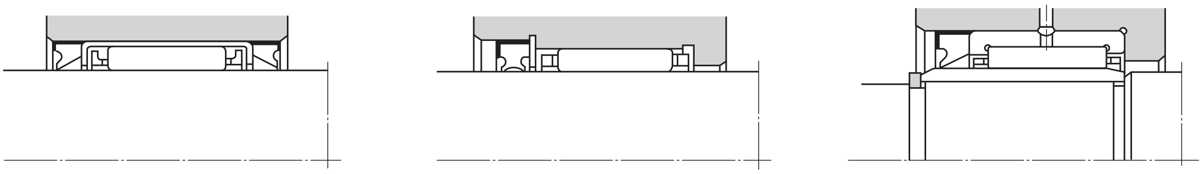


Fig. 10.13 Bearing sealing by NTN seals (Example)

10.7 Shaft surface roughness

Sealing performance and seal life depend on the surface roughness, accuracy and hardness of shaft sliding surface with which the seal lip comes in contact. **Table 10.7**shows the surface roughness as a guideline. For improved wear resistance of shaft surface it is desirable to maintain shaft surface hardness at least at HRC40 (HRC55 if possible) by heat treatment or hard chrome plating.

Table 10.7 Shaft surface hardness (Reference)

Speed m/s		Surface roughness
over	incl.	Ra
	5	0.8a
5	10	0.4a
10		0.2a

11. Bearing Handling

Bearings are precision parts. In order to preserve their accuracy and reliability, care must be exercised in their handling. In particular, bearing cleanliness must be maintained, sharp impacts avoided and rust prevented.

[1] Keep the bearing and other related parts clean
Foreign matters such as dust, moisture, etc. causes harmful effects on the life of the bearing. To avoid such harmful effects, bearings must be kept clean. In addition, tools, lubricants, washing oils, work environments, etc. must always be maintained in clean condition.

[2] Careful handling
Any shock to a bearing in handling could result in creating surface flaws and indentations of its raceway surface and rolling elements. In severe cases, cracking and chipping can occur. To avoid such defects, bearings must be handled with care.

[3] Use proper handling tools
Inappropriate tools should be avoided when installing and removing bearings.
Specific tools suited to the individual bearing types must be used. Special-purpose handling tools must be used particularly when installing a drawn cup needle roller bearing.

[4] Protect bearing from rusting
As a general rule, rust preventive oil is coated on all bearings. Direct handling of bearings should be avoided since the natural oil on hands can cause rusting of the bearings. To protect bearings from this type of rust, use a pair of gloves or coat mineral oil on the hands if directly handling the bearings with hands.

11.1 Bearing storage

Store bearings at room temperature with a relative humidity of 60% or less.

11.2 Washing

Never rotate a bearing with foreign matter within the raceway. This could result in damage to the raceway surfaces or rolling elements.
Therefore, any dismounted bearing is usually washed by light oil, kerosene or any other mild solvent to completely remove foreign matter.
In this case, two washing containers must be used: one for rough washing and another for finish washing.
Rough washing is done for removal of oil and foreign matter from bearings, while finish washing is done for fine washing of the roughly-washed bearing.
Further, any containers used for washing must be provided with a steel net in the center above the bottom of the container, as illustrated in **Fig. 11.1**, to prevent the bearing from coming in direct contact with the bottom of the container.
Furthermore, rust preventive treatment must be applied to the bearing immediately after washing, to protect it from corrosion.

<u>Do not rinse grease-prefilled bearings (shielded bearings, sealed bearings, one-way clutches, etc.). Otherwise, prefilled grease can wash away</u> or <u>deteriorate.</u>

<u>In addition, follow all applicable legal requirements such as environmental preservation, industrial labor safety laws, etc. and use the washing instructions provided by the detergent manufacturer and washing tank manufacturer</u>.

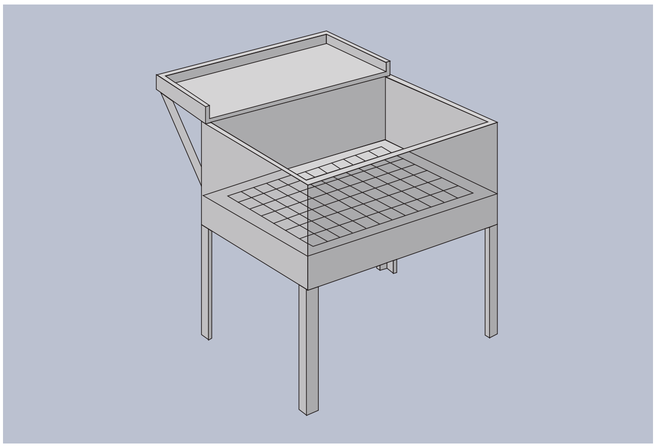


Fig. 11.1 Washing tank

11.3 Installation

Depending on bearing type and fitting conditions, the methods described below are used as a general method of installation. However, for installation of drawn cup needle roller bearings refer to Commentary given in the Dimensions Table.

(1) Preparations prior to installing
For the installation of bearings, it is desirable to prepare a clean and dry work place.
Contaminants, burrs, chips, etc. must be removed completely from all the parts related to a shaft and a housing before installing. Keep bearing in original packaging until ready for installation.
If the bearing is used in a grease-lubricated machine, it may be installed without removing the rust preventive oil coat on it. However, remove the rust preventive coat if the bearing is to be used with oil lubrication, or grease lubrication. Lubrication performance of the grease is jeopardized when mixed with the rust preventive agent. Use uncontaminated cleaning oil to remove the rust preventive agent coat and then allow the cleaning oil to dry or thoroughly wipe it away. Only then, install the bearing.
Do no to wash shield type and seal type bearings and one-way clutches.

(2) Interference-fit with a mechanical or hydraulic press

In general, the press-fit method using a press machine is used for the installation of bearings. The bearing ring (inner ring or outer ring) is press-fitted slowly via a backing strip as illustrated in **Fig. 11.2. Do not apply the press force to a bearing through its rolling elements. See example illustrated in Fig. 11.3.**

Further, a small bearing with minimal interference may be installed by hammering the bearing ring with a plastic hammer or similar tool. **In that case, however, the uniform hammering force must be applied to the bearing side face via the backing strip as illustrated in Fig. 11.2, because direct hammering to the bearing end face or partial hammering by use of a punch could impair the specific bearing performance.**

While installing a bearing, NEVER hit the outer ring with a hard tool such as a hammer to fit the inner ring over the shaft. Never hammer the inner ring to install the bearing to the shaft. Otherwise, a flaw and/or dent mark may occur on the raceway surface and rolling elements of the bearing. Also, coating the fitting surfaces with high-viscosity oil will help reduce friction on the fitting surfaces.

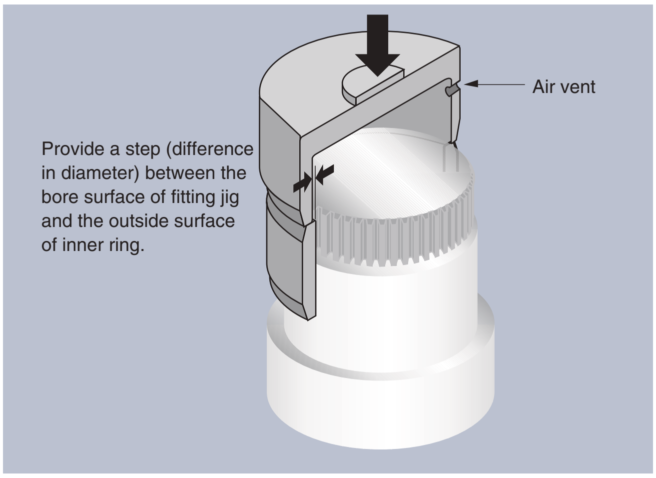


Fig. 11.2 Press-fitting of inner ring

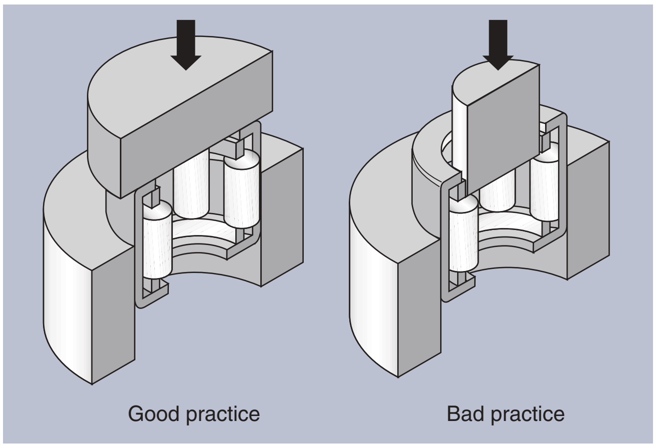


Fig.11.3 Good practice for press-fitting

(3) Shrink fit

This method too, is often used to install a bearing onto a shaft. The inner ring is heated in a medium such as a clean oil bath to expand its bore and is then fitted over the shaft. The oil used for this process should be pure mineral oil as it is less corrosive. The inner ring fitted onto the shaft is then allowed to stand to cool down. During the cool-down period, the inner ring shrinks in the axial direction too: therefore, the inner ring should be kept forced toward the shaft shoulder until it is fully cool in order to avoid a gap between it and the shaft shoulder. **Fig. 11.4** graphically illustrates the relationship between the expansion of the inner ring bore and the heating temperature. **Remember, however, that the inner ring must not be heated in excess of 120˚C. Also, do not apply shrink fit technique to a bearing with prefilled grease, or a bearing with a shield or seal.**

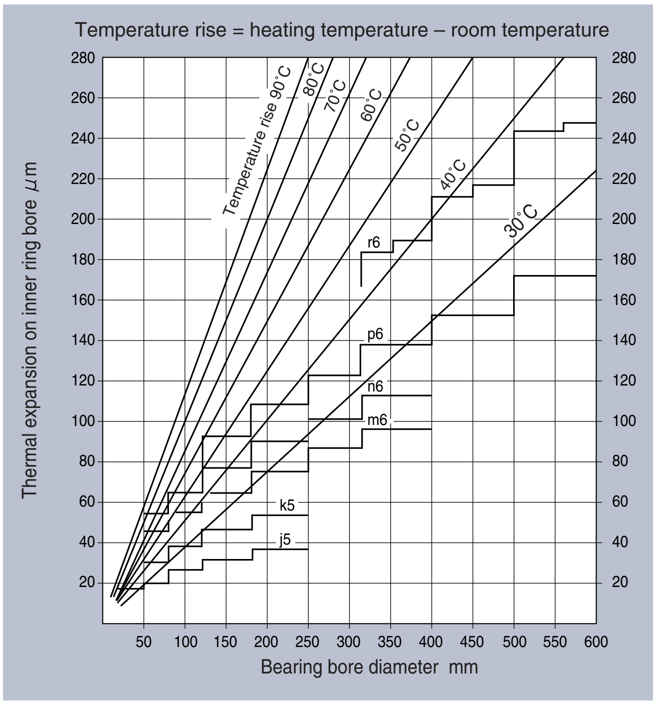


Fig. 11.4 Temperature rise needed for successful shrink fitting for inner ring

11.4 Bearing running test

To ensure that the bearing has been properly installed, a running test is performed after mounting.

Avoid running the bearing at its rated speed immediately after its installation. Otherwise, the bearing can fail if it has been incorrectly installed, or can seize if it is poorly lubricated. The shaft or housing should first be rotated by hand. If turning the shaft manually has proved to be problem-free, turn it at low speed with no load, and gradually increase the running speed and load while monitoring smoothness of bearing operation.

Carefully monitor noise and heat buildup on the running bearing. If any problem is detected, stop and

inspect the machine. If necessary, remove and inspect the bearing.

Sound level and tone of a running bearing can be checked by a sound scope held in contact with the bearing housing. The sound is normal if a pure sound is heard. A high metallic sound or irregular sounds from the bearing, indicates an error of function. In such a case, the possible cause of the failure can be measured by using a vibrometer to quantitatively determine vibration amplitude and frequency.

Generally, bearing temperature can be estimated from the housing surface temperature. However, if the bearing outer ring is accessible through oil holes, etc, the temperature can be more accurately measured.

Under normal conditions, bearing temperatures rise with rotation and then reach a stable operating temperature after a certain period of time. If the temperature does not level off and continues to rise, if there is a sudden temperature rise, or if the temperature is unusually high, the bearing must be inspected.

Table 11.1 shows the required check items.

Table 11.1

Hand operation	Variation in torque Over-torque Sticking Abnormal sound	Imperfect installation Under-clearance, great seal friction, etc. Indent and flaw on raceway surface Inclusion of dust and other foreign matter
Power operation	Abnormal noise and vibration Abnormal temperature	Inclusion of dust and other foreign matter, indent on raceway surface,over-clearance, inadequate lubrication Use of improper lubricant, incorrect installation, under-clearance

11.5 Bearing removal (dismounting)

Bearings are often removed as part of periodic inspection procedures or during the replacement of other parts. In this case, these bearings must be handled with the same care as when it was installed. Bearings, shafts, housings and other related parts must be designed to prevent damage during the dismounting procedure and the proper dismounting tools must be employed.

Regarding the dismounting method, generally the press method (**Fig. 11.5**) and the puller method (Fig.11.6) are used to dismount the inner ring depending on bearing type and fitting conditions.

Be sure to apply the extraction force to the inner ring or outer ring only when removing the bearing. Never attempt to extract the bearing ring by applying force through the rolling elements.

11.6 Force needed for press-fitting and extraction

The force needed for press-fitting or extracting a particular inner ring onto or from a shaft can be determined by **formula (11.1)** below:

$$K_a = f_K f_E \frac{d}{d+3} \Delta d_F \cdots\cdots (11.1)$$

Where,

K_a : Force required for press-fitting or extraction N (kgf)

f_K : Resistance factor being determined by shaft to inner ring friction factor

For press-fitting········ 40 (4)

For extraction··········· 60 (6)

f_E : Coefficient depending on inner ring dimension

$$f_E = B\left[1 - \left(\frac{d}{F_1}\right)^2\right]$$

B : Inner ring width mm

d : Inner ring bore diameter mm

F_1 : Mean outer diameter of inner ring mm

Δd_F : Apparent interference μm

Actual press-fit force and extraction force could eventually exceed the respective calculate value due to installing error. Hence, it is recommended to design the dismounting tools so as to have the strength (rigidity) resistible to a load 5 times as much as the calculated press-fit force and pull-out force.

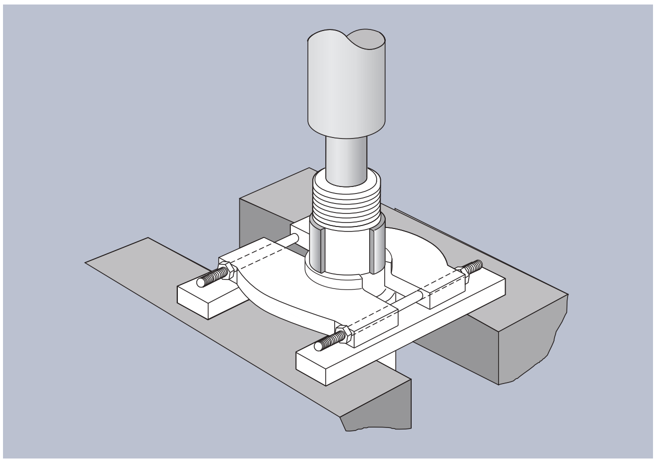


Fig. 11.5 Bearing removal by a press machine

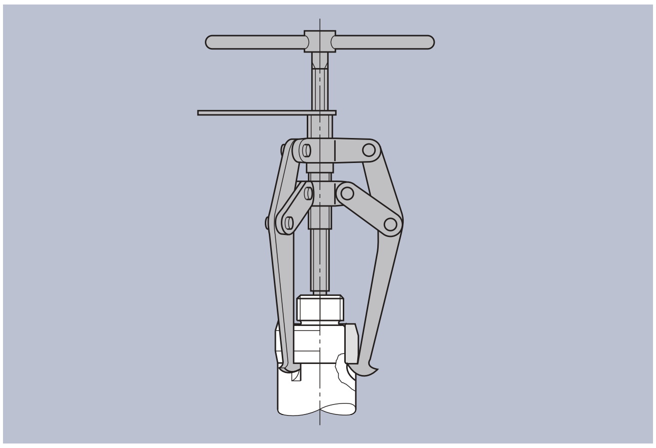


Fig. 11.6 Bearing removal by a puller

12. New Products Information

12. 1 HL Bearing

Bearing flaking can be categorized into two types: that which originates from inside of the bearing (subsurface flaking), and that which originates from the surface of the bearing.

Subsurface flaking usually occurs in areas where lubrication is considered to be good. This problem is believed to occur only when there exists a high level of contact stress. Present day steel is sufficiently clean so that cleanliness is not a contributing factor.

On the other hand, surface flaking is believed to be caused in areas where lubrication is insufficient. It is widely known that this problem is related to the oil film parameter (i.e. the ratio of oil film thickness at the point of contact to the combined surface roughness of the two objects in contact) which was derived from the elastohydrodynamic lubrication theory (EHL theory).

To reduce surface flaking, the oil film parameter needs to be increased. To do this, bearing manufactures have been working on both improving lubricants and surface roughness of the bearing raceway.

The EHL theory is based on the major premise that surface roughness of the contact surfaces is uniform. However, there are cases where the surface roughness determined in accordance with the EHL theory does not agree with the actual measured surface roughness.

In recent years a new theory has emerged. It contends that oil film formation in the contact areas can be improved by changing the character and direction of the machined parts surface finish.

NTN developed the long life HL (High Lubrication) bearing, based on the Micro EHL Theory, to reduce the problem of surface flaking.

12.1.1 Basic concept of HL bearing

The basic concept behind the development of the HL bearing is expressed by **Fig. 12.1**. These diagram are based on a flow model of the lubricant inside the contact area, developed by H.S. Cheng and his associates.The hatched areas in the diagrams are the contact points (elastically deformed) while the dotted lines show the flow of the lubricant.

The flow resistance of the lubricant is greater in (B) than in (A). This means that the volume of lubricant in each contact area increases, and accordingly the thickness of the oil film on the rolling contact surface also increases.

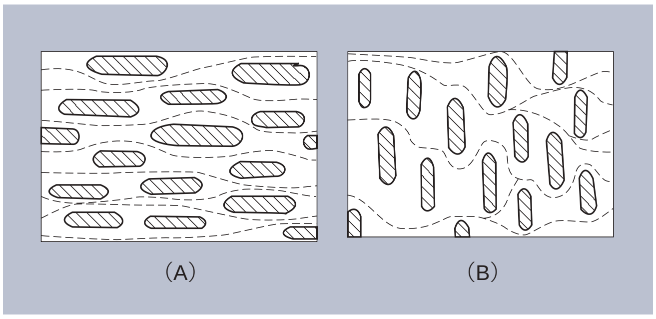


Fig. 12.1 Directional characteristics of finished surfaces and their effect on lubricant movement in a floe model

12.1.2 HL surface

As shown in **Fig. 12.2**, this newly developed surface (the HL surface : HL = High Lubrication) features a countless number of indentations (which are called micro oil pots) of about 10μm which are produced at random. The black areas in the figure are the micro oil pots. This surface , featuring the desired size and number of micro oil pots, can be produced by changing the grinding conditions. Depth of the micro oil pots is about 1μm.

12.1.3 HL bearing application examples

The HL surface-treated bearings are widely used in various fields. Such as car transmission, hydraulic devices, various reduction gears, etc.

HL surface treatment is applied to special applications, such as the rocker arm of a car engine where HL is on effective seizure preventive measure.

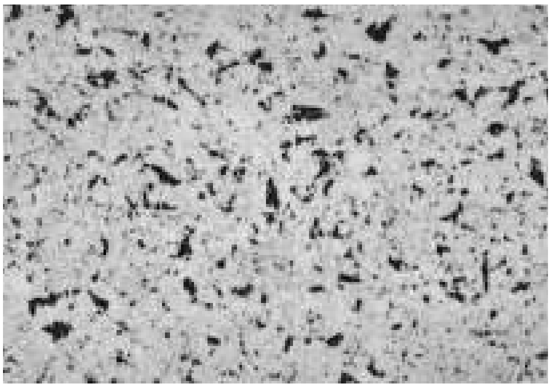


Fig. 12.2 Magnified photo showing HL roller surface

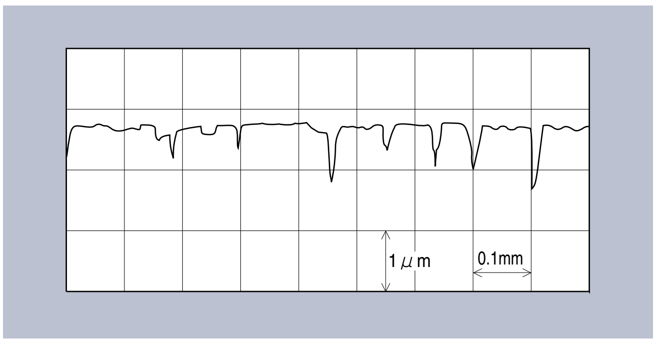


Fig. 12.3 HL surface roughness

12.2 Bearings with Solid Grease

"Solid grease" is a lubricant essentially composed of lubricating grease and ultra-high polymer polyethylene. Solid grease has the same viscosity as ordinary grease at normal temperature, but as a result of a special heat treatment process, this grease solidifies retaining a large proportion of the lubricant in it.

Thanks to this solidification, the grease does not easily leak from the bearing, even when the bearing is subjected to strong vibrations or centrifugal force, helping to extend bearing life.

All **NTN** needle roller bearings with Solid Grease are "full pack" products whose bearing space is nearly fully prefilled with solid grease.

12.2.1 Features of Bearings with Solid Grease

(1) Reduced lubricant leakage

Because the base oil is retained in a solid mixture, it is less likely to leak out of the bearing. During operation, temperature rise and/or centrifugal force will cause a gradual release of the base oil into the raceway groove. Eliminating grease leakage from the bearing ensures a consistent supply of lubricant and prevents contamination of the surrounding environment.

(2) Superior lubrication

Bearings with solid grease resist grease leakage prolonging bearing life in applications where high centrifugal force or vibration are present. The solid lubricant does not emulsify when exposed to water also extending both grease and bearing life.

(3) Sealing effect

Though solid grease protects a bearing against ingress of foreign matters (water, dust, etc.), it is not a sufficient means as a sealing device. Therefore, for applications that need reliable sealing performance, we recommend the use of contact type rubber seals.

12.2.2 Varieties of NTN Needle roller bearings with Solid Grease

The **NTN** needle roller bearings with Solid Grease can be categorized into the general purpose group and the high-speed group (**Table 12.1**).

12.2.3 Precautions for using NTN needle roller bearing with Solid Grease

(1) Each **NTN** needle roller bearing type has unique set of available dimensions. For detailed information, contact **NTN** Engineering.

(2) A minimum radial load is required to prevent skidding of the rolling elements when using full-pack solid grease. The minimum load required is approximately 1% of the bearing dynamic load rating.

(3) Do not use any **NTN** needle roller bearing with Solid Grease in a situation where it will come into contact with organic solvents (acetone, petroleum benzene, refined kerosene, etc.).

12.2.4 Typical applications of bearings with Solid Grease

- Bearing for the paper feeder of a printing machine
- Bearing for the mast roller guide of a forklift
- Support bearing for the swing arm of a motorcycle
- Bearing for a machine tool
- Guide bearing for the guide unit of a press machine
- Bearing for the link mechanism of an automatic loom
- Bearing for the conveyor guide of a food packaging machine

For detailed information about **NTN** bearings with Solid Grease, refer to **NTN** CAT. NO. 3022 (Bearings with Solid Grease).

Table 12.1 Varieties of NTN needle roller bearings with Solid Grease

Type	General purpose group (LP03)	High-speed group (LP08)
Major components	(Resin) Super high-molecular weight polyethylene (Lubricant) Li-mineral oil based grease	(Resin) Super high-molecular weight polyethylene (Lubricant) Urea-synthetic oil based grease
Permissible temperature range (Bearing outer ring)	-20 – 80˚C 60˚C max. for prolonged operation	-20 – 100˚C 80˚C max. for prolonged operation
	For installing the bearing to a shaft or housing, shrink fit technique may be adopted. However, be sure to limit the maximum heating temperature to 100˚C and maximum retention time to 2 hours. During this process, be careful not to turn the bearing.	
Limiting speed F_w: Roller set bore diameter (mm) n : Operating running speed (min^{-1})	$F_w \cdot n$ value$\leqq 3\times10^4$	$F_w \cdot n$ value$\leqq 6\times10^4$

13. Bearing Type Symbols and Auxiliary Symbols

Table 13.1 Bearing Type Symbols

Type code	Bearing type
811	Single-direction thrust cylindrical roller bearing, dimension series 11
812	Single-direction thrust cylindrical roller bearing, dimension series 12
893	Single-direction thrust cylindrical roller bearing, dimension series 93
874	Single-direction thrust cylindrical roller bearing, dimension series 74
A	Needle roller, spherical type
ARA821	Double-direction thrust cylindrical roller bearing
ARB821	Double-direction thrust cylindrical roller bearing
ARN	Needle roller bearing with double-direction thrust cylindrical roller bearing
AS11	Steel plate thrust washer, dimension series 11
AXA21	Double-direction thrust needle roller bearing
AXB21	Double-direction thrust needle roller bearing
AXK11	Needle roller and cage thrust assembly, dimension series 11
AXN	Needle roller bearing with double-direction thrust needle roller bearing
BF	Metallic flat cage for linear flat rollers
BK	Drawn cup needle roller bearing with close end
BR	Housing snap ring
CR	Cam follower, inch series
CRV	Full complement roller for cam follower,
DCL	inch series
	Drawn cup needle roller bearing with open end, inch series
F	Needle roller, plane type
FF	Linear flat roller
FR	Bottom roller bearing, for drawing frame
FRIS	Bottom roller bearing, for fine spinning frame and flyer frame
G	Synthetic rubber seal, one-lip type
GD	Synthetic rubber seal, double-lip type
GK	Needle rollers with split type cage
GS811	Housing washer, dimension series 11
GS812	Housing washer, dimension series 12
GS893	Housing washer, dimension series 93
GS874	Housing washer, dimension series 74
HCK	Drawn cup needle roller bearing for universal joint
HF	One-way clutch
HFL	One-way clutch integral with bearing
HK	Drawn cup needle roller bearing with open end
HMK	Drawn cup needle roller bearing with open end, for heavy load application
IR	Inner ring
JF‥S	Tension pulley holder
JPU‥S	Tension pulley and jockey pulley
K	Needle rollers with cage
K811	Cylindrical roller and cage thrust assembly, dimension series 11
K812	Cylindrical roller and cage thrust assembly, dimension series 12
K893	Cylindrical roller and cage thrust assembly, dimension series 93
K874	Cylindrical roller and cage thrust assembly, dimension series 74
KBK	Needle roller and cage assembly, for small end
KD	Linear ball bearing, stroking type
KH	Linear ball bearing, drawn cup type
KJ‥S	Needle roller and cage assembly
KLM	Linear ball bearing, machined ring type
KLM‥S	Linear ball bearing, clearance-adjustable type
KLM‥P	Linear ball bearing, open type
KMJ	Needle roller and cage assembly
KLJ‥S	Needle roller and cage assembly
KR	Cam follower
KRM	Miniature cam follower
KRMV	Miniature cam follower, full complement roller type
KRT	Cam follower, w/ tapped hole
KRU	Cam follower, shaft eccentric type
KRVT	Cam follower, full complement roller type, w/ tapped hole
KRV	Cam follower, full complement roller type
KRVU	Cam follower, full complement roller and shaft eccentric type
KV‥S	Needle roller and cage assembly
MI	Inner ring, inch series
MR	Machined ring needle roller bearing without inner ring, inch series
NA22	Roller follower with inner ring, dimension series 22
NA48	Machined ring needle roller bearing with inner ring, dimension series 48
NA49	Machined ring needle roller bearing with inner ring, dimension series 49
NA59	Machined ring needle roller bearing with inner ring, dimension series 59
NA69	Machined ring needle roller bearing with inner ring, dimension series 69
NA49…S	Clearance-adjustable needle roller bearing with inner ring
NAB2	Separable roller follower, w/ inner ring, diameter series2
NACV	Roller follower, full complement roller type, inch series
NAO	Machined ring needle roller bearing, separable type, with inner ring
NATR	Roller follower
NATV	Roller follower, full complement roller type
NIP	Grease nipple
NK	Machined ring needle roller bearing without inner ring
NKIA59	Complex bearing : Needle roller bearing with angular ball bearing dimension series 59
NKIB59	Complex bearing : Needle roller bearing with three-point contact type ball bearing dimension series 59
NKS	Machined ring needle roller bearing, w/o inner ring
NKX	Complex bearing : needle roller bearing with thrust ball bearing without dust-proof cover
NKX…Z	Complex bearing: Needle roller bearing with thrust ball bearing with dust-proof cover
NKXR	Complex bearing: Needle roller bearing with thrust cylindrical roller bearing without dust-proof cover
NKXR…Z	Complex bearing: Needle roller bearing with thrust cylindrical roller bearing with dust-proof cover
NUKR	Cam follower, full complement roller type
NUKRT	Cam follower, full complement roller type, w/ tapped hole
NUKRU	Cam follower, full complement roller type, w/ tapped hole, eccentric stud
NUTR2	Roller follower, diameter series 2
NUTR3	Roller follower, diameter series 3
NUTW	Roller follower, outer ring with center rib
PCJ	Needle roller and cage assembly, inch series
PK	Needle roller and cage assembly, for large end
PNA…R	Self-aligning needle roller bearing with inner ring
RF	Polyamide resin cage for linear flat rollers
RLM	Linear roller bearing
RNA22	Roller follower without inner ring, dimension series 22
RNA48	Machined ring needle roller bearing without inner ring, dimension series 48
RNA49	Machined ring needle roller bearing without inner ring, dimension series 49
RNA59	Machined ring needle roller bearing without inner ring, dimension series 59
RNA69	Machined ring needle roller bearing without inner ring, dimension series 69
RNA49…S	Clearance-adjustable needle roller bearing, without inner ring
RNAB2	Separable roller follower, w/o inner ring, diameter series 2
RNAO	Machined ring needle roller bearing, separable type, without inner ring
RPNA…R	Self-aligning needle roller bearing, w/o inner ring
WR	Snap ring for shaft
WS811	Thrust inner ring, dimension series 11
WS812	Thrust inner ring, dimension series 12
WS893	Thrust inner ring, dimension series 93
WS874	Thrust inner ring, dimension series 74
ZS	Thrust central ring

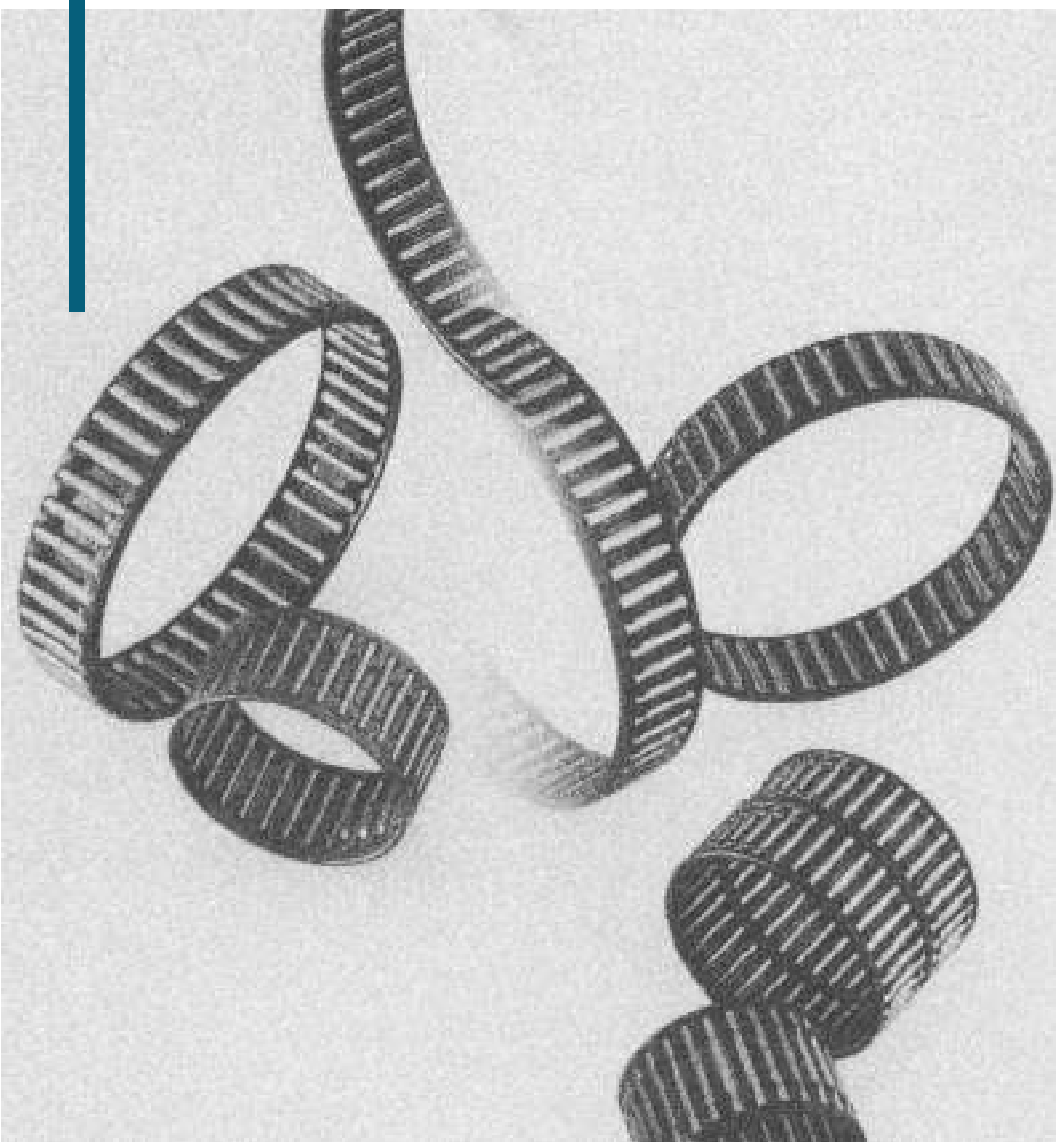
Table 13.2 Auxiliary symbols

	Symbol		Symbol representation
Initial symbols	Material heat-treatment symbols	TS-	Bearing for high temperature application which was heat-treated for dimensional stabilization
		E-	Bearing made of case-hardened steel
		8Q-	Nitro-carburized cage
		F-	Bearing made of stainless steel
		C-	Bearing made of carbon steel
	Expansion compensation	EC-	Expansion-compensated bearing
Basic symbols			
Suffix	Internal construction symbols	ZW	Double-row cage
		A,B,C	Internal construction change
	Cage symbols	J,JW	Steel plate punched cage
		L1	High strength brass cage
		T2	Polyamide resin cage
		S	Welded cage
	Seal symbol	L,LL	With synthetic rubber seal
	Bearing ring profile symbols	D	With oil hole
		D1	With oil hole and oil groove
		H	Cam follower with hexagon hole
	Roller symbol	T	Crowning and special heat treatment
	Combination symbols	D2,Dn	Complex bearing using two or more same bearings
	Clearance symbols	C2	Clearance smaller than ordinary clearance
		C3	Clearance larger than ordinary clearance
		C4	Radial clearance larger than C3
		NA	Non-interchangeable clearance
	Accuracy class symbols	P6	Bearing of JIS Class-6
		P5	Bearing of JIS Class-5
		P4	Bearing of JIS Class-4
	Lubrication symbols	/2AS	SHELL ALVANIA Grease 2
		/3AS	SHELL ALVANIA Grease 3
		/P03	Solid Grease
	Special symbols	V1~Vn	Special specification, requirements

Needle Roller Bearings

BEARING TABLES

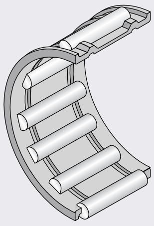
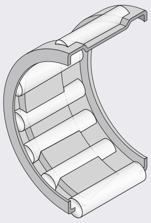
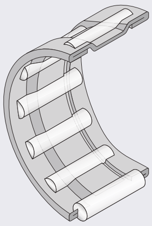
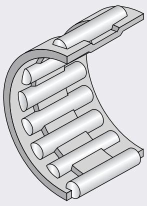
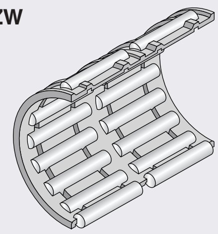
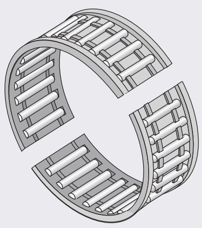
Needle Roller and Cage Assemblies



Needle Roller and Cage Assemblies

This needle roller and cage assembly is one of the basic components for the needle roller bearing of a construction wherein the needle rollers are fitted with a cage so as not to separate from each other. The use of this roller and cage assembly enables to design a compact and lightweight construction by utilizing a shaft or a housing as the direct raceway surface, without using inner ring and outer ring.

The needle rollers are guided by the cage more precisely than the full complement roller type, hence enabling high speed running of bearing. In addition, its rigidity and load capacity are high for the specific space.

Type of needle roller and cage assembly	Cage type	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and respective dimensions
K (K··S) (K··T2) 	Machined ring type Polyamide resin type	φ3 – φ285	K 20 × 24 × 10 S Suffix Width Roller set outer diameter Roller set bore diameter Type code	K20×24×10S	Roller set bore diameter : φ20 Roller set outer diameter : φ24 Width : 10 S : Welded type
	Welded type	φ10 – φ100			
KMJ (KMJ··S) (PCJ) 	Punched type	φ15 – φ100	KMJ 20 × 26 × 13 Width Roller set outer diameter Roller set bore diameter Type code	KMJ20×26×13	Roller set bore diameter : φ20 Roller set outer diameter : φ26 Width : 13
	Welded type	φ10 – φ40			
KJ··S 	Welded type	φ20 – φ40	KJ 30 × 35 × 17 S Suffix Width Roller set outer diameter Roller set bore diameter Type code	KJ30×35×17S	Roller set bore diameter : φ30 Roller set outer diameter : φ35 Width : 17 S : Welded type
KV··S 	Welded type	φ7 – φ100	KV 30 × 35 × 17 S Suffix Width Roller set outer diameter Roller set bore diameter Type code	KV30×35×17S	Roller set bore diameter : φ30 Roller set outer diameter : φ35 Width : 17 S : Welded type
K··ZW 	Machined ring type	φ8 – φ285	K 20 × 24 × 45 ZW Suffix Width Roller set outer diameter Roller set bore diameter Type code	K20×24×45ZW	Roller set bore diameter : φ20 Roller set outer diameter : φ24 Width : 45 ZW : Double-row type
GK 	Machined ring type Split type	φ8 – φ285	GK 30 × 35 × 17 Width Roller set outer diameter Roller set bore diameter Type code	GK30×35×17	Roller set bore diameter : φ30 Roller set outer diameter : φ35 Width : 17

The ones with tail code T2 using polyamide resin cage shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C or less.
The applied shaft diameter of welded type are described based on size that manufacturers can deal with a manufacturing. Therefore, it has nothing to do with the Demention Table.
Data for the GK type is not included in the dimension table. For detailed information, contact **NTN** Engineering.

Diameter variation of needle rollers

Diameter variation of needle rollers within one cage is less than 2um. The diameter tolerance groups for built-in needle rollers are identified by identification colors on the package label, as shown in **Table 1**.

The standard identification colors marked on each label are red, dark blue, blue, black and white, unless otherwise specially indicated.

In case of two or more bearings are mounted in tandem, those of same identification color must be used for equal distribution of bearing load.

Table 1 Color identification of diameter tolerances for needle rollers

Identification color on label	Diameter tolerance μm	Classification
Red	0〜−2	Standard
Dark blue	−1〜−3	
Blue	−2〜−4	
Black	−3〜−5	
White	−4〜−6	
Gray	−5〜−7	Semi-standard
Green	−6〜−8	
Brown	−7〜−9	
Yellow	−8〜−10	

Radial Clearance

When a shaft and a housing are used as the direct raceway surface, the radial clearance is determined by the shaft diameter and the housing hole dimension. Where the diameter tolerances for needle rollers are standard (tolerances color-identified in red, dark blue, blue, black, white), the shaft diameters and housing hole dimensions shown in **Table 2** are used.

Table 2 Recommended fits

Shaft diameter mm	Radial clearance					
	Smaller than ordinary clearance		Ordinary clearance		Larger than ordinary clearance	
	Shaft	Housing	Shaft	Housing	Shaft	Housing
〜80	j5	G6	h5	G6	g6	G6
80〜140	h5	G6	g5	G6	f6	G6
140〜	h5	G6	f5	H6	f6	G6

Shaft and housing specifications

Where a shaft and a housing are used as the direct raceway surface, the raceway surface must meet the specifications described in **Table 3**.

Table 3 Shaft and housing specifications (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT3	IT4
Cylindricality (max)	IT3	IT4
Surface roughness (max)	Refer to **Table 8.4** on page A-40.	
Surface hardness	HRC58〜64	
Depth of hardened layer (min)	Refer to formula **(8.1)** on page A-40.	

Bearing installation related dimensions

The tolerances for the nominal dimension "Bc" of cage specified in **Table 4** are recommended as the guide width b of cage.

Table 4 Guide width dimensions (recommended)

Unit : mm

Classification	Tolerances for guide width b	
	Single row	Double row
Metric system	$Bc\,^{+0.2}_{0}$	$Bc\,^{+0.3}_{+0.1}$
Inch system	$Bc\,^{+0.4}_{+0.2}$	$Bc\,^{+0.5}_{+0.3}$

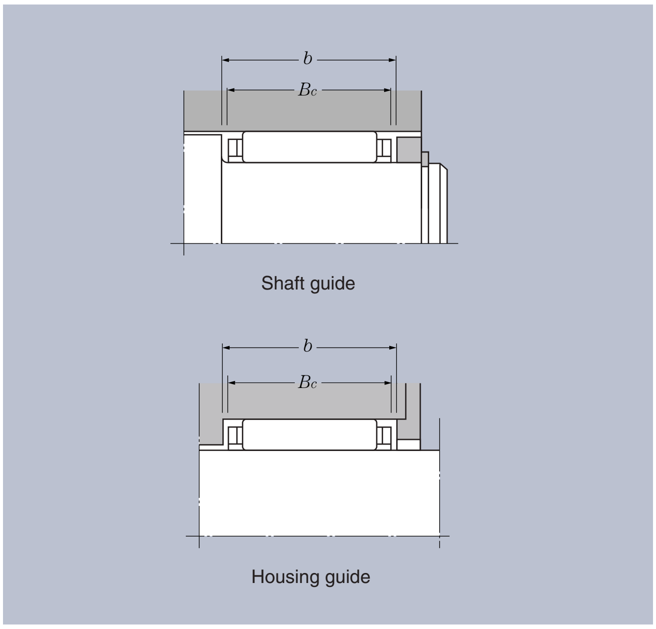
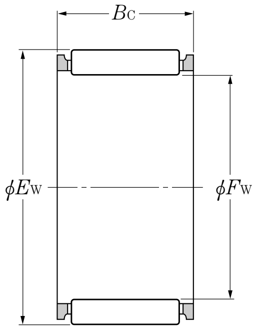
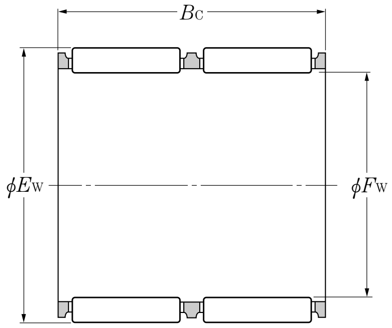


Fig. 1

Type K
Type K··T2
Type K··S
Type K··ZW
Type KMJ
Type KV··S



Type K
Type K··T2
Type K··S

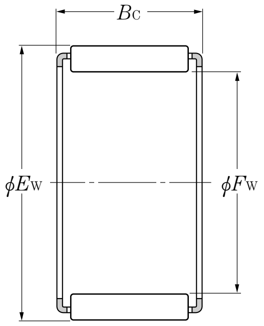


Type K··ZW

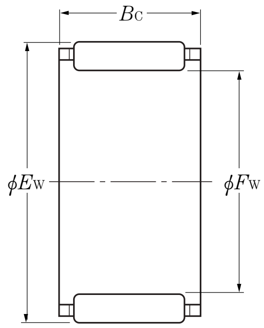
F_w 3~10mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
3	6	7 $^{-0.2}_{-0.55}$	1 460	970	149	99	33 000	50 000	K3×6×7T2	0.0004
	6	8	1 560	1 330	159	136	30 000	45 000	K4×6×7.8XT2	0.0003
4	7	7 $^{-0.2}_{-0.55}$	1 770	1 270	180	129	30 000	45 000	K4×7×7T2	0.0005
5	8	8 $^{-0.2}_{-0.55}$	2 640	2 190	269	224	27 000	40 000	K5×8×8T2	0.0007
	8	10	2 720	2 250	277	230	27 000	40 000	K5×8×10T2	0.0009
6	9	8	2 660	2 280	272	233	25 000	37 000	K6×9×8T2	0.0009
	9	10 $^{-0.2}_{-0.55}$	3 400	3 150	345	320	25 000	37 000	K6×9×10T2	0.0011
	10	13	4 400	3 700	450	380	25 000	37 000	K6×10×13T2	0.0019
7	10	8	2 670	2 350	272	239	23 000	34 000	K7×10×8T2	0.0009
	10	10 $^{-0.2}_{-0.55}$	3 400	3 200	345	330	23 000	34 000	K7×10×10T2	0.0011
	10	13	5 050	5 400	515	550	23 000	34 000	KV7×10×12.8X3S	0.0023
8	11	8	3 150	3 000	320	305	21 000	32 000	K8×11×8T2	0.0011
	11	9	3 150	3 000	320	305	21 000	32 000	8E-KV8×11×8.8X2S	0.0019
	11	10	4 000	4 100	410	420	21 000	32 000	K8×11×10T2	0.0013
	11	12 $^{-0.2}_{-0.55}$	4 450	4 650	450	475	21 000	32 000	8E-KV8×11×11.8X2S	0.0025
	11	13	4 850	5 200	495	535	21 000	32 000	K8×11×13	0.0026
	12	10	4 650	4 150	475	425	21 000	32 000	K8×12×10T2	0.0020
	12	12	5 600	5 300	570	545	21 000	32 000	8E-KV8×12×11.8X1S	0.0040
	12	13	5 050	4 650	515	470	21 000	32 000	K8×12×13	0.0036
9	12	10 $^{-0.2}_{-0.55}$	4 550	5 000	465	510	20 000	30 000	K9×12×10T2	0.0015
	12	13	5 500	6 400	560	650	20 000	30 000	K9×12×13T2	0.0021
10	13	10	4 550	5 100	460	520	19 000	28 000	K10×13×10T2	0.0016
	13	13	5 450	6 450	555	660	19 000	28 000	8E-KV10×13×12.8XS	0.0032
	14	8	4 300	3 950	435	405	19 000	28 000	K10×14×8	0.0027
	14	10 $^{-0.2}_{-0.55}$	5 500	5 450	560	555	19 000	28 000	K10×14×10	0.0034
	14	11	5 500	5 450	560	555	19 000	28 000	8E-KV10×14×10.8XS	0.0039
	14	11.5	6 800	7 200	695	730	19 000	28 000	KMJ10×14×11.3XS	0.0040
	14	13	6 600	6 900	675	705	19 000	28 000	K10×14×13	0.0044
	14	14	7 150	7 650	730	780	19 000	28 000	8E-KV10×14×13.8X4S	0.0050

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.



KMJ··S



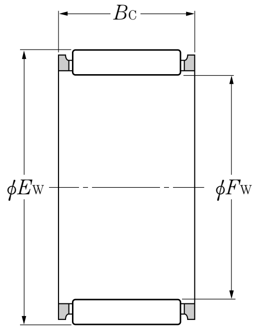
KV··S

F_w 10～15mm

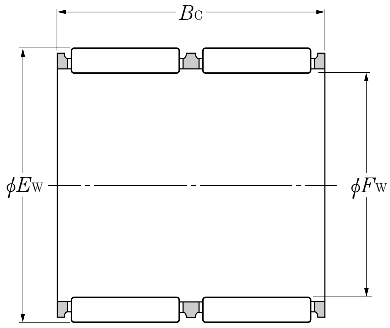
Boundary dimensions (mm)			Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1})		Bearing numbers	Mass (kg)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)
10	14	17 $^{-0.2}_{-0.55}$	8 050	8 850	820	900	19 000	28 000	**8E-K10×14×16.8X1**	0.0064
	16	12	7 100	5 950	720	610	19 000	28 000	**K10×16×12**	0.0066
11	14	10 $^{-0.2}_{-0.55}$	5 050	6 000	515	615	18 000	27 000	**K11×14×10**	0.0028
	15	9	4 450	5 250	455	535	17 000	26 000	**K12×15×9**	0.0027
	15	10	5 000	6 100	510	620	17 000	26 000	**8Q-K12×15×10**	0.0030
	15	13	6 000	7 700	615	785	17 000	26 000	**K12×15×13**	0.0038
	15	20	8 550	12 200	875	1 240	17 000	26 000	**K12×15×20ZW**	0.0059
	16	8	4 850	4 900	495	500	17 000	26 000	**K12×16×8**	0.0034
	16	11.5	6 750	7 400	685	755	17 000	26 000	**KMJ12×16×11.3XS**	0.0047
12	16	13 $^{-0.2}_{-0.55}$	7 500	8 500	765	870	17 000	26 000	**8Q-K12×16×13**	0.0060
	16	18	9 800	11 900	1000	1220	17 000	26 000	**8E-K12×16×17.8X1**	0.0070
	16	20	10 300	12 800	1 050	1 300	17 000	26 000	**K12×16×19.8X4**	0.0100
	17	10	7 350	7 200	745	735	17 000	26 000	**KMJ12×17×9.8XS**	0.0050
	17	13	9 000	9 400	920	960	17 000	26 000	**K12×17×13**	0.0075
	17	18	12 600	14 400	1 280	1 470	17 000	26 000	**KV12×17×17.8XS**	0.0080
	18	12	8 650	8 000	880	815	17 000	26 000	**8Q-K12×18×12**	0.0089
	17	10	5 400	7 050	550	720	16 000	24 000	**KV14×17×10S**	0.0040
	18	10	6 900	8 000	705	815	16 000	24 000	**K14×18×10**	0.0046
	18	11	7 600	9 050	775	925	16 000	24 000	**K14×18×11**	0.0053
	18	13	8 300	10 100	845	1 030	16 000	24 000	**K14×18×13**	0.0063
14	18	15 $^{-0.2}_{-0.55}$	9 650	12 300	985	1 250	16 000	24 000	**K14×18×15S**	0.0076
	18	17	10 900	14 400	1 120	1 470	16 000	24 000	**K14×18×17V5**	0.0079
	18	39	18 800	28 900	1 910	2 950	16 000	24 000	**K14×18×39ZW**	0.0180
	19	13	8 950	9 650	915	985	16 000	24 000	**K14×19×13**	0.0080
	20	12	9 350	9 150	955	930	16 000	24 000	**K14×20×12**	0.0095
	20	17	13 500	14 600	1 370	1 490	16 000	24 000	**K14×20×17**	0.0140
	18	14	7 850	11 600	800	1 190	15 000	23 000	**K15×18×14**	0.0060
15	19	8 $^{-0.2}_{-0.55}$	5 350	5 850	545	600	15 000	23 000	**KV15×19×7.8XS**	0.0033
	19	10	6 850	8 050	700	820	15 000	23 000	**K15×19×10**	0.0055
	19	13	8 250	10 200	840	1 040	15 000	23 000	**K15×19×13**	0.0067

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··T2
Type K··S
Type K··ZW
Type KMJ
Type KV··S



Type K
Type K··T2
Type K··S

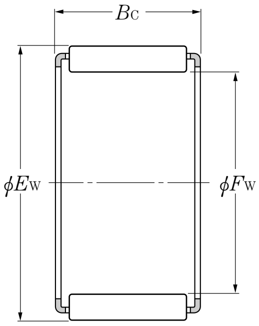


Type K··ZW

F_w 15～18mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
	19	17	10 900	14 600	1 110	1 490	15 000	23 000	**K15×19×17**	0.0090
	19	24	14 100	20 400	1 440	2 080	15 000	23 000	**K15×19×24ZW**	0.0130
	20	13	10 100	11 500	1 030	1 170	15 000	23 000	**K15×20×13**	0.0088
15	20	16 $^{-0.2}_{-0.55}$	12 600	15 200	1 280	1 550	15 000	23 000	**KMJ15×20×15.8XS**	0.0090
	21	15	11 900	12 500	1 210	1 280	15 000	23 000	**K15×21×15**	0.0130
	21	17	14 900	16 800	1 510	1 720	15 000	23 000	**KMJ15×21×16.8X1SK**	0.0120
	21	21	16 500	19 100	1 680	1 950	15 000	23 000	**K15×21×21**	0.0170
	20	10	7 500	9 250	765	945	15 000	23 000	**K16×20×10**	0.0057
	20	11	8 300	10 500	845	1 070	15 000	23 000	**K16×20×11**	0.0061
	20	13	9 050	11 800	925	1 200	15 000	23 000	**K16×20×13**	0.0071
	20	17	11 900	16 800	1 220	1 710	15 000	23 000	**K16×20×17S**	0.0092
16	22	12 $^{-0.2}_{-0.55}$	11 700	12 500	1 190	1 280	15 000	23 000	**K16×22×12**	0.0100
	22	13	12 600	13 900	1 290	1 410	15 000	23 000	**KMJ16×22×13**	0.0110
	22	16	13 600	15 200	1 380	1 550	15 000	23 000	**K16×22×15.8X**	0.0140
	22	17	14 400	16 400	1 470	1 670	15 000	23 000	**K16×22×17**	0.0150
	22	20	16 000	18 800	1 640	1 920	15 000	23 000	**K16×22×20**	0.0170
	21	10	7 450	9 300	760	950	15 000	22 000	**K17×21×10S**	0.0056
	21	13	9 400	12 600	960	1 280	15 000	22 000	**K17×21×13S**	0.0075
	21	15	10 400	14 400	1 060	1 460	15 000	22 000	**K17×21×15**	0.0089
17	21	17 $^{-0.2}_{-0.55}$	11 800	16 900	1 210	1 720	15 000	22 000	**K17×21×17**	0.0095
	22	20	14 700	19 200	1 500	1 960	15 000	22 000	**K17×22×20**	0.0150
	23	17	14 400	16 500	1 460	1 690	15 000	22 000	**K17×23×17**	0.0160
	23	23	16 800	20 200	1 710	2 060	15 000	22 000	**K17×23×22.8X1T2**	0.0130
	22	10	7 400	9 400	755	955	14 000	21 000	**K18×22×10**	0.0061
	22	13	8 900	11 900	910	1 210	14 000	21 000	**K18×22×13**	0.0077
18	22	17 $^{-0.2}_{-0.55}$	11 700	17 000	1 200	1 730	14 000	21 000	**K18×22×17**	0.0110
	23	20	14 600	19 300	1 490	1 970	14 000	21 000	**K18×23×20S**	0.0150
	24	12	12 300	13 800	1 250	1 410	14 000	21 000	**K18×24×12**	0.0120
	24	13	11 600	12 800	1 180	1 300	14 000	21 000	**K18×24×13**	0.0130

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.



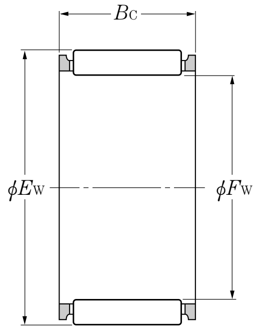
Type KMJ
Type KMJ··S

F_w 18～22mm

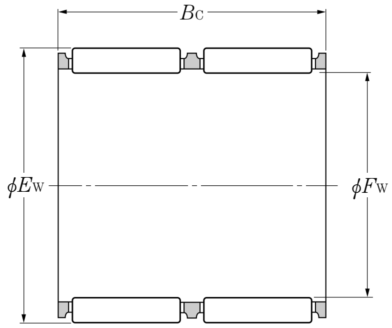
Boundary dimensions (mm)			Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1})		Bearing numbers	Mass (kg)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)
	24	17	16 000	19 300	1 630	1 970	14 000	21 000	**KMJ18×24×17SV1**	0.0140
18	24	20 $^{-0.2}_{-0.55}$	17 000	20 900	1 730	2 130	14 000	21 000	**K18×24×20**	0.0190
	25	17	18 000	20 400	1 830	2 080	14 000	21 000	**K18×25×17**	0.0190
	25	22	22 100	26 600	2 250	2 710	14 000	21 000	**K18×25×22**	0.0240
19	23	13 $^{-0.2}_{-0.55}$	9 650	13 500	985	1 370	14 000	21 000	**K19×23×13**	0.0082
	23	17	12 700	19 200	1 300	1 960	14 000	21 000	**K19×23×17**	0.0110
	24	10	8 300	11 200	845	1 150	13 000	20 000	**K20×24×10S**	0.0065
	24	11	9 500	13 400	970	1 370	13 000	20 000	**K20×24×11**	0.0072
	24	13	10 000	14 300	1 020	1 460	13 000	20 000	**K20×24×13S**	0.0086
	24	17	13 200	20 400	1 340	2 080	13 000	20 000	**K20×24×17S**	0.0110
	24	45	16 400	27 100	1 680	2 760	13 000	20 000	**K20×24×45ZW**	0.0280
	25	40	29 000	48 000	2 950	4 900	13 000	20 000	**K20×25×40ZW**	0.0330
	26	12 $^{-0.2}_{-0.55}$	12 900	15 100	1 320	1 540	13 000	20 000	**K20×26×12**	0.0130
20	26	13	14 000	16 700	1 420	1 700	13 000	20 000	**KMJ20×26×13**	0.0120
	26	14	15 800	1 9 600	16 100	2 000	13 000	13 000	**KMJ20×26×13.8X1S**	0.0130
	26	17	17 800	22 800	1 810	2 330	13 000	20 000	**KMJ20×26×17S**	0.0160
	26	20	20 600	27 600	2 100	2 820	13 000	20 000	**KMJ20×26×20S**	0.0190
	28	17	21 700	2 4600	2 210	2 510	13 000	20 000	**KMJ20×28×16.8XS**	0.0220
	28	20	24 600	2 8900	2 500	2 940	13 000	20 000	**KMJ20×28×19.8X4S**	0.0260
	28	25	27 100	3 2500	2 760	3 300	13 000	20 000	**8Q-K20×28×25**	0.0390
21	25	13 $^{-0.2}_{-0.55}$	10 700	1 5900	1 090	1 620	13 000	19 000	**KMJ21×25×12.8X1S**	0.0081
	25	17	13 600	2 1500	1 380	2 200	13 000	19 000	**K21×25×17**	0.0120
	26	10	8 500	1 1900	865	1 220	12 000	18 000	**K22×26×10S**	0.0071
	26	11	10 100	1 4900	1 030	1 520	12 000	18 000	**8Q-K22×26×11**	0.0090
	26	13	10 200	1 5200	1 040	1 550	12 000	18 000	**K22×26×13**	0.0094
22	26	17 $^{-0.2}_{-0.55}$	13 500	21 600	1 370	2 200	12 000	18 000	**K22×26×17S**	0.0120
	27	20	17 500	2 5900	1 780	2 640	12 000	18 000	**K22×27×20**	0.0200
	27	28.5	24 200	3 9500	2 470	4 000	12 000	18 000	**K22×27×28.3X**	0.0276
	27	40	50 500	10 3000	5 150	10 500	12 000	18 000	**K22×27×40ZW**	0.0390
	28	17	17 700	2 3300	1 810	2 380	12 000	18 000	**K22×28×17V1**	0.0200

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··T2
Type K··S
Type K··ZW
Type KMJ
Type KMJ··S
Type KV··S



Type K
Type K··T2
Type K··S

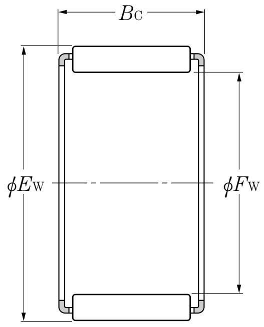


Type K··ZW

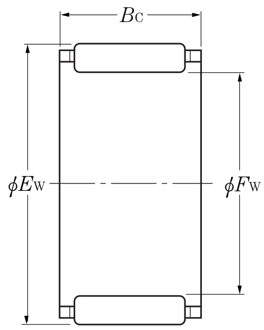
F_W 22～25mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c		C_r	C_{or}	C_r	C_{or}				
	29	16		18 700	2 2700	1 910	2 310	12 000	18 000	**K22×29×16**	0.0230
22	30	15	−0.2 −0.55	19 300	21 700	1 970	2 210	12 000	18 000	**K22×30×15**	0.0220
	30	17.5		23 200	2 7500	2 370	2 800	12 000	18 000	**KMJ22×30×17.3X2S**	0.0240
	30	24		31 000	4 0000	3 150	4 100	12 000	18 000	**KMJ22×30×23.8X3S**	0.0348
	27	13		11 400	1 7700	1 160	1 800	11 000	17 000	**KMJ23×27×12.8X1S**	0.0086
23	28	24	−0.2 −0.55	19 800	3 1000	2 020	3 150	11 000	17 000	**K23×28×24**	0.0230
	29	18		20 600	2 8800	2 100	2 930	11 000	17 000	**KMJ23×29×17.8X2S**	0.0190
	28	10		9 000	1 3200	915	1 350	11 000	17 000	**K24×28×10**	0.0080
	28	13		10 800	16 800	1 100	1 710	11 000	17 000	**K24×28×13**	0.0100
24	28	17	−0.2 −0.55	14 300	23 900	1 460	2 440	11 000	17 000	**K24×28×17**	0.0130
	29	13		12 300	16 900	1 250	1 720	11 000	17 000	**K24×29×13**	0.0120
	30	17		18 400	25 200	1 880	2 570	11 000	17 000	**K24×30×17**	0.0220
	30	31		27 900	43 000	2 840	4 350	11 000	17 000	**K24×30×31ZW**	0.0390
	29	10		8 950	13 300	910	1 350	11 000	16 000	**K25×29×10**	0.0083
	29	13		10 800	16 900	1 100	1 720	11 000	16 000	**K25×29×13**	0.0100
	29	17		14 200	24 000	1 450	2 450	11 000	16 000	**K25×29×17S**	0.0140
	30	13		13 200	18 800	1 350	1 920	11 000	16 000	**K25×30×13**	0.0130
	30	17		17 400	2 6800	1 770	2 730	11 000	16 000	**K25×30×17S**	0.0170
	30	20		19 400	3 1000	1 980	3 150	11 000	16 000	**K25×30×20SV3**	0.0210
	30	22		22 300	3 7000	2 270	3 750	11 000	16 000	**KMJ25×30×21.8XS**	0.0200
25	30	26	−0.2 −0.55	36 500	7 1500	3 750	7 300	11 000	16 000	**K25×30×26ZW**	0.0270
	30	39		29 800	5 3500	3 050	5 450	11 000	16 000	**K25×30×39ZW**	0.0400
	31	13		15 200	19 900	1 550	2 030	11 000	16 000	**K25×31×13V3**	0.0180
	31	14		16 500	22 100	1 680	2 250	11 000	16 000	**K25×31×14**	0.0180
	31	17		18 300	25 300	1 870	2 580	11 000	16 000	**K25×31×17**	0.0220
	31	18.5		21 000	30 000	2 140	3 050	11 000	16 000	**KMJ25×31×18.3X1SK**	0.0210
	31	21		22 500	33 000	2 290	3 350	11 000	16 000	**K25×31×21V3**	0.0283
	32	16		19 500	24 700	1 990	2 520	11 000	16 000	**K25×32×16**	0.0270
	33	24		34 500	47 000	3 500	4 800	11 000	16 000	**KMJ25×33×24S**	0.040

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.



Type KMJ
Type KMJ··S



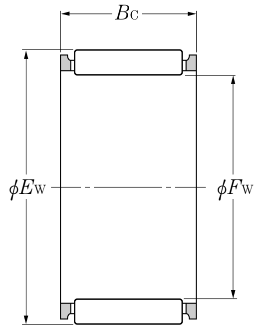
Type KV··S

F_W 26〜30mm

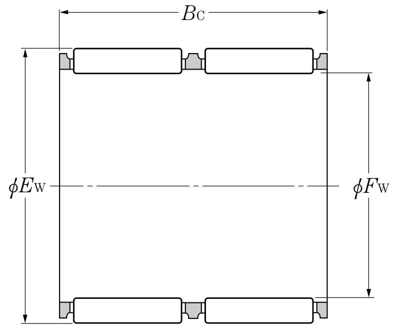
Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min-1 grease	oil	Bearing numbers	Mass kg
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				(approx.)
26	30	13 $^{-0.2}_{-0.55}$	11 800	19 200	1 200	1 960	10 000	15 000	K26×30×13	0.011
	30	17	15 500	27 400	1 580	2 790	10 000	15 000	K26×30×17	0.015
	31	24	21 400	35 500	2 180	3 600	10 000	15 000	8E-K26×31×23.8X1ZW	0.029
	34	22	24 200	30 000	2 470	3 050	10 000	15 000	K26×34×22	0.041
28	32	17 $^{-0.2}_{-0.55}$	15 300	27 500	1 560	2 810	9 500	14 000	K28×32×17	0.017
	32	21	18 700	35 500	1 910	3 650	9 500	14 000	K28×32×21	0.020
	33	13	13 900	20 900	1 420	2 130	9 500	14 000	K28×33×13	0.015
	33	17	18 300	29 800	1 870	3 050	9 500	14 000	K28×33×17S	0.020
	33	26	23 900	42 000	2 430	4 250	9 500	14 000	K28×33×26ZW	0.033
	33	27	28 300	52 000	2 890	5 300	9 500	14 000	K28×33×27	0.032
	34	14	17 500	24 800	1 790	2 530	9 500	14 000	K28×34×14	0.020
	34	17	18 100	25 800	1 850	2 630	9 500	14 000	K28×34×17V1	0.025
	35	16	21 200	28 400	2 160	2 900	9 500	14 000	K28×35×16	0.029
	35	18	21 500	28 900	2 190	2 950	9 500	14 000	K28×35×18	0.031
29	34	17 $^{-0.2}_{-0.55}$	18 900	31 000	1 920	3 200	9 500	14 000	K29×34×17S	0.022
	34	27	28 100	52 000	2 870	5 300	9 500	14 000	K29×34×27	0.033
30	34	14 $^{-0.2}_{-0.55}$	12 400	21 500	1 260	2 190	8 500	13 000	KV30×34×13.8XS	0.014
	34	23	18 000	34 500	1 830	3 500	8 500	13 000	K30×34×22.8X1T2	0.013
	35	11	12 200	18 000	1 240	1 840	8 500	13 000	K30×35×11S	0.014
	35	13	14 700	22 900	1 500	2 340	8 500	13 000	KV30×35×13S	0.017
	35	17	18 800	31 500	1 910	3 200	8 500	13 000	KJ30×35×17S	0.021
	35	20	21 600	37 500	2 200	3 850	8 500	13 000	K30×35×20S	0.025
	35	26	25 200	46 000	2 570	4 650	8 500	13 000	K30×35×26ZWV1	0.036
	35	27	29 900	57 000	3 050	5 800	8 500	13 000	K30×35×27S	0.033
	36	14	18 600	27 400	1 900	2 790	8 500	13 000	KMJ30×36×14V2	0.021
	37	16	21 900	30 500	2 230	3 100	8 500	13 000	K30×37×16	0.029
	37	18	23 300	33 000	2 370	3 350	8 500	13 000	K30×37×18	0.034
	37	20	26 200	38 000	2 670	3 850	8 500	13 000	KMJ30×37×20S	0.032
	37	48	40 000	65 500	4 050	6 700	8 500	13 000	K30×37×48ZW	0.075
	38	18	25 000	33 000	2 550	3 350	8 500	13 000	K30×38×18	0.036

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··T2
Type K··ZW
Type KMJ
Type KJ··S
Type KV··S



Type K
Type K··T2

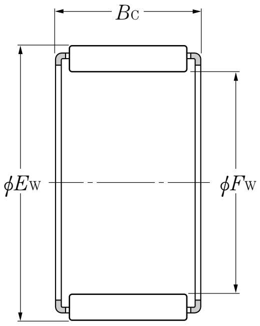


Type K··ZW

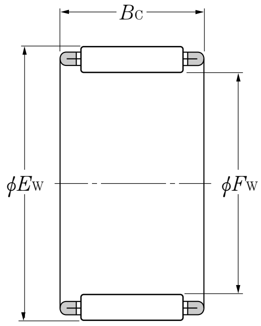
F_w 31～35mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c		C_r	C_{or}	C_r	C_{or}	grease	oil		
31	35	24	−0.2 −0.55	21 200	43 500	2 160	4 400	8 500	13 000	KV31×35×23.8XS	0.022
	36	14		15 800	25 400	1 610	2 590	8 500	13 000	KV31×36×13.8XS	0.017
32	36	15	−0.2 −0.55	14 300	26 400	1 460	2 700	8 500	13 000	K32×36×15S	0.017
	37	13		14 500	23 000	1 480	2 350	8 500	13 000	K32×37×13	0.018
	37	17		19 200	33 000	1 950	3 350	8 500	13 000	K32×37×17S	0.022
	37	24		22 900	41 500	2 340	4 200	8 500	13 000	K32×37×24.8X2	0.018
	37	26		24 900	46 000	2 540	4 700	8 500	13 000	K32×37×26ZWV3	0.032
	37	27		29 600	57 500	3 000	5 850	8 500	13 000	K32×37×27	0.037
	38	14		19 800	30 500	2 020	3 100	8 500	13 000	KMJ32×38×14	0.022
	38	20		25 100	41 000	2 560	4 150	8 500	13 000	KJ32×38×20S	0.031
	38	26		31 500	54 000	3 200	5 550	8 500	13 000	K32×38×26	0.041
	39	16		22 600	32 000	2 310	3 300	8 500	13 000	K32×39×16V1	0.033
	39	18		24 000	35 000	2 450	3 550	8 500	13 000	K32×39×18	0.037
	39	20		26 800	40 000	2 740	4 100	8 500	13 000	KJ32×39×20S	0.041
33	38	30.5	−0.2 −0.55	28 400	55 000	2 900	5 600	8 000	12 000	K33×38×30.3X1T2	0.026
34	40	39.5	−0.2 −0.55	39 000	73 500	4 000	7 500	8 000	12 000	KV34×40×39.3X1ZWS	0.066
35	39	22.5	−0.2 −0.55	21 500	46 000	2 200	4 700	7 500	11 000	KV35×39×22.3XS	0.024
	39	24		21 300	45 000	2 170	4 600	7 500	11 000	K35×39×23.8X1T2	0.015
	40	13		15 200	25 100	1 550	2 560	7 500	11 000	K35×40×13	0.019
	40	17		20 000	36 000	2 040	3 650	7 500	11 000	K35×40×17	0.025
	40	19		22 300	41 000	2 270	4 200	7 500	11 000	K35×40×19	0.029
	40	26		44 000	100 000	4 450	10 200	7 500	11 000	K35×40×26ZW	0.037
	40	27		32 000	65 000	3 250	6 600	7 500	11 000	KJ35×40×27S	0.039
	40	30		26 100	50 000	2 660	5 100	7 500	11 000	K35×40×30ZW	0.043
	41	14		19 400	30 500	1 980	3 100	7 500	11 000	K35×41×14	0.026
	41	15		20 900	33 500	2 130	3 400	7 500	11 000	K35×41×15	0.027
	41	24		31 000	55 500	3 200	5 650	7 500	11 000	K35×41×23.8X1	0.042
	41	40		72 000	168 000	7 350	17 100	7 500	11 000	K35×41×40ZW	0.055
	42	16		24 100	36 000	2 450	3 650	7 500	11 000	K35×42×16	0.035
	42	18		24 700	37 000	2 510	3 750	7 500	11 000	K35×42×18	0.039

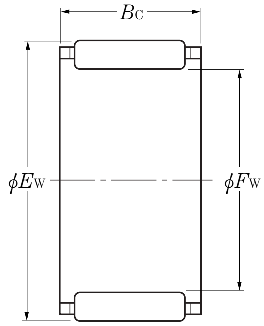
Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.



Type KMJ



Type KJ··S



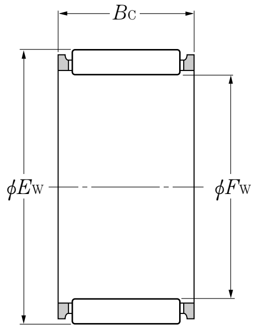
Type KV··S

F_w 35～42mm

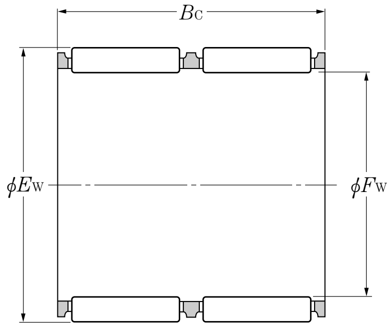
Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
35	42	20	26 500	40 500	2 700	4 100	7 500	11 000	KV35×42×20SV2	0.040
	42	30 $^{-0.2}_{-0.55}$	39 500	68 000	4 050	6 950	7 500	11 000	K35×42×30	0.062
	42	45	42 500	74 000	4 300	7 550	7 500	11 000	K35×42×45ZW	0.106
36	42	46 $^{-0.2}_{-0.55}$	51 000	106 000	5 200	10 800	7 500	11 000	K36×42×46ZW	0.086
37	42	13	15 900	27 100	1 620	2 770	7 500	11 000	K37×42×13V4	0.021
	42	17	21 000	38 500	2 140	3 950	7 500	11 000	K37×42×17V2	0.026
	42	27 $^{-0.2}_{-0.55}$	32 500	67 500	3 300	6 900	7 500	11 000	KJ37×42×27S	0.041
	43	33.5	39 000	76 000	4 000	7 750	7 500	11 000	KV37×43×33.3XS	0.062
	44	18	26 300	41 000	2 680	4 150	7 500	11 000	K37×44×18	0.042
	45	25	37 000	58 000	3 800	5 900	7 500	11 000	K37×45×24.8XT2	0.039
38	43	17	20 900	38 500	2 130	3 950	7 500	11 000	8E-K38×43×17	0.027
	43	27	32 000	67 500	3 300	6 900	7 500	11 000	K38×43×27	0.043
	43	29 $^{-0.2}_{-0.55}$	32 500	68 000	3 300	6 950	7 500	11 000	K38×43×28.8X	0.047
	46	20	34 000	52 000	3 450	5 350	7 500	11 000	KMJ38×46×20	0.046
	46	32	54 000	95 500	5 500	9 700	7 500	11 000	K38×46×32	0.073
40	45	13	16 500	29 200	1 680	2 980	6 500	10 000	K40×45×13V2	0.023
	45	17	21 800	41 500	2 220	4 250	6 500	10 000	K40×45×17	0.027
	45	21	26 700	54 000	2 720	5 500	6 500	10 000	K40×45×21V2	0.035
	45	27	33 500	72 500	3 400	7 400	6 500	10 000	K40×45×27	0.044
	46	17 $^{-0.2}_{-0.55}$	24 600	43 000	2 500	4 350	6 500	10 000	K40×46×17	0.030
	46	34	40 500	80 500	4 100	8 250	6 500	10 000	KV40×46×33.8XS	0.063
	47	18	27 700	45 000	2 820	4 550	6 500	10 000	K40×47×18	0.045
	47	20	31 000	51 500	3 150	5 250	6 500	10 000	K40×47×20	0.048
	48	20	33 000	51 000	3 350	5 200	6 500	10 000	K40×48×20	0.052
	48	25	41 000	68 000	4 200	6 900	6 500	10 000	KV40×48×25SV1	0.065
41	49	22 $^{-0.2}_{-0.55}$	30 500	46 000	3 100	4 700	6 500	9 500	8E-KV41×49×21.8XS	0.065
42	47	17	22 100	43 000	2 250	4 400	6 500	9 500	K42×47×17	0.028
	47	27 $^{-0.2}_{-0.55}$	34 000	75 500	3 450	7 700	6 500	9 500	K42×47×27	0.047
	48	17	25 700	46 000	2 630	4 700	6 500	9 500	K42×48×17	0.036
	50	20	34 000	53 500	3 450	5 500	6 500	9 500	K42×50×20	0.054

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··T2
Type K··ZW
Type KV··S



Type K
Type K··T2

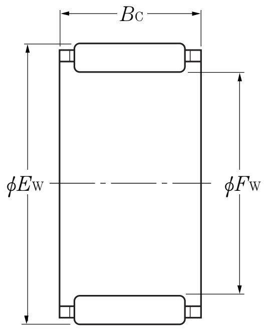


Type K··ZW

F_w 43～50mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
43	48	17	22 000	43 000	2 240	4 400	6 500	9 500	K43×48×17	0.029
	48	27 $_{-0.55}^{-0.2}$	34 000	75 500	3 450	7 700	6 500	9 500	K43×48×27	0.046
	48	38	41 000	96 000	4 150	9 800	6 500	9 500	KV43×48×37.8XZWS	0.058
	50	18	29 100	49 000	2 960	5 000	6 500	9 500	K43×50×18	0.049
44	50	31 $_{-0.55}^{-0.2}$	43 500	91 500	4 400	9 300	6 500	9 500	KV44×50×30.8XS	0.067
45	49	19	22 100	52 000	2 260	5 300	6 000	9 000	K45×49×19	0.027
	50	17	22 300	44 500	2 280	4 550	6 000	9 000	K45×50×17	0.033
	50	25.8	30 500	66 500	3 100	6 750	6 000	9 000	KV45×50×25.8XS	0.045
	50	27	34 500	78 000	3 500	7 950	6 000	9 000	K45×50×27	0.050
	51	27 $_{-0.55}^{-0.2}$	34 500	68 000	3 500	6 950	6 000	9 000	KV45×51×26.8XS	0.058
	52	18	29 700	51 000	3 000	5 200	6 000	9 000	K45×52×18	0.051
	52	21	32 000	56 500	3 300	5 750	6 000	9 000	K45×52×21	0.061
	53	20	36 000	59 000	3 650	6 000	6 000	9 000	K45×53×20	0.062
	53	25	46 500	82 000	4 700	8 400	6 000	9 000	K45×53×25	0.077
	53	28	49 500	90 000	5 050	9 200	6 000	9 000	KJ45×53×28S	0.078
47	52	15.5	19 400	38 000	1 980	3 900	5 500	8 500	8E-K47×52×15.3X2	0.031
	52	17	23 200	47 500	2 360	4 850	5 500	8 500	K47×52×17	0.033
	52	23 $_{-0.55}^{-0.2}$	29 600	65 500	3 000	6 650	5 500	8 500	KV47×52×22.8XS	0.044
	52	24	33 500	76 500	3 400	7 800	5 500	8 500	K47×52×23.8X	0.044
	52	27	35 500	83 000	3 650	8 450	5 500	8 500	K47×52×27	0.051
	52	33	38 000	90 500	3 900	9 250	5 500	8 500	KV47×52×32.8×ZWS	0.064
48	53	22.5	31 000	69 500	3 150	7 050	5 500	8 500	KV48×53×22.3XS	0.042
	53	26	36 500	86 500	3 750	8 850	5 500	8 500	K48×53×25.8X3T2	0.029
	53	30	36 500	85 500	3 700	8 750	5 500	8 500	K48×53×29.8X1	0.062
	53	37 $_{-0.55}^{-0.2}$	45 000	112 000	4 550	11 400	5 500	8 500	KV48×53×36.8XZWS	0.064
	53	37.5	41 500	101 000	4 200	10 300	5 500	8 500	K48×53×37.5ZW	0.072
	54	19	31 000	61 000	3 150	6 250	5 500	8 500	K48×54×19	0.044
	55	24.5	39 000	73 500	4 000	7 600	5 500	8 500	KV48×55×24.3XS	0.070
50	55	13.5 $_{-0.55}^{-0.2}$	18 100	35 500	1 850	3 600	5 500	8 000	K50×55×13.5	0.023
	55	20	27 900	62 000	2 850	6 300	5 500	8 000	KV50×55×20S	0.040

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.



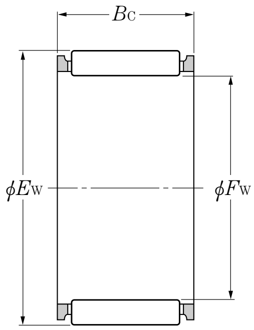
Type KV··S

F_w 50～60mm

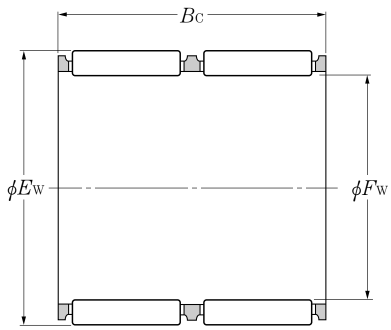
Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min-1)		Bearing numbers	Mass (kg)
F_w	E_w	B_c		C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)
	55	27		37 000	88 500	3 750	9 000	5 500	8 000	K50×55×27	0.053
	55	30		39 500	97 000	4 050	9 900	5 500	8 000	K50×55×30	0.059
50	57	18	$^{-0.2}_{-0.55}$	31 500	57 000	3 200	5 800	5 500	8 000	K50×57×18	0.053
	58	20		38 500	67 500	3 950	6 850	5 500	8 000	K50×58×20	0.065
	58	25		48 500	90 000	4 950	9 150	5 500	8 000	K50×58×25	0.081
	58	58		83 500	181 000	8 500	18 400	5 500	8 000	KV50×58×57.8XZWS	0.188
	57	18		22 800	48 000	2 320	4 900	5 000	7 500	KV52×57×17.8XS	0.037
52	57	23	$^{-0.2}_{-0.55}$	30 500	69 500	3 100	7 100	5 000	7 500	KV52×57×22.8X1S	0.048
	58	19		32 000	65 500	3 250	6 650	5 000	7 500	K52×58×19	0.048
54	59	23	$^{-0.2}_{-0.55}$	31 500	73 500	3 200	7 500	5 000	7 500	KV54×59×22.8XS	0.049
	60	17		25 800	58 000	2 630	5 900	5 000	7 500	K55×60×17	0.043
	60	20		28 800	66 500	2 940	6 750	5 000	7 500	K55×60×20	0.045
	60	30		42 000	108 000	4 300	11 000	5 000	7 500	KV55×60×30S	0.069
	60	37		47 500	127 000	4 850	12 900	5 000	7 500	K55×60×36.8X	0.086
	61	19		33 000	69 500	3 350	7 100	5 000	7 500	K55×61×19	0.051
55	61	20	$^{-0.2}_{-0.55}$	33 000	69 500	3 350	7 100	5 000	7 500	K55×61×20	0.054
	61	30		48 000	113 000	4 900	11 500	5 000	7 500	K55×61×30	0.081
	62	18		33 500	63 000	3 400	6 450	5 000	7 500	K55×62×18	0.054
	63	20		39 000	70 000	3 950	7 100	5 000	7 500	K55×63×20	0.073
	63	25		50 500	97 500	5 150	9 950	5 000	7 500	K55×63×25	0.088
	63	32		61 000	125 000	6 200	12 700	5 000	7 500	K55×63×32	0.117
56	66	41	$^{-0.2}_{-0.55}$	90 000	178 000	9 200	18 100	5 000	7 500	K56×66×40.8XT2	0.148
57	65	40	$^{-0.2}_{-0.55}$	66 000	140 000	6 750	14 300	4 700	7 000	KV57×65×39.8XZWS	0.145
58	64	19	$^{-0.2}_{-0.55}$	34 000	73 500	3 450	7 500	4 700	7 000	K58×64×19	0.052
	65	20		29 800	71 500	3 050	7 300	4 300	6 500	K60×65×20	0.051
	65	27		40 000	104 000	4 050	10 600	4 300	6 500	K60×65×26.8X	0.067
60	65	30	$^{-0.2}_{-0.55}$	43 500	116 000	4 450	11 800	4 300	6 500	K60×65×30	0.071
	66	19		33 500	73 500	3 450	7 500	4 300	6 500	K60×66×19	0.053
	66	20		33 500	73 500	3 450	7 500	4 300	6 500	K60×66×20	0.056

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··T2
Type K··ZW
Type KV··S



Type K
Type K··T2

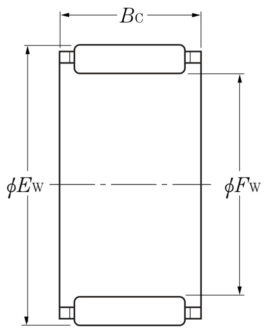


Type K··ZW

F_w 60～73mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
60	66	30 $^{-0.2}_{-0.55}$	49 000	119 000	5 000	12 200	4 300	6 500	K60×66×30	0.084
	68	15	27 200	45 500	2 780	4 650	4 300	6 500	K60×68×15	0.058
	68	20	40 000	75 000	4 100	7 650	4 300	6 500	K60×68×20	0.077
	68	23	44 500	85 000	4 500	8 700	4 300	6 500	K60×68×23	0.092
	68	25	52 000	105 000	5 300	10 700	4 300	6 500	K60×68×25	0.097
	68	27	52 000	105 000	5 300	10 700	4 300	6 500	K60×68×27	0.098
	68	30	46 500	91 000	4 750	9 300	4 300	6 500	K60×68×30ZW	0.119
61	66	20 $^{-0.2}_{-0.55}$	29 700	71 500	3 050	7 300	4 300	6 500	K61×66×20	0.054
	66	30	43 500	116 000	4 400	11 900	4 300	6 500	K61×66×30	0.073
63	70	21 $^{-0.2}_{-0.55}$	44 500	95 500	4 500	9 700	4 300	6 500	K63×70×21	0.075
	71	50.5	74 500	167 000	7 600	17 000	4 300	6 500	KV63×71×50.3XZWS	0.193
64	70	16 $^{-0.2}_{-0.55}$	28 400	60 500	2 900	6 150	4 300	6 500	K64×70×16	0.053
65	70	20 $^{-0.2}_{-0.55}$	30 500	75 000	3 100	7 650	4 000	6 000	K65×70×20	0.055
	70	21.5	30 500	75 000	3 100	7 650	4 000	6 000	KV65×70×21.3X1S	0.056
	70	30	45 000	124 000	4 600	12 700	4 000	6 000	K65×70×30	0.083
	73	23	47 000	94 000	4 800	9 600	4 000	6 000	K65×73×23	0.100
	73	30	61 000	132 000	6 200	13 400	4 000	6 000	K65×73×30	0.126
68	74	20 $^{-0.2}_{-0.55}$	36 000	83 500	3 700	8 550	4 000	6 000	K68×74×20	0.065
	74	30	51 500	133 000	5 250	13 500	4 000	6 000	K68×74×30	0.097
	74	35	49 500	125 000	5 050	12 800	4 000	6 000	K68×74×35ZW	0.116
	75	21	45 500	101 000	4 600	10 300	4 000	6 000	K68×75×21	0.077
70	76	20 $^{-0.2}_{-0.55}$	36 500	86 000	3 700	8 750	3 700	5 500	K70×76×20	0.070
	76	30	53 000	139 000	5 400	14 200	3 700	5 500	K70×76×30	0.100
	77	21	45 000	101 000	4 600	10 300	3 700	5 500	K70×77×21	0.080
	78	23	49 500	103 000	5 050	10 500	3 700	5 500	K70×78×23	0.107
	78	30	65 500	149 000	6 700	15 200	3 700	5 500	K70×78×30	0.136
72	79	21 $^{-0.2}_{-0.55}$	46 500	106 000	4 750	10 800	3 700	5 500	K72×79×21	0.085
73	79	20 $^{-0.2}_{-0.55}$	37 500	90 000	3 800	9 150	3 700	5 500	K73×79×20	0.074
	79	30	54 500	146 000	5 550	14 900	3 700	5 500	K73×79×30	0.106
74	90	50 $^{-0.2}_{-0.55}$	157 000	287 000	16 000	29 200	3 700	5 500	K74×90×49.8XT2	0.380

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.



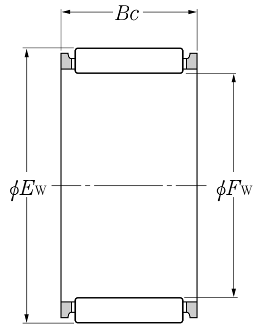
Type KV··S

F_W 75〜105mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers	Mass kg
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)
75	81	20	40 000	99 500	4 100	10 200	3 700	5 500	**KV75×81×19.8X1S**	0.071
	81	30	56 000	152 000	5 700	15 500	3 700	5 500	**K75×81×30**	0.108
	82	21 $^{-0.2}_{-0.55}$	46 000	106 000	4 700	10 800	3 700	5 500	**K75×82×21**	0.088
	83	23	50 500	109 000	5 150	11 100	3 700	5 500	**K75×83×23**	0.113
	83	30	67 500	157 000	6 850	16 100	3 700	5 500	**K75×83×30**	0.147
80	86	20	39 000	98 000	4 000	10 000	3 300	5 000	**KV80×86×20SV1**	0.077
	86	30	57 000	159 000	5 800	16 200	3 300	5 000	**K80×86×30**	0.110
	88	23 $^{-0.2}_{-0.55}$	53 000	118 000	5 400	12 100	3 300	5 000	**K80×88×23**	0.125
	88	26	61 000	142 000	6 250	14 500	3 300	5 000	**K80×88×26**	0.131
	88	30	69 000	166 000	7 050	17 000	3 300	5 000	**K80×88×30**	0.157
85	92	20	47 500	115 000	4 850	11 700	3 100	4 700	**KMJ85×92×20**	0.083
	92	30 $^{-0.2}_{-0.55}$	66 000	176 000	6 750	18 000	3 100	4 700	**K85×92×30**	0.142
	93	27	64 000	153 000	6 500	15 600	3 100	4 700	**K85×93×27**	0.145
	93	30	71 000	175 000	7 200	17 900	3 100	4 700	**8Q-K85×93×30**	0.174
90	97	20	46 000	113 000	4 700	11 500	2 900	4 400	**K90×97×20**	0.103
	97	30	67 500	184 000	6 850	18 700	2 900	4 400	**K90×97×30**	0.151
	98	26 $^{-0.2}_{-0.55}$	64 000	157 000	6 550	16 000	2 900	4 400	**K90×98×26**	0.148
	98	27	64 000	157 000	6 550	16 000	2 900	4 400	**K90×98×27**	0.150
	98	30	72 500	184 000	7 400	18 800	2 900	4 400	**K90×98×30**	0.172
95	102	21	48 000	122 000	4 900	12 400	2 800	4 200	**K95×102×21**	0.115
	102	31 $^{-0.2}_{-0.55}$	70 500	199 000	7 200	20 300	2 800	4 200	**K95×102×31**	0.172
	103	27	65 500	165 000	6 700	16 800	2 800	4 200	**K95×103×27**	0.159
	103	30	74 000	193 000	7 550	19 600	2 800	4 200	**K95×103×30**	0.165
100	107	21	47 500	122 000	4 850	12 500	2 700	4 000	**KV100×107×21S**	0.120
	107	31 $^{-0.3}_{-0.65}$	71 500	207 000	7 300	21 100	2 700	4 000	**K100×107×31**	0.173
	108	27	61 000	153 000	6 250	15 600	2 700	4 000	**K100×108×27**	0.176
	108	30	76 000	201 000	7 700	20 500	2 700	4 000	**K100×108×30**	0.190
105	112	21	48 500	127 000	4 950	12 900	2 500	3 800	**K105×112×21**	0.130
	112	31 $^{-0.3}_{-0.65}$	71 000	207 000	7 250	21 100	2 500	3 800	**K105×112×31**	0.176
	113	30	77 500	210 000	7 900	21 400	2 500	3 800	**K105×113×30**	0.198

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K
Type K··L1



Type K
Type K··L1

F_W 110～195mm

Boundary dimensions (mm) F_w	E_w	B_c	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers	Mass kg (approx.)
	117	24	54 500	149 000	5 550	15 200	2 400	3 600	**K110×117×24**	0.145
110	117	34 $^{-0.3}_{-0.65}$	77 500	235 000	7 900	24 000	2 400	3 600	**K110×117×34**	0.205
	118	30	79 000	219 000	8 050	22 300	2 400	3 600	**K110×118×30**	0.217
115	123	27 $^{-0.3}_{-0.65}$	64 000	170 000	6 550	17 300	2 300	3 500	**K115×123×27**	0.200
	125	34	95 000	241 000	9 700	24 600	2 300	3 500	**K115×125×34**	0.330
120	127	24 $^{-0.3}_{-0.65}$	57 500	165 000	5 850	16 800	2 200	3 300	**K120×127×24**	0.160
	127	34	82 000	260 000	8 350	26 600	2 200	3 300	**K120×127×34**	0.235
125	133	35 $^{-0.3}_{-0.65}$	87 000	260 000	8 900	26 500	2 100	3 200	**K125×133×35**	0.275
	135	34	100 000	265 000	10 200	27 000	2 100	3 200	**K125×135×34**	0.350
130	137	24 $^{-0.3}_{-0.65}$	59 000	175 000	6 000	17 900	2 100	3 100	**K130×137×24**	0.170
	137	34	84 500	277 000	8 600	28 300	2 100	3 100	**K130×137×34**	0.240
135	143	35 $^{-0.3}_{-0.65}$	92 500	288 000	9 450	29 400	2 000	3 000	**K135×143×35L1**	0.313
	150	38	145 000	325 000	14 800	33 500	2 000	3 000	**K135×150×38**	0.590
	153	26	72 000	214 000	7 350	21 800	1 900	2 800	**K145×153×26**	0.250
145	153	28 $^{-0.3}_{-0.65}$	80 500	247 000	8 200	25 200	1 900	2 800	**K145×153×28**	0.252
	153	36	100 000	325 000	10 200	33 000	1 900	2 800	**K145×153×36**	0.335
150	160	46 $^{-0.3}_{-0.65}$	149 000	470 000	15 200	48 000	1 800	2 700	**K150×160×46**	0.550
155	163	26 $^{-0.3}_{-0.65}$	73 500	224 000	7 500	22 800	1 700	2 600	**K155×163×26**	0.270
	163	36	102 000	340 000	10 400	34 500	1 700	2 600	**K155×163×36**	0.355
160	170	46 $^{-0.3}_{-0.65}$	155 000	505 000	15 800	51 500	1 700	2 500	**K160×170×46**	0.570
	173	26	79 000	251 000	8 050	25 600	1 600	2 400	**K165×173×26**	0.290
165	173	32 $^{-0.3}_{-0.65}$	97 000	330 000	9 900	33 500	1 600	2 400	**K165×173×32**	0.340
	173	36	109 000	380 000	11 100	39 000	1 600	2 400	**K165×173×36**	0.375
170	180	46 $^{-0.3}_{-0.65}$	160 000	540 000	16 400	55 000	1 600	2 400	**K170×180×46**	0.620
175	183	32 $^{-0.3}_{-0.65}$	101 000	350 000	10 300	35 500	1 500	2 300	**K175×183×32L1**	0.379
185	195	37 $^{-0.3}_{-0.65}$	131 000	425 000	13 300	43 500	1 500	2 200	**K185×195×37L1**	0.581
195	205	37 $^{-0.3}_{-0.65}$	135 000	450 000	13 800	46 000	1 400	2 100	**K195×205×37L1**	0.620

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.

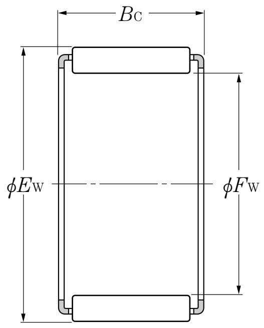
F_W 210～285mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_w	E_w	B_c	C_r	C_{or}	C_r	C_{or}				
210	220	42 $^{-0.3}_{-0.65}$	156 000	560 000	15 900	57 000	1 300	1 900	**K210×220×42**	0.740
220	230	42 $^{-0.3}_{-0.65}$	161 000	590 000	16 400	60 000	1 200	1 800	**K220×230×42**	0.790
240	250	42 $^{-0.3}_{-0.65}$	167 000	635 000	17 000	64 500	1 100	1 700	**K240×250×42L1**	0.849
265	280	50 $^{-0.3}_{-0.65}$	256 000	850 000	26 100	87 000	1 000	1 500	**K265×280×50L1**	1.768
285	300	50 $^{-0.3}_{-0.65}$	268 000	930 000	27 300	94 500	950	1 400	**K285×300×50**	1.970

Remarks: Even when an order is placed with reference to “Nominal bearing number” listed in this table, the ordered bearings are subject to being delivered with different cage type.

Inch System

Type PCJ



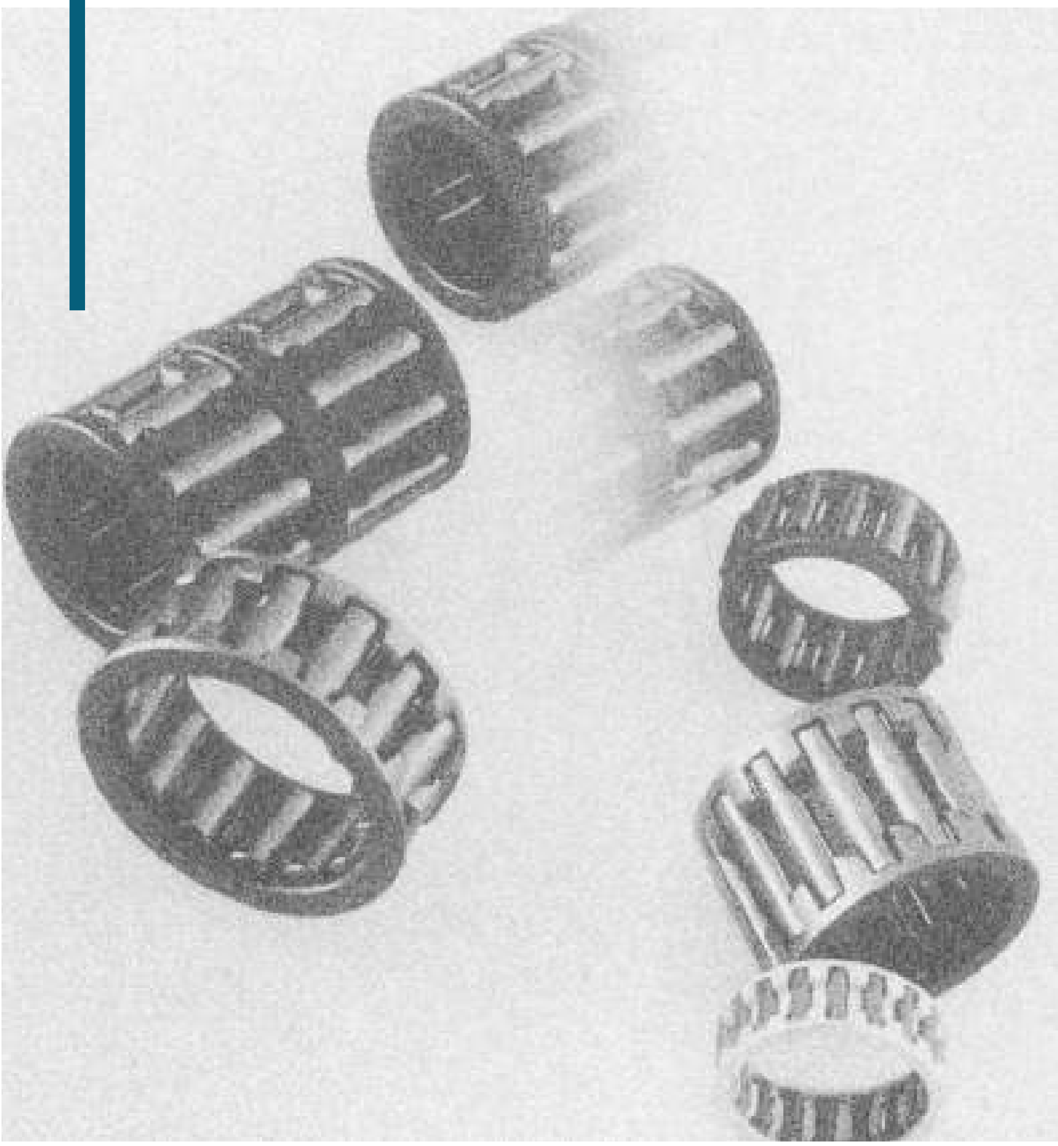
F_w 12.700～63.500mm

Boundary dimensions (mm)			Basic load ratings: dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1})		Bearing numbers	Mass (kg)
F_w	E_w	B_c $^{0}_{-0.35}$ ($^{0}_{-0.014}$)	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)
12.700(½)	15.875(⅝)	12.70(½)	6 650	8 600	680	875	16 000	24 000	**PCJ081008**	0.003
19.050(¾)	25.400(1)	25.40(1)	25 700	35 000	2 620	3 550	13 000	20 000	**PCJ121616**	0.023
22.225(⅞)	28.575(1⅛)	25.40(1)	29 600	44 000	3 000	4 450	11 000	17 000	**PCJ141816**	0.028
25.400(1)	33.338(1 5/16)	19.05(¾)	29 200	38 500	2 980	3 950	10 000	15 000	**PCJ162112**	0.032
	33.338(1 5/16)	25.40(1)	38 000	54 000	3 850	5 500	10 000	15 000	**PCJ162116**	0.044
28.575(1⅛)	38.100(1½)	25.40(1)	44 000	59 500	4 450	6 050	9 500	14 000	**PCJ182416**	0.058
	38.100(1½)	31.75(1¼)	53 500	77 000	5 450	7 850	9 500	14 000	**PCJ182420**	0.073
31.750(1¼)	41.275(1⅝)	19.05(¾)	35 000	46 000	3 600	4 700	8 500	13 000	**PCJ202612**	0.045
	41.275(1⅝)	25.40(1)	35 000	46 000	3 600	4 700	8 500	13 000	**PCJ202616**	0.062
	41.275(1⅝)	38.10(1½)	65 000	101 000	6 600	10 300	8 500	13 000	**PCJ202624**	0.096
34.925(1⅜)	44.450(1¾)	31.75(1¼)	60 000	94 500	6 150	9 650	7 500	11 000	**PCJ222820**	0.090
38.100(1½)	47.625(1⅞)	25.40(1)	51 000	78 000	5 200	7 950	6 500	10 000	**PCJ243016**	0.075
	47.625(1⅞)	31.75(1¼)	62 000	101 000	6 300	10 300	6 500	10 000	**PCJ243020**	0.095
	47.625(1⅞)	38.10(1½)	72 500	123 000	7 400	12 600	6 500	10 000	**PCJ243024**	0.114
44.450(1¾)	53.975(2⅛)	25.40(1)	55 500	92 000	5 650	9 400	6 000	9 000	**PCJ283416**	0.086
	53.975(2⅛)	31.75(1¼)	68 000	119 000	6 900	12 100	6 000	9 000	**PCJ283420**	0.110
	53.975(2⅛)	38.10(1½)	79 000	145 000	8 050	14 800	6 000	9 000	**PCJ283424**	0.132
50.800(2)	60.325(2⅜)	25.40(1)	58 000	102 000	5 950	10 400	5 000	7 500	**PCJ323816**	0.094
	60.325(2⅜)	31.75(1¼)	71 000	131 000	7 250	13 400	5 000	7 500	**PCJ323820**	0.120
	60.325(2⅜)	38.10(1½)	83 000	160 000	8 450	16 300	5 000	7 500	**PCJ323824**	0.144
52.388(2 1/16)	61.913(2 7/16)	25.40(1)	55 000	95 500	5 600	9 750	5 000	7 500	**PCJ333916**	0.087
53.975(2⅛)	63.500(2½)	25.40(1)	56 500	99 500	5 750	10 200	5 000	7 500	**PCJ344016**	0.091
	63.500(2½)	38.10(1½)	82 000	161 000	8 350	16 400	5 000	7 500	**PCJ344024**	0.144
57.150(2¼)	66.675(2⅝)	25.40(1)	57 500	104 000	5 900	10 600	4 300	6 500	**PCJ364216**	0.094
60.325(2⅜)	69.850(2¾)	38.10(1½)	87 500	182 000	8 950	18 500	4 300	6 500	**PCJ384424**	0.161
63.500(2½)	73.025(2⅞)	25.40(1)	61 500	117 000	6 250	11 900	4 000	6 000	**PCJ404616**	0.105

F_w 63.500〜101.600mm

Boundary dimensions mm F_w	E_w	B_c ${}^{0}_{-0.35}$ $\left({}^{0}_{-0.014}\right)$	Basic load ratings dynamic N C_r	static N C_{or}	dynamic kgf C_r	static kgf C_{or}	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
63.500(2½)	73.025(2⅞)	38.10(1½)	89 000	189 000	9 100	19 300	4 000	4 000	**PCJ404624**	0.167
69.850(2¾)	79.375(3⅛)	25.40(1)	65 000	130 000	6 650	13 200	3 700	5 500	**PCJ445016**	0.116
76.200(3)	85.725(3⅜)	25.40(1)	68 500	143 000	7 000	14 600	3 300	5 000	**PCJ485416**	0.127
	85.725(3⅜)	38.10(1½)	99 500	231 000	10 100	23 500	3 300	5 000	**PCJ485424**	0.201
88.900(3½)	98.425(3⅞)	25.40(1)	75 000	169 000	7 650	17 200	2 900	4 400	**PCJ566216**	0.149
	101.600(4)	25.40(1)	82 000	154 000	8 350	15 700	2 900	4 400	**PCJ566416**	0.187
	101.600(4)	38.10(1½)	121 000	253 000	12 300	25 800	2 900	4 400	**PCJ566424**	0.305
101.600(4)	114.300(4½)	25.40(1)	87 500	176 000	8 950	18 000	2 500	3 800	**PCJ647216**	0.212
	114.300(4½)	38.10(1½)	129 000	290 000	13 200	29 500	2 500	3 800	**PCJ647224**	0.345

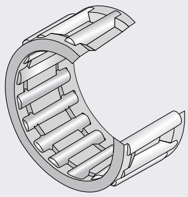
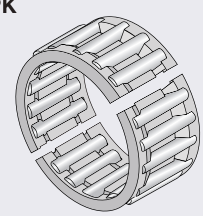
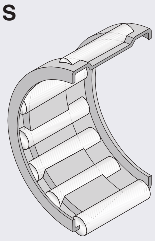
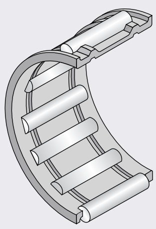
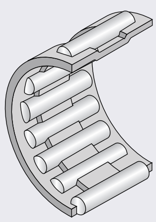
Needle Roller and Cage Assemblies for connecting rod bearings



Needle Roller and Cage Assemblies for connecting rod bearings

These needle roller and cage assemblies are specially designed so as to be adaptable to the operating environmental conditions for the connecting rods of small and medium reciprocal engines and compressors.

The connecting rods are used under a severe operating condition wherein acting load magnitude and direction fluctuate rapidly as well as under an high temperature and strict lubrication environment. Therefore, special measures are manly undertaken for the cage structure, material and machining method so that the needle roller and cage assemblies are resistible to the said operating condition and environment.

Type of needle roller and cage assembly	Location	Cage type	Applicable shaft diameter (mm)	Composition of bearing number
PK 	Large end side	Machined ring type	ϕ10 – ϕ38	PK 20×26×13.8 X1 Suffix Width Roller set outer diameter Roller set bore diameter Type code
GPK 		Machined type Split type	ϕ10 – ϕ38	GPK 20 × 26 × 13.8 X Suffix Width Roller set outer diameter Roller set bore diameter Type code
KMJ··S 		Welded type	ϕ10 – ϕ38	KMJ 10 × 14 × 8.8 S Suffix Width Roller set outer diameter Roller set bore diameter Type code
KBK 	Small end side	Machined ring type	ϕ7 – ϕ25	KBK 14 × 18 × 17 Width Roller set outer diameter Roller set bore diameter Type code
KV··S 		Welded type	ϕ7 – ϕ100	KV 8 × 11 × 8 S V4 Suffix Suffix Width Roller set outer diameter Roller set bore diameter Type code

Data for the GPK, KMJ··S, KV··S types are not included in the dimension table. For detailed information, contact NTN Engineering.

Bearing number	Code items and respective dimensions	Remarks
PK20×26×13.8X1	Roller set bore diameter : φ20 Roller set outer diamete r: φ26 Width : 13.8 X1 : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
GPK20× 26 ×13.8X	Roller set bore diameter : φ20 Roller set outer diameter : φ26 Width :13.8 X : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc. Can be applied to a crank of integral structure.
KMJ10×14×8.8S	Roller set bore diameter : φ10 Roller set outer diameter : φ14 Width :8.8 S : welded type	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
KBK14×18×17	Roller set bore diameter : φ14 Roller set outer diameter : φ18 Width : 17	Type KBK is intended to guide inner ring, which of the guide surface is designed as long as possible to thereby reduce the surface pressure. In addition, the roller length is so designed as to be maximum against the width of connecting rod, for high load capacity. On the other hand, Type V••S intended for outer ring guide needs a guide along the bore surface of connecting rod.
KV8×11×8SV4	Roller set bore diameter : φ8 Roller set outer diameter : φ11 Width : 8 S : welded type V4 : Special specification	

Radial clearance

Table 1 shows the recommended clearance values though the radial clearance differs depending on bearing clearance, load, revolutions and ambient temperature.

The proper radial clearance can be got by proper selection and combination of roller diameter, connecting rod hole diameter and pin diameter. **Table 2** shows the examples of selection and combination of those.

Table 1 Recommended clearance values

Unit : μm

Pin diameter mm Over	incl.	Large end side	Small end side
6	10	9～23	5～17
10	18	10～24	5～17
18	30	10～24	5～17
30	40	18～33	—

Table 2 Radial clearance values obtainable by selection and combination

Case of needle roller and cage assembly Type PK for crank pin
Crank pin hole diameter 22mm H6 (0 to +13μm)
Crank pin diameter 14mm h5 (0 to -8μm)

Unit : μm

Hole diameter sorting class	0～+4	+4～+8	+8～+13
Sorting class of needle roller used / Pin diameter sorting class	−4～−6	−2～−4	0～−2
0～−3	10～17	10～17	10～18
−3～−6	13～20	13～20	13～21
−6～−8	16～22	16～22	16～23

Connecting rod and pin specifications

Connecting rod (bore surface), crank pin and piston pin (outer surface) can be used as direct raceway surface. However, these surfaces must be resistible to great load while maintaining high accuracy. For that, connecting rods and pins acting as the direct raceway surface must comply with the specifications specified hereunder.

Any connecting rods shall be made of cement steel, e.g. chrome molybdenum steel (SCM415, etc.), nickel chrome molybdenum steel (SNCM420, etc.) and any crank pins and piston pins shall also be made of cement steel, e.g. chrome steel (SCr420, etc.), all of which shall be surface-hardened by carburizing.

The surface hardness of each shall range from HRC58 to 64 and adequate depth of effective carburizing-hardened layer shall be secured up to Hv550. The depth of effective carburizing-hardened layer differs depending on actual load and pin diameter.

Feel free to contact **NTN** for the more detailed information.

The respective profile accuracy of connecting rod hole, crank and piston pin outer surfaces shall be as specified in **Table 3**.

Furthermore, the parallelism of crank pin and piston pin shall be 0.02mm or less against 100mm. (**Fig. 1**)

The surface roughness shall be 0.2a for connecting rod and 0.1a for pin outer surface as a guideline.

Table 3 Recommended accuracy of connecting rod and pin

Unit : μm

Parts	Characteristics	Pin diameter classification mm ～14	14～18	18～25	25～30	30～40
Connecting rod	Roundness (max)	3	4	4	5	5
	Cylindricality (max)	2	3	3	4	4
Pin	Roundness (max)	2	2	3	3	4
	Cylindricality (max)	1	1	2	2	3

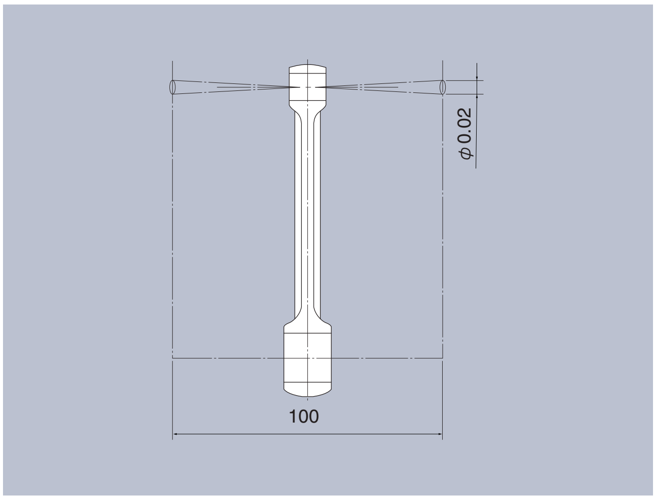


Fig. 1

Regulation to connecting rod

Two methods are available as follows to regulate axial motion of a connecting rod; one method is to make smaller a clearance between the rod and crank web at large end side (Method of regulating at large end side) and another method is to narrow a clearance between the rod and piston boss at the small end side (Method of regulating at small end side).

In general, the method of regulation at large end side is mostly adopted to get accurate motion of a connecting rod.

On the other hand, the method of regulation at small end side is adopted when regulation at large end side disables to secure good lubrication to the bearing and the guide surface at large end side due to short connecting rod and comparatively high revolutions.

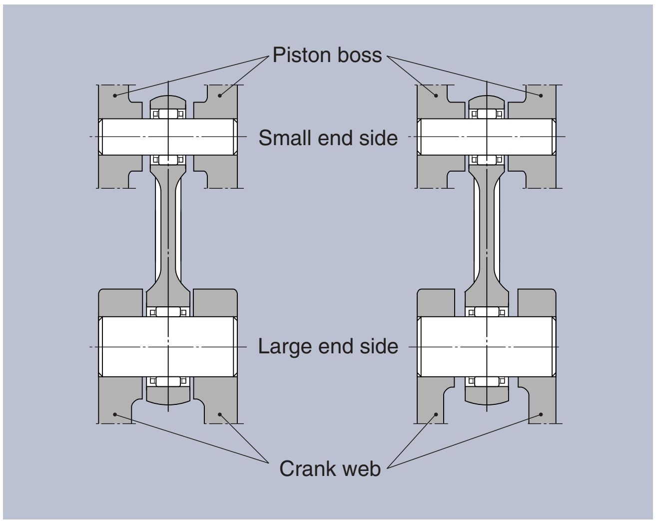


Fig. 2. Regulation at large end side Fig. 3 Regulation at small end side

Regulation at large end side

This method regulates axial motion of a connecting rod by forming a sliding surface between the large end of the connecting rod and the side face of crank web. For the use of this method, however, the connecting rod must be provided, on its bore surface, with oil hole, slot and oil groove to feed lubrication oil in and onto the bearing and guide surface at large end side.

The crank web end face shall be surface-hardened as necessary or otherwise a side washer of copper alloy or hardened steel shall be fitted on the guide surface.

On the other hand, the needle roller and cage assembly at small end side shall be guided in axial direction by the side face of piston boss. A great play shall be secured between the piston boss and the connecting rod.

Regulation at small end side

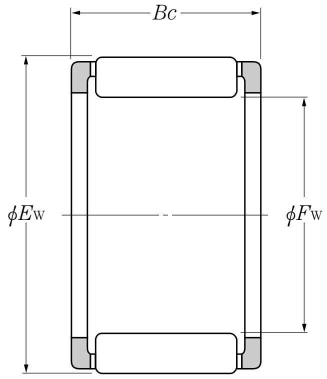
This method regulates axial motion at the small end face of a connecting rod and the side face of a piston rod. Generally a connecting rod is not provided with oil groove and slot to lubricate the guide surface at small end side, but on occasion it is surface-hardened and uses a side washer.

Usually a connecting rod shall be provided with a through-hole (at its small end side) to lubricate the bearing unit.

On the other hand, at the large end side a free clearance exists between the connecting rod and the crank web and, therefore, generally special measures such as oil groove to lubricate, etc.

For crank-pin

Type PK



F_w 10～28mm

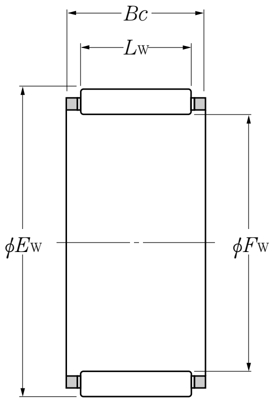
Boundary dimensions mm F_w	E_w	B_c 0 −0.2	Basic load ratings dynamic N C_r	static N C_{or}	dynamic kgf C_r	static kgf C_{or}	Bearing numbers	Mass kg (approx.)
10	14	9.8	5 050	4 900	515	500	**PK10×14×9.8X14**	0.0037
12	16	10	5 450	5 600	555	570	**PK12×16×10.2**	0.0044
	17	9.8	6 800	6 550	695	670	**PK12×17×9.8X15**	0.0053
14	19	9.7	7 300	7 400	745	755	**PK14×19× 9.7X1**	0.0065
	19	11.8	8 200	8 600	840	880	**PK14×19×11.8X1**	0.0070
	20	11.8	19 100	10 000	1 030	1020	**PK14×20×11.8X3**	0.0091
15	20	9.8	7 250	7 450	740	760	**PK15×20× 9.8X**	0.0067
	21	11.8	10 000	10 200	1 020	1 040	**PK15×21×11.8X8**	0.0095
16	22	11.8	10 000	10 300	1 020	1 050	**PK16×22×11.8X2**	0.0097
	22	13.2	10 900	11 500	1 110	1 170	**PK16×22×13.2X**	0.0110
18	24	11.8	11 300	12 400	1 150	1 260	**PK18×24×11.8X3**	0.0110
	24	13.3	13 300	15 300	1 360	1 560	**PK18×24×13.3X1**	0.0120
19	24	13.9	11 900	15 200	1 220	1 550	**PK19×24×13.9X**	0.0110
	25	15.8	14 300	17 000	1 460	1 730	**PK19×25×15.8X1**	0.0150
20	26	13.8	14 000	16 700	1 420	1 700	**PK20×26×13.8X6**	0.0140
22	28	15.8	15 900	20 200	1 620	2 060	**PK22×28×15.8X1**	0.0170
	29	17.8	18 800	22 800	1 920	2 320	**PK22×29×17.8X7**	0.0240
	30	14.7	16 900	18 200	1 720	1 860	**PK22×30×14.7X2**	0.0240
	30	17.8	21 900	25 400	2 230	2 590	**PK22×30×17.8X2**	0.0270
24	31	16.8	20 800	26 600	2 120	2 710	**PK24×31×16.8X7**	0.0240
	32	19.8	22 900	27 500	2 340	2 810	**PK24×32×19.8X6**	0.0330
26	31	13.8	14 200	20 900	1 450	2 130	**PK26×31×13.8X31**	0.0139
	32	13.8	16 400	22 200	1 670	2260	**PK26×32×13.8X**	0.0180
	34	16.8	21 600	26 100	2 200	2 660	**PK26×34×16.8X7**	0.0320
27	36	20.8	30 500	38 500	3 150	3 950	**PK27×36×20.8X1**	0.0440
28	35	14	18 400	23 700	1 880	2 420	**PK28×35×13.8X1**	0.0226
	36	14	20 600	25 100	2 100	2 560	**PK28×36×13.8X4**	0.0250

F_w 28～38mm

Boundary dimensions mm			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Bearing numbers	Mass kg
F_w	E_w	B_c $^{0}_{-0.2}$	C_r	C_{or}	C_r	C_{or}		(approx.)
28	36	15.8	23 700	30 000	2 410	3 050	**PK28×36×15.8X6**	0.0310
	37	20.8	32 500	41 500	3 300	4 250	**PK28×37×20.8X**	0.0480
29	39	21.4	32 500	39 500	3 300	4 000	**PK29×39×21.4X2**	0.0550
30	37	15.9	21 900	30 500	2 230	3 100	**PK30×37×15.9X**	0.0280
	38	13.8	21 400	26 900	2 180	2 750	**PK30×38×13.8X1**	0.0294
	38	15.8	24 600	32 000	2 510	3 300	**PK30×38×15.8X**	0.0320
	38	17.8	27 700	37 500	2 820	3 800	**PK30×38×17.8X1**	0.037
31	41	21.4	34 000	43 000	3 500	4 350	**PK31×41×21.4X**	0.057
32	43	22.4	40 000	49 500	4 100	5 050	**PK32×43×22.4X**	0.069
34	42	19.8	31 500	45 500	3 200	4 650	**PK34×42×19.8X**	0.046
38	47	19.8	35 500	51 000	3 600	5 200	**PK38×47×19.8X1**	0.056

For piston-pin

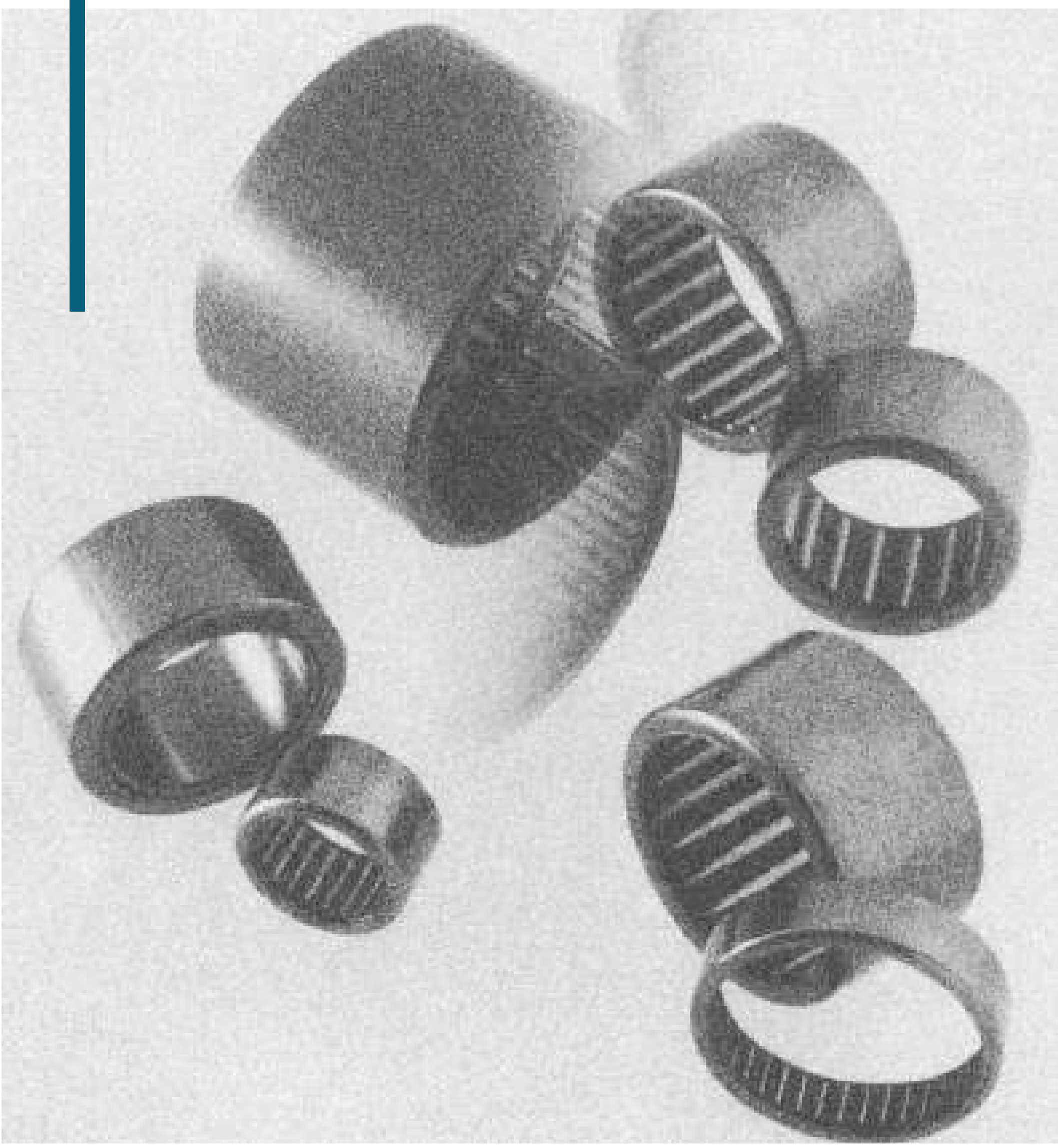
Type KBK



F_w 7～22mm

Boundary dimensions				Basic load ratings				Bearing numbers	Mass
				dynamic	static	dynamic	static		
mm				N		kgf			kg
F_w	E_w	B_c $^{0}_{-0.2}$	L_w	C_r	C_{or}	C_r	C_{or}		(approx.)
7	10	9.8	6.8	3 050	2 780	310	284	**KBK 7×10× 9.8X**	0.0022
8	11	11.8	8.8	4 100	4 200	415	430	**KBK 8×11×11.8X1**	0.0028
9	12	11.5	8.8	4 400	4 750	450	485	**KBK9×12×11.7V2**	0.0030
	14	9.8	6.8	4 500	4 200	460	430	**KBK10×14× 9.8X**	0.0042
10	14	12.5	9.8	6 100	6 200	620	635	**KBK10×14×12.5X1**	0.0053
	14	14.8	9.8	6 100	6 200	620	635	**KBK10×14×14.8X**	0.0064
	14	13.5	10.8	5 850	7 250	595	740	**KBK11×14×13.5X1**	0.0044
11	15	12.3	9.8	7 050	7 700	720	785	**KBK11×15×12.3X5**	0.0049
	15	15.8	11.8	7 050	7 650	720	780	**KBK11×15×15.8X2**	0.0069
	15	16.4	13.8	7 500	10200	765	1040	**KBK12×15×16.6V1**	0.0056
	16	14.8	11.8	7 600	8 600	775	875	**KBK12×16×14.8X1**	0.0062
12	16	15.4	9.8	7 000	7 800	715	795	**KBK12×16×15.6**	0.0079
	16	15.8	12.8	8 100	9 350	825	955	**KBK12×16×16**	0.0073
	17	14.8	9.8	8 400	8 550	855	875	**KBK12×17×14.8X**	0.0094
	18	16.8	13.8	9 750	12 400	995	1 260	**KBK14×18×17**	0.0089
14	18	19.8	13.8	9 150	11 300	930	1 160	**KBK14×18×20**	0.0130
	19	17.1	12.8	11 100	12 700	1 130	1 300	**KBK14×19×17.1X**	0.0120
15	19	17.3	13.8	10 900	14 600	1 110	1 490	**KBK15×19×17.3X**	0.0100
	20	16.8	13.8	10 800	14 700	1 100	1 500	**KBK16×20×17**	0.0100
16	20	19.6	13.8	10 200	13 600	1 040	1 390	**KBK16×20×19.8**	0.0130
	20	23.8	19.8	13 600	19 700	1 390	2 010	**KBK16×20×23.8X**	0.0150
	21	19.6	15.8	13 900	17 600	1 420	1 790	**KBK16×21×19.6X**	0.0160
	21	23	15.8	13 200	19 400	1 340	1 980	**KBK17×21×23.2**	0.0160
17	21	25	17.8	13 100	19 200	1 340	1 960	**KBK17×21×25X**	0.0170
	22	22	18.8	16 900	22 900	1 720	2 340	**KBK17×22×22X1**	0.0170
18	22	21.8	15.8	12 500	18 300	1 270	1 870	**KBK18×22×21.8X3**	0.0150
	22	23.8	17.8	13 000	19 300	1 330	1 970	**KBK18×22×23.8X1**	0.0160
20	25	27.9	21.8	20 800	31 500	2 120	3 200	**KBK20×25×27.9X**	0.0270
22	28	29.9	23.8	26 000	38 000	2 650	3 900	**KBK22×28×29.9X4**	0.038

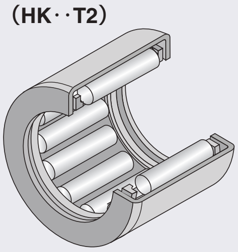
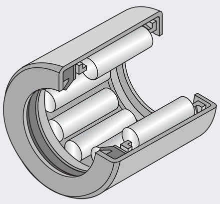
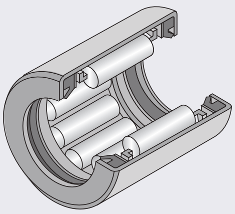
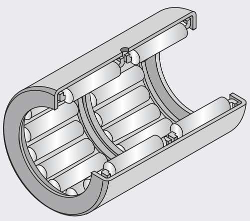
Drawn Cup Needle Roller Bearings



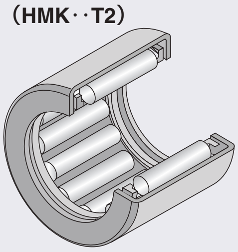
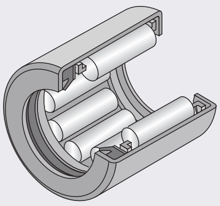
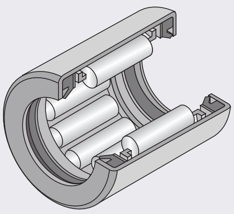
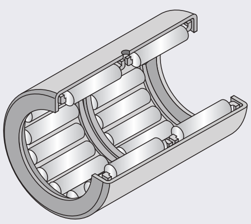
Drawn Cup Needle Roller Bearings

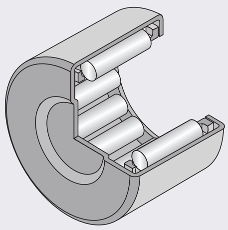
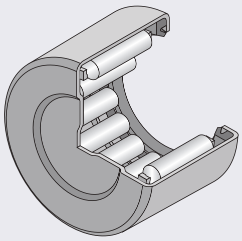
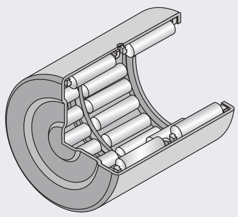
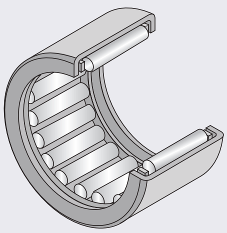
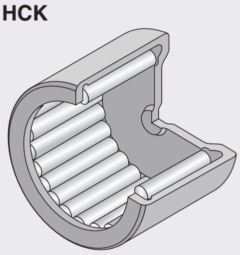
This bearing type is composed of an outer ring drawn from a thin steel plate by precision drawing, needle rollers and a cage assembled in the outer ring after the raceway surface thereof was hardened (A bearing marked with a suffix including “M” is subjected to heat-treatment after assembly.). Of the bearings with outer ring, this bearing type is a bearing with the smallest section height which enables space-saving and cost-saving.

Usually design is so made as to use a shaft as th direct raceway surface without using inner ring. The outer ring of this bearing type is of such a constructi that the needle rollers and the cage are not separated from one another, so that the bearing is only press-fitt in a rigid housing with proper fit torque. Thus, this bearing type needs no snap ring, etc. to fix itself in direction and, in addition, is easy to handle.

Type of bearing			Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks
HK (HK··T2) 	Standard series	Open end	φ3 – φ50	HK 06 09 T2 T2: Suffix 09: Width 06: Roller set bore diameter HK: Type code [Suffix] T2 : Resin cage C : Welding cage	HK0609T2	Roller set bore diameter : φ6 Width : 9 T2 : Resin cage	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less. A bearing marked with a suffix including “F” is a Premium Shell bearing. For detailed information about Premium Shell bearings, refer to **NTN** CAT. NO. 3029 (Premium Shell Bearings). A bearing marked with a suffix including “M” is a drawn cup bearing that is heat-treated after assembly (“pre-bent” specification).
HK··L 	Standard series	Open end single side seal	φ12 – φ50	HK 20 18 L / 3AS 3AS: Suffix L: Suffix 18: Width 20: Roller set bore diameter HK: Type code	HK2018L/3AS	Roller set bore diameter : φ20 Width : 18 L : single side seal 3AS : grease	This seal type (Tail code : L or LL) synthetic rubber seal built in at its single side or double sides is internally filled with lithium soap base grease. To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C. The roller length and rated load of this bearing type are shorter and smaller than those of the open type of same dimension.
HK··LL 	Standard series	Open end double-side seal	φ12 – φ50	HK 20 20 LL / 3AS 3AS: Suffix LL: Suffix 20: Width 20: Roller set bore diameter HK: Type code	HK2020LL/3AS	Roller set bore diameter : φ20 Width : 20 LL: Double-side seal 3AS : grease	
HK··ZWD 	Standard series	Open end double-row type	φ15 – φ30	HK 20 30 ZW D D: Suffix ZW: Suffix 30: Width 20: Roller set bore diameter HK: Type code	HK2030ZWD	Roller set bore diameter : φ20 Width : 30 ZW : Double-row cage D : Outer ring with oil hole	This type is provided with oil hole on its outer ring.

The lower limit of safety factor S_0 for NTN drawn cup needle roller bearings shall be 3. The lower limit for NTN Premium Shell bearings shall be 2.

Type of bearing			Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks
HMK **(HMK··T2)** 	Heavy load series	Open end	φ8 – φ50	**HMK 20 15** Width Roller set bore diameter Type code	HMK2015	Roller set bore diameter : φ20 Width : 15	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less.
HMK··L 		Open end single side seal	φ8 – φ50	**HMK 20 18 L / 3AS** Suffix Suffix Width Roller set bore diameter Type code	HMK2018L/3AS	Roller set bore diameter : φ20 Width : 18 L : single side seal 3AS : Grease	This seal type (Tail code : L or LL) synthetic rubber seal built in at its single side or double sides is internally filled with lithium soap base grease. To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C. The roller length and rated load of this bearing type are shorter and smaller than those of the open type of same dimension.
HMK··LL 		Open end double-side seal	φ8 – φ50	**HMK 20 20 LL / 3AS** Suffix Suffix Width Roller set bore diameter Type code	HMK2020LL/3AS	Roller set bore diameter : φ20 Width : 20 LL: Double-side seal 3AS : Grease	
HMK··ZWD 		Open end double-row type	φ38 – φ50	**HMK 38 45 ZW D** Suffix Suffix Width Roller set bore diameter Type code	HK3845ZWD	Roller set bore diameter : φ38 Width : 45 ZW : Double-row cage D : Outer ring with oil hole	This type is provided with oil hole on its outer ring.

Type of bearing			Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks
BK (**BK··T2**) 	Standard series	Closed end	ϕ3 – ϕ50	**BK 20 20 C** Suffix Width Roller set bore diameter Type code	BK2020C	Roller set bore diameter : ϕ20 Width : 20 C : Welding cage	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less.
BK··L 	Standard series	Closed end single side seal	ϕ12 – ϕ50	**BK 20 18 L / 3AS** Suffix Suffix Width Roller set bore diameter Type code	BK2018L/3AS	Roller set bore diameter : ϕ20 Width : 18 L : single side seal 3AS : greas code	This seal type (Tail code: L) is internally filled up with lithium soap base grease. To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C.
BK··ZWD 	Standard series	Closed end double-row type	ϕ15 – ϕ30	**BK 20 30 ZW D** Suffix Suffix Width Roller set bore diameter Type code	BK2030ZWD	Roller set bore diameter : ϕ20 Width : 30 ZW : Double-row cage D : Outer ring with oil hole	Inscribed circle diameter
DCL 	Inch series	Open end	ϕ6.35 – ϕ50.8	**DCL 16 20** Width code Roller set bore diameter code Type code	DCL1620	Roller set bore diameter : ϕ25.4 Width : 31.75	
HCK 	Bearing series for universal joints	Closed end	ϕ10 – ϕ20	**HCK 16 22 Vn** Suffix Outer diameter Roller set bore diameter Type code	HCK1622Vn	Roller set bore diameter : ϕ16 Width : ϕ22 Vn : Special specification	Full complement roller type with no cage. Already filled up with specific grease.

Bearing Fits

It is common that drawn cup needle bearing is press-fitted in a housing by shrinkage fit so post press-fit inscribed circle diameter (F_w) comes to ISO Tolerance Rang Class F8. The post press-fit inscribed circle diameter (F_w) depends on the housing material and rigidity. It is therefore desirable to decide the interference based on the data measured in pre-testing.

Where the housing rigidity is adequately high, the post press-fit inscribed circle diameter (F_w) is secured in nearly F8 range and nearly ordinary radial clearance can be got by adopting the data of bearing fit in housing and on shaft as shown in **Table-1**.

Table 1 Bearing fit in housing and on shaft (recommended)

Bearing type	Housing		Shaft	
	Iron series	Light alloy	Without inner ring	With inner ring
HK,BK	N6 (N7)	R6 (R7)	h5 (h6)	k5 (j6)
HMK,DCL	J6 (J7)	M6 (M7)		
HCK	F7	—	k6	—

Accuracy of housing and shaft

Since the outer ring of drawn cup needle roller bearing is thin-walled, the bearing performance is significantly affected by the dimensional accuracy, profile accuracy and bore surface roughness of the housing into which the bearing is press-fitted. Therefore, the housing bore should satisfy the accuracy levels summarized in **Table 2**. For accuracy of a shaft that uses an inner ring, refer to **Table 8.3** in Sec. **8.3 "Accuracy of shaft and housing"** (page A-40); for accuracy of a shaft that is directly used as a raceway surface, refer to **Table 8.4** in Sec. **8.4 "Accuracy of raceway surface"** (page A-40).

Table 2 Accuracy of housing bore (recommended)

Property	Tolerance
Roundness (Max)	IT4 or less
Cylindricity (Max)	IT4 or less
Surface roughness (Max)	1.6a

Oil hole dimension in outer ring

The outer rings of double-row (Tail code : ZW) needle roller and cage assembly Type HK and Type BK are provided with an oil hole to facilitate oil lubrication to the bearing. **Table 3** shows the nominal oil hole diameter.

Table 3 Diameter of oil hole in outer ring (Metric system)

Unit : mm

Outer ring diameter over	Outer ring diameter incl.	Nominal oil hole diameter
5	10	1.5
10	20	2.0
20	40	2.5
40	80	3.0
80	200	3.5

Bearing installation

When installing a drawn cup needle roller bearing to a housing, place the jig on the marking side of the bearing, and then press-fit the bearing into the correct location in the housing bore. (A "pre-bent" bearing marked with a suffix including "M" has no directivity for installation.) **Further, hammering directly the bearing ring in installing (press-fitting) is not allowed absolutely.** In installing, it is recommended to use a mandrel with O-ring as illustrated in **Fig. 1** as a press-fitting jig. The use of this mandrel would enable to insert easily any drawn cup needle bearing in a housing without risk of twisting and fall-down.

Drawn cup needle roller bearing needs no a snap ring and a shoulder for positioning itself in a housing, **but the bearing must be press-fitted so carefully as not to allow its side face to strike the shoulder for preventing it from deforming, where press-fitted in a housing with shoulder.**

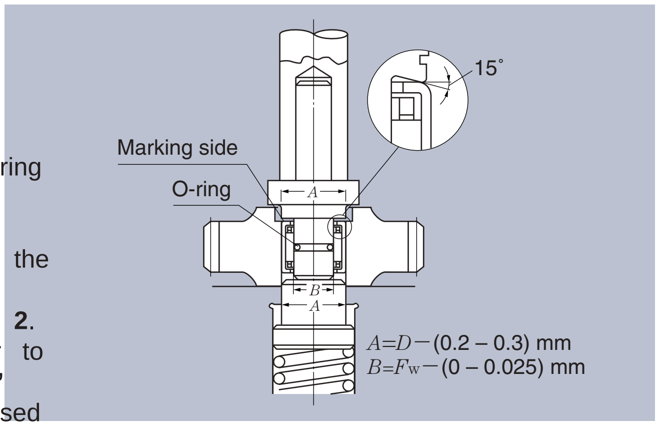


Fig. 1

The Type HCK for application to universal joints is fixed to the joint yoke by caulking, using a special-purposed assembler. Feel free to contact NTN for any inquiry about the special-purposed assembler (IPH Machine).

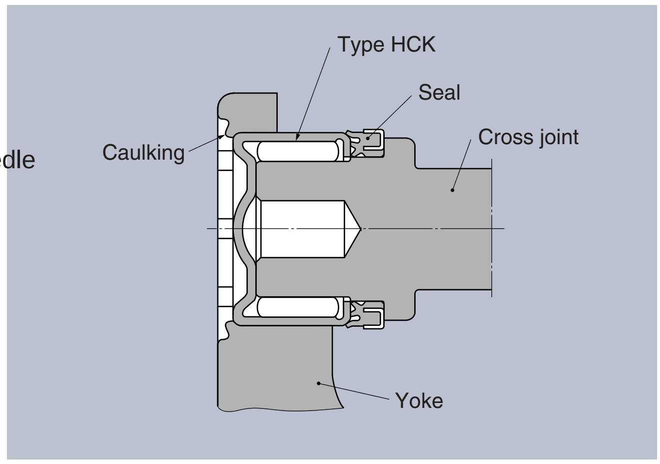


Fig. 2

Bearing Tolerances and Measuring Methods

The outer ring of drawn cup needle roller bearing is so thin-walled that deformation thereof to a certain extent is unavoidable in the manufacturing processes, particularly in the heat-treating process. However, the outer ring is so designed that it is reformed normally from such deformation when being press-fitted in a housing with specific dimensional accuracy and, as a result, it can have the accuracy required to fulfill its specific function.

Hence, **it is meaningless to measure the dimensional accuracy of bearing itself before being press-fitted. So, the following measuring method is used; a bearing to be measured is press-fitted in a linkage of specific dimension (20mm or more in wall thickness) and thereafter the inscribed circle diameter (F_w) is measured using a plug gauge or a taper gauge to evaluate the bearing accuracy.**

Tables 4 to **7** show the dimensional tolerances for the bore diameter of each ring gauge and the roller set b diameter (F_w) each of standard metric series drawn cup needle roller bearings Type HK and BK, heavy load series Type HMK (metric series), inch series Type DCL and inch series HCK for application to universal joints.

When measuring the roller set bore diameter (F_w) of a drawn cup needle roller bearing, the GO side dimensio shall be the lower limit of dimensional tolerance of the roller set bore diameter; and the NOT GO side dimens shall be a sum of the upper limit of dimensional toler of the roller set bore diameter and 2μm.

When measuring the roller set bore diameter of a drawn cup needle roller bearing, do not repeat insertion/removal with the ring gage. Also, do not install a bearing, which has been press-fitted into the ring gage for inspection, to an actual machine product.

Table 4 Dimensional tolerance for inscribed circle diameter (Type HK and BK)

Unit : mm

Nominal inscribed circle dia. F_w	Nominal outer ring outer dia. D	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.010
5	9	8.984	5.022	5.010
6	10	9.984	6.022	6.010
7	11	10.980	7.028	7.013
8	12	11.980	8.028	8.013
9	13	12.980	9.028	9.013
10	14	13.980	10.028	10.013
12	16	15.980	12.034	12.016
12	18	17.980	12.034	12.016
13	19	18.976	13.034	13.016
14	20	19.976	14.034	14.016
15	21	20.976	15.034	15.016
16	22	21.976	16.034	16.016
17	23	22.976	17.034	17.016
18	24	23.976	18.034	18.016
20	26	25.976	20.041	20.020
22	28	27.976	22.041	22.020
25	32	31.972	25.041	25.020
28	35	34.972	28.041	28.020
30	37	36.972	30.041	30.020
35	42	41.972	35.050	35.025
40	47	46.972	40.050	40.025
45	52	51.967	45.050	45.025
50	58	57.967	50.050	50.025

Table 5 Dimensional tolerance for inscribed circle diameter (Type HMK)

Unit : mm

Nominal inscribed circle dia. F_w	Nominal outer ring outer dia. D	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	16.034	16.016
17	24	23.995	17.034	17.016
18	25	24.995	18.034	18.016
19	27	26.995	19.041	19.020
20	27	26.995	20.041	20.020
21	29	28.995	21.041	21.020
22	29	28.995	22.041	22.020
24	31	30.994	24.041	24.020
25	33	32.994	25.041	25.020
26	34	33.994	26.041	26.020
28	37	36.994	28.041	28.020
29	38	37.994	29.041	29.020
30	40	39.994	30.041	30.020
32	42	41.994	32.050	32.025
35	45	44.994	35.050	35.025
37	47	46.994	37.050	37.025
38	48	47.994	38.050	38.025
40	50	49.994	40.050	40.025
45	55	54.994	45.050	45.025
50	62	61.994	50.050	50.025

Table 6 Dimensional tolerance for inscribed circle diameter (Type DCL)

Unit : mm

Nominal inscribed circle dia. F_w	Nominal outer ring outer dia. D	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
6.350	11.112	11.125	6.411	6.388
7.938	12.700	12.713	7.998	7.976
9.525	14.288	14.300	9.586	9.563
11.112	15.875	15.888	11.173	11.151
12.700	17.462	17.475	12.761	12.738
14.288	19.050	19.063	14.348	14.326
15.875	20.638	20.650	15.936	15.913
17.462	22.225	22.238	17.523	17.501
19.050	25.400	25.387	19.086	19.063
20.638	26.988	26.975	20.673	20.650
22.225	28.575	28.562	22.261	22.238
23.812	30.162	30.150	23.848	23.825
25.400	31.750	31.737	25.436	25.413
26.988	33.338	33.325	27.023	27.000
28.575	34.925	34.912	28.611	28.588
30.162	38.100	38.087	30.198	30.175
31.750	38.100	38.087	31.786	31.763
34.925	41.275	41.262	34.963	34.938
38.100	47.625	47.612	38.141	38.113
41.275	50.800	50.787	41.316	41.288
44.450	53.975	53.962	44.493	44.463
47.625	57.150	57.137	47.668	47.638
50.800	60.325	60.312	50.846	50.815

Table 7 Dimensional tolerance for inscribed circle diameter (Type HCK)

Unit : mm

Nominal inscribed circle dia. F_w	Nominal outer ring outer dia. D	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
10	15	15.016	10.026	10.011
11.656	17.1	17.116	11.687	11.669
13	19	19.020	13.031	13.013
14	20	20.020	14.031	14.013
16	22	22.020	16.031	16.013
18	24	24.020	18.031	18.013
18	24.6	24.620	18.031	18.013
20	27.9	27.920	20.038	20.017

Calculation Examples

Shrinkage factor and post-installation clearance of drawn cup needle roller bearing

The recommended fit data for the standard bearings is as described in **Table 1** on page B-35. This paragraph describes hereunder the calculation methods to be used when the bearing fit conditions are reviewed in detail.

1) Calculation of bearing shrinkage factor

For the drawn cup bearings, the shrinkage factor is calculated using the following method.

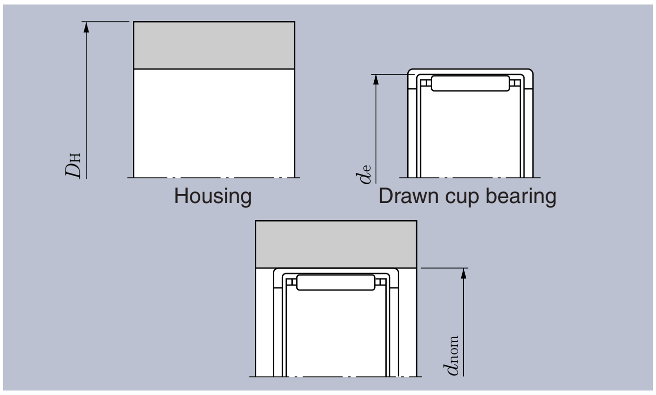


Fig. 3

$$\lambda = \frac{2t}{E_2} \cdot \frac{1-S^2}{\dfrac{(0.7S^2+1.3)(1-t^2)}{E_1} + \dfrac{(0.7+1.3t^2)(1-S^2)}{E_2}} \quad \cdots\cdots \quad \textbf{(1)}$$

Where,

λ : Outer ring shrinkage factor
D_H : Housing outer diameter mm
d_{nom} : Nominal diameter of fitting portion mm
d_e : Rolling surface diameter of outer ring mm
E_1 : Modulus of housing vertical elasticity (Young's modulus) MPa (kgf/mm²)
E_2 : Modulus of outer ring vertical elasticity (Young's modulus) 2.07×10^6MPa (21 200kgf/mm²)

$$S = \frac{d_{nom}}{D_H}$$

$$t = \frac{d_e}{d_{nom}}$$

2) Inscribed circle diameter after complete bearing fit in the housing on actual machine

[1] Inscribed circle diameter in press-fitting of master ring

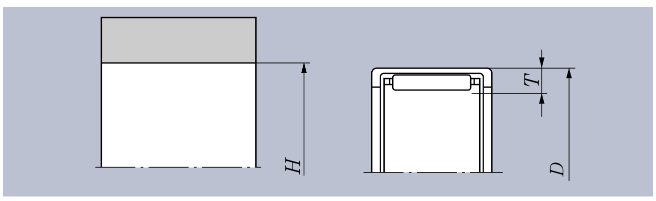


Fig. 4

H : Housing inner diameter mm
T : Roller diameter + plate thickness mm
D : Outer diameter of drawn cup needle roller bearing mm
L_i : Post press-fit inscribed circle diameter mm

When the master ring is press-fitted, the dimension of "roller diameter + plate thickness" remains unchanged. Hence, the inscribed circle diameter L_i is determined by the following **formula**.

$$L_i = D - 2T - \lambda (D - H) = (1-\lambda)D - 2T + \lambda H \cdots\cdots\cdots \textbf{(2)}$$

Determine the mean value of "roller diameter + plate thickness" (2T) and standard deviation from **formula (2)**. The mean value of **formula (2)** is determined as follows.

$$m_{Li} = (1-\lambda)\, m_D - m_{2T} + \lambda\, m_H \cdots\cdots\cdots\cdots\cdots\cdots \textbf{(3)}$$

Standard deviation of formula **(2)**

$$\sigma_{Li}{}^2 = (1-\lambda)^2 \cdot \sigma_D{}^2 + \sigma_{2T}{}^2 + \lambda^2 \sigma_H{}^2 \cdots\cdots\cdots\cdots \textbf{(4)}$$

In the case of master ring, $\sigma_H = 0$ due to the **formula (4)** is expressed as follows.

$$\sigma_{Li}{}^2 = (1-\lambda)^2 \cdot \sigma_D{}^2 + \sigma_{2T}{}^2 \cdots\cdots\cdots\cdots\cdots\cdots\cdots \textbf{(5)}$$

The unknown values in **formulas (3)**, **(5)** are only m_{2T} and $\sigma_{2T}{}^2$. Hence, substitute the known numerical values for **formulas (3) (5)** to determine m_{2T} and $\sigma_{2T}{}^2$.

[2] Even when bearing ring is press-fitted in the housing on actual machine, consider the inscribed circle diameter similarly to the master ring press-fit. Herein, the calculation formulas for press-fit in the housing on actual machine can be discriminated as follows from **formula (3)**, **(4)** by adding " ' " to each formula.

$$m_{Li}' = (1-\lambda')\, m_D - m_{2T} + \lambda'\, m_H' \cdots\cdots\cdots\cdots\cdots \textbf{(6)}$$

$$\sigma_{Li}'^2 = (1-\lambda')^2 \cdot \sigma_D{}^2 + \sigma_{2T}{}^2 + \lambda'^2 \sigma_H'^2 \cdots\cdots\cdots \textbf{(7)}$$

[3] For m_{2T} and $\sigma_{2T}{}^2$ in **formula (6)**, **(7)**, substitute the values determined previously for the respective formula.

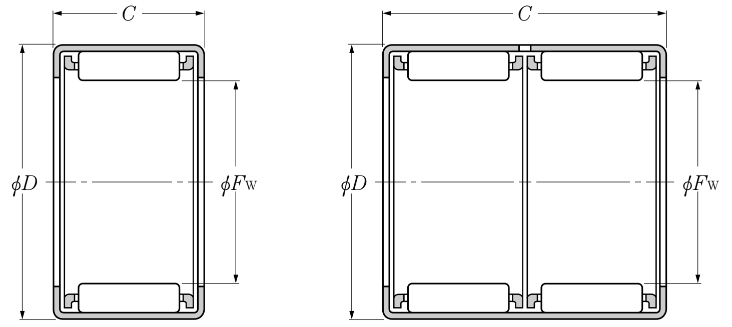
[4] From the calculations, the inscribed circle diameter in press-fitting in the housing on actual machine can be expressed in the following **formula**

$$L_i' = m_{Li}' \pm 3\sigma_{Li}' \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \textbf{(8)}$$

[5] Radial internal clearance can be determined considering the mean value and standard deviation of shaft in **formulas (6)**, **(7)**.

[6] The aiming radial internal clearance value is generally set up so an ordinary clearance can be got. However, the recommended clearance values are available every the individual portions in the case of bearing application to automobile. Feel free to contact **NTN** for the detail.

Type HK, Type HK··ZWD
Type HMK
Type BK, Type BK··ZWD



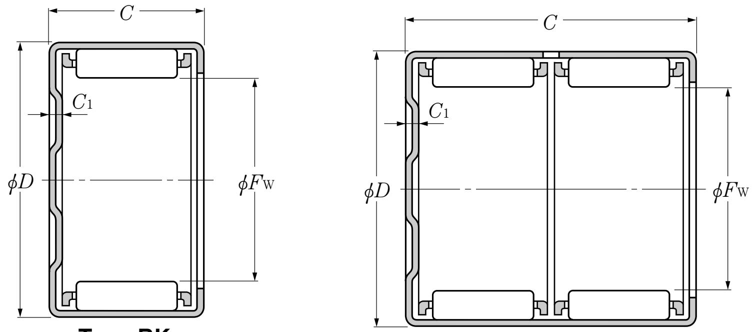
Type HK, Type HMK   Type HK··ZWD

Opened End Type

F_w 3～10mm

Boundary dimensions (mm) F_w	D	C ($^{0}_{-0.2}$)	C_1 max	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers open end design	closed end design	Mass kg (approx.)	Appropriate[1] inner ring (as a reference)
3	6.5	6	—	925	565	94	58	33 000	50 000	**HK0306FT2**	—	0.0006	—
	6.5	6	0.8	925	565	94	58	33 000	50 000	—	**BK0306T2**	0.0007	—
4	8	8	—	1 770	1 270	180	129	30 000	45 000	**HK0408FT2**	—	0.0016	—
	8	8	1.6	1 770	1 270	180	129	30 000	45 000	—	**BK0408T2**	0.0018	—
5	9	9	—	2 450	1 990	349	203	27 000	40 000	**HK0509FM**	—	0.0019	—
	9	9	1.6	2 640	2 190	269	224	27 000	40 000	—	**BK0509T2**	0.0021	—
6	10	9	—	2 920	2 590	298	264	25 000	37 000	**HK0609FM**	—	0.0022	—
	10	9	1.6	2 660	2 280	272	233	25 000	37 000	—	**BK0609T2**	0.0024	—
7	11	9	—	3 150	2 930	320	299	23 000	34 000	**HK0709FM**	—	0.0025	—
	11	9	1.6	3 150	2 930	320	299	23 000	34 000	—	**BK0709CT**	0.0027	—
8	12	10	—	3 850	3 950	395	400	20 000	30 000	**HK0810FM**	—	0.0032	IR 5×8×12
	12	10	1.6	3 850	3 950	395	400	20 000	30 000	—	**BK0810CT**	0.0034	IR 5×8×12
	15	10	—	4 200	3 300	430	335	20 000	30 000	**HMK0810C**	—	0.0067	IR 5×8×12
	15	15	—	6 600	5 800	675	590	20 000	30 000	**HMK0815**	—	0.0100	IR 5×8×16
	15	20	—	9 050	8 750	925	890	20 000	30 000	**HMK0820T2**	—	0.0130	—
9	13	10	—	4 300	4 650	440	475	18 000	27 000	**HK0910FM**	—	0.0035	IR 6×9×12
	13	10	1.6	4 750	5 300	485	540	18 000	27 000	—	**BK0910**	0.0039	IR 6×9×12
	13	12	—	5 400	6 250	550	640	18 000	27 000	**HK0912F**	—	0.0042	IR 6×9×12
	13	12	1.6	5 650	6 650	575	680	18 000	27 000	—	**BK0912**	0.0045	IR 6×9×12
	16	12	—	5 300	4 450	540	455	18 000	27 000	**HMK0912**	—	0.0087	IR 6×9×16
	16	16	—	7 400	6 850	755	700	18 000	27 000	**HMK0916**	—	0.0120	—
10	14	10	—	4 500	5 100	460	520	16 000	24 000	**HK1010FM**	—	0.0038	IR 7×10×10.5
	14	10	1.6	4 500	5 100	460	520	16 000	24 000	—	**BK1010**	0.0042	IR 7×10×10.5
	14	12	—	5 650	6 800	575	695	16 000	24 000	**HK1012F**	—	0.0045	IR 7×10×16
	14	12	1.6	5 900	7 250	605	735	16 000	24 000	—	**BK1012**	0.0050	IR 7×10×16
	14	15	—	7 250	9 400	740	955	16 000	24 000	**HK1015F**	—	0.0056	IR 7×10×16
	14	15	1.6	7 100	9 150	725	935	16 000	24 000	—	**BK1015**	0.0062	IR 7×10×16
	17	10	—	4 250	3 450	435	350	16 000	24 000	**HMK1010**	—	0.0079	IR 7×10×10.5
	17	12	—	5 600	4 850	570	495	16 000	24 000	**HMK1012**	—	0.0094	IR 7×10×16

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129.)
EX. HK1012 + IR7×10×16



Type BK Type BK··ZWD

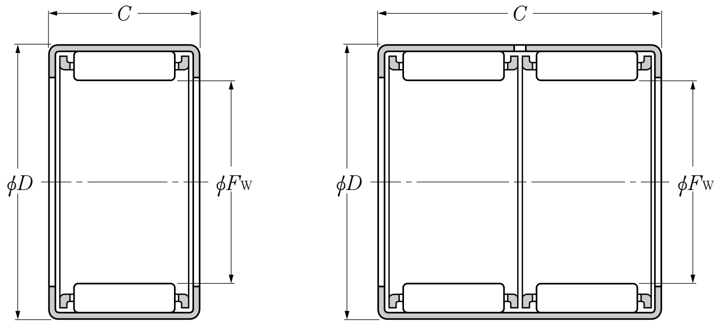
Closed End Type

F_w 10～16mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers		Mass kg	Appropriate[1)] inner ring
F_w	D	C ($^{0}_{-0.2}$)	C_1 max	C_r	C_{or}	C_r	C_{or}	grease	oil	open end design	closed end design	(approx.)	(as a reference)
10	17	15	—	7 400	6 950	755	710	16 000	24 000	HMK1015	—	0.0120	IR7×10×16
	17	20	—	10 200	10 500	1 040	1 070	16 000	24 000	HMK1020	—	0.0160	—
12	16	10	—	5 050	6 250	515	635	13 000	20 000	HK1210FM	—	0.0046	IR8×12×10.5
	16	10	1.6	5 050	6 250	515	635	13 000	20 000	—	BK1210	0.0052	IR8×12×10.5
	18	12	—	6 600	7 300	675	745	13 000	20 000	HK1212FM	—	0.0091	IR8×12×12.5
	18	12	2.7	6 600	7 300	675	745	13 000	20 000	—	BK1212	0.0100	IR8×12×12.5
	19	12	—	7 100	6 900	725	705	13 000	20 000	HMK1212	—	0.0110	IR8×12×12.5
	19	15	—	9 400	9 900	955	1 010	13 000	20 000	HMK1215	—	0.0140	IR9×12×16
	19	20	—	12 300	14 000	1 260	1 430	13 000	20 000	HMK1220	—	0.0180	—
	19	25	—	15 300	18 600	1 560	1 890	13 000	20 000	HMK1225	—	0.0230	—
13	19	12	—	6 950	7 900	705	805	12 000	18 000	HK1312FM	—	0.0100	IR10×13×12.5
	19	12	2.7	6 950	7 900	705	805	12 000	18 000	—	BK1312	0.0110	IR10×13×12.5
14	20	12	—	7 200	8 500	735	865	11 000	17 000	HK1412FM	—	0.0110	IR10×14×13
	20	12	2.7	7 200	8 500	735	865	11 000	17 000	—	BK1412	0.0120	IR10×14×13
	20	16	—	10 300	13 400	1 050	1 370	11 000	17 000	HK1416F	—	0.0150	—
	20	16	2.7	10 700	14 000	1 090	1 430	11 000	17 000	—	BK1416	0.0160	—
	22	16	—	11 500	12 000	1 180	1 220	11 000	17 000	HMK1416C	—	0.0190	IR10×14×20
	22	20	—	14 600	16 200	1 490	1 650	11 000	17 000	HMK1420C	—	0.0240	—
15	21	12	—	7 500	9 100	765	930	11 000	16 000	HK1512FM	—	0.0110	IR12×15×12.5
	21	12	2.7	7 500	9 100	765	930	11 000	16 000	—	BK1512	0.0130	IR12×15×12.5
	21	16	—	10 700	14 400	1 090	1 470	11 000	16 000	HK1516F	—	0.0150	IR12×15×16.5
	21	16	2.7	10 700	14 400	1 090	1 470	11 000	16 000	—	BK1516	0.0170	IR12×15×16.5
	21	22	—	12 900	18 200	1 310	1 860	11 000	16 000	HK1522ZWFD	—	0.0200	IR12×15×22.5
	21	22	2.7	12 900	18 200	1 310	1 860	11 000	16 000	—	BK1522ZWD	0.0220	IR12×15×22.5
	22	10	—	6 100	6 000	620	610	11 000	16 000	HMK1510	—	0.0110	IR10×15×12.5
	22	12	—	7 950	8 450	810	860	11 000	16 000	HMK1512	—	0.0130	IR12×15×12.5
	22	15	—	10 500	12 100	1 070	1 240	11 000	16 000	HMK1515C	—	0.0160	IR12×15×16
	22	20	—	14 900	18 900	1 510	1 920	11 000	16 000	HMK1520	—	0.0220	IR12×15×22.5
	22	25	—	18 500	25 000	1 880	2 550	11 000	16 000	HMK1525	—	0.0270	—
16	22	12	—	7 750	9 700	795	990	10 000	15 000	HK1612FM	—	0.0120	IR12×16×13

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129, B130.)
EX. HK1312FM + IR10×13×12.5

Type HK, Type HK··ZWD
Type HMK
Type BK, Type BK··ZWD



Type HK, Type HMK

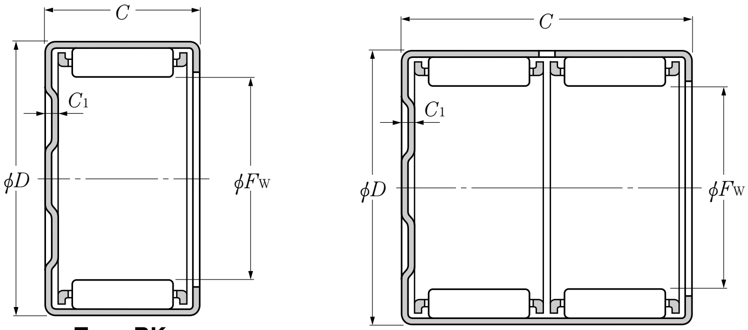
Type HK··ZWD

Opened End Type

F_W 16～20mm

Boundary dimensions (mm) F_W	D	C $^{0}_{-0.2}$	C_1 max	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds min⁻¹ grease	oil	Bearing numbers open end design	closed end design	Mass kg (approx.)	Appropriate[1)] inner ring (as a reference)
16	22	12	2.7	7 750	9 700	795	990	10 000	15 000	—	BK1612	0.014	IR12×16×13
	22	16	—	11 100	15 300	1 130	1 560	10 000	15 000	HK1616F	—	0.016	IR12×16×20
	22	16	2.7	11 100	15 300	1 130	1 560	10 000	15 000	—	BK1616	0.018	IR12×16×20
	22	22	—	13 300	19 400	1 360	1 980	10 000	15 000	HK1622ZWFD	—	0.022	—
	22	22	2.7	13 300	19 400	1 360	1 980	10 000	15 000	—	BK1622ZWD	0.023	—
	24	16	—	12 400	13 500	1 260	1 370	10 000	15 000	HMK1616	—	0.021	IR12×16×20
	24	20	—	15 600	18 200	1 590	1 860	10 000	15 000	HMK1620CT	—	0.027	IR12×16×22
17	23	12	—	8 050	10 300	820	1 050	9 500	14 000	HK1712FM	—	0.012	—
	23	12	2.7	8 500	11 100	865	1 130	9 500	14 000	—	BK1712	0.015	—
	24	15	—	12 100	15 000	1 230	1 530	9 500	14 000	HMK1715	—	0.018	IR14×17×17
	24	20	—	15 200	20 000	1 540	2 040	9 500	14 000	HMK1720CT	—	0.024	IR12×17×20.5
	24	25	—	19 3000	26 700	1 930	2 720	9 500	14 000	7E-HMK1725CT	—	0.030	IR12×17×25.5
18	24	12	—	8 300	10 900	845	1 110	8 500	13 000	HK1812FM	—	0.013	IR15×18×12.5
	24	12	2.7	8 300	10 900	845	1 110	8 500	13 000	—	BK1812	0.015	IR15×18×12.5
	24	16	—	11 800	17 300	1 210	1 760	8 500	13 000	HK1816F	—	0.018	IR15×18×16.5
	24	16	2.7	11 800	17 300	1 210	1 760	8 500	13 000	—	BK1816	0.020	IR15×18×16.5
	25	13	—	10 200	12 200	1 040	1 240	8 500	13 000	HMK1813	—	0.016	IR15×18×16
	25	15	—	12 000	15 100	1 220	1 540	8 500	13 000	HMK1815	—	0.019	IR15×18×16
	25	17	—	13 300	17 200	1 360	1 760	8 500	13 000	HMK1817C	—	0.021	IR15×18×17.5
	25	19	—	15 500	20 900	1 580	2 130	8 500	13 000	HMK1819	—	0.024	IR15×18×20.5
	25	20	—	16 300	22 300	1 660	2 280	8 500	13 000	HMK1820	—	0.025	IR15×18×20.5
	25	25	—	20 300	29 600	2 070	3 000	8 500	13 000	HMK1825	—	0.031	IR15×18×25.5
19	27	16	—	13 900	16 300	1 410	1 660	8 500	13 000	HMK1916	—	0.025	IR15×19×20
	27	20	—	17 500	22 100	1 790	2 250	8 500	13 000	HMK1920	—	0.031	—
20	26	12	—	8 750	12 100	895	1240	8 000	12 000	HK2012FM	—	0.014	IR15×20×13
	26	12	2.7	9 250	13 000	945	1330	8 000	12 000	—	BK2012	0.017	IR15×20×13
	26	16	—	12 500	19 200	1 280	1 960	8 000	12 000	HK2016F	—	0.019	IR17×20×16.5
	26	16	2.7	13 000	20 100	1 320	2 050	8 000	12 000	—	BK2016	0.022	IR17×20×16.5
	26	20	—	16 000	26 200	1 630	2 670	8 000	12 000	HK2020F	—	0.024	IR17×20×20.5
	26	20	2.7	16 400	27 100	1 670	2 760	8 000	12 000	—	BK2020	0.027	IR17×20×20.5

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-130, B131.)
EX. HK1812FM + IR15×18×12.5



Type BK   Type BK··ZWD

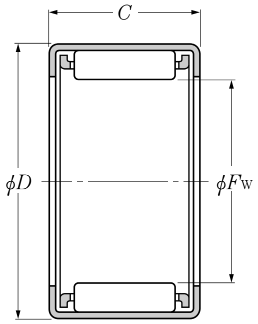
Closed End Type

F_w 20～25mm

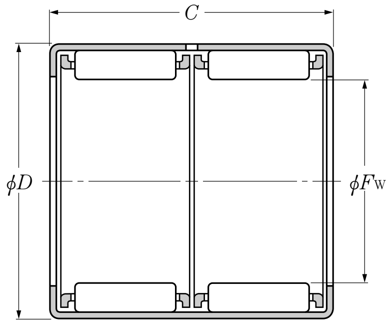
Boundary dimensions (mm) F_w	D	C $^{0}_{-0.2}$	C_1 max	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers open end design	closed end design	Mass kg (approx.)	Appropriate[1] inner ring (as a reference)
20	26	30	—	21 500	38 500	2 190	3 900	8 000	12 000	HK2030ZWFD	—	0.035	IR17×20×30.5
	26	30	2.7	22 200	40 000	2 270	4 100	8 000	12 000	—	BK2030ZWD	0.037	IR17×20×30.5
	27	15	—	13 000	17 300	1 330	1 760	8 000	12 000	HMK2015	—	0.021	IR17×20×16.5
	27	20	—	17 700	25 600	1 800	2 610	8 000	12 000	HMK2020	—	0.027	IR17×20×20.5
	27	25	—	22 000	34 000	2 240	3 450	8 000	12 000	HMK2025	—	0.034	IR15×20×26
	27	30	—	26 100	42 000	2 660	4 300	8 000	12 000	HMK2030	—	0.041	IR17×20×30.5
21	29	16	—	15 300	19 100	1 560	1 940	7 500	11 000	HMK2116	—	0.027	IR17×21×20
	29	20	—	19 400	25 800	1 970	2 630	7 500	11 000	HMK2120	—	0.033	—
22	28	12	—	9 200	13 400	940	1 360	7 500	11 000	HK2212FM	—	0.013	IR17×22×13
	28	12	2.7	9 750	14 300	995	1 460	7 500	11 000	—	BK2212	0.015	IR17×22×13
	28	16	—	13 200	21 100	1 340	2 150	7 500	11 000	HK2216F	—	0.021	IR17×22×18
	28	16	2.7	13 600	22 100	1 390	2 250	7 500	11 000	—	BK2216	0.024	IR17×22×18
	28	20	—	16 800	28 800	1 710	2 940	7 500	11 000	HK2220F	—	0.026	IR17×22×20.5
	28	20	2.7	17 200	29 800	1 760	3 050	7 500	11 000	—	BK2220	0.030	IR17×22×20.5
	29	10	—	8 400	10 100	855	1 030	7 500	11 000	HMK2210	—	0.015	IR17×22×13
	29	15	—	13 400	18 500	1 370	1 890	7 500	11 000	HMK2215	—	0.022	IR17×22×16D
	29	20	—	18 200	27 400	1 860	2 790	7 500	11 000	HMK2220	—	0.030	IR17×22×20.5
	29	25	—	23 600	38 500	2 410	3 900	7 500	11 000	HMK2225	—	0.037	IR17×22×26
	29	30	—	26 900	45 000	2 740	4 600	7 500	11 000	HMK2230	—	0.045	IR17×22×32
24	31	20	—	18 300	28 200	1 860	2 880	6 500	10 000	HMK2420CT	—	0.032	—
	31	28	—	26 000	44 500	2 650	4 500	6 500	10 000	HMK2428	—	0.045	IR20×24×28.5
25	32	12	—	11 100	15 200	1 140	1 550	6 500	9 500	HK2512F	—	0.021	IR20×25×12.5
	32	12	2.7	11 800	16 300	1 200	1 660	6 500	9 500	—	BK2512	0.023	IR20×25×12.5
	32	16	—	15 900	24 000	1 620	2 450	6 500	9 500	HK2516F	—	0.027	IR20×25×17
	32	16	2.7	15 900	24 000	1 620	2 450	6 500	9 500	—	BK2516	0.031	IR20×25×17
	32	20	—	20 300	33 000	2 070	3 350	6 500	9 500	HK2520	—	0.034	IR20×25×20.5
	32	20	2.7	20 300	33 000	2 070	3 350	6 500	9 500	—	BK2520	0.039	IR20×25×20.5
	32	26	—	26 400	46 000	2 690	4 700	6 500	9 500	HK2526	—	0.045	IR20×25×26.5
	32	26	2.7	26 400	46 000	2 690	4 700	6 500	9 500	—	BK2526	0.049	IR20×25×26.5
	32	38	—	35 000	65 500	3 550	6 700	6 500	9 500	HK2538ZWD	—	0.065	IR20×25×38.5

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131, B132.)
EX. HK2512F + IR20×25×12.5

Type HK, Type HK··ZWD
Type HMK, Type HMK··ZWD
Type BK, Type BK··ZWD



Type HK, Type HMK



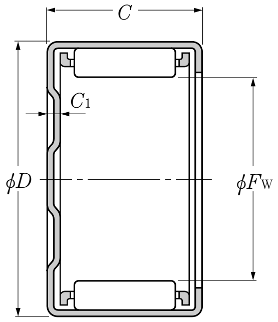
Type HK··ZWD
Type HMK··ZWD

Opened End Type

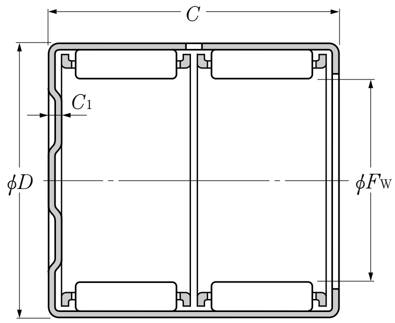
F_w 25～30mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate[1] inner ring
mm				dynamic N	static N	dynamic kgf	static kgf	min⁻¹				kg	
F_w	D	C 0 -0.2	C_1 max	C_r	C_{or}	C_r	C_{or}	grease	oil	open end design	closed end design	(approx.)	(as a reference)
25	32	38	2.7	35 000	65 500	3 550	6 700	6 500	9 500	—	BK2538ZWD	0.069	IR20×25×38.5
	33	10	—	9 150	10 400	935	1 060	6 500	9 500	HMK2510	—	0.019	IR20×25×12.5
	33	15	—	15 200	19 900	1 550	2 030	6 500	9 500	HMK2515CT	—	0.029	IR20×25×16
	33	20	—	21 800	31 500	2 220	3 200	6 500	9 500	HMK2520	—	0.039	IR20×25×20.5
	33	25	—	26 700	41 000	2 720	4 200	6 500	9 500	HMK2525	—	0.048	IR20×25×26.5
	33	30	—	32 500	53 000	3 300	5 400	6 500	9 500	HMK2530	—	0.058	IR20×25×32
26	34	16	—	17 100	23 400	1 740	2 390	6 000	9 000	HMK2616	—	0.032	IR22×26×20
	34	20	—	21 100	30 500	2 150	3 150	6 000	9 000	7E-HMK2620CT	—	0.040	—
28	35	16	—	16 700	26 400	1 700	2 690	5 500	8 500	HK2816C	—	0.030	IR22×28×17
	35	16	2.7	17 300	27 600	1 760	2 820	5 500	8 500	—	BK2816	0.034	IR22×28×17
	35	20	—	21 300	36 000	2 170	3 700	5 500	8 500	HK2820	—	0.038	IR22×28×20.5
	35	20	2.7	21 300	36 000	2 170	3 700	5 500	8 500	—	BK2820	0.043	IR22×28×20.5
	37	20	—	23 600	32 500	2 410	3 350	5 500	8 500	HMK2820	—	0.049	IR22×28×20.5
	37	30	—	35 000	54 500	3 600	5 550	5 500	8 500	HMK2830	—	0.073	—
29	38	20	—	24 600	35 000	2 510	3 550	5 500	8 500	HMK2920	—	0.050	—
	38	30	—	34 500	54 000	3 550	5 550	5 500	8 500	HMK2930	—	0.075	—
30	37	12	—	13 000	19 500	1 320	1 990	5 500	8 000	HK3012	—	0.024	IR25×30×12.5
	37	12	2.7	13 000	19 500	1 320	1 990	5 500	8 000	—	BK3012	0.028	IR25×30×12.5
	37	16	—	18 100	30 000	1 850	3 050	5 500	8 000	HK3016	—	0.032	IR25×30×17
	37	16	2.7	18 100	30 000	1 850	3 050	5 500	8 000	—	BK3016	0.037	IR25×30×17
	37	20	—	22 300	39 500	2 280	4 000	5 500	8 000	HK3020F	—	0.040	IR25×30×20.5
	37	20	2.7	22 300	39 500	2 280	4 000	5 500	8 000	—	BK3020	0.047	IR25×30×20.5
	37	26	—	28 500	54 000	2 910	5 500	5 500	8 000	HK3026F	—	0.053	IR25×30×26.5
	37	26	2.7	28 500	54 000	2 910	5 500	5 500	8 000	—	BK3026	0.059	IR25×30×26.5
	37	38	—	38 500	78 500	3 900	8 000	5 500	8 000	HK3038ZWD	—	0.076	IR25×30×38.5
	37	38	2.7	38 500	78 500	3 900	8 000	5 500	8 000	—	BK3038ZWD	0.083	IR25×30×38.5
	40	13	—	14 100	17 100	1 430	1 750	5 500	8 000	HMK3013	—	0.040	IR25×30×16
	40	15	—	17 100	22 100	1 750	2 250	5 500	8 000	HMK3015	—	0.044	IR25×30×16
	40	20	—	24 200	34 500	2 470	3 500	5 500	8 000	HMK3020	—	0.058	IR25×30×20.5
	40	25	—	31 000	47 000	3 150	4 800	5 500	8 000	HMK3025	—	0.073	IR25×30×26.5

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131, B-132.)
EX. HK2820 + IR22×28×20.5



Type BK



Type BK‥ZWD

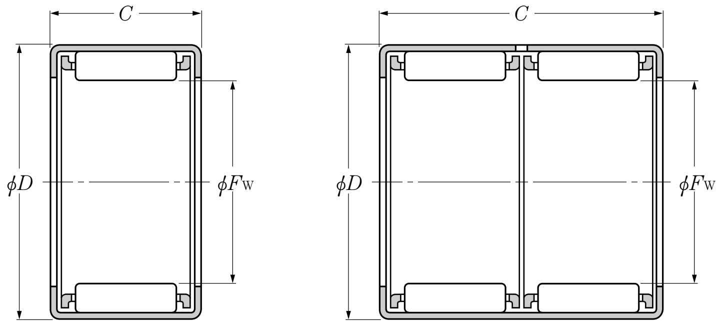
Closed End Type

F_w 30～40mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1}		Bearing numbers		Mass kg	Appropriate[1)] inner ring
F_w	D	C $^{0}_{-0.2}$	C_1 max	C_r	C_{or}	C_r	C_{or}	grease	oil	open end design	closed end design	(approx.)	(as a reference)
30	40	30	—	36 000	57 500	3 700	5 850	5 500	8 000	**HMK3030**	—	0.087	IR25×30×32
32	42	20	—	27 500	38 000	2 800	3 850	5 000	7 500	**HMK3220**	—	0.062	—
	42	30	—	41 500	64 500	4 250	6 550	5 000	7 500	**HMK3230**	—	0.092	—
35	42	12	—	14 000	22 800	1 430	2 320	4 700	7 000	**HK3512**	—	0.028	—
	42	12	2.7	14 000	22 800	1 430	2 320	4 700	7 000	—	**BK3512**	0.033	—
	42	16	—	19 000	33 500	1 940	3 400	4 700	7 000	**HK3516C**	—	0.037	—
	42	16	2.7	19 700	35 000	2 000	3 600	4 700	7 000	—	**BK3516**	0.044	—
	42	20	—	24 800	47 500	2 530	4 850	4 700	7 000	**HK3520**	—	0.046	—
	42	20	2.7	24 800	47 500	2 530	4 850	4 700	7 000	—	**BK3520**	0.055	—
	45	12	—	14 900	17 600	1 520	1 800	4 700	7 000	**HMK3512**	—	0.040	—
	45	15	—	20 200	26 200	2 060	2 670	4 700	7 000	**HMK3515**	—	0.050	—
	45	20	—	28 400	40 500	2 890	4 100	4 700	7 000	**HMK3520**	—	0.067	—
	45	25	—	36 000	54 500	3 650	5 550	4 700	7 000	**HMK3525**	—	0.083	—
	45	30	—	43 000	69 000	4 400	7 000	4 700	7 000	**HMK3530**	—	0.100	—
37	47	20	—	29 300	43 000	2 990	4 350	4 300	6 500	**HMK3720**	—	0.070	—
	47	30	—	44 500	73 000	4 550	7 450	4 300	6 500	**HMK3730**	—	0.105	—
38	48	15	—	21 700	29 300	2 210	2 990	4 300	6 500	**HMK3815**	—	0.054	—
	48	20	—	30 500	45 000	3 100	4 600	4 300	6 500	**HMK3820**	—	0.072	—
	48	25	—	38 500	61 000	3 900	6 250	4 300	6 500	**HMK3825**	—	0.090	—
	48	30	—	46 000	77 000	4 700	7 850	4 300	6 500	**HMK3830**	—	0.107	IR32×38×32
	48	45	—	62 000	113 000	6 300	11 500	4 300	6 500	**HMK3845ZWD**	—	0.161	—
40	47	12	—	15 100	26 000	1 540	2 660	4 000	6 000	**HK4012**	—	0.031	IR35×40×12.5
	47	12	2.7	15 100	26 000	1 540	2 660	4 000	6 000	—	**BK4012**	0.038	IR35×40×12.5
	47	16	—	20 300	38 500	2 070	3 900	4 000	6 000	**HK4016C**	—	0.041	IR35×40×17
	47	16	2.7	21 100	40 000	2 150	4 100	4 000	6 000	—	**BK4016**	0.051	IR35×40×17
	47	20	—	25 900	52 500	2 650	5 350	4 000	6 000	**HK4020**	—	0.052	IR35×40×20.5
	47	20	2.7	25 900	52 500	2 650	5 350	4 000	6 000	—	**BK4020**	0.064	IR35×40×20.5
	50	15	—	23 100	32 500	2 350	3 300	4 000	6 000	**HMK4015**	—	0.056	IR35×40×17
	50	20	—	32 500	50 000	3 300	5 100	4 000	6 000	**HMK4020**	—	0.075	IR35×40×20.5
	50	25	—	41 000	67 500	4 150	6 900	4 000	6 000	**HMK4025**	—	0.094	—

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-132 to B134.)
EX. HK4012 + IR35×40×12.5

Type HK
Type HMK, Type HMK··ZWD
Type BK



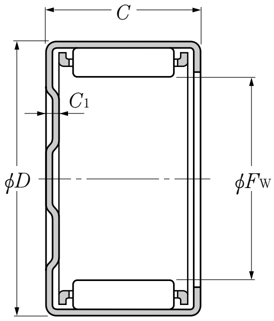
Type HK, Type HMK **Type HMK··ZWD**

Opened End Type

F_w 40～50mm

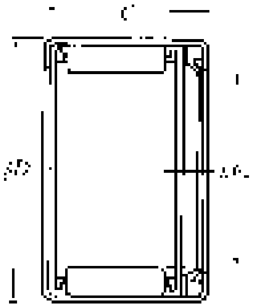
Boundary dimensions (mm) F_w	D	C (0/-0.2)	C_1 max	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers open end design	closed end design	Mass kg (approx.)	Appropriate inner ring[1)] (as a reference)
40	50	30	—	49 000	85 000	5 000	8 700	4 000	6 000	**HMK4030**	—	0.112	IR35×40×34
	50	40	—	58 500	107 000	5 950	10 900	4 000	6 000	**HMK4040ZWD**	—	0.150	—
45	52	16	—	21 600	43 000	2 210	4 400	3 700	5 500	**HK4516**	—	0.046	IR40×45×17
	52	16	2.7	21 600	43 000	2 210	4 400	3 700	5 500	—	**BK4516**	0.058	IR40×45×17
	52	20	—	27 600	59 000	2 810	6 000	3 700	5 500	**HK4520**	—	0.058	IR40×45×20.5
	52	20	2.7	27 600	59 000	2 810	6 000	3 700	5 500	—	**BK4520**	0.072	IR40×45×20.5
	55	20	—	32 000	51 000	3 250	5 200	3 700	5 500	**HMK4520CT**	—	0.083	IR40×45×20.5
	55	25	—	41 500	71 500	4 250	7 300	3 700	5 500	**HMK4525**	—	0.104	IR40×45×26.5
	55	30	—	49 500	90 000	5 050	9 150	3 700	5 500	**HMK4530**	—	0.125	IR40×45×34
	55	40	—	59 500	113 000	6 050	11 500	3 700	5 500	**HMK4540ZWD**	—	0.167	—
50	58	20	—	31 500	63 000	3 200	6 450	3 200	4 800	**HK5020**	—	0.072	IR40×50×22
	58	20	2.7	31 500	63 000	3 200	6 450	3 200	4 800	—	**BK5020**	0.087	IR40×50×22
	58	25	—	38 500	82 000	3 900	8 400	3 200	4 800	**HK5025**	—	0.090	IR45×50×25.5
	58	25	2.7	38 500	82 000	3 900	8 400	3 200	4 800	—	**BK5025**	0.109	IR45×50×25.5
	62	12	—	18 200	23 600	1 860	2 410	3 200	4 800	**HMK5012**	—	0.067	—
	62	15	—	25 900	37 000	2 650	3 800	3 200	4 800	**HMK5015**	—	0.084	—
	62	20	—	37 500	60 000	3 850	6 100	3 200	4 800	**HMK5020**	—	0.112	IR40×50×22
	62	25	—	48 000	82 500	4 900	8 450	3 200	4 800	**HMK5025**	—	0.140	IR45×50×25.5
	62	30	—	58 500	105 000	5 950	10 700	3 200	4 800	**HMK5030B**	—	0.168	IR45×50×32
	62	40	—	70 000	134 000	7 150	13 600	3 200	4 800	**HMK5040ZWD**	—	0.224	—
	62	45	—	79 000	156 000	8 050	15 900	3 200	4 800	**HMK5045ZWBD**	—	0.252	—

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-134, B135.)
EX. HK4516 + IR40×45×17

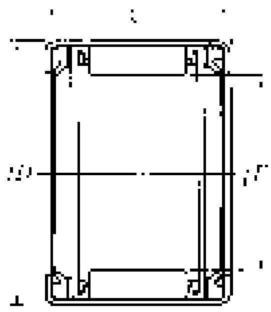


Type BK
Closed End Type

Type HK··L
Type HMK··L
Type HK··LL
Type HMK··LL
Type BK··L



Type HK··L, Type HMK··L
(Opened end and single-side seal type)

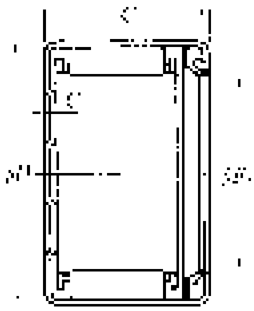


Type HK··LL, Type HMK··LL
(Opened end and double-side seal type)

F_w 8～25mm

Boundary dimensions (mm)					Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1}) grease	Bearing numbers open end single seal	open end double seal	closed end single seal
F_w	D	C_1 (0/−0.2)	C_2 (0/−0.2)	C_3 max	C_r	C_{or}	C_r	C_{or}				
8	15	12	14	—	3 800	2 870	390	293	10 000	HMK0812L/3AS	HMK0814LL/3AS	—
10	17	12	14	—	4 250	3 450	435	350	10 000	HMK1012L/3AS	HMK1014LL/3AS	—
12	18	14	16	2.7	6 600	7 300	675	745	10 000	HK 1214L/3AS	HK 1216LL/3AS	BK1214L/3AS
	19	14	16	—	7 100	6 900	725	705	10 000	HMK1214L/3AS	HMK1216LL/3AS	—
14	20	14	16	2.7	7 200	8 500	735	865	10 000	HK 1414L/3AS	HK 1416LL/3AS	BK1414L/3AS
	22	19	22	—	11 500	12 000	1 180	1 220	10 000	HMK1419L/3AS	HMK1422LL/3AS	—
15	21	14	16	2.7	7 500	9 100	765	930	10 000	HK 1514L/3AS	HK 1516LL/3AS	BK1514L/3AS
	22	13	16	—	6 100	6 000	620	610	10 000	HMK1513L/3AS	HMK1516LL/3AS	—
	22	18	21	—	10 900	12 700	1 120	1 300	10 000	HMK1518L/3AS	HMK1521LL/3AS	—
16	22	14	16	2.7	7 750	9 700	795	990	10 000	HK 1614L/3AS	HK 1616LL/3AS	BK1614L/3AS
	24	23	26	—	15 600	18 200	1 590	1 860	10 000	HMK1623CLT/3AS	HMK1626CLLT/3AS	—
17	24	18	21	—	12 100	15 000	1 230	1 530	9 500	HMK1718L/3AS	HMK1721LL/3AS	—
18	24	14	16	2.7	8 300	10 900	845	1 110	9 000	HK 1814L/3AS	HK 1816LL/3AS	BK1814L/3AS
	25	18	21	—	12 000	15 100	1 220	1 540	9 000	HMK1818L/3AS	HMK1821LL/3AS	—
	25	20	23	—	13 800	18 000	1 400	1 830	9 000	HMK1820L/3AS	HMK1823LL/3AS	—
19	27	19	22	—	13 900	16 300	1 410	1 660	8 500	HMK1919L/3AS	HMK1922LL/3AS	—
20	26	—	16	—	9 250	13 000	945	1 330	8 000	—	HK 2016LL/3AS	—
	26	18	20	2.7	13 000	20 100	1 320	2 050	8 000	HK 2018L/3AS	HK 2020LL/3AS	BK2018L/3AS
	27	18	21	—	13 000	17 300	1 330	1 760	8 000	HMK2018L/3AS	HMK2021LL/3AS	—
	27	23	26	—	17 700	25 600	1 800	2 610	8 000	HMK2023L/3AS	HMK2026LL/3AS	—
22	28	—	16	—	9 750	14 300	995	1 460	7 500	—	HK 2216LL/3AS	—
	28	18	20	2.7	13 600	22 100	1 390	2 250	7 500	HK 2218L/3AS	HK 2220LL/3AS	BK2218L/3AS
	29	18	21	—	13 400	18 500	1 370	1 890	7 500	HMK2218L/3AS	HMK2221LL/3AS	—
	29	23	26	—	18 200	27 400	1 860	2 790	7 500	HMK2223L/3AS	HMK2226LL/3AS	—
24	31	23	26	—	18 300	28 200	1 860	2 880	6 500	HMK2423CLT /3AS	HMK2426CLLT/3AS	—
25	32	—	16	—	11 800	16 300	1 200	1 660	6 500	—	HK 2516LL/3AS	—
	32	18	20	2.7	15 900	24 100	1 620	2 450	6 500	HK 2518L /3AS	HK 2520LL/3AS	BK2518L/3AS

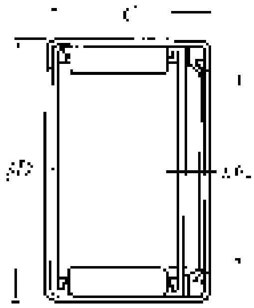
Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129 to B131.)
EX. HK1416LL/3AS + IR10×14×20



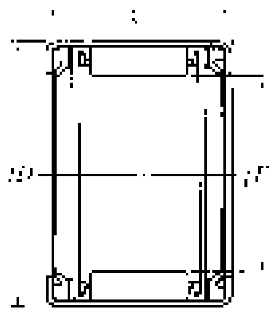
Type BK··L
(Closed end and single-side seal type)

Mass kg (approx.)			Appropriate[1)] inner ring (as a reference)	
open end single seal	open end double seal	closed end single seal	single seal	double seal
0.0071	0.0075	—	IR 5×8×16	IR 5×8×16
0.0084	0.0089	—	IR 7×10×16	IR 7×10×16
0.011	0.0120	0.012	IR 9×12×16	—
0.011	0.0120	—	IR 9×12×16	—
0.012	0.0140	0.014	IR10×14×16	IR10×14×20
0.020	0.0210	—	IR10×14×20	—
0.013	0.0140	0.014	IR12×15×16.5	IR12×15×16.5
0.014	0.0150	—	IR12×15×16	IR12×15×16.5
0.017	0.0180	—	IR12×15×22.5	IR12×15×22.5
0.013	0.0150	0.015	IR12×16×16	IR12×16×20
0.028	0.0290	—	—	—
0.019	0.0200	—	IR12×17×20.5	IR12×17×25.5
0.015	0.0170	0.017	IR15×18×16	IR15×18×17.5
0.020	0.0210	—	IR15×18×20.5	IR15×18×25.5
0.023	0.0240	—	IR15×18×20.5	IR15×18×25.5
0.027	0.0290	—	IR15×19×20	—
—	0.0190	—	—	IR15×20×18
0.021	0.0240	0.024	IR17×20×20	IR17×20×20.5
0.022	0.0240	—	IR17×20×20	IR15×20×23
0.029	0.0310	—	IR15×20×26	IR17×20×30.5
—	0.0200	—	—	IR17×22×18
0.024	0.0260	0.027	IR17×22×20.5	IR17×22×23
0.024	0.0260	—	IR17×22×20.5	IR17×22×23
0.032	0.0330	—	IR17×22×26	—
0.035	0.0370	—	—	IR20×24×28.5
—	0.0270	—	—	IR20×25×18D
0.031	0.0330	0.035	IR20×25×20	IR20×25×23

Type HK··L
Type HMK··L
Type HK··LL
Type HMK··LL
Type BK··L



Type HK··L, Type HMK··L
(Opened end and single-side seal type)

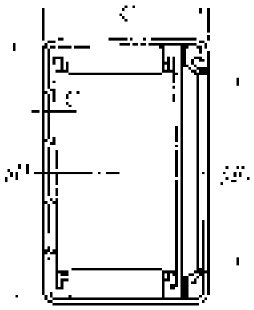


Type HK··LL, Type HMK··LL
(Opened end and double-side seal type)

F_w 25～50mm

Boundary dimensions (mm)					Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds min⁻¹ grease	Bearing numbers open end single seal	open end double seal	closed end single seal
F_w	D	C_1 $^{0}_{-0.2}$	C_2 $^{0}_{-0.2}$	C_3 max	C_r	C_{or}	C_r	C_{or}				
25	33	18	21	–	15 200	19 900	1 550	2 030	6 500	HMK2518CLT/3AS	HMK2521CLLT/3AS	–
	33	23	26	–	21 800	31 500	2 220	3 200	6 500	HMK2523L/3AS	HMK2526LL/3AS	–
28	35	–	20	–	17 300	27 600	1 760	2 820	5 500	–	HK 2820LL/3AS	–
	37	23	26	–	23 600	32 500	2 410	3 350	5 500	HMK2823L/3AS	HMK2826LL/3AS	–
30	37	–	16	–	13 000	19 500	1 320	1 990	5 500	–	HK 3016LL/3AS	–
	37	18	20	2.7	18 100	30 000	1 850	3 050	5 500	HK 3018L/3AS	HK 3020LL/3AS	BK3018L/3AS
	40	23	26	–	24 200	34 500	2 470	3 500	5 500	HMK3023L/3AS	HMK3026LL/3AS	–
	40	28	31	–	31 000	47 000	3 150	4 800	5 500	HMK3028L/3AS	HMK3031LL/3AS	–
32	42	23	26	–	27 500	38 000	2 800	3 850	5 000	HMK3223L/3AS	HMK3226LL/3AS	–
35	42	–	16	–	14 000	22 800	1 430	2 320	4 600	–	HK 3516LL/3AS	–
	42	18	20	2.7	19 700	35 000	2 000	3 600	4 600	HK 3518L/3AS	HK 3520LL/3AS	BK3518L/3AS
	45	18	21	–	20 200	26 200	2 060	2 670	4 600	HMK3518L/3AS	HMK3521LL/3AS	–
	45	28	31	–	36 000	54 500	3 650	5 550	4 600	HMK3528L/3AS	HMK3531LL/3AS	–
38	48	28	31	–	38 500	61 000	3 900	6 250	4 200	HMK3828L/3AS	HMK3831LL/3AS	–
40	47	–	16	–	15 100	26 000	1 540	2 660	4 000	–	HK 4016LL/3AS	–
	47	18	20	2.7	21 100	40 000	2 150	4 100	4 000	HK 4018L/3AS	HK 4020LL/3AS	BK4018L/3AS
	50	18	21	–	23 100	32 500	2 350	3 300	4 000	HMK4018L/3AS	HMK4021LL/3AS	–
	50	28	31	–	41 000	67 500	4 150	6 900	4 000	HMK4028L/3AS	HMK4031LL/3AS	–
45	52	18	20	2.7	21 600	43 000	2 210	4 400	3 600	HK 4518L/3AS	HK 4520LL/3AS	BK4518L/3AS
	55	23	26	–	32 000	51 000	3 250	5 200	3 600	HMK4523CLT/3AS	HMK4526CLLT/3AS	–
50	58	22	24	2.7	31 500	63 000	3 200	6 450	3 200	HK 5022L/3AS	HK 5024LL/3AS	BK5022L/3AS
	62	28	31	–	48 000	82 500	4 900	8 450	3 200	HMK5028L/3AS	HMK5031LL/3AS	–

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131 to B135.)
EX. HK5022L/3AS + IR45×50×25

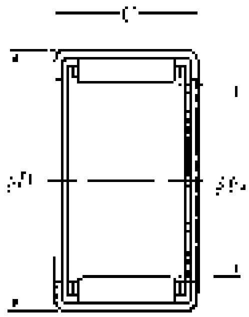


Type BK··L
(Closed end and single-side seal type)

Mass kg (approx.) open end single seal	open end double seal	closed end single seal	Appropriate[1)] inner ring (as a reference) single seal	double seal
0.031	0.034	—	IR20×25×20	IR20×25×23
0.041	0.043	—	IR20×25×26.5	IR20×25×26.5
—	0.037	—	—	IR22×28×23
0.051	0.054	—	—	IR22×28×30
—	0.027	—	—	IR25×30×18D
0.037	0.039	0.045	IR25×30×20	IR25×30×23
0.061	0.064	—	IR25×30×26	IR25×30×26.5
0.076	0.078	—	IR25×30×30	IR25×30×32
0.065	0.069	—	—	IR28×32×30
—	0.036	—	—	—
0.037	0.040	0.047	—	—
0.053	0.056	—	—	—
0.086	0.089	—	—	—
0.094	0.098	—	IR32×38×32	IR32×38×32
—	0.041	—	—	IR35×40×17
0.047	0.050	0.062	IR35×40×20	—
0.060	0.063	—	IR35×40×20	—
0.097	0.100	—	IR35×40×30	IR32×40×36
0.054	0.057	0.072	IR40×45×20	—
0.087	0.091	—	IR40×45×26.5	IR40×45×26.5
0.086	0.089	0.104	IR45×50×25	IR45×50×25.5
0.144	0.149	—	IR45×50×32	IR45×50×32

Inch series

Type DCL



Fw 6.350～15.875mm

Boundary dimensions mm (1/25.4mm)			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers	Mass kg	Appropriate inner ring[1]
F_w	D	C $^{0}_{-0.2}$	C_r	C_{or}	C_r	C_{or}				(approx.)	(as a reference)
6.350(1/4)	11.112(7/16)	6.350(1/4)	1 580	1 110	161	113	25 000	38 000	DCL 44T2	0.0022	—
	11.112(7/16)	7.938(5/16)	2 160	1 670	221	170	25 000	38 000	DCL 45T2	0.0033	—
	11.112(7/16)	11.112(7/16)	3 550	3 150	360	320	25 000	38 000	DCL 47T2	0.0038	—
7.938(5/16)	12.700(1/2)	7.938(5/16)	2 940	2 610	300	266	20 000	30 000	DCL 55	0.0032	—
	12.700(1/2)	9.525(3/8)	3 900	3 750	400	385	20 000	30 000	DCL 56	0.0039	—
	12.700(1/2)	11.112(7/16)	4 800	4 950	490	505	20 000	30 000	DCL 57	0.0048	—
	12.700(1/2)	14.288(9/16)	6 500	7 250	665	740	20 000	30 000	DCL 59	0.0058	—
9.525(3/8)	14.288(9/16)	7.938(5/16)	3 100	2 910	315	297	17 000	25 000	DCL 65	0.0037	—
	14.288(9/16)	9.525(3/8)	4 100	4 200	420	430	17 000	25 000	DCL 66	0.0045	—
	14.288(9/16)	12.700(1/2)	5 900	6 650	600	675	17 000	25 000	DCL 68	0.0065	—
	14.288(9/16)	15.875(5/8)	7 500	9 050	765	925	17 000	25 000	DCL 610	0.0075	—
11.112(7/16)	15.875(5/8)	12.700(1/2)	6 450	7 800	660	795	15 000	22 000	DCL 78	0.0068	—
12.700(1/2)	17.462(11/16)	7.938(5/16)	3 550	3 700	360	380	13 000	19 000	DCL 85	0.0047	—
	17.462(11/16)	9.525(3/8)	4 700	5 350	480	550	13 000	19 000	DCL 86	0.0057	—
	17.462(11/16)	11.112(7/16)	5 800	7 050	590	715	13 000	19 000	DCL 87	0.0066	—
	17.462(11/16)	12.700(1/2)	6 700	8 500	685	865	13 000	19 000	DCL 88	0.0080	—
	17.462(11/16)	15.875(5/8)	8 550	11 600	870	1 180	13 000	19 000	DCL 810	0.0095	—
	17.462(11/16)	19.050(3/4)	10 400	14 900	1 060	1 520	13 000	19 000	DCL 812	0.0120	—
14.288(9/16)	19.050(3/4)	7.938(5/16)	3 800	4 250	390	430	11 000	17 000	DCL 95	0.0052	—
	19.050(3/4)	9.525(3/8)	5 050	6 100	515	625	11 000	17 000	DCL 96	0.0063	MI-060908
	19.050(3/4)	11.112(7/16)	6 250	8 000	635	815	11 000	17 000	DCL 97	0.0073	MI-060908
	19.050(3/4)	12.700(1/2)	7 200	9 650	735	985	11 000	17 000	DCL 98	0.0086	MI-060908
	19.050(3/4)	15.875(5/8)	9 200	13 200	935	1 350	11 000	17 000	DCL 910	0.0110	—
	19.050(3/4)	19.050(3/4)	11 200	17 000	1 140	1 730	11 000	17 000	DCL 912	0.0130	—
15.875(5/8)	20.638(13/16)	7.938(5/16)	4 050	4 750	415	485	10 000	15 000	DCL 105	0.0075	—
	20.638(13/16)	11.112(7/16)	6 650	9 000	680	915	10 000	15 000	DCL 107	0.0080	—
	20.638(13/16)	12.700(1/2)	7 700	10 800	785	1 110	10 000	15 000	DCL 108	0.0091	—
	20.638(13/16)	15.875(5/8)	9 800	14 800	1 000	1 510	10 000	15 000	DCL1010	0.0130	MI-061012
	20.638(13/16)	19.050(3/4)	11 900	19 000	1 220	1 940	10 000	15 000	DCL1012	0.0140	MI-061012

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)
EX. DCL96 + MI-060908

Remarks: Manufacture of the closed end type bearings under this Table is also available.

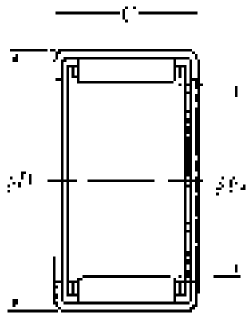
F_w 15.875～25.400mm

Boundary dimensions mm (1/25.4 mm)			Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds min⁻¹		Bearing numbers	Mass kg	Appropriate[1) inner ring
F_w	D	C $^{0}_{-0.2}$	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)	(as a reference)
15.875(5/8)	20.638(13/16)	22.225(7/8)	14 100	23 500	1 430	2 400	10 000	15 000	**DCL1014**	0.0160	MI-061016
17.462(11/16)	22.225(7/8)	9.525(3/8)	5 700	7 650	585	780	9 500	14 000	**DCL 116**	0.0075	—
	22.225(7/8)	12.700(1/2)	8 150	12 000	830	1 230	9 500	14 000	**DCL 118**	0.0110	—
	22.225(7/8)	15.875(5/8)	10 400	16 400	1 060	1 680	9 500	14 000	**DCL1110**	0.0130	—
	22.225(7/8)	19.050(3/4)	12 600	21 100	1 290	2 150	9 500	14 000	**DCL1112**	0.0160	—
19.050(3/4)	25.400(1)	9.525(3/8)	6 450	6 950	660	705	8 500	13 000	**DCL 126**	0.0110	—
	25.400(1)	12.700(1/2)	9 800	11 900	1 000	1 210	8 500	13 000	**DCL 128**	0.0140	MI-081210
	25.400(1)	15.875(5/8)	12 900	16 800	1 310	1 720	8 500	13 000	**DCL1210**	0.0170	MI-081210
	25.400(1)	19.050(3/4)	15 900	22 100	1 620	2 250	8 500	13 000	**DCL1212**	0.0210	MI-081212
	25.400(1)	22.225(7/8)	19 000	27 700	1 930	2 830	8 500	13 000	**DCL1214**	0.0260	MI-081216
	25.400(1)	25.400(1)	21 700	33 000	2 210	3 350	8 500	13 000	**DCL1216**	0.0300	MI-081216
20.638(13/16)	26.988(1 1/16)	9.525(3/8)	6 950	7 800	710	795	8 000	12 000	**DCL 136**	0.0120	—
	26.988(1 1/16)	12.700(1/2)	10 600	13 400	1 080	1 370	8 000	12 000	**DCL 138**	0.0160	—
	26.988(1 1/16)	15.875(5/8)	13 900	19 000	1 410	1 930	8 000	12 000	**DCL1310**	0.0200	—
	26.988(1 1/16)	19.050(3/4)	17 100	24 900	1 750	2 540	8 000	12 000	**DCL1312**	0.0230	—
	26.988(1 1/16)	22.225(7/8)	20 400	31 500	2 080	3 200	8 000	12 000	**DCL1314**	0.0280	—
	26.988(1 1/16)	25.400(1)	23 400	37 000	2 380	3 800	8 000	12 000	**DCL1316**	0.0320	—
	26.988(1 1/16)	31.750(1 1/4)	29 000	49 000	2 960	5 000	8 000	12 000	**DCL1320**	0.0400	—
22.225(7/8)	28.575(1 1/8)	9.525(3/8)	7 150	8 300	730	845	7 500	11 000	**DCL 146**	0.0130	MI-101406
	28.575(1 1/8)	12.700(1/2)	10 900	14 200	1 110	1 450	7 500	11 000	**DCL 148**	0.0170	MI-101408
	28.575(1 1/8)	19.050(3/4)	17 600	26 400	1 800	2 700	7 500	11 000	**DCL1412**	0.0250	MI-101412
	28.575(1 1/8)	22.225(7/8)	21 000	33 000	2 140	3 400	7 500	11 000	**DCL1414**	0.0340	MI-101416
	28.575(1 1/8)	25.400(1)	24 100	39 500	2 450	4 000	7 500	11 000	**DCL1416**	0.0340	MI-101416
23.812(15/16)	30.162(1 3/16)	15.875(5/8)	14 600	21 300	1 490	2 170	6 500	10 000	**DCL1510**	0.0230	—
	30.162(1 3/16)	25.400(1)	24 700	41 500	2 520	4 250	6 500	10 000	**DCL1516**	0.0360	—
25.400(1)	31.750(1 1/4)	9.525(3/8)	7 550	9 250	770	940	6 500	9 500	**DCL 166**	0.0140	—
	31.750(1 1/4)	12.700(1/2)	11 500	15 800	1 170	1 610	6 500	9 500	**DCL 168**	0.0190	—
	31.750(1 1/4)	19.050(3/4)	18 600	29 500	1 890	3 000	6 500	9 500	**DCL1612**	0.0310	MI-121612
	31.750(1 1/4)	22.225(7/8)	22 100	37 000	2 260	3 750	6 500	9 500	**DCL1614**	0.0340	MI-121616

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)
EX. DCL128 + MI-081210
Remarks: Manufacture of the closed end type bearings under this Table is also available.

Inch series

Type DCL



F_w 25.400～41.275mm

Boundary dimensions mm (1/25.4mm)			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers	Mass kg	Appropriate[1)] inner ring
F_w	D	C 0/−0.2	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)	(as a reference)
25.400(1)	31.750(1 1/4)	25.400(1)	25 400	44 000	2 590	4 500	6 500	9 500	**DCL1616**	0.038	MI-121616
	31.750(1 1/4)	31.750(1 1/4)	31 500	58 000	3 200	5 900	6 500	9 500	**DCL1620**	0.048	—
26.988(1 1/16)	33.338(1 5/16)	15.875(5/8)	15 900	24 600	1 620	2 510	6 000	9 000	**DCL1710**	0.025	—
28.575(1 1/8)	34.925(1 3/8)	9.525(3/8)	8 150	10 600	830	1 080	5 500	8 500	**DCL 186**	0.016	MI-141808
	34.925(1 3/8)	12.700(1/2)	12 400	18 200	1 260	1 850	5 500	8 500	**DCL 188**	0.021	MI-141808
	34.925(1 3/8)	19.050(3/4)	20 100	34 000	2 050	3 450	5 500	8 500	**DCL1812**	0.032	MI-141812
	34.925(1 3/8)	25.400(1)	27 400	50 500	2 790	5 150	5 500	8 500	**DCL1816**	0.043	MI-141816
	34.925(1 3/8)	31.750(1 1/4)	34 000	66 500	3 450	6 800	5 500	8 500	**DCL1820**	0.053	MI-141820
30.162(1 3/16)	38.100(1 1/2)	25.400(1)	33 000	54 000	3 350	5 500	5 500	8 000	**DCL1916**	0.057	—
31.750(1 1/4)	38.100(1 1/2)	12.700(1/2)	12 500	19 000	1 280	1 940	5 000	7 500	**DCL 208**	0.023	—
	38.100(1 1/2)	15.875(5/8)	16 400	27 000	1 670	2 750	5 000	7 500	**DCL2010**	0.029	—
	38.100(1 1/2)	19.050(3/4)	20 300	35 500	2 070	3 600	5 000	7 500	**DCL2012**	0.036	—
	38.100(1 1/2)	25.400(1)	27 700	53 000	2 830	5 400	5 000	7 500	**DCL2016**	0.047	—
	38.100(1 1/2)	31.750(1 1/4)	34 500	70 000	3 500	7 100	5 000	7 500	**DCL2020**	0.058	—
34.925(1 3/8)	41.275(1 5/8)	12.700(1/2)	13 400	21 400	1 360	2 180	4 700	7 000	**DCL 228**	0.027	—
	41.275(1 5/8)	19.050(3/4)	21 700	40 000	2 210	4 050	4 700	7 000	**DCL2212**	0.038	—
	41.275(1 5/8)	25.400(1)	29 600	59 500	3 000	6 050	4 700	7 000	**DCL2216**	0.051	—
	41.275(1 5/8)	31.750(1 1/4)	36 500	78 500	3 750	8 000	4 700	7 000	**DCL2220**	0.064	—
38.100(1 1/2)	47.625(1 7/8)	12.700(1/2)	17 100	22 800	1 750	2 320	4 300	6 500	**DCL 248**	0.043	—
	47.625(1 7/8)	15.875(5/8)	21 000	29 700	2 150	3 050	4 300	6 500	**DCL2410**	0.054	—
	47.625(1 7/8)	19.050(3/4)	26 600	40 000	2 710	4 100	4 300	6 500	**DCL2412**	0.065	—
	47.625(1 7/8)	22.225(7/8)	32 000	50 500	3 250	5 150	4 300	6 500	**DCL2414**	0.076	MI-202416
	47.625(1 7/8)	25.400(1)	36 500	60 500	3 750	6 200	4 300	6 500	**DCL2416**	0.087	MI-202416
	47.625(1 7/8)	31.750(1 1/4)	46 500	82 000	4 750	8 350	4 300	6 500	**DCL2420**	0.107	MI-202420
41.275(1 5/8)	50.800(2)	12.700(1/2)	18 000	24 900	1 840	2 540	4 000	6 000	**DCL 268**	0.046	MI-222610
	50.800(2)	15.875(5/8)	22 100	32 500	2 260	3 300	4 000	6 000	**DCL2610**	0.058	MI-222610
	50.800(2)	25.400(1)	38 500	66 500	3 950	6 800	4 000	6 000	**DCL2616**	0.106	—
	50.800(2)	31.750(1 1/4)	49 000	90 000	5 000	9 150	4 000	6 000	**DCL2620**	0.116	MI-212620

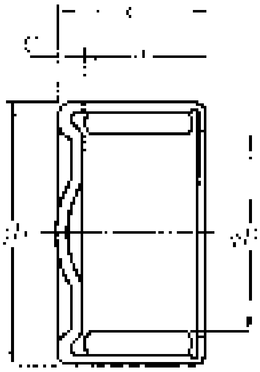
Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)
EX. DCL2414 ＋ MI-202416
Remarks: Manufacture of the closed end type bearings under this Table is also available.

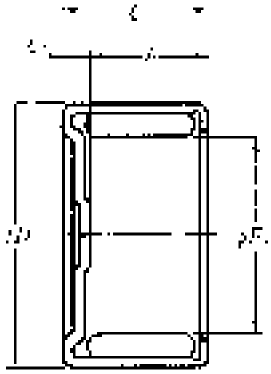
F_w 44.450～50.800mm

Boundary dimensions mm (1/25.4mm)			Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers	Mass kg	Appropriate[1)] inner ring
F_w	D	C $^{0}_{-0.2}$	C_r	C_{or}	C_r	C_{or}	grease	oil		(approx.)	(as a reference)
	53.975(2 ⅛)	19.050(¾)	29 200	47 500	2 980	4 850	3 700	5 500	**DCL2812**	0.074	MI-242812
44.450(1 ¾)	53.975(2 ⅛)	25.400(1)	40 500	72 000	4 100	7 350	3 700	5 500	**DCL2816**	0.099	MI-242816
	53.975(2 ⅛)	38.100(1 ½)	62 000	126 000	6 350	12 800	3 700	5 500	**DCL2824**	0.149	—
	57.150(2 ¼)	12.700(½)	19 700	29 200	2 000	2 980	3 300	5 000	**DCL 308**	0.053	—
47.625(1 ⅞)	57.150(2 ¼)	15.875(⅝)	24 200	38 000	2 460	3 900	3 300	5 000	**DCL3010**	0.066	—
	57.150(2 ¼)	25.400(1)	42 000	78 000	4 300	7 950	3 300	5 000	**DCL3016**	0.106	—
	60.325(2 ⅜)	12.700(½)	20 400	31 500	2 080	3 200	3 100	4 700	**DCL 328**	0.056	—
	60.325(2 ⅜)	25.400(1)	44 000	83 500	4 450	8 550	3 100	4 700	**DCL3216**	0.112	—
50.800(2)	60.325(2 ⅜)	31.750(1 ¼)	55 500	113 000	5 650	11 500	3 100	4 700	**DCL3220**	0.140	—
	60.325(2 ⅜)	38.100(1 ½)	67 500	146 000	6 850	14 800	3 100	4 700	**DCL3224**	0.168	—

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-142.)
EX. DCL2816 + MI-242816
Remarks: Manufacture of the closed end type bearings under this Table is also available.

Type HCK


Dimple type


Waffle type

F_W 10～20mm

Boundary dimensions mm					Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Bearing numbers		Mass kg
F_w	D	C	b	C_1	C_r	C_{or}	C_r	C_{or}	standard type	waffle type	(approx.)
10	15	9.35	7.6	1.75	6 200	9 250	635	940	**HCK1015Vn**	—	◯	0.007
11.656	17.1	11.85	9.6	2.25	8 850	13 800	905	1 400	**HCK1217Vn**	◯	—	0.013
13	19	11.85	9.6	2.25	10 000	15 000	1 020	1 530	**HCK1319Vn**	◯	—	0.013
14	20	11.85	9.6	2.25	10 500	16 600	1 070	1 690	**HCK1420Vn**	◯	◯	0.014
16	22	12.85	10.6	2.25	12 200	20 700	1 240	2 110	**HCK1622Vn**	◯	◯	0.017
18	24	13.85	11.6	2.25	13 900	25 300	1 420	2 580	**HCK1824Vn**	◯	—	0.021
18	24.6	13.85	11.6	2.25	13 900	25 300	1 420	2 580	**HCK1825Vn**	◯	◯	0.025
20	27.9	15.82	13.1	2.72	17 800	31 000	1 810	3 150	**HCK2028Vn**	◯	—	0.037

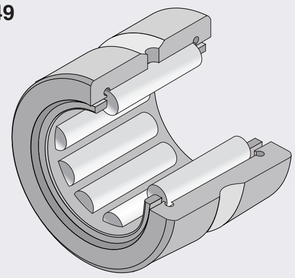
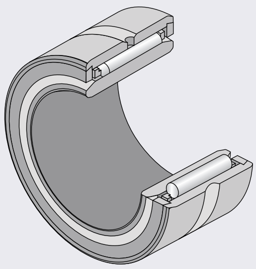
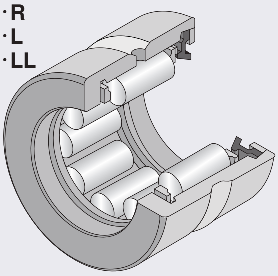
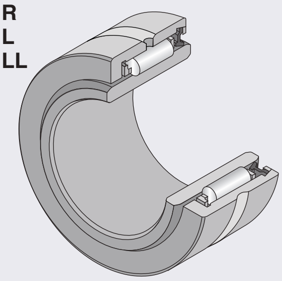
Suffix (Vn) is different from the Dimple type and the Waffle type. For more informations, contact NTN engineering

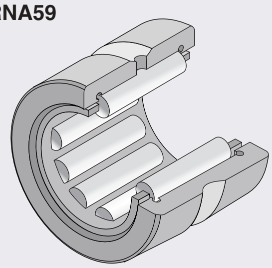
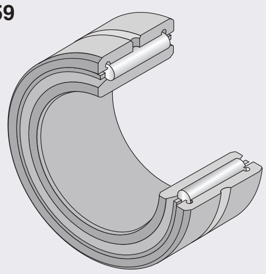
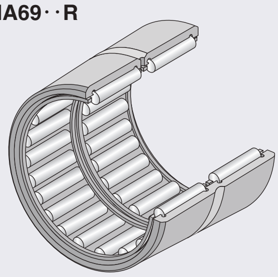
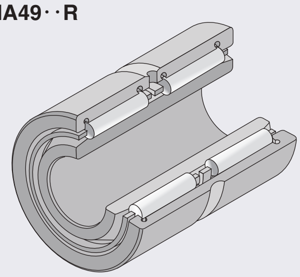
Machined Ring Needle Roller Bearings

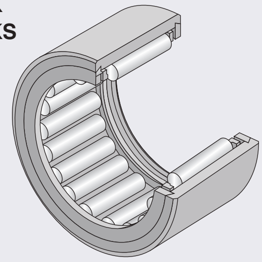
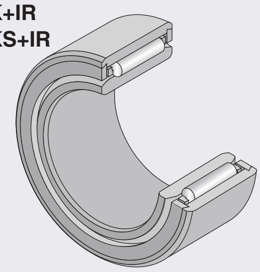
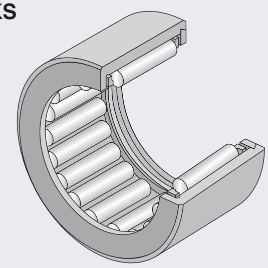
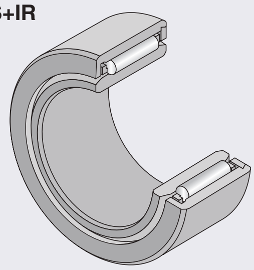
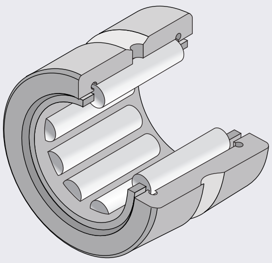
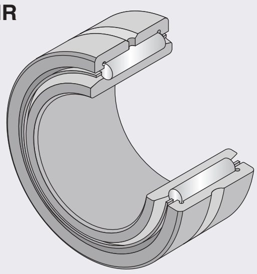
Machined Ring Needle Roller Bearings

The machined ring of this bearing type contains needle rollers and a cage. The outer ring and the needle rollers are inseparable from each other by means of double-side ribs on the outer ring or side plates.

Because of its machined (solid) outer ring enabling to make it more rigid and upgrade the bearing accuracy, this bearing type is suitable for an application requiring high speed, high load and high running accuracy. These machined ring needle roller bearings are available in two types -- one without inner ring and another with inner ring -- considering the case of using a shaft as the direct raceway surface without using inner ring.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type RNA49 	ϕ7 – ϕ12	**RNA 49 5 T2** Suffix (T2) Bore dia. No. (5) Dimension series (49) Type code (RNA) **[Suffix]** T2: Resin cage	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less. The dimension series is in compliance with JIS B 1512 or ISO 15.
Type NA49 	ϕ5 – ϕ9		
Type RNA49‥R **Type RNA49‥L** **Type RNA49‥LL** 	Type RNA49‥R ϕ14 – ϕ490 Sealed type Type RNA49‥L Type RNA49‥LL ϕ14 – ϕ58	**RNA 49 02 R** Suffix (R) Bore dia. No. (02) Dimension series (49) Type code (RNA) **[Suffix]** R: Ribbed type L: Single-side seal type LL: Double-side seal type	Bearing with seal type (Suffix: L or LL) - synthetic rubber seal built in at single side or double sides is internally filled up with ithium soap base grease. To avoid deterioration of seal and grease in a sealed bearing, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C. The dimension series is in compliance with JIS B 15 or ISO 15.
Type NA49‥R **Type NA49‥L** **Type NA49‥LL** 	Type NA49‥R ϕ10 – ϕ440 Sealed type Type NA49‥L Type NA49‥LL ϕ10 – ϕ50		

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type RNA59 	ϕ20 – ϕ160	**RNA 59 02** 02: Bore dia. No. 59: Dimension series RNA: Type code	The dimension series is in compliance with JIS B 1512 or ISO 15.
Type NA59 	ϕ15 – ϕ140	**NA 59 ／22** 22: Dimension code 59: Dimension series NA: Type code	
Type RNA69··R 	ϕ16 – ϕ35 Built-in cage single-row type ϕ40 – ϕ110 Built-in cage double-row type	**RNA 69 01 R** R: Suffix 01: Bore dia. No. 69: Dimension series RNA: Type code	
Type NA49··R 	ϕ12 – ϕ30 Built-in cage single-row type ϕ32 – ϕ95 Built-in cage double-row type	**NA 69 ／22** 22: Dimension code 69: Dimension series NA: Type code	

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type NK **Type NKS** 	NK φ5 – φ12 NKS φ8 – φ40	**NK 7／10 T2** T2: Suffix 10: Width 7: Roller set bore diameter NK: Type code	
Type NK+IR **Type NKS+IR** 	NK φ5 – φ9 NKS＋IR φ6 – φ30	**NKS 16** 16: Roller set bore diameter NKS: Type code	
Type NKS 	φ43 – φ110	**NK24／16R＋IR 20 × 24 × 16** IR: Type code 20: Bore diameter 24: Outer diameter 16: Width	Bearing with suffix T2 uses a polyamide resin cage and, therefore, it shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and lower.
Type NKS+IR 	φ35 – φ95	**[Suffix]** R: Ribbed type T2: Resin cage	
Type NK··R **Type NKS** **Type MR** **(Inch series)** 	NK··R φ14 – φ165 NKS φ115 – φ170 MR φ15.875 – φ234.95	**MR 10 18 12** 12: Width code 18: Outer diameter code 10: Roller set bore diameter code MR: Type code	
Type NK··R+IR **Type NKS+IR** **Type MR+IR** **(Inch series)** 	NK··R＋IR φ10 – φ150 NKS＋IR φ100 – φ150 MR＋MI φ9.525 – φ203.2	**MR101812＋ MI－ 06 10 12** MI: Type code 06: Bore diameter code 10: Outer diameter code 12: Width code	

Bearing Tolerances

The dimensional accuracy, profile accuracy and running accuracy of machined ring needle roller bearings are specified in JIS B 1514 (Accuracy of Rolling Bearings). (Refer to Section 4 "**Bearing Tolerances**", **Table 4.3** on page A-26.) Although the accuracy of **NTN** standard bearings conforms to JIS Class-0, **NTN** can also supply bearings conforming to JIS Class-6, -5 and -4.

The dimensional tolerances for the roller set bore diameter (F_w) of **Types NK**, **RNA**, **NKS**, and **MR** each lacking an inner ring fall in the ISO tolerance class F6.

Feel free to contact **NTN** for the further detail of these bearings.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, **NTN** will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact **NTN** Engineering.

Radial internal clearance and bearing fits

NTN machined ring needle roller bearings (with inner ring) are manufactured to the tolerance range of radial internal clearance in **Table 5.1** in Sec. **5.1 "Bearing radial internal clearance"** (page A-30). Because of the narrow non-interchangeable clearance range, the bearings shipped after adjusted to a specific non-interchangeable clearance must be installed with the clearance remained unchanged.

The dimensional tolerances (fits) of a shaft and housing bore to which the bearing with inner ring is installed should be in accordance with type and magnitude of load, and dimensions of the shaft and housing bore. For information about the dimensional tolerances of a shaft and housing bore, refer to Sec. **6.4 "Recommended internal fits"** (page A-33). For the profile accuracy and surface roughness of the shaft and housing bore corresponding to the recommended internal fits, **Table 8.3** in Sec. **8.3 "Shaft and housing accuracy"** (page A-40).

A bearing not having an inner ring directly uses the shaft as raceway surface, and the dimensional tolerances of the shaft diameter (raceway diameter) can vary depending on the operating internal clearance of the bearing as summarized in **Table 1** below. For this type of bearing usage, the dimensional tolerance class for the housing bore is K7, which is most commonly adopted tolerance class. When wishing to adopt a dimensional tolerance class other than K7 for the housing bore, contact **NTN** Engineering for technical assistance.

For the profile accuracy, surface roughness and surface hardness of the shaft that functions as raceway surface, refer to Sec. **8.4 "Raceway surface accuracy"** (page A-40) and Sec. **8.5 "Material and hardness of raceway"** (page A-40).

Oil hole dimension of the outer ring

The outer ring is provided with an oil hole and an oil groove to facilitate oil lubrication to bearing. (However, the description above does not apply to the **Type NK** bearings whose roller set bore diameter (F_w) measures 12 mm or less and the **Type NKS** bearing whose roller set bore diameter (F_w) measures 110 mm or less.)

Table 2 shows the oil hole dimension every outer ring diameter.

Table 2 Oil hole dimension

Outer ring outer diameter Over	incl.	Oil hole dia. (mm)	Number of oil hole
—	20	2.0	1
20	40	2.5	1
40	80	3.0	1
80	200	3.5	1
200	350	4.0	1
350	—	5.0	1

Mounting relations

In the case of raceway with an oil hole, **the bearing must be installed so that the oil hole can locate on the non-load area.** In addition, any bearing with inner ring **must be used within the allowable stroking value (s) (with the rollers retained within the effective contact length range of inner ring).**

For the allowable stroking value (s), refer to **Fig. 1** and applicable "Dimensions Table".

The inner ring and outer ring of machined ring needle roller bearing must be positioned in axial direction by shoulder or snap ring in this case. The mounting relation dimensions about the shaft and housing bore for this case are found in the relevant dimension table.

Table 1 Shaft diameter (raceway diameter) tolerance (recommended)

Roller inscribed circle dia. F_w mm Over	incl.	Tolerance range class for shaft: Smaller than ordinary clearance	Ordinary class	Larger than ordinary clearance
	80	k5	h5	f6
80	160	k5	g5	f6
160	180	k5	g5	e6
180	200	j5	g5	e6
200	250	j5	f6	e6
250	315	h5	f6	e6
315	400	g5	f6	d6

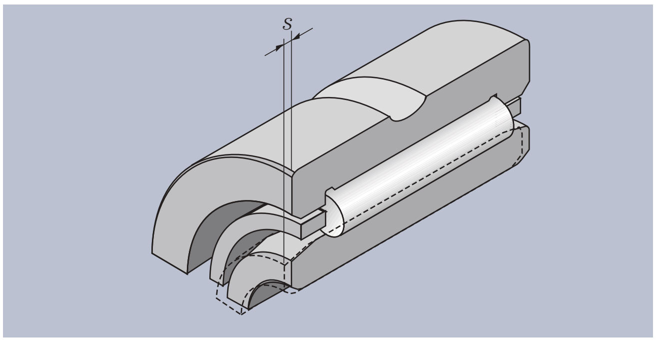
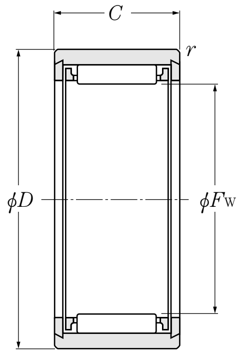


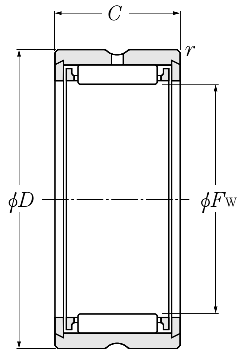
Fig. 1

Without Inner Ring

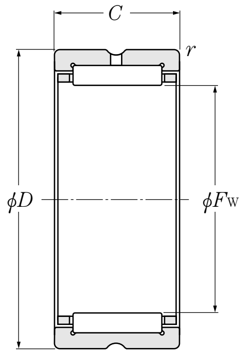
Type RNA49
Type RNA59
Type RNA69
Type NK
Type NKS



Type NK（ϕFw≦12mm）
Type NKS



Type RNA49（ϕFw≦12mm）

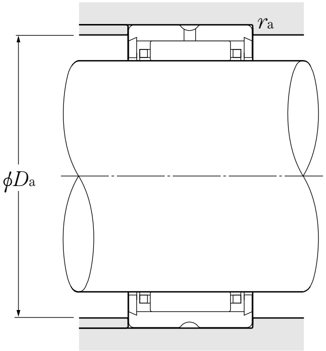


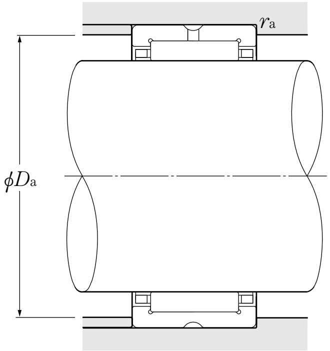
Type RNA49··R（ϕFw≧14mm）
Type RNA59
Type RNA69··R
Type NK··R（ϕFw≧14mm）

F_w 5～15mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass
mm				dynamic N	static N	dynamic kgf	static kgf	min⁻¹			mm		kg
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
5 +0.018/+0.010	10	10	0.15	2 640	2 190	269	224	27 000	40 000	NK5/10T2	6.5	0.15	0.0031
	10	12	0.15	2 720	2 250	277	230	27 000	40 000	NK5/12T2	6.5	0.15	0.0037
6 +0.018/+0.010	12	10	0.15	2 660	2 280	272	233	25 000	37 000	NK6/10T2	7.5	0.15	0.0047
	12	12	0.15	3 400	3 150	345	320	25 000	37 000	NK6/12T2	7.5	0.15	0.0057
7 +0.022/+0.013	13	10	0.15	2 670	2 350	272	239	23 000	34 000	RNA495T2	8.5	0.15	0.0055
	14	10	0.3	2 670	2 350	272	239	23 000	34 000	NK7/10T2	8.5	0.3	0.0069
	14	12	0.3	3 400	3 200	345	330	23 000	34 000	NK7/12T2	8.5	0.3	0.0082
8 +0.022/+0.013	15	10	0.15	3 150	3 000	320	305	21 000	32 000	RNA496T2T	9.5	0.15	0.0073
	15	12	0.3	4 000	4 100	410	420	21 000	32 000	NK8/12T2	9.5	0.3	0.0087
	15	16	0.3	4 850	5 200	495	535	21 000	32 000	NK8/16	9.5	0.3	0.0120
	16	13	0.3	4 650	4 150	475	425	21 000	32 000	NKS8T2	10	0.3	0.011
9 +0.022/+0.013	16	12	0.3	4 550	5 000	465	510	20 000	30 000	NK9/12T2	10.5	0.3	0.0100
	16	16	0.3	5 500	6 400	560	650	20 000	30 000	NK9/16T2	10.5	0.3	0.0130
	17	10	0.15	3 600	3 650	365	375	20 000	30 000	RNA497	10.5	0.15	0.0095
10 +0.022/+0.013	17	12	0.3	4 550	5 100	460	520	19 000	28 000	NK10/12T2	11.5	0.3	0.0100
	17	16	0.3	5 450	6 450	555	660	19 000	28 000	8E-NK10/16CT	11.5	0.3	0.0130
	19	11	0.15	5 250	5 150	535	525	19 000	28 000	RNA498CT	12	0.15	0.0130
	19	13	0.3	5 500	5 450	560	555	19 000	28 000	NKS10	12	0.3	0.015
12 +0.027/+0.016	19	12	0.3	5 000	6 100	510	620	17 000	26 000	NK12/12	13.5	0.3	0.0130
	19	16	0.3	6 000	7 700	615	785	17 000	26 000	NK12/16	13.5	0.3	0.0160
	20	11	0.3	4 850	4 900	495	500	17 000	26 000	RNA499	14	0.3	0.0130
	22	16	0.3	9 000	9 400	920	960	17 000	26 000	NKS12	14.5	0.3	0.026
14 +0.027/+0.016	22	13	0.3	8 600	9 200	875	935	16 000	24 000	RNA4900R	20	0.3	0.0170
	22	16	0.3	10 300	11 500	1 050	1 170	16 000	24 000	NK14/16R	20	0.3	0.0210
	22	20	0.3	13 000	15 600	1 330	1 590	16 000	24 000	NK14/20R	20	0.3	0.0260
	25	16	0.3	8 950	9 650	915	985	16 000	24 000	NKS14	16.5	0.3	0.035
15 +0.027/+0.016	23	16	0.3	10 900	12 700	1 110	1 290	15 000	23 000	NK15/16R	21	0.3	0.0220
	23	20	0.3	13 800	17 200	1 410	1 750	15 000	23 000	NK15/20R	21	0.3	0.0270
	26	16	0.3	10 100	11 500	1 030	1 170	15 000	23 000	NKS15	17.5	0.3	0.028

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.





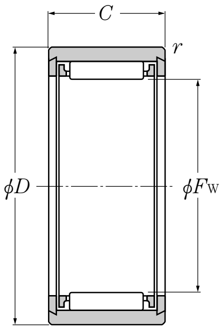
F_w 16～24mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass
mm				dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	min⁻¹			mm		kg
								grease	oil		D_a	r_{as}	
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}				max	max	(approx.)
$16^{+0.027}_{+0.016}$	24	13	0.3	9 550	10 900	975	1 110	15 000	23 000	**RNA4901R**	22	0.3	0.0170
	24	16	0.3	12 200	14 900	1 240	1 520	15 000	23 000	**NK16/16R**	22	0.3	0.0220
	24	20	0.3	14 600	18 800	1 490	1 920	15 000	23 000	**NK16/20R**	22	0.3	0.0280
	24	22	0.3	15 400	20 000	1 570	2 040	15 000	23 000	**RNA6901R**	22	0.3	0.0310
	28	16	0.3	12 600	13 900	1 290	1 410	15 000	23 000	**NKS16**	19	0.3	0.039
$17^{+0.027}_{+0.016}$	25	16	0.3	12 100	15 000	1 240	1 530	15 000	22 000	**NK17/16R**	23	0.3	0.024
	25	20	0.3	15 400	20 400	1 570	2 080	15 000	22 000	**NK17/20R**	23	0.3	0.030
$18^{+0.027}_{+0.016}$	26	16	0.3	12 700	16 200	1 300	1 650	14 000	21 000	**NK18/16R**	24	0.3	0.025
	26	20	0.3	16 100	22 000	1 640	2 250	14 000	21 000	**NK18/20RCT**	24	0.3	0.031
	30	16	0.3	11 600	12 800	1 180	1 300	14 000	21 000	**NKS18**	21	0.3	0.038
$19^{+0.033}_{+0.020}$	27	16	0.3	13 300	17 400	1 350	1 780	14 000	21 000	**NK19/16R**	25	0.3	0.026
	27	20	0.3	16 000	22 200	1 630	2 260	14 000	21 000	**NK19/20R**	25	0.3	0.032
$20^{+0.033}_{+0.020}$	28	13	0.3	10 300	12 800	1 050	1 310	13 000	20 000	**RNA4902R**	26	0.3	0.022
	28	16	0.3	13 200	17 500	1 340	1 790	13 000	20 000	**NK20/16RCT**	26	0.3	0.027
	28	18	0.3	14 100	19 100	1 440	1 950	13 000	20 000	**RNA5902CT**	26	0.3	0.033
	28	20	0.3	16 700	23 800	1 700	2 420	13 000	20 000	**NK20/20R**	26	0.3	0.034
	28	23	0.3	17 600	25 300	1 790	2 580	13 000	20 000	**RNA6902R**	26	0.3	0.040
	32	20	0.3	17 800	22 800	1 810	2 330	13 000	20 000	**NKS20**	23	0.3	0.049
$21^{+0.033}_{+0.020}$	29	16	0.3	13 700	18 700	1 400	1 910	13 000	19 000	**NK21/16R**	27	0.3	0.028
	29	20	0.3	17 400	25 400	1 770	2 590	13 000	19 000	**NK21/20R**	27	0.3	0.035
$22^{+0.033}_{+0.020}$	30	16	0.3	14 200	19 900	1 450	2 030	12 000	18 000	**NK22/16R**	28	0.3	0.034
	30	20	0.3	18 000	27 000	1 840	2 760	12 000	18 000	**NK22/20R**	28	0.3	0.037
	30	13	0.3	11 200	14 600	1 140	1 490	12 000	18 000	**RNA4903R**	28	0.3	0.022
	30	18	0.3	15 200	21 700	1 550	2 210	12 000	18 000	**RNA5903**	28	0.3	0.035
	30	23	0.3	18 200	27 200	1 850	2 770	12 000	18 000	**RNA6903R**	28	0.3	0.042
	35	20	0.6	17 700	23 300	1 810	2 380	12 000	18 000	**NKS22**	25	0.6	0.062
$24^{+0.033}_{+0.020}$	32	16	0.3	15 200	22 300	1 550	2 280	11 000	170 00	**NK24/16R**	30	0.3	0.032
	32	20	0.3	18 600	28 800	1 890	2 930	11 000	17 000	**NK24/20R**	30	0.3	0.040
	37	20	0.6	18 400	25 200	1 880	2 570	11 000	17 000	**NKS24**	27	0.6	0.066

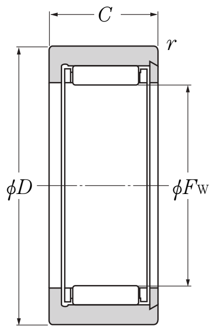
Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

Without Inner Ring

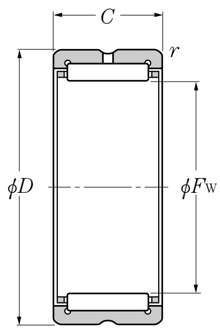
Type RNA49
Type RNA59
Type RNA69
Type NK
Type NKS



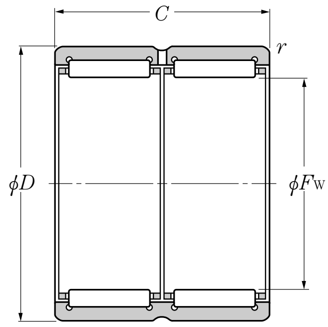
Type NKS
(ϕFw≦40mm)



Type NKS
(ϕFw>43mm)



Type RNA49··R, Type RNA59
Type RNA69··R (ϕFw≧35mm)
Type NK··R

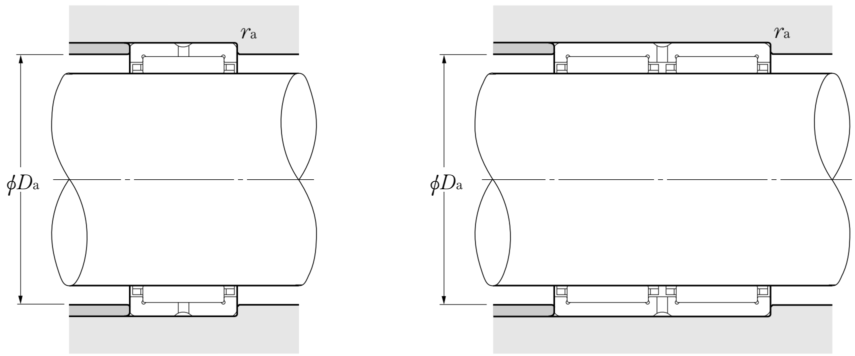


Type RNA69··R
(ϕFw≧40mm)

F_w 25〜32mm

Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers	Abutment dimensions (mm)		Mass (kg)
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}				D_a max	r_{as} max	(approx.)
25 +0.033 +0.020	33	16	0.3	15 100	22 400	1 540	2 280	11 000	16 000	NK25/16R	31	0.3	0.033
	33	20	0.3	19 200	30 500	1 960	3 100	11 000	16 000	NK25/20RCT	31	0.3	0.042
	37	17	0.3	21 300	25 500	2 170	2 600	11 000	16 000	RNA4904RCT	35	0.3	0.052
	37	23	0.3	28 400	37 000	2 900	3 750	11 000	16 000	RNA5904	35	0.3	0.084
	37	30	0.3	36 500	50 500	3 700	5 150	11 000	16 000	RNA6904R	35	0.3	0.100
	38	20	0.6	18 300	25 300	1 870	2 580	11 000	16 000	NKS25	28	0.6	0.068
26 +0.033 +0.020	34	16	0.3	15 600	23 600	1 590	2 410	10 000	15 000	NK26/16R	32	0.3	0.034
	34	20	0.3	19 100	30 500	1 940	3 100	10 000	15 000	NK26/20R	32	0.3	0.042
28 +0.033 +0.020	37	20	0.3	22 300	34 000	2 280	3 450	9 500	14 000	NK28/20R	35	0.3	0.052
	37	30	0.3	26 700	48 000	2 720	4 900	9 500	14 000	NK28/30RCT	35	0.3	0.082
	39	17	0.3	23 200	29 300	2 360	2 990	9 500	14 000	RNA49/22R	37	0.3	0.050
	39	23	0.3	26 400	37 500	2 690	3 850	9 500	14 000	RNA59/22	37	0.3	0.092
	39	30	0.3	40 000	58 500	4 050	6 000	9 500	14 000	RNA69/22R	37	0.3	0.100
	42	20	0.6	18 100	25 800	1 850	2 630	9 500	14 000	NKS28	31	0.6	0.084
29 +0.033 +0.020	38	20	0.3	22 200	34 000	2 270	3 450	9 500	14 000	NK29/20R	36	0.3	0.054
	38	30	0.3	27 500	50 500	2 810	5 150	9 500	14 000	NK29/30R	36	0.3	0.084
30 +0.033 +0.020	40	20	0.3	22 100	34 000	2 260	3 500	8 500	13 000	NK30/20R	38	0.3	0.065
	40	30	0.3	33 000	57 000	3 350	5 800	8 500	13 000	NK30/30R	38	0.3	0.098
	42	17	0.3	24 000	31 500	2 450	3 200	8 500	13 000	RNA4905R	40	0.3	0.061
	42	23	0.3	30 500	43 000	3 150	4 350	8 500	13 000	RNA5905	40	0.3	0.101
	42	30	0.3	41 500	63 000	4 200	6 400	8 500	13 000	RNA6905R	40	0.3	0.112
	45	22	0.6	23 300	33 000	2 370	3 350	8 500	13 000	NKS30	33.5	0.6	0.104
32 +0.041 +0.025	42	20	0.3	23 500	37 500	2 400	3 850	8 500	13 000	NK32/20R	40	0.3	0.068
	42	30	0.3	34 000	60 500	3 450	6 150	8 500	13 000	NK32/30R	40	0.3	0.102
	45	17	0.3	24 800	33 500	2 530	3 400	8 500	13 000	RNA49/28RCT	43	0.3	0.073
	45	23	0.3	32 000	45 500	3 250	4 650	8 500	13 000	RNA59/28	43	0.3	0.108
	45	30	0.3	43 000	67 000	4 350	6 850	8 500	13 000	RNA69/28R	43	0.3	0.135
	47	22	0.6	24 000	35 000	2 450	3 550	8 500	13 000	NKS32	35.5	0.6	0.11

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



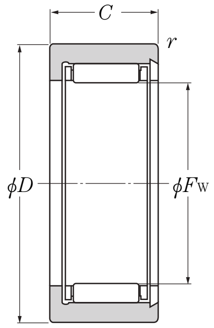
F_w 35～45mm

Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹)		Bearing numbers	Abutment dimensions (mm)		Mass (kg)
F_w	D	C	$r_{s\,min}$ [1)]	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
35 $^{+0.041}_{+0.025}$	45	20	0.3	24 800	41 500	2 520	4 250	7 500	11 000	**NK35/20RCT**	43	0.3	0.074
	45	30	0.3	36 000	66 500	3 650	6 800	7 500	11 000	**NK35/30R**	43	0.3	0.112
	47	17	0.3	25 500	35 500	2 600	3 600	7 500	11 000	**RNA4906R**	45	0.3	0.069
	47	23	0.3	32 500	48 500	3 350	4 950	7 500	11 000	**RNA5906**	45	0.3	0.108
	47	30	0.3	42 500	67 500	4 300	6 900	7 500	11 000	**RNA6906R**	45	0.3	0.126
	50	22	0.6	24 700	37 000	2 510	3 750	7 500	11 000	**NKS35**	38.5	0.6	0.118
37 $^{+0.041}_{+0.025}$	47	20	0.3	25 300	43 500	2 580	4 400	7 500	11 000	**NK37/20R**	45	0.3	0.077
	47	30	0.3	36 500	69 500	3 750	7 100	7 500	11 000	**NK37/30R**	45	0.3	0.107
	52	22	0.6	26 300	41 000	2 680	4 150	7 500	11 000	**NKS37**	40.5	0.6	0.123
38 $^{+0.041}_{+0.025}$	48	20	0.3	25 900	45 000	2 640	4 600	7 500	11 000	**NK38/20R**	46	0.3	0.079
	48	30	0.3	37 500	73 000	3 850	7 400	7 500	11 000	**NK38/30R**	46	0.3	0.107
40 $^{+0.041}_{+0.025}$	50	20	0.3	26 400	47 000	2 700	4 800	6 500	10 000	**NK40/20R**	48	0.3	0.083
	50	30	0.3	38 500	76 000	3 900	7 750	6 500	10 000	**NK40/30R**	48	0.3	0.125
	52	20	0.6	31 500	47 500	3 200	4 850	6 500	10 000	**RNA49/32R**	48	0.6	0.089
	52	27	0.6	38 000	61 000	3 850	6 250	6 500	10 000	**RNA59/32**	48	0.6	0.149
	52	36	0.6	47 500	82 000	4 850	8 350	6 500	10 000	**RNA69/32R**	48	0.6	0.162
	55	22	0.6	27 700	45 000	2 820	4 550	6 500	10000	**NKS40**	43.5	0.6	0.129
42 $^{+0.041}_{+0.025}$	52	20	0.3	26 900	49 000	2 750	5 000	6 500	9 500	**NK42/20R**	50	0.3	0.086
	52	30	0.3	39 000	79 000	4 000	8 050	6 500	9 500	**NK42/30R**	50	0.3	0.130
	55	20	0.6	32 000	50 000	3 300	5 100	6 500	9 500	**RNA4907R**	51	0.6	0.107
	55	27	0.6	39 000	64 500	3 950	6 550	6 500	9 500	**RNA5907**	51	0.6	0.176
	55	36	0.6	49 000	86 500	5 000	8 800	6 500	9 500	**RNA6907R**	51	0.6	0.193
43 $^{+0.041}_{+0.025}$	53	20	0.3	27 500	51 000	2 810	5 200	6 500	9 500	**NK43/20R**	51	0.3	0.086
	53	30	0.3	40 000	82 000	4 100	8 400	6 500	9 500	**NK43/30R**	51	0.3	0.133
	58	22	0.6	29 100	49 000	2 960	5 000	6 500	9 500	**NKS43**	46.5	0.6	0.14
45 $^{+0.041}_{+0.025}$	55	20	0.3	28 000	52 500	2 860	5 400	6 000	9 000	**NK45/20R**	53	0.3	0.092
	55	30	0.3	41 000	85 500	4 150	8 700	6 000	9 000	**NK45/30RCT**	53	0.3	0.139
	60	22	0.6	29 700	51 000	3 000	5 200	6 000	9 000	**NKS45**	48.5	0.6	0.16

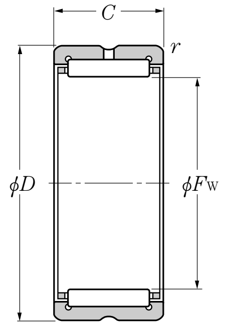
Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

Without Inner Ring

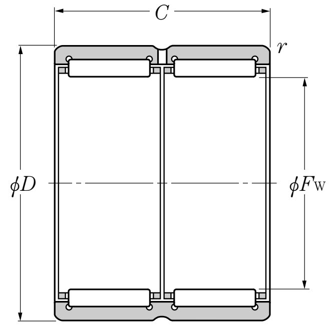
Type RNA49
Type RNA59
Type RNA69
Type NK
Type NKS



Type NKS



Type RNA48
Type RNA49··R
Type RNA59
Type NK··R

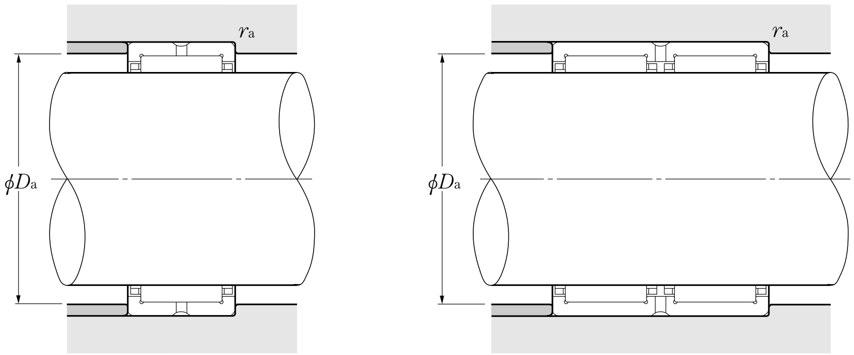


Type RNA69··R

F_w 47～68mm

Boundary dimensions (mm) F_w	D	C	$r_{s\,min}$ 1)	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers	Abutment dimensions (mm) D_a max	r_{as} max	Mass (kg) (approx.)
47 $^{+0.041}_{+0.025}$	57	20	0.3	28 800	55 500	2 940	5 650	5 500	8 500	**NK47/20RCT**	55	0.3	0.095
	57	30	0.3	42 500	91 500	4 350	9 350	5 500	8 500	**NK47/30R**	55	0.3	0.142
48 $^{+0.041}_{+0.025}$	62	22	0.6	43 500	66 500	4 450	6 800	5 500	8 500	**RNA4908R**	58	0.6	0.140
	62	30	0.6	53 000	92 500	5 450	9 450	5 500	8 500	**RNA5908**	58	0.6	0.225
	62	40	0.6	67 000	116 000	6 850	11 800	5 500	8 500	**RNA6908R**	58	0.6	0.256
50 $^{+0.041}_{+0.025}$	62	25	0.6	38 500	74 500	3 950	7 550	5 500	8 000	**NK50/25RCT**	58	0.6	0.158
	62	35	0.6	51 000	106 000	5 200	10 800	5 500	8 000	**NK50/35R**	58	0.6	0.221
	65	22	1	31 500	57 000	3 200	5 800	5 500	8 000	**NKS50**	53.5	1	0.157
52 $^{+0.049}_{+0.030}$	68	22	0.6	46 000	73 000	4 700	7 450	5 000	7 500	**RNA4909R**	64	0.6	0.182
	68	30	0.6	56 000	101 000	5 700	10 300	5 000	7 500	**RNA5909**	64	0.6	0.232
	68	40	0.6	70 500	127 000	7 200	13 000	5 000	7 500	**RNA6909R**	64	0.6	0.273
55 $^{+0.049}_{+0.030}$	68	25	0.6	41 000	82 000	4 150	8 400	5 000	7 500	**NK55/25R**	64	0.6	0.193
	68	35	0.6	54 000	118 000	5 500	12 000	5 000	7 500	**NK55/35R**	64	0.6	0.26
	72	22	1	33 500	63 000	3 400	6 450	5 000	7 500	**NKS55**	58.5	1	0.221
58 $^{+0.049}_{+0.030}$	72	22	0.6	48 000	80 000	4 900	8 150	4 700	7 000	**RNA4910R**	68	0.6	0.163
	72	30	0.6	58 000	110 000	5 950	11 200	4 700	7 000	**RNA5910**	68	0.6	0.289
	72	40	0.6	74 000	139 000	7 500	14 200	4 700	7 000	**RNA6910R**	68	0.6	0.320
60 $^{+0.049}_{+0.030}$	72	25	0.6	41 000	85 000	4 200	8 700	4 300	6 500	**NK60/25R**	68	0.6	0.185
	72	35	0.6	57 000	130 000	5 800	13 200	4 300	6 500	**NK60/35R**	68	0.6	0.258
	80	28	1.1	44 500	85 000	4 500	8 700	4 300	6 500	**NKS60**	64	1.1	0.335
63 $^{+0.049}_{+0.030}$	80	25	1	58 500	99 500	6 000	10 100	4 300	6 500	**RNA4911R**	75	1	0.255
	80	34	1	76 500	140 000	7 800	14 300	4 300	6 500	**RNA5911**	75	1	0.367
	80	45	1	94 000	183 000	9 600	18 600	4 300	6 500	**RNA6911R**	75	1	0.470
65 $^{+0.049}_{+0.030}$	78	25	0.6	45 000	98 000	4 550	10 000	4 000	6 000	**NK65/25R**	74	0.6	0.221
	78	35	0.6	60 000	142 000	6 100	14 400	4 000	6 000	**NK65/35R**	74	0.6	0.310
	85	28	1.1	47 000	94 000	4 800	9 600	4 000	6 000	**NKS65**	69	1.1	0.356
68 $^{+0.049}_{+0.030}$	82	25	1	44 500	89 000	4 500	9 050	4 000	6 000	**NK68/25R**	77	0.6	0.241
	82	35	0.6	63 000	139 000	6 400	14 200	4 000	6 000	**NK68/35R**	78	0.6	0.338
	85	25	1	61 500	108 000	6 250	11 000	4 000	6 000	**RNA4912R**	80	1	0.275

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



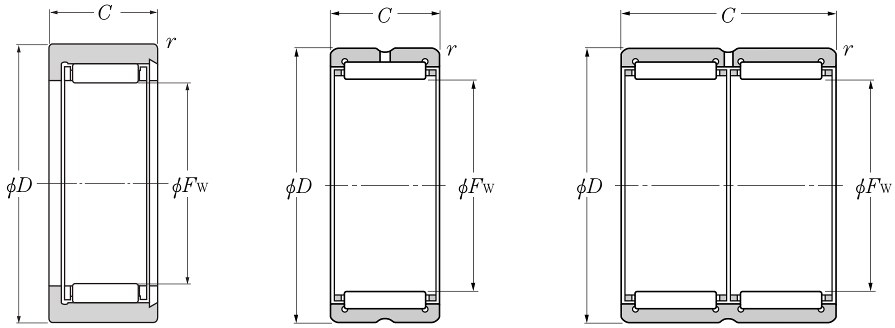
F_W 68～90mm

Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1})		Bearing numbers	Abutment dimensions (mm)		Mass (kg)
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
68 $^{+0.049}_{+0.030}$	85	34	1	80 500	153 000	8 200	15 600	4 000	6 000	RNA5912	80	1	0.408
	85	45	1	95 500	191 000	9 750	19 400	4 000	6 000	RNA6912R	80	1	0.488
70 $^{+0.049}_{+0.030}$	85	25	0.6	45 000	91 500	4 600	9 350	3 700	5 500	NK70/25R	81	0.6	0.275
	85	35	0.6	64 000	144 000	6 550	14 700	3 700	5 500	NK70/35R	81	0.6	0.386
	90	28	1.1	49 500	103 000	5 050	10 500	3 700	5 500	NKS70	74	1.1	0.38
72 $^{+0.049}_{+0.030}$	90	25	1	62 500	112 000	6 350	11 400	3 700	5 500	RNA4913R	85	1	0.312
	90	34	1	84 000	165 000	8 600	16 800	3 700	5 500	RNA5913	85	1	0.462
	90	45	1	97 000	198 000	9 900	20 200	3 700	5 500	RNA6913R	85	1	0.520
73 $^{+0.049}_{+0.030}$	90	25	0.6	54 000	100 000	5 500	10 200	3 700	5 500	NK73/25R	86	0.6	0.302
	90	35	0.6	76 500	156 000	7 800	16 000	3 700	5 500	NK73/35R	86	0.6	0.428
75 $^{+0.049}_{+0.030}$	92	25	0.6	55 000	104 000	5 600	10 600	3 700	5 500	NK75/25R	88	0.6	0.315
	92	35	0.6	78 000	162 000	7 950	16 500	3 700	5 500	NK75/35R	88	0.6	0.492
	95	28	1.1	50 500	109 000	5 150	11 100	3 700	5 500	NKS75	79	1.1	0.402
80 $^{+0.049}_{+0.030}$	95	25	1	57 000	119 000	5 800	12 200	3 300	5 000	NK80/25R	90	1	0.301
	95	35	1	79 500	184 000	8 150	18 700	3 300	5 000	NK80/35R	90	1	0.425
	100	28	1.1	53 000	118 000	5 400	12 100	3 300	5 000	NKS80	84	1.1	0.413
	100	30	1	85 500	156 000	8 750	15 900	3 300	5 000	RNA4914R	95	1	0.460
	100	40	1	103 000	187 000	10 500	19 100	3 300	5 000	RNA5914	95	1	0.706
	100	54	1	130 000	267 000	13 300	27 200	3 300	5 000	RNA6914R	95	1	0.857
85 $^{+0.058}_{+0.036}$	105	25	1	70 500	123 000	7 200	12 600	3 100	4 700	NK85/25R	100	1	0.404
	105	30	1	87 000	162 000	8 900	16 500	3 100	4 700	RNA4915R	100	1	0.489
	105	32	1.1	64 000	153 000	6 500	15 600	3 100	4 700	NKS85	89	1.1	0.475
	105	35	1	100 000	193 000	10 200	19 700	3 100	4 700	NK85/35R	100	1	0.517
	105	40	1	109 000	205 000	11 100	20 900	3 100	4 700	RNA5915	100	1	0.745
	105	54	1	132 000	277 000	13 500	28 300	3 100	4 700	RNA6915R	100	1	0.935
90 $^{+0.058}_{+0.036}$	110	25	1	71 500	128 000	7 300	13 100	2 900	4 400	NK90/25R	105	1	0.426
	110	30	1	90 500	174 000	9 250	17 700	2 900	4 400	RNA4916R	105	1	0.516
	110	32	1.1	64 000	157 000	6 550	16 000	2 900	4 400	NKS90	94	1.1	0.714
	110	35	1	104 000	208 000	10 600	21 200	2 900	4 400	NK90/35R	105	1	0.604

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

Without Inner Ring

Type RNA49
Type RNA59
Type RNA69
Type NK
Type NKS



Type NKS
(ϕF_W≦110mm)

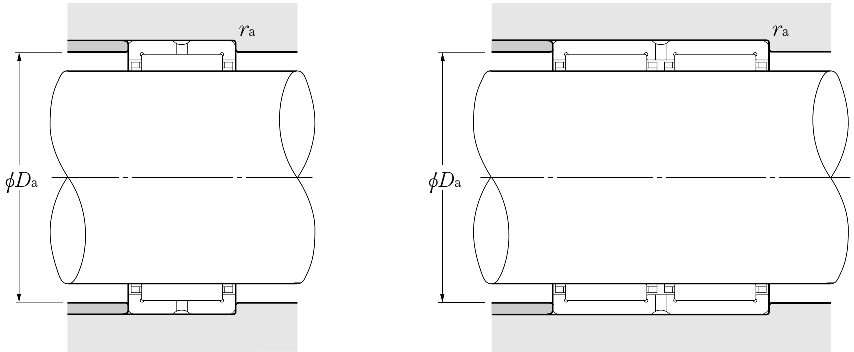
Type RNA48
Type RNA49··R, Type RNA49
Type RNA59
Type NK··R, Type NK
Type NKS (ϕF_W≧115mm)

Type RNA69··R

F_W 90～125mm

Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers	Abutment dimensions (mm)		Mass (kg)
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
$90^{+0.058}_{+0.036}$	110	40	1	115 000	223 000	11 700	22 700	2 900	4 400	**RNA5916**	105	1	0.787
	110	54	1	138 000	298 000	14 000	30 500	2 900	4 400	**RNA6916R**	105	1	0.987
$95^{+0.058}_{+0.036}$	115	26	1	74 500	137 000	7 600	14 000	2 800	4 200	**NK95/26R**	110	1	0.364
	115	32	1.1	65 500	165 000	6 700	16 800	2 800	4 200	**NKS95**	99	1.1	0.765
	115	36	1	108 000	223 000	11 100	22 700	2 800	4 200	**NK95/36R**	110	1	0.652
$100^{+0.058}_{+0.036}$	120	26	1	73 500	137 000	7 500	14 000	2 700	4 000	**NK100/26R**	115	1	0.487
	120	32	1.1	61 000	153 000	6 250	15 600	2 700	4 000	**NKS100**	104	1.1	0.67
	120	35	1.1	112 000	237 000	11 500	24 200	2 700	4 000	**RNA4917R**	113.5	1	0.657
	120	36	1	107 000	223 000	11 000	22 800	2 700	4 000	**NK100/36R**	115	1	0.679
	120	46	1.1	137 000	290 000	14 000	29 600	2 700	4 000	**RNA5917**	113.5	1	1.00
	120	63	1.1	169 000	400 000	17 300	41 000	2 700	4 000	**RNA6917R**	113.5	1	1.20
$105^{+0.058}_{+0.036}$	125	26	1	76 500	147 000	7 800	14 900	2 500	3 800	**NK105/26R**	120	1	0.506
	125	32	1.1	67 500	176 000	6 850	18 000	2 500	3 800	**NKS105**	109	1.1	0.68
	125	35	1.1	116 000	252 000	11 900	25 700	2 500	3 800	**RNA4918R**	118.5	1	0.697
	125	36	1	111 000	238 000	11 400	24 300	2 500	3 800	**NK105/36R**	120	1	0.713
	125	46	1.1	143 000	310 000	14 600	32 000	2 500	3 800	**RNA5918**	118.5	1	1.04
	125	63	1.1	175 000	425 000	17 900	43 500	2 500	3 800	**RNA6918R**	118.5	1	1.33
$110^{+0.058}_{+0.036}$	130	30	1.1	97 500	204 000	9 950	20 800	2 400	3 600	**NK110/30R**	123.5	1	0.612
	130	32	1.1	64 500	170 000	6 600	17 300	2 400	3 600	**NKS110**	114	1.1	0.695
	130	35	1.1	118 000	260 000	12 000	26 500	2 400	3 600	**RNA4919R**	123.5	1	0.719
	130	40	1.1	129 000	292 000	13 100	29 700	2 400	3 600	**NK110/40R**	123.5	1	0.830
	130	46	1.1	149 000	335 000	15 200	34 000	2 400	3 600	**RNA5919**	123.5	1	1.13
	130	63	1.1	177 000	440 000	18 100	45 000	2 400	3 600	**RNA6919R**	123.5	1	1.46
$115^{+0.058}_{+0.036}$	135	32	1.1	90 500	199 000	9 250	20 300	2 300	3 500	**NKS115**	128.5	1.1	0.7
	140	40	1.1	127 000	260 000	12 900	26 500	2 300	3 500	**RNA4920**	133.5	1	1.15
	140	54	1.1	182 000	395 000	18 600	40 500	2 300	3 500	**RNA5920**	133.5	1	1.76
$120^{+0.058}_{+0.036}$	140	30	1	93 500	210 000	9 550	21 400	2 200	3 300	**RNA4822**	135	1	0.670
	140	40	1.1	113 000	268 000	11 500	27 300	2 200	3 300	**NK120/40**	133.5	1	0.910
$125^{+0.068}_{+0.043}$	150	40	1.1	131 000	279 000	13 300	28 400	2 100	3 200	**RNA4922**	143.5	1	1.24

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



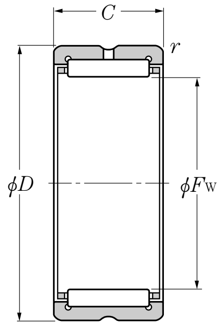
F_w 125～190mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1}		Bearing numbers	Abutment dimensions mm		Mass kg
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
$125^{+0.068}_{+0.043}$	150	54	1.1	193 000	440 000	19 700	45 000	2 100	3 200	RNA5922	143.5	1	1.89
$130^{+0.068}_{+0.043}$	150	30	1	99 500	233 000	10 100	23 800	2 100	3 100	RNA4824	145	1	0.730
	150	40	1.1	116 000	283 000	11 800	28 800	2 100	3 100	NK130/40	143.5	1	0.98
$135^{+0.068}_{+0.043}$	160	40	2	135 000	298 000	13 800	30 500	2 000	3 000	NKS135	151	2	1.32
	165	45	1.1	180 000	380 000	18 300	38 500	2 000	3 000	RNA4924	158.5	1	1.86
	165	60	1.1	246 000	530 000	25 100	54 000	2 000	3 000	RNA5924	158.5	1	2.67
$145^{+0.068}_{+0.043}$	165	35	1.1	118 000	305 000	12 100	31 000	1 900	2 800	RNA4826	158.5	1	0.95
	170	32	1.5	111 000	238 000	11 300	24 300	1 900	2 800	NK145/32	162.5	1.5	1.12
	170	42	1.5	153 000	360 000	15 600	36 500	1 900	2 800	NK145/42	162.5	1.5	1.49
$150^{+0.068}_{+0.043}$	180	50	1.5	202 000	455 000	20 600	46 500	1 800	2 700	RNA4926	172	1.5	2.21
	180	52	2	202 000	455 000	20 600	46 500	1 800	2 700	NKS150	171	2	2.32
	180	67	1.5	296 000	690 000	30 000	70 500	1 800	2 700	RNA5926	172	1.5	3.21
$155^{+0.068}_{+0.043}$	175	35	1.1	121 000	315 000	12 300	32 500	1 700	2 600	RNA4828	168.5	1	1.02
	180	32	1.5	114 000	252 000	11 600	25 700	1 700	2 600	NK155/32	172	1.5	1.20
	180	42	1.5	156 000	380 000	16 000	38 500	1 700	2 600	NK155/42	172	1.5	1.59
$160^{+0.068}_{+0.043}$	190	50	1.5	209 000	485 000	21 300	49 500	1 700	2 500	RNA4928	182	1.5	2.35
	190	52	2	209 000	485 000	21 300	49 500	1 700	2 500	NKS160	181	2	2.45
	190	67	1.5	315 000	760 000	32 000	77 500	1 700	2 500	RNA5928	182	1.5	3.48
$165^{+0.068}_{+0.043}$	190	32	1.5	117 000	265 000	11 900	27 000	1 600	2 400	NK165/32	182	1.5	1.42
	190	40	1.1	152 000	390 000	15 500	40 000	1 600	2 400	RNA4830	183.5	1	1.60
	190	42	1.5	160 000	400 000	16 300	40 500	1 600	2 400	NK165/42	182	1.5	1.66
$170^{+0.068}_{+0.043}$	200	52	2	215 000	515 000	21 900	52 500	1 600	2 400	NKS170	191	2	2.59
	210	60	2	261 000	610 000	26 600	62 500	1 600	2 400	RNA4930	201	2	2.98
$175^{+0.068}_{+0.043}$	200	40	1.1	160 000	425 000	16 300	43 500	1 500	2 300	RNA4832	193.5	1	1.70
$180^{+0.068}_{+0.043}$	220	60	2	270 000	650 000	27 600	66 500	1 500	2 200	RNA4932	211	2	3.10
$185^{+0.079}_{+0.050}$	215	45	1.1	185 000	495 000	18 800	50 500	1 500	2 200	RNA4834	208.5	1	2.54
$190^{+0.079}_{+0.050}$	230	60	2	279 000	690 000	28 500	70 500	1 400	2 100	RNA4934	221	2	3.22

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

Without Inner Ring

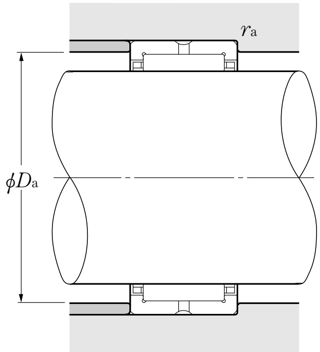
Type RNA48
Type RNA49



F_W 195～450mm

Boundary dimensions (mm) F_w	D	C	$r_{s\,min}$ 1)	Basic load ratings dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (min^{-1}) grease	oil	Bearing numbers	Abutment dimensions (mm) D_a max	r_{as} max	Mass (kg) (approx.)
195 $^{+0.079}_{+0.050}$	225	45	1.1	195 000	540 000	19 800	55 000	1 400	2 100	**RNA4836**	218.5	1	2.68
205 $^{+0.079}_{+0.050}$	250	69	2	375 000	890 000	38 500	90 500	1 300	2 000	**RNA4936**	241	2	4.48
210 $^{+0.079}_{+0.050}$	240	50	1.5	227 000	680 000	23 200	69 000	1 300	1 900	**RNA4838**	232	1.5	3.21
215 $^{+0.079}_{+0.050}$	260	69	2	390 000	945 000	40 000	96 500	1 300	1 900	**RNA4938**	251	2	4.53
220 $^{+0.079}_{+0.050}$	250	50	1.5	231 000	705 000	23 600	71 500	1 200	1 800	**RNA4840**	242	1.5	3.35
225 $^{+0.079}_{+0.050}$	280	80	2.1	505 000	1 180 000	51 500	120 000	1 200	1 800	**RNA4940**	269	2	7.20
240 $^{+0.079}_{+0.050}$	270	50	1.5	244 000	780 000	24 900	79 500	1 100	1 700	**RNA4844**	262	1.5	3.62
245 $^{+0.079}_{+0.050}$	300	80	2.1	525 000	1 270 000	53 500	129 000	1 100	1 600	**RNA4944**	289	2	7.81
265 $^{+0.088}_{+0.056}$	300	60	2	360 000	1 080 000	37 000	110 000	1 000	1 500	**RNA4848**	291	2	5.40
	320	80	2.1	540 000	1 350 000	55 000	138 000	1 000	1 500	**RNA4948**	309	2	8.40
285 $^{+0.088}_{+0.056}$	320	60	2	375 000	1 160 000	38 000	119 000	950	1 400	**RNA4852**	311	2	5.80
290 $^{+0.088}_{+0.056}$	360	100	2.1	805 000	1 900 000	82 000	193 000	950	1 400	**RNA4952**	349	2	15.90
305 $^{+0.088}_{+0.056}$	350	69	2	455 000	1 300 000	46 500	133 000	850	1 300	**RNA4856**	341	2	9.30
310 $^{+0.088}_{+0.056}$	380	100	2.1	835 000	2 030 000	85 000	207 000	850	1 300	**RNA4956**	369	2	16.70
330 $^{+0.098}_{+0.062}$	380	80	2.1	625 000	1 770 000	64 000	180 000	800	1 200	**RNA4860**	369	2	12.70
340 $^{+0.098}_{+0.062}$	420	118	3	1 080 000	2 640 000	110 000	269 000	800	1 200	**RNA4960**	407	2.5	24.00
350 $^{+0.098}_{+0.062}$	400	80	2.1	640 000	1 850 000	65 500	189 000	750	1 100	**RNA4864**	389	2	13.40
360 $^{+0.098}_{+0.062}$	440	118	3	1 120 000	2 820 000	114 000	288 000	750	1 100	**RNA4964**	427	2.5	25.20
370 $^{+0.098}_{+0.062}$	420	80	2.1	655 000	1 940 000	66 500	197 000	750	1 100	**RNA4868**	409	2	14.00
380 $^{+0.098}_{+0.062}$	460	118	3	1 160 000	3 000 000	118 000	305 000	750	1 100	**RNA4968**	447	2.5	26.50
390 $^{+0.098}_{+0.062}$	440	80	2.1	665 000	2 020 000	68 000	206 000	650	1 000	**RNA4872**	429	2	14.80
400 $^{+0.108}_{+0.068}$	480	118	3	1 200 000	3 200 000	122 000	325 000	650	1 000	**RNA4972**	467	2.5	28.20
415 $^{+0.108}_{+0.068}$	480	100	2.1	1 000 000	2 840 000	102 000	289 000	650	950	**RNA4876**	469	2	26.00
430 $^{+0.108}_{+0.068}$	520	140	4	1 400 000	3 750 000	143 000	385 000	650	950	**RNA4976**	504	3	38.60
450 $^{+0.108}_{+0.068}$	540	140	4	1 450 000	4 000 000	148 000	410 000	600	900	**RNA4980**	524	3	40.10

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



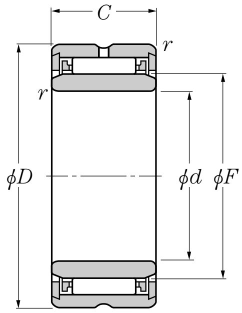
F_w 470～490mm

Boundary dimensions (mm)				Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1}) grease	oil	Bearing numbers	Abutment dimensions (mm)		Mass (kg)
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil		D_a max	r_{as} max	(approx.)
470 $^{+0.108}_{+0.068}$	560	140	4	1 500 000	4 250 000	153 000	430 000	550	850	**RNA4984**	544	3	51.60
490 $^{+0.108}_{+0.068}$	600	160	4	1 750 000	4 600 000	179 000	470 000	550	800	**RNA4988**	584	3	66.90

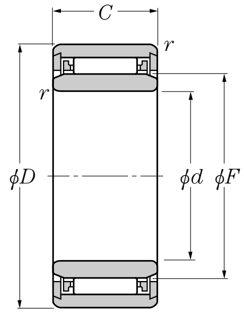
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

With inner ring

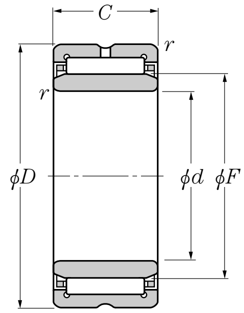
Type NA49
Type NA59
Type NA69
Type NK＋IR
Type NKS＋IR



Type NA49（ϕd≦9mm）



Type NK＋IR（ϕd≦9mm）
Type NKS＋IR

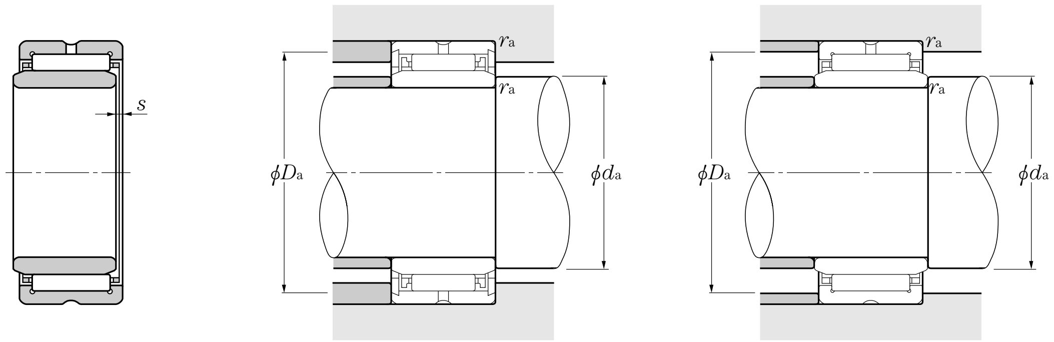


Type NA49··R（ϕd≧10mm）
Type NA59
Type NA69··R
Type NK··R＋IR（ϕd≧10mm）

d 5～15mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}			
5	13	10	0.15	7	—	2 670	2 350	272	239	23 000	34 000	**NA495T2**
	15	12	0.3	8	1.5	4 000	4 100	410	420	21 000	32 000	**NK8/12T2＋IR5×8×12**
	15	16	0.3	8	2	4 850	5 200	495	535	21 000	32 000	**NK8/16T2＋IR5×8×16**
6	15	10	0.15	8	—	3 150	3 000	320	305	21 000	32 000	**NA496T2T**
	16	12	0.3	9	1.5	4 550	5 000	465	510	20 000	30 000	**NK9/12T2＋IR6×9×12**
	16	16	0.3	9	2	5 500	6 400	560	650	20 000	30 000	**NK9/16T2＋IR6×9×16**
	19	13	0.3	10	1.5	5 500	5 450	560	555	19 000	28 000	**NKS10＋IR6×10×13**
7	17	10	0.15	9	—	3 600	3 650	365	375	20 000	30 000	**NA497**
	17	12	0.3	10	1.5	4 550	5 100	460	520	19 000	28 000	**NK10/12T2＋IR7×10×12**
	17	16	0.3	10	2	5 450	6 450	555	660	19 000	28 000	**8E-NK10/16CT＋IR7×10×16**
	22	16	0.3	12	2	9 000	9 400	920	960	17 000	26 000	**NKS12＋IR7×12×16**
8	19	11	0.15	10	—	5 250	5 150	535	525	19 000	28 000	**NA498CT**
	25	16	0.3	14	2	8 950	9 650	915	985	16 000	24 000	**NKS14＋IR8×14×16**
9	19	12	0.3	12	1.5	5 000	6 100	510	620	17 000	26 000	**NK12/12＋IR9×12×12**
	19	16	0.3	12	2	6 000	7 700	615	785	17 000	26 000	**NK12/16＋IR9×12×16**
	20	11	0.3	12	—	4 850	4 900	495	500	17 000	26 000	**NA499**
	26	16	0.3	15	2	10 100	11 500	1 030	1 170	15 000	23 000	**NKS15＋IR9×15×16**
10	22	13	0.3	14	0.5	8 600	9 200	875	935	16 000	24 000	**NA4900R**
	22	16	0.3	14	0.5	10 300	11 500	1 050	1 170	16 000	24 000	**NK14/16R＋IR10×14×16**
	22	20	0.3	14	0.5	13 000	15 600	1 330	1 590	16 000	24 000	**NK14/20R＋IR10×14×20**
	28	16	0.3	16	1.5	12 600	13 900	1 290	1 410	15 000	23 000	**NKS16＋IR10×16×16**
12	24	13	0.3	16	0.5	9 550	10 900	975	1 110	15 000	23 000	**NA4901R**
	24	16	0.3	16	0.5	12 200	14 900	1 240	1 520	15 000	23 000	**NK16/16R＋IR12×16×16**
	24	20	0.3	16	0.5	14 600	18 800	1 490	1 920	15 000	23 000	**NK16/20R＋IR12×16×20**
	24	22	0.3	16	1	15 400	20 000	1 570	2 040	15 000	23 000	**NA6901R**
	30	16	0.3	18	1.5	11 600	12 800	1 180	1 300	14 000	21 000	**NKS18＋IR12×18×16**
15	27	16	0.3	19	0.5	13 300	17 400	1 350	1 780	14 000	21 000	**NK19/16R＋IR15×19×16**
	27	20	0.3	19	0.5	16 000	22 200	1 630	2 260	14 000	21 000	**NK19/20R＋IR15×19×20**
	28	13	0.3	20	0.5	10 300	12 800	1 050	1 310	13 000	20 000	**NA4902R**

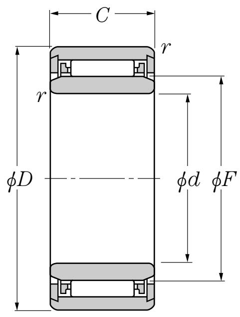
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



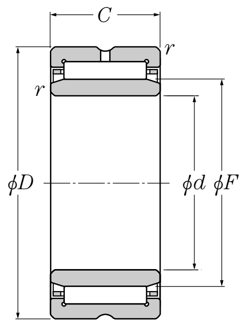
Abutment dimensions mm d_a min	D_a max	r_{as} [3)] max	Mass kg (approx.)
6.2	8.5	0.15	0.007
7	9.5	0.3	0.012
7	9.5	0.3	0.016
8	9.5	0.15	0.009
8	10.5	0.3	0.013
8	10.5	0.3	0.017
8	12	0.3	0.02
9	10.5	0.15	0.010
9	11.5	0.3	0.014
9	11.5	0.3	0.018
9	14.5	0.3	0.035
10	12	0.15	0.016
10	16.5	0.3	0.048
11	13.5	0.3	0.018
11	13.5	0.3	0.022
11	14	0.3	0.017
11	17.5	0.3	0.042
12	20	0.3	0.024
12	20	0.3	0.030
12	20	0.3	0.038
12	19	0.3	0.054
14	22	0.3	0.026
14	22	0.3	0.033
14	22	0.3	0.042
14	22	0.3	0.046
14	21	0.3	0.056
17	25	0.3	0.039
17	25	0.3	0.045
17	26	0.3	0.036

With inner ring

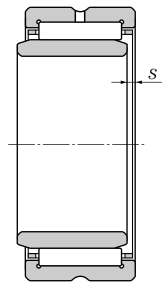
Type NA49
Type NA59
Type NA69
Type NK+IR
Type NKS+IR



Type NKS+IR



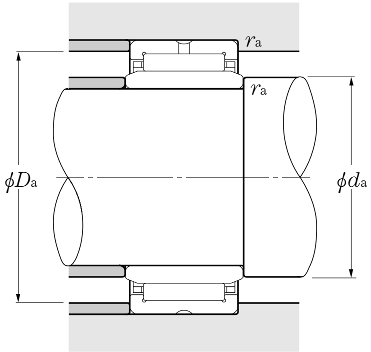
Type NA49··R
Type NA59
Type NA69··R
Type NK··R+IR



d 15~28mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers
d	*D*	*C*	$r_{s\,min}$ 1)	*F*	*s* 2)	C_r	C_{or}	C_r	C_{or}			
15	28	18	0.3	20	0.5	14 100	19 100	1 440	1 950	13 000	20 000	NA5902CT
	28	23	0.3	20	1	17 600	25 300	1 790	2 580	13 000	20 000	NA6902R
	35	20	0.6	22	1.5	17 700	23 300	1 810	2 380	12 000	18 000	NKS22+IR15×22×20
17	29	16	0.3	21	0.5	13 700	18 700	1 400	1 910	13 000	19 000	NK21/16R+IR17×21×16
	29	20	0.3	21	0.5	17 400	25 400	1 770	2 590	13 000	19 000	NK21/20R+IR17×21×20
	30	13	0.3	22	0.5	11 200	14 600	1 140	1 490	12 000	18 000	NA4903R
	30	18	0.3	22	0.5	15 200	21 700	1 550	2 210	12 000	18 000	NA5903
	30	23	0.3	22	1	18 200	27 200	1 850	2 770	12 000	18 000	NA6903R
	37	20	0.6	24	1.5	18 400	25 200	1 880	2 570	11 000	17 000	NKS24+IR17×24×20
20	32	16	0.3	24	0.5	15 200	22 300	1 550	2 280	11 000	17 000	NK24/16R+IR20×24×16
	32	20	0.3	24	0.5	18 600	28 800	1 890	2 930	11 000	17 000	NK24/20R+IR20×24×20
	37	17	0.3	25	0.8	21 300	25 500	2 170	2 600	11 000	16 000	NA4904RCT
	37	23	0.3	25	0.8	28 400	37 000	2 900	3 750	11 000	16 000	NA5904
	37	30	0.3	25	1	36 500	50 500	3 700	5 150	11 000	16 000	NA6904R
	42	20	0.6	28	2	18 100	25 800	1 850	2 630	9500	14000	NKS28+IR20×28×20
22	34	16	0.3	26	0.5	15 600	23 600	1 590	2 410	10 000	15 000	NK26/16R+IR22×26×16
	34	20	0.3	26	0.5	19 100	30 500	1 940	3 100	10 000	15 000	NK26/20R+IR22×26×20
	39	17	0.3	28	0.8	23 200	29 300	2 360	2 990	9 500	14 000	NA49/22R
	39	23	0.3	28	0.8	26 400	37 500	2 690	3 850	9 500	14 000	NA59/22
	39	30	0.3	28	0.5	40 000	58 500	4 050	6 000	9 500	14 000	NA69/22R
25	38	20	0.3	29	1	22 200	34 000	2 270	3 450	9 500	14 000	NK29/20R+IR25×29×20
	38	30	0.3	29	1.5	27 500	50 500	2 810	5 150	9 500	14 000	NK29/30R+IR25×29×30
	42	17	0.3	30	0.8	24 000	31 500	2 450	3 200	8 500	13 000	NA4905R
	42	23	0.3	30	0.8	30 500	43 000	3 150	4 350	8 500	13 000	NA5905
	42	30	0.3	30	1	41 500	63 000	4 200	6 400	8 500	13 000	NA6905R
	47	22	0.6	32	2	24 000	35 000	2 450	3 550	8 500	13 000	NKS32+IR25×32×22
28	42	20	0.3	32	1	23 500	37 500	2 400	3 850	8 500	13 000	NK32/20R+IR28×32×20
	42	30	0.3	32	1.5	34 000	60 500	3 450	6 150	8 500	13 000	NK32/30R+IR28×32×30
	45	17	0.3	32	0.8	24 800	33 500	2 530	3 400	8 500	13 000	NA49/28RCT
	45	23	0.3	32	0.8	32 000	45 500	3 250	4 650	8 500	13 000	NA59/28

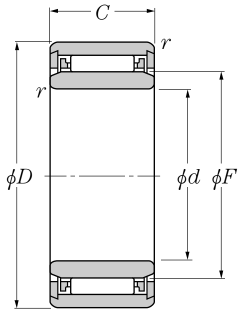
Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



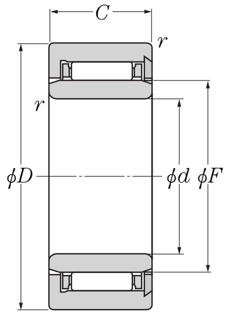
Abutment dimensions mm			Mass kg
d_a min	D_a max	r_{as} [3)] max	(approx.)
17	26	0.3	0.052
17	26	0.3	0.064
19	25	0.6	0.094
19	27	0.3	0.042
19	27	0.3	0.053
19	28	0.3	0.037
19	28	0.3	0.056
19	28	0.3	0.069
21	27	0.6	0.1
22	30	0.3	0.049
22	30	0.3	0.061
22	35	0.3	0.074
22	35	0.3	0.115
22	35	0.3	0.141
24	31	0.6	0.129
24	32	0.3	0.046
24	32	0.3	0.064
24	37	0.3	0.080
24	37	0.3	0.134
24	37	0.3	0.154
27	36	0.3	0.079
27	36	0.3	0.123
27	40	0.3	0.088
27	40	0.3	0.139
27	40	0.3	0.162
29	35.5	0.6	0.162
30	40	0.3	0.096
30	40	0.3	0.146
30	43	0.3	0.098
30	43	0.3	0.142

With inner ring

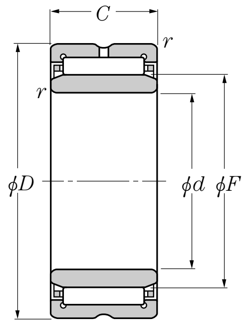
Type NA49
Type NA59
Type NA69
Type NK+IR
Type NKS+IR



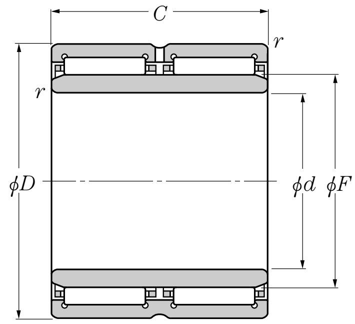
Type NKS+IR
(ϕd≦30mm)



Type NKS+IR
(ϕd≧35mm)



Type NA49‥R
Type NA59
Type NA69‥R(ϕd≦30mm)
Type NK‥R+IR

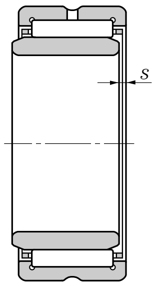


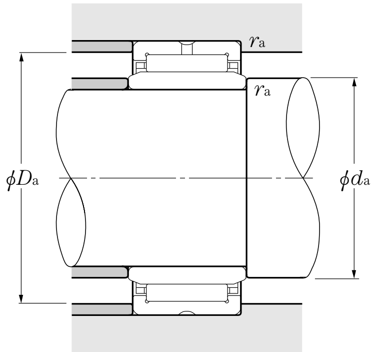
Type NA69‥R
(ϕd≧32mm)

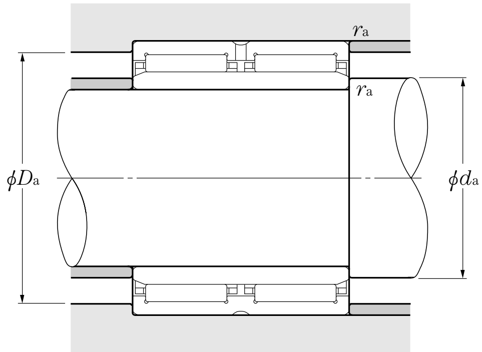
d 28～45mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1})		Bearing numbers
d	D	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}	grease	oil	
28	45	30	0.3	32	1	43 000	67 000	4 350	6 850	8 500	13 000	**NA69/28R**
30	45	20	0.3	35	0.5	24 800	41 500	2 520	4 250	7 500	11 000	**NK35/20RCT+IR30×35×20**
	45	30	0.3	35	1	36 000	66 500	3 650	6 800	7 500	11 000	**NK35/30R+IR30×35×30**
	47	17	0.3	35	0.8	25 500	35 500	2 600	3 600	7 500	11 000	**NA4906R**
	47	23	0.3	35	0.8	32 500	48 500	3 350	4 950	7 500	11 000	**NA5906**
	47	30	0.3	35	1	42 500	67 500	4 300	6 900	7 500	11 000	**NA6906R**
	52	22	0.6	37	2	26 300	41 000	2 680	4 150	7 500	11 000	**NKS37+IR30×37×22**
32	47	20	0.3	37	0.5	25 300	43 500	2 580	4 400	7 500	11 000	**NK37/20R+IR32×37×20**
	47	30	0.3	37	1	36 500	69 500	3 750	7 100	7 500	11 000	**NK37/30R+IR32×37×30**
	52	20	0.6	40	0.8	31 500	47 500	3 200	4 850	6 500	10 000	**NA49/32R**
	52	27	0.6	40	0.8	38 000	61 000	3 850	6 250	6 500	10 000	**NA59/32**
	52	36	0.6	40	0.5	47 500	82 000	4 850	8 350	6 500	10 000	**NA69/32R**
35	50	20	0.3	40	0.5	26 400	47 000	2 700	4 800	6 500	10 000	**NK40/20R+IR35×40×20**
	50	30	0.3	40	1	38 500	76 000	3 900	7 750	6 500	10 000	**NK40/30R+IR35×40×30**
	55	20	0.6	42	0.8	32 000	50 000	3 300	5 100	6 500	9 500	**NA4907R**
	55	27	0.6	42	0.8	39 000	64 500	3 950	6 550	6 500	9 500	**NA5907**
	55	36	0.6	42	0.5	49 000	86 500	5 000	8 800	6 500	9 500	**NA6907R**
	58	22	0.6	43	1.5	29 100	49 000	2 960	5 000	6 500	9 500	**NKS43+IR35×43×22**
38	53	20	0.3	43	0.5	27 500	51 000	2 810	5 200	6 500	9 500	**NK43/20R+IR38×43×20**
	53	30	0.3	43	1	40 000	82 000	4 100	8 400	6 500	9 500	**NK43/30R+IR38×43×30**
40	55	20	0.3	45	0.5	28 000	52 500	2 860	5 400	6 000	9 000	**NK45/20R+IR40×45×20**
	55	30	0.3	45	1	41 000	85 500	4 150	8 700	6 000	9 000	**NK45/30R+IR40×45×30**
	62	22	0.6	48	1	43 500	66 500	4 450	6 800	5 500	8 500	**NA4908RCT**
	62	30	0.6	48	1	53 000	92 500	5 450	9 450	5 500	8 500	**NA5908**
	62	40	0.6	48	0.5	67 000	116 000	6 850	11 800	5 500	8 500	**NA6908R**
	65	22	1	50	1.5	31 500	57 000	3 200	5 800	5 500	8 000	**NKS50+IR40×50×22**
42	57	20	0.3	47	0.5	28 800	55 500	2 940	5 650	5 500	8 500	**NK47/20RCT+IR42×47×20**
	57	30	0.3	47	1	42 500	91 500	4 350	9 350	5 500	8 500	**NK47/30R+IR42×47×30**
45	62	25	0.6	50	1.5	38 500	74 500	3 950	7 550	5 500	8 000	**NK50/25RCT+IR45×50×25**

Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



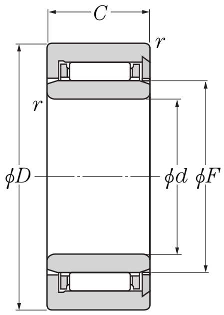




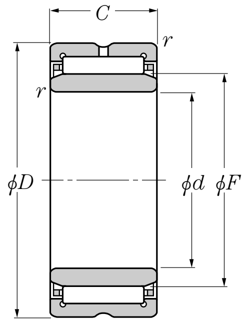
Abutment dimensions			Mass
	mm		kg
d_a min	D_a max	r_{as} [3] max	(approx.)
30	43	0.3	0.179
32	43	0.3	0.112
32	43	0.3	0.171
32	45	0.3	0.101
32	45	0.3	0.152
32	45	0.3	0.185
34	40.5	0.6	0.184
34	45	0.3	0.117
34	45	0.3	0.170
36	48	0.6	0.157
36	48	0.6	0.241
36	48	0.6	0.286
37	48	0.3	0.130
37	48	0.3	0.193
39	51	0.6	0.171
39	51	0.6	0.256
39	51	0.6	0.310
39	46.5	0.6	0.229
40	51	0.3	0.134
40	51	0.3	0.207
42	53	0.3	0.143
42	53	0.3	0.216
44	58	0.6	0.232
44	58	0.6	0.348
44	58	0.6	0.426
45	53.5	1	0.263
44	55	0.3	0.148
44	55	0.3	0.222
48	58	0.6	0.229

With inner ring

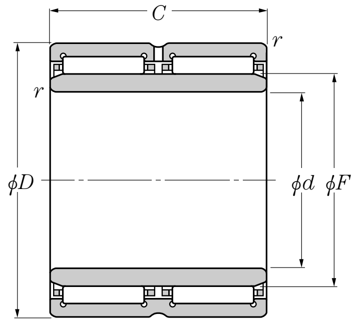
Type NA49
Type NA59
Type NA69
Type NK+IR
Type NKS+IR



Type NKS+IR



Type NA49··R
Type NA59
Type NK··R+IR

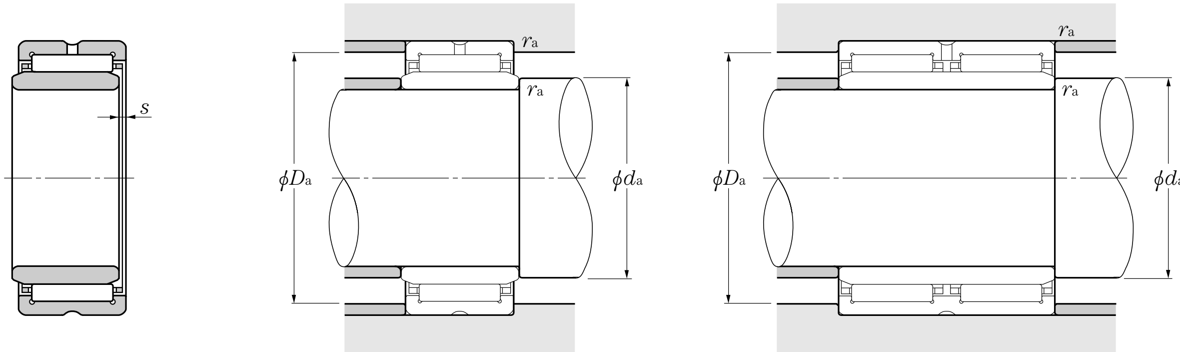


Type NA69··R

d 45～70mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1}) grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ [1]	F	s [2]	C_r	C_{or}	C_r	C_{or}			
45	62	35	0.6	50	2	51 000	106 000	5 200	10 800	5 500	8 000	NK50/35R+IR45×50×35
	68	22	0.6	52	1	46 000	73 000	4 700	7 450	5 000	7 500	NA4909R
	68	30	0.6	52	1	56 000	101 000	5 700	10 300	5 000	7 500	NA5909
	68	40	0.6	52	0.5	70 500	127 000	7 200	13 000	5 000	7 500	NA6909R
	72	22	1	55	1.5	33 500	63 000	3 400	6 450	5 000	7 500	NKS55+IR45×55×22
50	68	25	0.6	55	1.5	41 000	82 000	4 150	8 400	5 000	7 500	NK55/25R+IR50×55×25
	68	35	0.6	55	2	54 000	118 000	5 500	12 000	5 000	7 500	NK55/35R+IR50×55×35
	72	22	0.6	58	1	48 000	80 000	4 900	8 150	4 700	7 000	NA4910R
	72	30	0.6	58	1	58 000	110 000	5 950	11 200	4 700	7 000	NA5910
	72	40	0.6	58	0.5	74 000	139 000	7 500	14 200	4 700	7 000	NA6910R
	80	28	1.1	60	2.5	44 500	85 000	4 500	8 700	4 300	6 500	NKS60+IR50×60×28
55	72	25	0.6	60	1.5	41 000	85 000	4 200	8 700	4 300	6 500	NK60/25R+IR55×60×25
	72	35	0.6	60	2	57 000	130 000	5 800	13 200	4 300	6 500	NK60/35R+IR55×60×35
	80	25	1	63	1.5	58 500	99 500	6 000	10 100	4 300	6 500	NA4911R
	80	34	1	63	1.5	76 500	140 000	7 800	14 300	4 300	6 500	NA5911
	80	45	1	63	1.5	94 000	183 000	9 600	18 600	4 300	6 500	NA6911R
	85	28	1.1	65	2.5	47 000	94 000	4 800	9 600	4 000	6 000	NKS65+IR55×65×28
60	82	25	1	68	1	44 500	89 000	4 500	9 050	4 000	6 000	NK68/25R+IR60×68×25
	82	35	0.6	68	1	63 000	139 000	6 400	14 200	4 000	6 000	NK68/35R+IR60×68×35
	85	25	1	68	1.5	61 500	108 000	6 250	11 000	4 000	6 000	NA4912R
	85	34	1	68	1.5	80 500	153 000	8 200	15 600	4 000	6 000	NA5912
	85	45	1	68	1.5	95 500	191 000	9 750	19 400	4 000	6 000	NA6912R
	90	28	1.1	70	2.5	49 500	103 000	5 050	10 500	3 700	5 500	NKS70+IR60×70×28
65	90	25	0.6	73	1	54 000	100 000	5 500	10 200	3 700	5 500	NK73/25R+IR65×73×25
	90	25	1	72	1.5	62 500	112 000	6 350	11 400	3 700	5 500	NA4913R
	90	34	1	72	1.5	84 000	165 000	8 600	16 800	3 700	5 500	NA5913
	90	35	0.6	73	1	76 500	156 000	7 800	16 000	3 700	5 500	NK73/35R+IR65×73×35
	90	45	1	72	1.5	97 000	198 000	9 900	20 200	3 700	5 500	NA6913R
	95	28	1.1	75	2.5	50 500	109 000	5 150	11 100	3 700	5 500	NKS75+IR65×75×28
70	95	25	1	80	0.8	57 000	119 000	5 800	12 200	3 300	5 000	NK80/25R+IR70×80×25

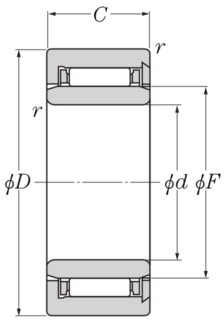
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



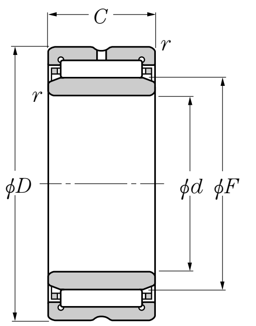
Abutment dimensions mm			Mass kg
d_a min	D_a max	r_{as} 3) max	(approx.)
48	58	0.6	0.322
49	64	0.6	0.270
49	64	0.6	0.396
49	64	0.6	0.437
50	58.5	1	0.351
53	64	0.6	0.271
53	64	0.6	0.379
54	68	0.6	0.276
54	68	0.6	0.498
54	68	0.6	0.529
56.5	64	1.1	0.518
58	68	0.6	0.271
58	68	0.6	0.379
60	75	1	0.396
60	75	1	0.559
60	75	1	0.726
61.5	69	1.1	0.562
65	77	0.6	0.393
64	78	0.6	0.551
65	80	1	0.427
65	80	1	0.614
65	80	1	0.758
66.5	74	1.1	0.591
69	86	0.6	0.466
70	85	1	0.454
70	85	1	0.655
69	86	0.6	0.660
70	85	1	0.779
71.5	79	1.1	0.642
75	90	1	0.525

With inner ring

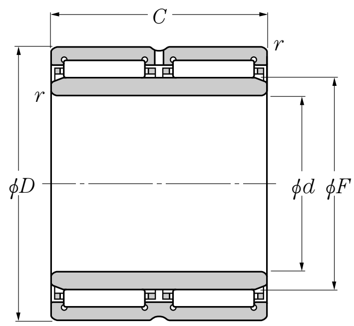
Type NA48
Type NA49
Type NA59
Type NA69
Type NK+IR
Type NKS+IR



Type NKS+IR



Type NA49··R
Type NA59
Type NK··R+IR

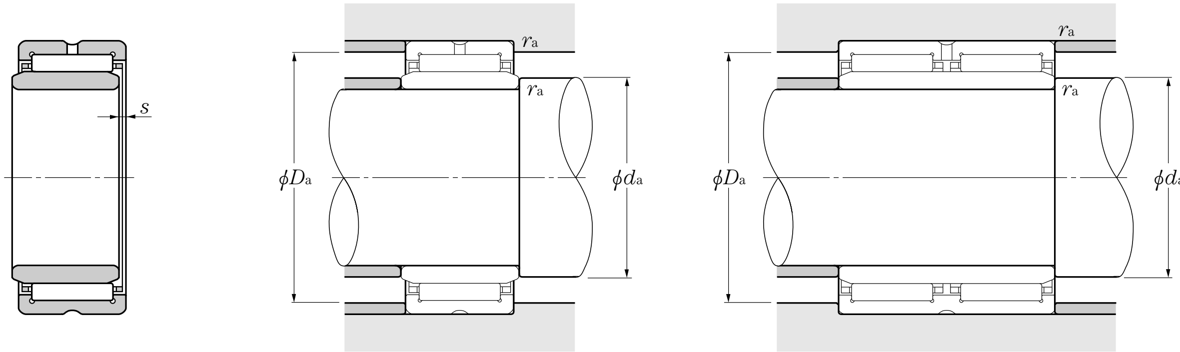


Type NA69··R

d 70～95mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}	grease	oil	
70	95	35	1	80	0.8	79 500	184 000	8 150	18 700	3 300	5 000	NK80/35R+IR70×80×35
	100	28	1.1	80	2.5	53 000	118 000	5 400	12 100	3 300	5 000	NKS80+IR70×80×28
	100	30	1	80	1.5	85 500	156 000	8 750	15 900	3 300	5 000	NA4914R
	100	40	1	80	1.5	103 000	187 000	10 500	19 100	3 300	5 000	NA5914
	100	54	1	80	1	130 000	267 000	13 300	27 200	3 300	5 000	NA6914R
75	105	25	1	85	1	70 500	123 000	7 200	12 600	3 100	4 700	NK85/25R+IR75×85×25
	105	30	1	85	1.5	87 000	162 000	8 900	16 500	3 100	4 700	NA4915R
	105	35	1	85	1	100 000	193 000	10 200	19 700	3 100	4 700	NK85/35R+IR75×85×35
	105	40	1	85	1.5	109 000	205 000	11 100	20 900	3 100	4 700	NA5915
	105	54	1	85	1	132 000	277 000	13 500	28 300	3 100	4 700	NA6915R
	110	32	1.1	90	1.5	64 000	157 000	6 550	16 000	2 900	4 400	NKS90+IR75×90×32
80	110	25	1	90	1	71 500	128 000	7 300	13 100	2 900	4 400	NK90/25R+IR80×90×25
	110	30	1	90	1.5	90 500	174 000	9 250	17 700	2 900	4 400	NA4916R
	110	35	1	90	1	104 000	208 000	10 600	21 200	2 900	4 400	NK90/35R+IR80×90×35
	110	40	1	90	1.5	115 000	223 000	11 700	22 700	2 900	4 400	NA5916
	110	54	1	90	1.5	138 000	298 000	14 000	30 500	2 900	4 400	NA6916R
	115	32	1.1	95	2.5	65 500	165 000	6 700	16 800	2 800	4 200	NKS95+IR80×95×32
85	115	26	1	95	1.5	74 500	137 000	7 600	14 000	2 800	4 200	NK95/26R+IR85×95×26
	115	36	1	95	1.5	108 000	223 000	11 100	22 700	2 800	4 200	NK95/36R+IR85×95×36
	120	32	1.1	100	3	61 000	153 000	6 250	15 600	2 700	4 000	NKS100+IR85×100×32
	120	35	1.1	100	1	112 000	237 000	11 500	24 200	2 700	4 000	NA4917R
	120	46	1.1	100	1.5	137 000	290 000	14 000	29 600	2 700	4 000	NA5917
	120	63	1.1	100	1	169 000	400 000	17 300	41 000	2 700	4 000	NA6917R
90	120	26	1	100	1.5	73 500	137 000	7 500	14 000	2 700	4 000	NK100/26R+IR90×100×26
	120	36	1	100	1.5	107 000	223 000	11 000	22 800	2 700	4 000	NK100/36R+IR90×100×36
	125	32	1.1	105	2	67 500	176 000	6 850	18 000	2 500	3 800	NKS105+IR90×105×32
	125	35	1.1	105	1	116 000	252 000	11 900	25 700	2 500	3 800	NA4918R
	125	46	1.1	105	1	143 000	310 000	14 600	32 000	2 500	3 800	NA5918
	125	63	1.1	105	1	175 000	425 000	17 900	43 500	2 500	3 800	NA6918R
95	125	26	1	105	1.5	76 500	147 000	7 800	14 900	2 500	3 800	NK105/26R+IR95×105×26

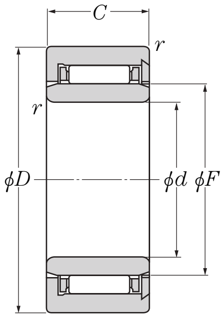
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



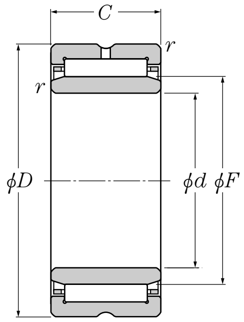
Abutment dimensions mm d_a min	D_a max	r_{as}[3] max	Mass kg (approx.)
75	90	1	0.738
76.5	84	1.1	0.663
75	95	1	0.727
75	95	1	1.06
75	95	1	1.34
80	100	1	0.642
80	100	1	0.776
80	100	1	0.853
80	100	1	1.13
80	100	1	1.45
81.5	94	1.1	1.19
85	105	1	0.680
85	105	1	0.820
85	105	1	0.959
85	105	1	1.15
85	105	1	1.53
86.5	99	1.1	1.28
90	110	1	0.644
90	110	1	1.05
91.5	104	1.1	1.2
91.5	113.5	1	1.24
91.5	113.5	1	1.76
91.5	104	1.1	2.25
95	115	1	0.781
95	115	1	1.09
96.5	109	1.1	1.24
96.5	118.5	1	1.84
96.5	118.5	1	2.44
96.5	109	1.1	2.37
100	120	1	0.819

With inner ring

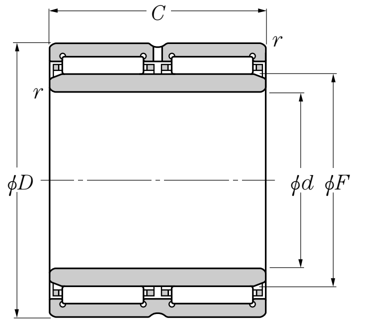
Type NA48
Type NA49
Type NA59
Type NA69
Type NK+IR
Type NKS+IR



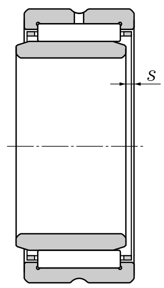
Type NKS+IR
(ϕd≦95mm)



Type NA48
Type NA49‥R, Type NA49
Type NA59
Type NK‥R+IR, Type NK+IR
Type NKS+IR (ϕd≧100mm)



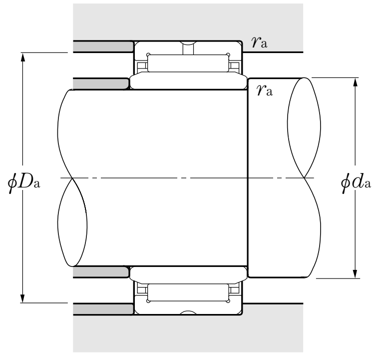
Type NA69‥R



d 95～140mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers
d	*D*	*C*	$r_{s\,min}$ 1)	*F*	*s* 2)	C_r	C_{or}	C_r	C_{or}	grease	oil	
95	125	36	1	105	1.5	111 000	238 000	11 400	24 300	2 500	3 800	NK105/36R+IR95×105×36
	130	32	1.1	110	3	64 500	170 000	6 600	17 300	2 400	3 600	NKS110+IR95×110×32
	130	35	1.1	110	1	118 000	260 000	12 000	26 500	2 400	3 600	NA4919R
	130	46	1.1	110	1	149 000	335 000	15 200	34 000	2 400	3 600	NA5919
	130	63	1.1	110	1	177 000	440 000	18 100	45 000	2 400	3 600	NA6919R
100	130	30	1.1	110	1.5	97 500	204 000	9 950	20 800	2 400	3 600	NK110/30R+IR100×110×30
	130	40	1.1	110	2	129 000	292 000	13 100	29 700	2 400	3 600	NK110/40R+IR100×110×40
	135	32	1.1	115	1.5	90 500	199 000	9 250	20 300	2 300	3 500	NKS115+IR100×115×32
	140	40	1.1	115	2	127 000	260 000	12 900	26 500	2 300	3 500	NA4920
	140	54	1.1	115	2	182 000	395 000	18 600	40 500	2 300	3 500	NA5920
110	140	30	1	120	0.8	93 500	210 000	9 550	21 400	2 200	3 300	NA4822
	140	40	1.1	120	—	113 000	268 000	11 500	27 300	2 200	3 300	NK120/40+IR110×120×40
	150	40	1.1	125	2	131 000	279 000	13 300	28 400	2 100	3 200	NA4922
	150	54	1.1	125	2	193 000	440 000	19 700	45 000	2 100	3 200	NA5922
120	150	30	1	130	0.8	99 500	233 000	10 100	23 800	2 100	3 100	NA4824
	150	40	1.1	130	—	116 000	283 000	11 800	28 800	2 100	3 100	NK130/40+IR120×130×40
	160	40	2	135	2.5	135 000	298 000	13 800	30 500	2 000	3 000	NKS135+IR120×135×40
	165	45	1.1	135	2	180 000	380 000	18 300	38 500	2 000	3 000	NA4924
	165	60	1.1	135	2	246 000	530 000	25 100	54 000	2 000	3 000	NA5924
130	165	35	1.1	145	1	118 000	305 000	12 100	31 000	1 900	2 800	NA4826
	170	32	1.5	145	—	111 000	238 000	11 300	24 300	1 900	2 800	NK145/32+IR130×145×32
	170	42	1.5	145	—	153 000	360 000	15 600	36 500	1 900	2 800	NK145/42+IR130×145×42
	180	50	1.5	150	1.5	202 000	455 000	20 600	46 500	1 800	2 700	NA4926
	180	52	2	150	3	202 000	455 000	20 600	46 500	1 800	2 700	NKS150+IR130×150×52
	180	67	1.5	150	1.5	296 000	690 000	30 000	70 500	1 800	2 700	NA5926
140	175	35	1.1	155	1	121 000	315 000	12 300	32 500	1 700	2 600	NA4828
	180	32	1.5	155	—	114 000	252 000	11 600	25 700	1 700	2 600	NK155/32+IR140×155×32
	180	42	1.5	155	—	156 000	380 000	16 000	38 500	1 700	2 600	NK155/42+IR140×155×42
	190	50	1.5	160	1.5	209 000	485 000	21 300	49 500	1 700	2 500	NA4928
	190	52	2	160	3	209 000	485 000	21 300	49 500	1 700	2 500	NKS160+IR140×160×52

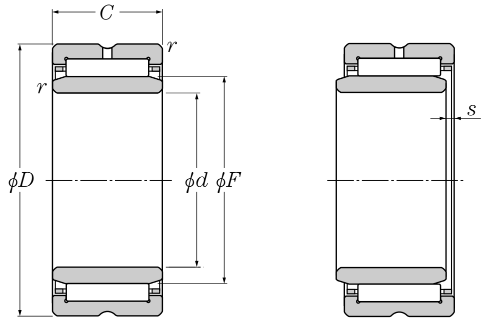
Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



Abutment dimensions mm d_a min	D_a max	r_{as} [3] max	Mass kg (approx.)
100	120	1	1.15
101.5	114	1.1	1.29
101.5	123.5	1	1.36
101.5	123.5	1	1.98
101.5	123.5	1	2.63
106.5	123.5	1	0.990
106.5	123.5	1	1.34
106.5	128.5	1.1	1.32
106.5	133.5	1	1.93
106.5	133.5	1	2.85
115	135	1	1.11
116.5	133.5	1	1.49
116.5	143.5	1	2.08
116.5	143.5	1	2.98
125	145	1	1.17
126.5	143.5	1	1.57
129	151	2	2.2
126.5	158.5	1	2.84
126.5	158.5	1	3.92
136.5	158.5	1	1.60
138	162.5	1.5	1.90
138	162.5	1.5	2.54
138	172	1.5	3.90
139	171	2	4.07
138	172	1.5	5.60
146.5	168.5	1	1.82
148	172	1.5	2.04
148	172	1.5	2.69
148	182	1.5	4.05
149	181	2	4.23

With inner ring

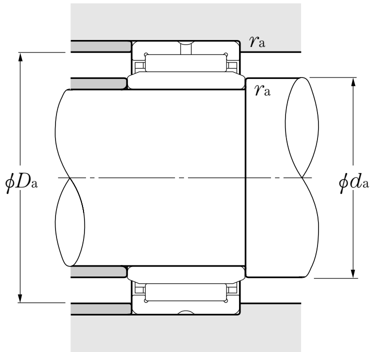
Type NA48
Type NA49
Type NA59
Type NK＋IR
Type NKS＋IR



d 140～320mm

Boundary dimensions mm						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds min⁻¹ grease	oil	Bearing numbers
d	*D*	*C*	$r_{s\,min}$ 1)	*F*	*s* 2)	C_r	C_{or}	C_r	C_{or}			
140	190	67	1.5	160	1.5	315 000	760 000	32 000	77 500	1 700	2 500	**NA5928**
150	190	32	1.5	165	—	117 000	265 000	11 900	27 000	1 600	2 400	**NK165/32＋IR150×165×32**
	190	40	1.1	165	1.5	152 000	390 000	15 500	40 000	1 600	2 400	**NA4830**
	190	42	1.5	165	—	160 000	400 000	16 300	40 500	1 600	2 400	**NK165/42＋IR150×165×42**
	200	52	2	170	3	215 000	515 000	21 900	52 500	1 600	2 400	**NKS170＋IR150×170×52**
	210	60	2	170	1.5	261 000	610 000	26 600	62 500	1 600	2 400	**NA4930**
160	200	40	1.1	175	1.5	160 000	425 000	16 300	43 500	1 500	2 300	**NA4832**
	220	60	2	180	1.5	270 000	650 000	27 600	66 500	1 500	2 200	**NA4932**
170	215	45	1.1	185	1.5	185 000	495 000	18 800	50 500	1 500	2 200	**NA4834**
	230	60	2	190	1.5	279 000	690 000	28 500	70 500	1 400	2 100	**NA4934**
180	225	45	1.1	195	1.5	195 000	540 000	19 800	55 000	1 400	2 100	**NA4836**
	250	69	2	205	1.5	375 000	890 000	38 500	90 500	1 300	2 000	**NA4936**
190	240	50	1.5	210	1.5	227 000	680 000	23 200	69 000	1 300	1 900	**NA4838**
	260	69	2	215	1.5	390 000	945 000	40 000	96 500	1 300	1 900	**NA4938**
200	250	50	1.5	220	1.5	231 000	705 000	23 600	71 500	1 200	1 800	**NA4840**
	280	80	2.1	225	1.5	505 000	1 180 000	51 500	120 000	1 200	1 800	**NA4940**
220	270	50	1.5	240	1.5	244 000	780 000	24 900	79 500	1 100	1 700	**NA4844**
	300	80	2.1	245	1.5	525 000	1 270 000	53 500	129 000	1 100	1 600	**NA4944**
240	300	60	2	265	2	360 000	1 080 000	37 000	110 000	1 000	1 500	**NA4848**
	320	80	2.1	265	2	540 000	1 350 000	55 000	138 000	1 000	1 500	**NA4948**
260	320	60	2	285	2	375 000	1 160 000	38 000	119 000	950	1 400	**NA4852**
	360	100	2.1	290	2	805 000	1 900 000	82 000	193 000	950	1 400	**NA4952**
280	350	69	2	305	2.5	455 000	1 300 000	46 500	133 000	850	1 300	**NA4856**
	380	100	2.1	310	2.5	835 000	2 030 000	85 000	207 000	850	1 300	**NA4956**
300	380	80	2.1	330	2	625 000	1 770 000	64 000	180 000	800	1 200	**NA4860**
	420	118	3	340	2	1 080 000	2 640 000	110 000	269 000	800	1 200	**NA4960**
320	400	80	2.1	350	2	640 000	1 850 000	65 500	189 000	750	1 100	**NA4864**
	440	118	3	360	2	1 120 000	2 820 000	114 000	288 000	750	1 100	**NA4964**

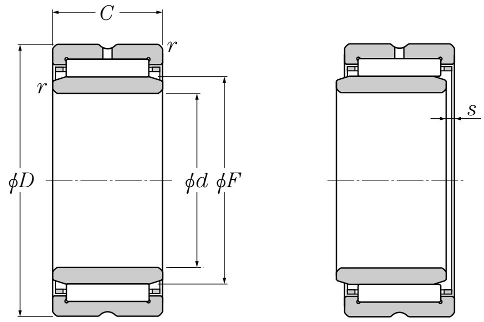
Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring (**IR**) comprises the codes of **IR** bore diameter×outer diameter×width.



Abutment dimensions mm			Mass kg
d_a min	D_a max	r_{as} [3)] max	(approx.)
148	182	1.5	6.18
158	182	1.5	2.32
156.5	183.5	1	2.72
158	182	1.5	2.84
159	191	2	4.59
159	201	2	5.33
166.5	193.5	1	2.90
169	211	2	5.60
176.5	208.5	1	3.99
179	221	2	5.87
186.5	218.5	1	4.19
189	241	2	8.58
198	232	1.5	5.62
199	251	2	8.68
208	242	1.5	5.84
211	269	2	12.2
228	262	1.5	6.37
231	289	2	13.5
249	291	2	10.0
251	309	2	14.7
269	311	2	10.8
271	349	2	25.9
289	341	2	15.5
291	369	2	27.5
311	369	2	22.0
313	407	2.5	42.5
331	389	2	23.2
333	427	2.5	45.2

With inner ring

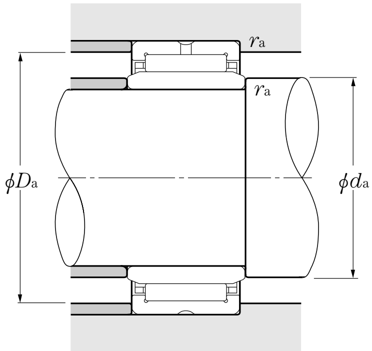
Type NA48
Type NA49



d 340～440mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers
d	*D*	*C*	$r_{s\,min}$ 1)	*F*	*s* 2)	C_r	C_{or}	C_r	C_{or}			
340	420	80	2.1	370	2	655 000	1 940 000	66 500	197 000	750	1 100	**NA4868**
	460	118	3	380	2	1 160 000	3 000 000	118 000	305 000	750	1 100	**NA4968**
360	440	80	2.1	390	2	665 000	2 020 000	68 000	206 000	650	1 000	**NA4872**
	480	118	3	400	2	1 200 000	3 200 000	122 000	325 000	650	1 000	**NA4972**
380	480	100	2.1	415	2	1 000 000	2 840 000	102 000	289 000	650	950	**NA4876**
	520	140	4	430	2	1 400 000	3 750 000	143 000	385 000	650	950	**NA4976**
400	540	140	4	450	2.5	1 450 000	4 000 000	148 000	410 000	600	900	**NA4980**
420	560	140	4	470	2.5	1 500 000	4 250 000	153 000	430 000	550	850	**NA4984**
440	600	160	4	490	2.5	1 750 000	4 600 000	179 000	470 000	550	800	**NA4988**

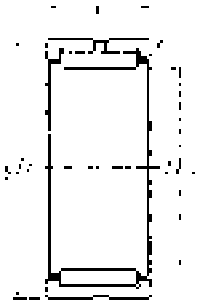
Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.
3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.



Abutment dimensions mm			Mass kg
d_a min	D_a max	r_{as} [3)] max	(approx.)
351	409	2	24.1
353	447	2.5	47.3
371	429	2	25.7
373	467	2.5	49.0
391	469	2	44.5
396	504	3	73.6
416	524	3	76.6
436	544	3	89.8
456	584	3	123

Inch series
Without inner ring

Type MR



F_w 15.875～63.500mm

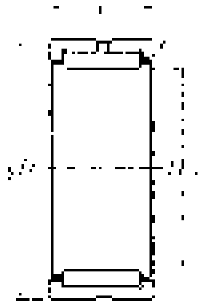
Boundary dimensions mm (1/25.4mm)					Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds r/min grease	oil (approx.)
F_w		D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil
15.875(5/8)	+0.027 +0.016	28.575(1 1/8)	19.05(3/4)	0.6	16 700	16 700	1 700	1 700	17 000	25 000
		28.575(1 1/8)	25.40(1)	0.6	21 500	23 000	2 190	2 350	17 000	25 000
19.050(3/4)	+0.033 +0.020	31.750(1 1/4)	19.05(3/4)	1	19 500	21 100	1 980	2 150	14 000	21 000
		31.750(1 1/4)	25.40(1)	1	25 000	29 100	2 550	2 970	14 000	21 000
22.225(7/8)	+0.033 +0.020	34.925(1 3/8)	19.05(3/4)	1	21 900	25 600	2 240	2 610	12 000	18 000
		34.925(1 3/8)	25.40(1)	1	28 200	35 500	2 870	3 600	12 000	18 000
25.400(1)	+0.033 +0.020	38.100(1 1/2)	19.05(3/4)	1	23 000	28 100	2 340	2 870	11 000	16 000
		38.100(1 1/2)	25.40(1)	1	29 500	38 500	3 000	3 950	11 000	16 000
28.575(1 1/8)	+0.033 +0.020	41.275(1 5/8)	25.40(1)	1	32 500	45 000	3 300	4 600	9 500	14 000
		41.275(1 5/8)	31.75(1 1/4)	1	40 500	60 000	4 100	6 100	9 500	14 000
31.750(1 1/4)	+0.041 +0.025	44.450(1 3/4)	25.40(1)	1	35 000	51 000	3 550	5 200	8 500	13 000
		44.450(1 3/4)	31.75(1 1/4)	1	43 500	68 000	4 450	6 950	8 500	13 000
34.925(1 3/8)	+0.041 +0.025	47.625(1 7/8)	25.40(1)	1	37 000	57 500	3 800	5 850	7 500	11 000
		47.625(1 7/8)	31.75(1 1/4)	1	46 500	76 500	4 750	7 800	7 500	11 000
38.100(1 1/2)	+0.041 +0.025	52.388(2 1/16)	25.40(1)	1.5	41 000	61 000	4 150	6 250	7 500	11 000
		52.388(2 1/16)	31.75(1 1/4)	1.5	51 000	81 500	5 200	8 300	7 500	11 000
41.275(1 5/8)	+0.041 +0.025	55.562(2 3/16)	25.40(1)	1.5	43 500	68 000	4 450	6 950	6 500	9 500
		55.562(2 3/16)	31.75(1 1/4)	1.5	54 500	90 500	5 550	9 250	6 500	9 500
44.450(1 3/4)	+0.041 +0.025	58.738(2 5/16)	25.40(1)	1.5	44 500	72 000	4 550	7 350	6 000	9 000
		58.738(2 5/16)	31.75(1 1/4)	1.5	55 500	95 500	5 700	9 750	6 000	9 000
47.625(1 7/8)	+0.041 +0.025	61.912(2 7/16)	31.75(1 1/4)	1.5	59 000	105 000	6 000	10 700	5 500	8 500
50.800(2)	+0.049 +0.030	65.088(2 9/16)	25.40(1)	1.5	49 500	86 000	5 050	8 800	5 500	8 000
		65.088(2 9/16)	31.75(1 1/4)	1.5	62 000	114 000	6 300	11 700	5 500	8 000
57.150(2 1/4)	+0.049 +0.030	76.200(3)	38.10(1 1/2)	1.5	83 500	142 000	8 500	14 500	4 700	7 000
		76.200(3)	44.45(1 3/4)	1.5	97 000	173 000	9 850	17 600	4 700	7 000
63.500(2 1/2)	+0.049 +0.030	82.550(3 1/4)	38.10(1 1/2)	2	88 000	158 000	8 950	16 100	4 300	6 500

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} corner roundness on shaft/housing.

Bearing numbers	Abutment dimensions mm D_a max	r_{as} 2) max	Mass kg (approx.)
MR101812	24.5	0.6	0.050
MR101816	24.5	0.6	0.068
MR122012	26.5	1	0.055
MR122016	26.5	1	0.073
MR142212	30	1	0.059
MR142216	30	1	0.082
MR162412	33	1	0.068
MR162416	33	1	0.091
MR182616	36.5	1	0.100
MR182620	36.5	1	0.127
MR202816	39.5	1	0.109
MR202820	39.5	1	0.136
MR223016	42.5	1	0.118
MR223020	42.5	1	0.150
MR243316	46	1.5	0.143
MR243320	46	1.5	0.180
MR263516	49	1.5	0.153
MR263520	49	1.5	0.191
MR283716	52	1.5	0.163
MR283720	52	1.5	0.204
MR303920	55.5	1.5	0.216
MR324116	58.5	1.5	0.183
MR324120	58.5	1.5	0.227
MR364824	69.5	1.5	0.422
MR364828	69.5	1.5	0.493
MR405224	74.5	2	0.472

Inch series
Without inner ring

Type MR



F_w 63.500～184.150mm

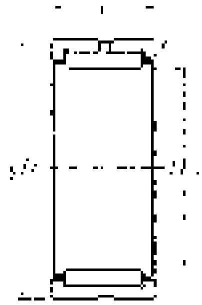
Boundary dimensions (mm) F_w		D	C	$r_{s\,min}$ [1)]	Basic load ratings, dynamic (N) C_r	static (N) C_{or}	dynamic (kgf) C_r	static (kgf) C_{or}	Limiting speeds (r/min, approx.) grease	oil
63.500(2 ½)	+0.049 +0.030	82.550(3 ¼)	44.45(1 ¾)	2	102 000	191 000	10 400	19 500	4 300	6 500
69.850(2 ¾)	+0.049 +0.030	88.900(3 ½)	25.40(1)	2	66 000	112 000	6 700	11 400	3 700	5 500
		88.900(3 ½)	38.10(1 ½)	2	92 000	173 000	9 400	17 600	3 700	5 500
		88.900(3 ½)	44.45(1 ¾)	2	107 000	209 000	10 900	21 300	3 700	5 500
76.200(3)	+0.049 +0.030	95.250(3 ¾)	38.10(1 ½)	2	96 000	188 000	9 800	19 100	3 300	5 000
		95.250(3 ¾)	44.45(1 ¾)	2	112 000	227 000	11 400	23 200	3 300	5 000
82.550(3 ¼)	+0.058 +0.036	107.950(4 ¼)	44.45(1 ¾)	2	134 000	240 000	13 600	24 500	3 300	5 000
		107.950(4 ¼)	50.80(2)	2	146 000	268 000	14 900	27 400	3 300	5 000
88.900(3 ½)	+0.058 +0.036	114.300(4 ½)	44.45(1 ¾)	2	141 000	264 000	14 400	26 900	3 000	4 500
		114.300(4 ½)	50.80(2)	2	154 000	295 000	15 700	30 000	3 000	4 500
95.250(3 ¾)	+0.058 +0.036	120.650(4 ¾)	50.80(2)	2.5	162 000	320 000	16 500	32 500	2 800	4 200
101.600(4)	+0.058 +0.036	127.000(5)	50.80(2)	2.5	169 000	345 000	17 200	35 500	2 600	3 900
107.950(4 ¼)	+0.058 +0.036	133.350(5 ¼)	50.80(2)	2.5	172 000	360 000	17 500	37 000	2 500	3 700
114.300(4 ½)	+0.058 +0.036	152.400(6)	57.15(2 ¼)	2.5	238 000	435 000	24 300	44 500	2 300	3 500
		152.400(6)	63.50(2 ½)	2.5	260 000	485 000	26 500	49 500	2 300	3 500
127.000(5)	+0.068 +0.043	165.100(6 ½)	50.80(2)	2.5	227 000	425 000	23 200	43 000	2 100	3 100
		165.100(6 ½)	57.15(2 ¼)	2.5	250 000	480 000	25 500	49 000	2 100	3 100
		165.100(6 ½)	63.50(2 ½)	2.5	273 000	535 000	27 800	54 500	2 100	3 100
139.700(5 ½)	+0.068 +0.043	177.800(7)	63.50(2 ½)	2.5	285 000	585 000	29 100	59 500	1 900	2 900
		177.800(7)	76.20(3)	2.5	345 000	740 000	35 000	75 500	1 900	2 900
146.050(5 ¾)	+0.068 +0.043	184.150(7 ¼)	76.20(3)	3	360 000	775 000	36 500	79 000	1 800	2 700
152.400(6)	+0.068 +0.043	190.500(7 ½)	63.50(2 ½)	3	310 000	630 000	31 500	64 000	1 700	2 600
		190.500(7 ½)	76.20(3)	3	375 000	800 000	38 000	81 500	1 700	2 600
165.100(6 ½)	+0.068 +0.043	203.200(8)	63.50(2 ½)	3	325 000	680 000	33 000	69 500	1 600	2 400
		203.200(8)	76.20(3)	3	390 000	870 000	39 500	88 500	1 600	2 400
184.150(7 ¼)	+0.079 +0.050	231.775(9 ⅛)	76.20(3)	3	435 000	915 000	44 500	93 000	1 500	2 200

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

Bearing numbers	Abutment dimensions mm D_a max	Abutment dimensions mm r_{as} [2)] max	Mass kg (approx.)
MR405228	74.5	2	0.533
MR445616	81	2	0.343
MR445624	81	2	0.504
MR445628	81	2	0.580
MR486024	87	2	0.558
MR486028	87	2	0.651
MR526828	100	2	1.02
MR526832	100	2	1.17
MR567228	106.5	2	1.08
MR567232	106.5	2	1.27
MR607632	111.5	2.5	1.28
MR648032	118	2.5	1.29
MR688432	124.5	2.5	1.36
MR729636	143.5	2.5	2.62
MR729640	143.5	2.5	2.91
MR8010432	156	2.5	2.53
MR8010436	156	2.5	2.87
MR8010440	156	2.5	3.19
MR8811240	169	2.5	3.46
MR8811248	169	2.5	4.16
MR9211648	172	3	4.30
MR9612040	177.5	3	3.74
MR9612048	177.5	3	4.49
MR10412840	190	3	4.02
MR10412848	190	3	4.82
MR11614648	219	3	7.36

Inch series
Without inner ring

Type MR



F_w 196.850～234.950mm

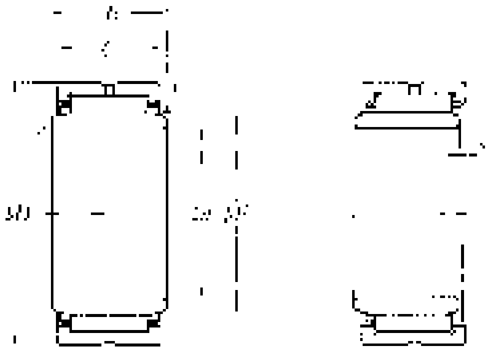
Boundary dimensions mm					Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds r/min (approx.) grease	oil
F_w		D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	grease	oil
196.850(7 3/4)	+0.079 +0.050	244.475(9 5/8)	76.20(3)	3	455 000	990 000	46 500	101 000	1 300	2 000
209.550(8 1/4)	+0.079 +0.050	257.175(10 1/8)	76.20(3)	3	475 000	1 060 000	48 500	109 000	1 300	1 900
222.250(8 3/4)	+0.079 +0.050	269.875(10 5/8)	76.20(3)	4	495 000	1 140 000	50 500	116 000	1 200	1 800
234.950(9 1/4)	+0.079 +0.050	282.575(11 1/8)	76.20(3)	4	510 000	1 210 000	52 000	124 000	1 100	1 700

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

Bearing numbers	Abutment dimensions mm		Mass kg
	D_a max	r_{as} [2] max	(approx.)
MR12415448	231.5	3	7.80
MR13216248	244	3	8.36
MR14017048	254	4	8.81
MR14817848	266.5	4	9.27

Inch series
With inner ring

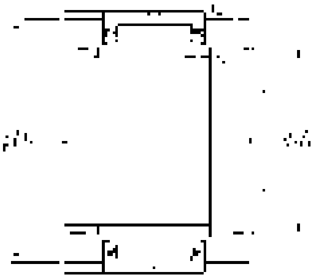
Type MR+MI



d 9.525～34.925mm

	Boundary dimensions mm (1/25.4 mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	*D*	*B*	*C*	$r_{s\,min}$ 1)	*F*	*s* 2)	C_r	C_{or}	C_r	C_{or}
9.525(3/8)	28.575(1 1/8)	19.30	19.05(3/4)	0.6	15.875	2	16 700	16 700	1 700	1 700
	28.575(1 1/8)	25.65	25.40(1)	0.6	15.875	3	21 500	23 000	2 190	2 350
12.700(1/2)	31.750(1 1/4)	19.30	19.05(3/4)	1	19.050	4	19 500	21 100	1 980	2 150
	31.750(1 1/4)	25.65	25.40(1)	1	19.050	2	25 000	29 100	2 550	2 970
15.875(5/8)	34.925(1 3/8)	19.30	19.05(3/4)	1	22.225	1	21 900	25 600	2 240	2 610
	34.925(1 3/8)	25.65	25.40(1)	1	22.225	2	28 200	35 500	2 870	3 600
17.462(11/16)	34.925(1 3/8)	19.30	19.05(3/4)	1	22.225	1.5	21 900	25 600	2 240	2 610
19.050(3/4)	38.100(1 1/2)	19.30	19.05(3/4)	1	25.400	1	23 000	28 100	2 340	2 870
	38.100(1 1/2)	25.65	25.40(1)	1	25.400	1.5	29 500	38 500	3 000	3 950
20.638(13/16)	38.100(1 1/2)	25.65	25.40(1)	1	25.400	2	29 500	38 500	3 000	3 950
22.225(7/8)	41.275(1 5/8)	25.65	25.40(1)	1	28.575	1.5	32 500	45 000	3 300	4 600
	41.275(1 5/8)	32.00	31.75(1 1/4)	1	28.575	2	40 500	60 000	4 100	6 100
23.812(15/16)	41.275(1 5/8)	25.65	25.40(1)	1	28.575	2	32 500	45 000	3 300	4 600
	41.275(1 5/8)	32.00	31.75(1 1/4)	1	28.575	2	40 500	60 000	4 100	6 100
25.400(1)	44.450(1 3/4)	25.65	25.40(1)	1	31.750	1.5	35 000	51 000	3 550	5 200
	44.450(1 3/4)	32.00	31.75(1 1/4)	1	31.750	2	43 500	68 000	4 450	6 950
28.575(1 1/8)	47.625(1 7/8)	25.65	25.40(1)	1	34.925	3	37 000	57 500	3 800	5 850
	47.625(1 7/8)	32.00	31.75(1 1/4)	1	34.925	2	46 500	76 500	4 750	7 800
30.162(1 3/16)	52.388(2 1/16)	32.00	31.75(1 1/4)	1	38.100	2	51 000	81 500	5 200	8 300
31.750(1 1/4)	52.388(2 1/16)	25.65	25.40(1)	1.5	38.100	0.5	41 000	61 000	4 150	6 250
	52.388(2 1/16)	32.00	31.75(1 1/4)	1.5	38.100	1	51 000	81 500	5 200	8 300
33.338(1 5/16)	55.562(2 3/16)	25.65	25.40(1)	1.5	41.275	0.5	43 500	68 000	4 450	6 950
	55.562(2 3/16)	32.00	31.75(1 1/4)	1.5	41.275	1	54 500	90 500	5 550	9 250
34.925(1 3/8)	55.562(2 3/16)	32.00	31.75(1 1/4)	1.5	41.275	0.5	54 500	90 500	5 550	9 250
	58.738(2 5/16)	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738(2 5/16)	32.00	31.75(1 1/4)	1.5	44.450	1	55 500	95 500	5 700	9 750

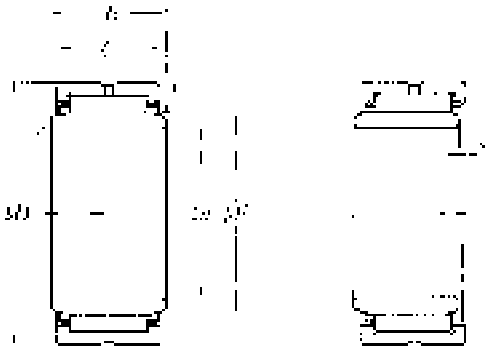
Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.
2) Max. allowable dimension of radius *ras* for corner roundness on shaft/housing.



Limiting speeds min⁻¹ grease	oil	Bearing numbers	Abutment dimensions mm d_a min	D_a max	r_{as} 3) max	Mass kg (approx.)
17 000	25 000	**MR101812+MI-061012**	13.5	24.5	0.6	0.069
17 000	25 000	**MR101816+MI-061016**	13.5	24.5	0.6	0.093
14 000	21 000	**MR122012+MI-081212**	17.5	26.5	1	0.079
14 000	21 000	**MR122016+MI-081216**	17.5	26.5	1	0.105
12 000	18 000	**MR142212+MI-101412**	21	30	1	0.086
12 000	18 000	**MR142216+MI-101416**	21	30	1	0.118
12 000	18 000	**MR142212+MI-111412**	21	30	1	0.079
11 000	16 000	**MR162412+MI-121612**	24	33	1	0.102
11 000	16 000	**MR162416+MI-121616**	24	33	1	0.136
11 000	16 000	**MR162416+MI-131616**	24	33	1	0.125
9 500	14 000	**MR182616+MI-141816**	27	36.5	1	0.152
9 500	14 000	**MR182620+MI-141820**	27	36.5	1	0.193
9 500	14 000	**MR182616+MI-151816**	27	36.5	1	0.139
9 500	14 000	**MR182620+MI-151820**	27	36.5	1	0.176
8 500	13 000	**MR202816+MI-162016**	30.5	39.5	1	0.161
8 500	13 000	**MR202820+MI-162020**	30.5	39.5	1	0.201
7 500	11 000	**MR223016+MI-182216**	33.5	42.5	1	0.181
7 500	11 000	**MR223020+MI-182220**	33.5	42.5	1	0.229
7 500	11 000	**MR243320+MI-192420**	35	46	1.5	0.286
7 500	11 000	**MR243316+MI-202416**	37	46	1.5	0.230
7 500	11 000	**MR243320+MI-202420**	37	46	1.5	0.285
6 500	9 500	**MR263516+MI-212616**	40	49	1.5	0.257
6 500	9 500	**MR263520+MI-212620**	40	49	1.5	0.325
6 500	9 500	**MR263520+MI-222620**	40	49	1.5	0.286
6 000	9 000	**MR283716+MI-222816**	41.5	52	1.5	0.294
6 000	9 000	**MR283720+MI-222820**	41.5	52	1.5	0.364

Inch series
With inner ring

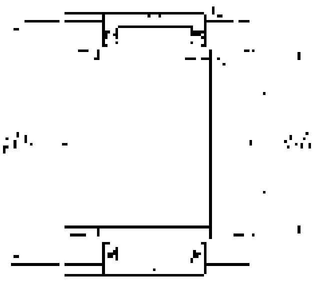
Type MR＋MI



d 36.512～66.675mm

Boundary dimensions mm (1/25.4 mm)							Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	D	B	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}
36.512(1 7/16)	58.738(2 5/16)	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738(2 5/16)	32.00	31.75(1 1/4)	1.5	44.450	0.5	55 500	95 500	5 700	9 750
38.100(1 1/2)	58.738(2 5/16)	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738(2 5/16)	32.00	31.75(1 1/4)	1.5	44.450	0.5	55 500	95 500	5 700	9 750
	65.088(2 9/16)	32.00	31.75(1 1/4)	1.5	50.800	0.5	62 000	114 000	6 300	11 700
39.688(1 9/16)	61.912(2 7/16)	32.00	31.75(1 1/4)	1.5	47.625	1	59 000	105 000	6 000	10 700
	65.088(2 9/16)	32.00	31.75(1 1/4)	1.5	50.800	0.5	62 000	114 000	6 300	11 700
41.275(1 5/8)	65.088(2 9/16)	25.65	25.40(1)	1.5	50.800	0.5	49 500	86 000	5 050	8 800
	65.088(2 9/16)	32.00	31.75(1 1/4)	1.5	50.800	1	62 000	114 000	6 300	11 700
42.682(1 11/16)	65.088(2 9/16)	25.65	25.40(1)	1.5	50.800	0.5	49 500	86 000	5 050	8 800
	65.088(2 9/16)	32.00	31.75(1 1/4)	1.5	50.800	0.5	62 000	114 000	6 300	11 700
44.450(1 3/4)	76.200(3)	38.35	38.10(1 1/2)	1.5	57.150	3.5	83 500	142 000	8 500	14 500
	76.200(3)	44.70	44.45(1 3/4)	1.5	57.150	3.5	97 000	173 000	9 850	17 600
49.212(1 15/16)	82.550(3 1/4)	38.35	38.10(1 1/2)	2	63.500	1.5	88 000	158 000	8 950	16 100
	82.550(3 1/4)	44.70	44.45(1 3/4)	2	63.500	2	102 000	191 000	10 400	19 500
50.800(2)	82.550(3 1/4)	38.35	25.40(1)	2	63.500	2.5	88 000	158 000	8 950	16 100
	82.550(3 1/4)	44.70	44.45(1 3/4)	2	63.500	3	102 000	191 000	10 400	19 500
55.562(2 3/16)	88.900(3 1/2)	44.70	44.45(1 3/4)	2	69.850	1.5	107 000	209 000	10 900	21 300
57.150(2 1/4)	88.900(3 1/2)	25.65	25.40(1)	2	69.850	0.5	66 000	112 000	6 700	11 400
	88.900(3 1/2)	38.35	38.10(1 1/2)	2	69.850	2.5	92 000	173 000	9 400	17 600
	88.900(3 1/2)	44.70	44.45(1 3/4)	2	69.850	3	107 000	209 000	10 900	21 300
60.325(2 3/8)	95.250(3 3/4)	44.70	44.45(1 3/4)	2	76.200	1.5	112 000	227 000	11 400	23 200
63.500(1/2)	95.250(3 3/4)	38.35	38.10(1 1/2)	2	76.200	2.5	96 000	188 000	9 800	19 100
	95.250(3 3/4)	44.70	44.45(1 3/4)	2	76.200	3	112 000	227 000	11 400	23 200
66.675(2 5/8)	107.950(4 1/4)	44.70	44.45(1 3/4)	2	82.550	3	134 000	240 000	13 600	24 500
	107.950(4 1/4)	51.05	50.80(2)	2	82.550	5.5	146 000	268 000	14 900	27 400

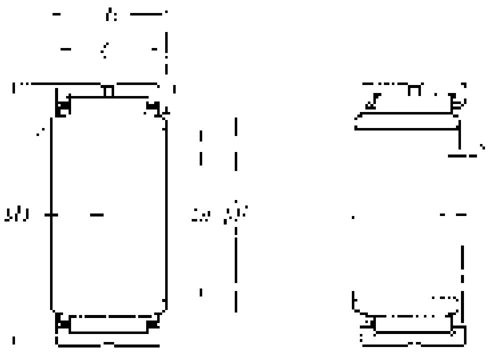
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



Limiting speeds min^{-1} grease	oil	Bearing numbers	Abutment dimensions mm d_a min	D_a max	r_{as} [3] max	Mass kg (approx.)
6 000	9 000	**MR283716+MI-232816**	43	52	1.5	0.264
6 000	9 000	**MR283720+MI-232820**	43	52	1.5	0.330
6 000	9 000	**MR283716+MI-242816**	43	52	1.5	0.246
6 000	9 000	**MR283720+MI-242820**	43	52	1.5	0.307
5 500	8 000	**MR324120+MI-243220**	44.5	58.5	1.5	0.448
5 500	8 500	**MR303920+MI-253020**	46.5	55.5	1.5	0.368
5 500	8 000	**MR324120+MI-253220**	46	58.5	1.5	0.424
5 500	8 000	**MR324116+MI-263216**	48	58.5	1.5	0.317
5 500	8 000	**MR324120+MI-263220**	48	58.5	1.5	0.402
5 500	8 000	**MR324116+MI-273216**	49.5	58.5	1.5	0.300
5 500	8 000	**MR324120+MI-273220**	49.5	58.5	1.5	0.373
4 700	7 000	**MR364824+MI-283624**	51	69.5	1.5	0.732
4 700	7 000	**MR364828+MI-283628**	51	69.5	1.5	0.853
4 300	6 500	**MR405224+MI-314024**	56	74.5	2	0.848
4 300	6 500	**MR405228+MI-314028**	56	74.5	2	0.975
4 300	6 500	**MR405224+MI-324024**	59	74.5	2	0.812
4 300	6 500	**MR405228+MI-324028**	59	74.5	2	0.923
3 700	5 500	**MR445628+MI-354428**	63.5	81	2	1.07
3 700	5 500	**MR445616+MI-364416**	65	81	2	0.594
3 700	5 500	**MR445624+MI-364424**	65	81	2	0.884
3 700	5 500	**MR445628+MI-364428**	65	81	2	1.02
3 300	5 000	**MR486028+MI-384828**	68	87	2	1.25
3 300	5 000	**MR486024+MI-404824**	71.5	87	2	0.978
3 300	5 000	**MR486028+MI-404828**	71.5	87	2	1.14
3 300	5 000	**MR526828+MI-425228**	74.5	100	2	1.67
3 300	5 000	**MR526832+MI-425232**	74.5	100	2	1.92

Inch series
With inner ring

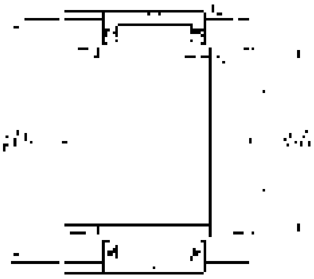
Type MR＋MI



d 69.850～127.000mm

Boundary dimensions mm (1/25.4mm)							Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	D	B	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}
69.850(2 ¾)	107.950(4 ¼)	44.70	44.45(1 ¾)	2	82.550	1.5	134 000	240 000	13 600	24 500
	107.950(4 ¼)	51.05	50.80(2)	2	82.550	3	146 000	268 000	14 900	27 400
74.612(2 15/16)	114.300(4 ½)	51.05	50.80(2)	2	88.900	3	154 000	295 000	15 700	30 000
76.200(3)	114.300(4 ½)	44.70	44.45(1 ¾)	2	88.900	3	141 000	264 000	14 400	26 900
	114.300(4 ½)	51.05	50.80(2)	2	88.900	5.5	154 000	295 000	15 700	30 000
79.375(3 ⅛)	120.650(4 ¾)	51.05	50.80(2)	2.5	95.250	5.5	162 000	320 000	16 500	32 500
82.550(3 ¼)	120.650(4 ¾)	51.05	50.80(2)	2.5	95.250	2.5	162 000	320 000	16 500	32 500
	127.000(5)	51.05	50.80(2)	2.5	101.600	2.5	169 000	345 000	17 200	35 500
85.725(3 ⅜)	127.000(5)	51.05	50.80(2)	2.5	101.600	4.5	169 000	345 000	17 200	35 500
88.900(3 ½)	127.000(5)	51.05	50.80(2)	2.5	101.600	2.5	169 000	345 000	17 200	35 500
	133.350(5 ¼)	51.05	50.80(2)	2.5	107.950	2.5	172 000	360 000	17 500	37 000
92.075(3 ⅝)	133.350(5 ¼)	51.05	50.80(2)	2.5	107.950	4.5	172 000	360 000	17 500	37 000
95.250(3 ¾)	133.350(5 ¼)	51.05	50.80(2)	2.5	107.950	2.5	172 000	360 000	17 500	37 000
	152.400(6)	57.40	57.15(2 ¼)	2.5	114.300	3	238 000	435 000	24 300	44 500
	152.400(6)	63.88	63.50(2 ½)	2.5	114.300	4	260 000	485 000	26 500	49 500
98.425(3 ⅞)	152.400(6)	57.40	57.15(2 ¼)	2.5	114.300	5.5	238 000	435 000	24 300	44 500
	152.400(6)	63.88	63.50(2 ½)	2.5	114.300	7	260 000	485 000	26 500	49 500
101.600(4)	165.100(6 ½)	51.05	50.80(2)	2.5	127.000	2.5	227 000	425 000	23 200	43 000
	165.100(6 ½)	57.40	57.15(2 ¼)	2.5	127.000	5.5	250 000	480 000	25 500	49 000
	165.100(6 ½)	63.88	57.15(2 ¼)	2.5	127.000	7	273 000	535 000	27 800	54 500
107.950(4 ¼)	165.100(6 ½)	57.40	57.15(2 ¼)	2.5	127.000	3	250 000	480 000	25 500	49 000
114.300(4 ½)	177.800(7)	63.88	63.50(2 ½)	2.5	139.700	5.5	285 000	585 000	29 100	59 500
	177.800(7)	76.58	76.20(3)	2.5	139.700	7	345 000	740 000	35 000	75 500
120.650(4 ¾)	184.150(7 ¼)	82.55	76.20(3)	3	146.050	3	360 000	775 000	36 500	79 000
127.000(5)	190.500(7 ½)	63.88	63.50(2 ½)	3	152.400	7	310 000	630 000	31 500	64 000
	190.500(7 ½)	76.58	76.20(3)	3	152.400	5.5	375 000	800 000	38 000	81 500

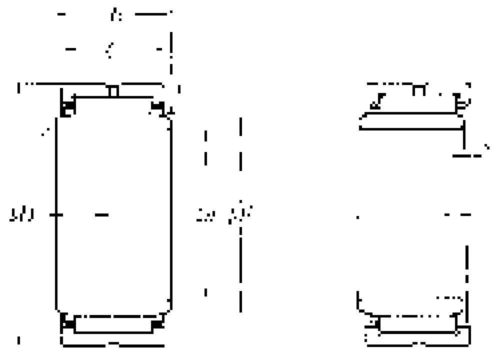
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
2) Max. allowable dimension of radius r_s for corner roundness on shaft/housing.



Limiting speeds min-1 grease	oil	Bearing numbers	Abutment dimensions mm d_a min	D_a max	r_{as} 3) max	Mass kg (approx.)
3 300	5 000	**MR526828 +MI-445228**	78	100	2	1.55
3 300	5 000	**MR526832 +MI-445232**	78	100	2	1.77
3 000	4 500	**MR567232 +MI-475632**	83	106.5	2	2.00
3 000	4 500	**MR567228 +MI-485628**	84	106.5	2	1.65
3 000	4 500	**MR567232 +MI-485632**	84	106.5	2	1.92
2 800	4 200	**MR607632 +MI-506032**	88.5	111.5	2.5	2.15
2 800	4 200	**MR607632 +MI-526032**	91.5	111.5	2.5	1.99
2 600	3 900	**MR648032 +MI-526432**	91.5	118	2.5	2.39
2 600	3 900	**MR648032 +MI-546432**	94.5	118	2.5	2.22
2 600	3 900	**MR648032 +MI-566432**	98	118	2.5	2.05
2 500	3 700	**MR688432 +MI-566832**	98	124.5	2.5	2.53
2 500	3 700	**MR688432 +MI-586832**	101	124.5	2.5	2.36
2 500	3 700	**MR688432 +MI-606832**	104.5	124.5	2.5	2.17
2 300	3 500	**MR729636 +MI-607236**	104.5	143.5	2.5	4.02
2 300	3 500	**MR729640 +MI-607240**	104.5	143.5	2.5	4.47
2 300	3 500	**MR729636 +MI-627236**	107.5	143.5	2.5	3.77
2 300	3 500	**MR729640 +MI-627240**	107.5	143.5	2.5	4.19
2 100	3 100	**MR8010432+MI-648032**	110.5	156	2.5	3.60
2 100	3 100	**MR8010436+MI-648036**	110.5	156	2.5	4.92
2 100	3 100	**MR8010440+MI-648040**	110.5	156	2.5	5.47
2 100	3 100	**MR8010436+MI-688036**	117	156	2.5	4.44
1 900	2 900	**MR8811240+MI-728840**	123.5	169	2.5	6.04
1 900	2 900	**MR8811248+MI-728848**	123.5	169	2.5	7.26
1 800	2 700	**MR9211648+MI-769248**	132	172	3	7.48
1 700	2 600	**MR9612040+MI-809640**	140	177.5	3	6.54
1 700	2 600	**MR9612048+MI-809648**	140	177.5	3	7.84

Inch series
With inner ring

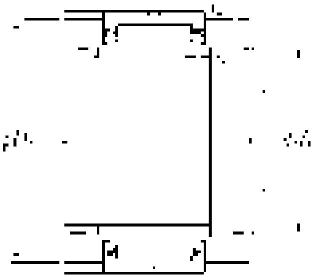
Type MR＋MI



d 139.700～203.200mm

Boundary dimensions mm (1/25.4mm)							Basic load ratings			
							dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	D	B	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{or}	C_r	C_{or}
139.700(5 ½)	203.200(8)	63.88	63.50(2½)	3	165.100	6	325 000	680 000	33 000	69 500
	203.200(8)	76.58	76.20(3)	3	165.100	5.5	390 000	870 000	39 500	88 500
152.400(6)	231.775(9⅛)	76.58	76.20(3)	3	184.150	8.5	435 000	915 000	44 500	93 000
165.100(6 ½)	244.475(9⅝)	76.58	76.20(3)	3	196.850	8.5	455 000	990 000	46 500	101 000
177.800(7)	257.175(10 ⅛)	76.58	76.20(3)	3	209.550	8.5	475 000	1 060 000	48 500	109 000
190.500(7 ½)	269.875(10 ⅝)	76.58	76.20(3)	4	222.250	7	495 000	1 140 000	50 500	116 000
203.200(8)	282.575(11 ⅛)	76.58	76.20(3)	4	234.950	7	510 000	1 210 000	52 000	124 000

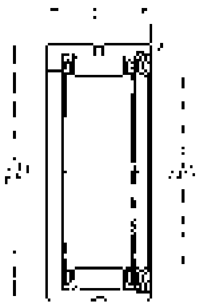
Note 1) Allowable minimum chamfer dimension r. 2) Allowable axial stroking value of inner ring against outer ring.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



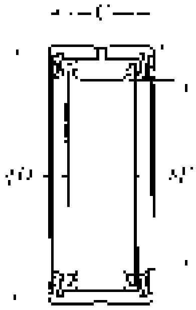
Limiting speeds min⁻¹ grease	oil	Bearing numbers	Abutment dimensions mm d_a min	D_a max	r_{as} [3] max	Mass kg (approx.)
1 600	2 400	**MR10412840+MI-8810440**	152.5	190	3	6.86
1 600	2 400	**MR10412848+MI-8810448**	152.5	190	3	8.22
1 500	2 200	**MR11614648+MI-9611648**	165.5	219	3	12.2
1 300	2 000	**MR12415448+MI-10412448**	178	231.5	3	13.1
1 300	1 900	**MR13216248+MI-11213248**	191	244	3	14.0
1 200	1 800	**MR14017048+MI-12014048**	206.5	254	4	15.0
1 100	1 700	**MR14817848+MI-12814848**	219	266.5	4	15.8

Without inner ring

Type RNA49··L
Type RNA49··LL



Type RNA49··L
(With single seal)



Type RNA49··LL
(With double seal)

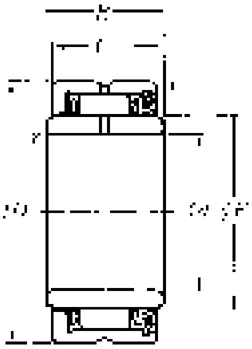
F_W 14～58mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	Bearing numbers Type RNA49··L	Type RNA49··LL	Abutment dimensions mm			Mass kg
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}				D_a max	D_b max	r_{as} 2) max	(approx.)
14 $^{+0.027}_{+0.016}$	22	13	0.3	7 200	8 500	735	865	10 000	RNA4900L/3AS	RNA4900LL/3AS	16	20	0.3	0.016
16 $^{+0.027}_{+0.016}$	24	13	0.3	7 750	9 700	795	990	10 000	RNA4901L/3AS	RNA4901LL/3AS	18	22	0.3	0.018
20 $^{+0.033}_{+0.020}$	28	13	0.3	8 300	11 200	845	1 150	10 000	RNA4902L/3AS	RNA4902LL/3AS	22	26	0.3	0.022
22 $^{+0.033}_{+0.020}$	30	13	0.3	8 500	11 900	865	1 220	9 000	RNA4903L/3AS	RNA4903LL/3AS	24	28	0.3	0.022
25 $^{+0.033}_{+0.020}$	37	17	0.3	15 200	19 900	1 550	2 030	8 000	RNA4904L/3AS	RNA4904LL/3AS	28	35	0.3	0.055
30 $^{+0.033}_{+0.020}$	42	17	0.3	16 000	22 600	1 640	2 300	6 500	RNA4905L/3AS	RNA4905LL/3AS	33	40	0.3	0.063
35 $^{+0.041}_{+0.025}$	47	17	0.3	18 000	27 400	1 830	2 800	5 500	RNA4906L/3AS	RNA4906LL/3AS	38	45	0.3	0.072
42 $^{+0.041}_{+0.025}$	55	20	0.6	22 700	39 500	2 320	4 000	4 800	RNA4907L/3AS	RNA4907LL/3AS	45	51	0.6	0.113
48 $^{+0.041}_{+0.025}$	62	22	0.6	27 800	53 500	2 830	5 450	4 200	RNA4908L/3AS	RNA4908LL/3AS	51	58	0.6	0.154
52 $^{+0.049}_{+0.030}$	68	22	0.6	28 600	57 000	2 920	5 800	3 800	RNA4909L/3AS	RNA4909LL/3AS	55	64	0.6	0.157
58 $^{+0.049}_{+0.030}$	72	22	0.6	30 500	64 000	3 100	6 500	3 400	RNA4910L/3AS	RNA4910LL/3AS	61	68	0.6	0.160

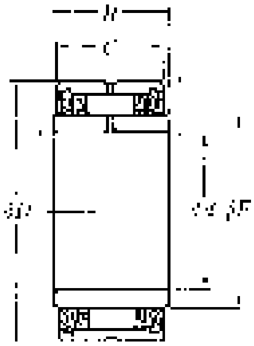
Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} corner roundness on shaft/housing.

With inner ring

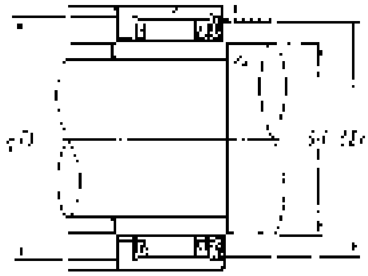
Type NA49··L
Type NA49··LL



Type NA49··L
(With single seal)



Type NA49··LL
(With double seal)

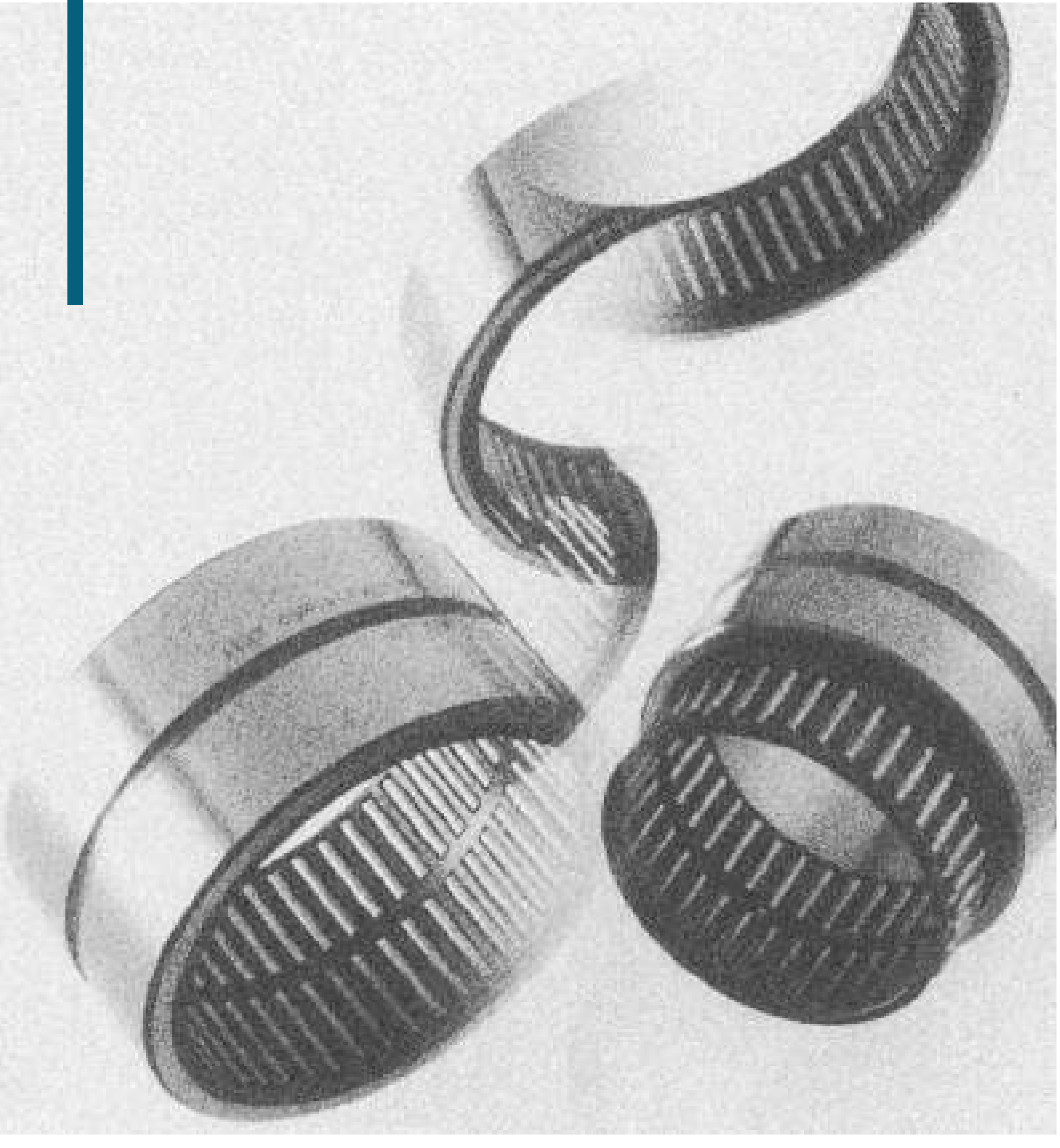


d 10～50mm

Boundary dimensions mm						Basic load ratings dynamic static (N)		dynamic static (kgf)		Limiting speeds min^{-1}	Bearing numbers		Abutment dimensions mm				Mass kg
d	D	B	C	$r_{s\,min}$ 1)	F	C_r	C_{or}	C_r	C_{or}	grease	Type NA49··L	Type RNA49··LL	d_a min	D_a max	D_b max	r_{as} 2) max	(approx.)
10	22	14	13	0.3	14	7 200	8 500	735	865	10 000	NA4900L/3AS	NA4900LL/3AS	12	16	20	0.3	0.025
12	24	14	13	0.3	16	7 750	9 700	795	990	10 000	NA4901L/3AS	NA4901LL/3AS	14	18	22	0.3	0.028
15	28	14	13	0.3	20	8 300	11 200	845	1 150	10 000	NA4902L/3AS	NA4902LL/3AS	17	22	26	0.3	0.036
17	30	14	13	0.3	22	8 500	11 900	865	1 220	9 000	NA4903L/3AS	NA4903LL/3AS	19	24	28	0.3	0.039
20	37	18	17	0.3	25	15 200	19 900	1 550	2 030	8 000	NA4904L/3AS	NA4904LL/3AS	22	28	35	0.3	0.080
25	42	18	17	0.3	30	16 000	22 600	1 640	2 300	6 500	NA4905L/3AS	NA4905LL/3AS	27	33	40	0.3	0.093
30	47	18	17	0.3	35	18 000	27 400	1 830	2 800	5 500	NA4906L/3AS	NA4906LL/3AS	32	38	45	0.3	0.107
35	55	21	20	0.6	42	22 700	39 500	2 320	4 000	4 800	NA4907L/3AS	NA4907LL/3AS	39	45	51	0.6	0.175
40	62	23	22	0.6	48	27 800	53 500	2 830	5 450	4 200	NA4908L/3AS	NA4908LL/3AS	44	51	58	0.6	0.252
45	68	23	22	0.6	52	28 600	57 000	2 920	5 800	3 800	NA4909L/3AS	NA4909LL/3AS	49	55	64	0.6	0.290
50	72	23	22	0.6	58	30 500	64 000	3 100	6 500	3 400	NA4910L/3AS	NA4910LL/3AS	54	61	68	0.6	0.295

Note 1) Allowable minimum chamfer dimension *r*.
2) Max. allowable dimension of radius *r*a for corner roundness on shaft/housing.

Machined Ring Needle Roller Bearings, Separable Type

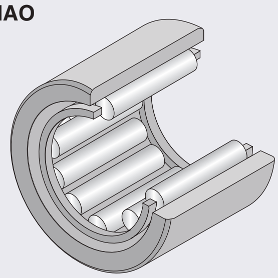
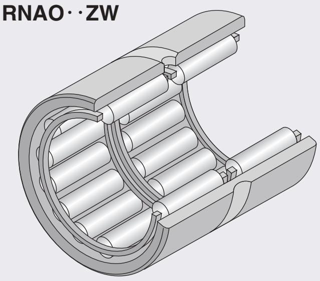
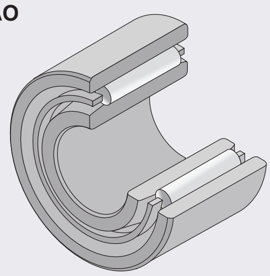
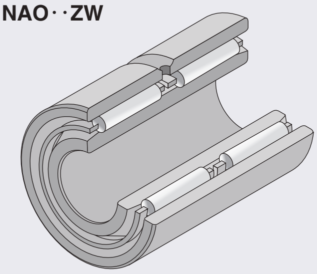


Machined Ring Needle Roller Bearings, Separable Type

The machined ring of this bearing type has no rib or side plate and, hence, the outer ring and the needle roller and cage assembly are separable from each other.

The outer ring can't regulate axial displacement of the needle roller and cage assembly and, therefore, the bearing construction must be designed so that the needle roller and cage assembly can be guided by a shaft or a housing. Furthermore, the needle roller and cage assembly can be separated from the outer ring so that the cage and roller assembly, and the outer and the inner ring can be mounted on a shaft or a housing independent. This could facilitate the bearing mounting work.

This bearing type is suitable for an application requiring high running accuracy because the radial clearance can be selected to a narrow range by combining appropriate inner ring, outer ring and needle roller and cage assembly.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type RNAO 	φ5 – φ100	**RNAO－10×17×10 T2** Suffix Width Outer diameter Roller set bore diameter Type code **[Suffix]** T2 : Resin cage ZW: Double-row type	Bearing with suffix T2 uses a polyamide resin cage and, therefore, it shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less. For applications required high running accuracy, manufacture of the bearings conforming to JIS Class-6, -5 and -4 is also available on special request.
Type RNAO··ZW 	φ8 – φ80		
Type NAO 	φ8 – φ90	**NAO－10×17×10 ZW** Suffix Width Outer diameter Bore diameter Type code **[Suffix]** T2 : Resin cage ZW: Double-row type	
Type NAO··ZW 	φ10 – φ70		

Accuracy of bearing

The dimensional accuracy, profile accuracy and running accuracy of machined ring needle roller bearing, separate type (with inner ring) are specified in JIS B 1514 (Accuracy of Rolling Bearings). (Refer to **Table 4.3** of Section 4. "**Bearing Tolerances**" on page A-26.) Although the accuracy of **NTN** standard bearings conforms to JIS Class-0, **NTN** can also supply bearings conforming to JIS Class-6, -5 and -4. Feel free to contact **NTN** for the further detail of these bearings.

The dimensional tolerances for the roller inscribed circle diameters (F_w) of the bearing type without inner ring conform to ISO Tolerance Range Class-F6. The outer ring and the needle roller and cage assembly are supplied in set and, therefore, the bearing must be installed with the combination of these two in set remained unchanged.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, **NTN** will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact **NTN** Engineering.

Radial internal clearance and bearing fits

For information about radial internal clearance of **NTN** machined ring needle roller bearings, separable type (with inner ring), refer to **Table 5.1** in Sec. **5.1 "Bearing radial internal clearance"** (page A-30). Because of the narrow non-interchangeable clearance range, the bearings shipped after adjusted to a specific non-interchangeable clearance must be installed with the clearance remained unchanged.

The dimensional tolerances (fits) of a shaft and housing bore to which the bearing with inner ring is installed should be in accordance with type and magnitude of load, and dimensions of the shaft and housing bore. For information about the dimensional tolerances of a shaft and housing bore, refer to Sec. **6.4 "Recommended internal fits"** (page A-33). For the profile accuracy and surface roughness of the shaft and housing bore corresponding to the recommended internal fits in Table 8.3 in Sec. **8.3 "Shaft and housing accuracy"** (page A-40).

A bearing not having an inner ring directly uses the shaft as raceway surface, and the dimensional tolerances of the shaft diameter (raceway diameter) can vary depending on the operating internal clearance of the bearing as summarized in **Table 1** in page B-57. For this type of bearing usage, the dimensional tolerance class for the housing bore is K7, which is most commonly adopted tolerance class. When wishing to adopt a dimensional tolerance class other than K7 for the housing bore, contact **NTN** Engineering for technical assistance.

For the profile accuracy, surface roughness and surface hardness of the shaft that functions as raceway surface, refer to Sec. **8.4 "Raceway surface accuracy"** (page A-40) and Sec. **8.5 "Material and hardness of raceway"** (page A-40).

Oil hole dimension of the outer ring

The outer ring of bearing Type ZW is provided with an oil hole and an oil groove to facilitate oil lubrication to bearing.

Table 1 shows the oil hole dimension.

Table 1 Oil hole dimension

Outer ring outer diameter		Oil hole dia. (mm)	Number of oil hole
over	incl.		
—	20	2.0	1
20	40	2.5	1
40	80	3.0	1
80	200	3.5	1

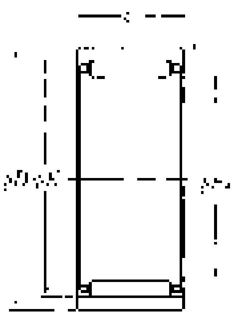
Mounting relations

The inner ring and outer ring of any machined ring needle roller bearing, separable type must be positioned in axial direction by shoulder or a snap ring.

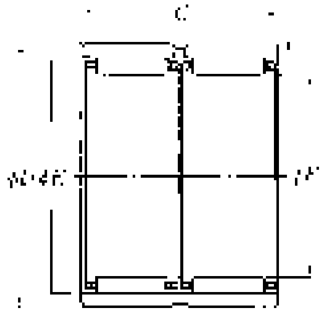
The mounting relation dimensions about the shaft and housing bore for this case are found in the relevant dimension table. The cage must be guided by the shaft or the side face of the housing shoulder, but the guide surface must be finished by, at least, grinding for deburring.

Without inner ring

Type RNAO
Type RNAO··ZW



Type RNAO

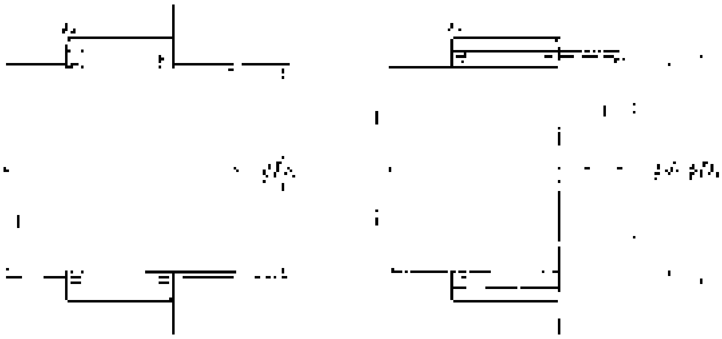


Type RNAO··ZW

F_W 5～20mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers
F_W		D	C	$r_{s\,min}$ 1)	E	C_r	C_{or}	C_r	C_{or}	grease	oil	
5	+0.018 / +0.010	10	8	0.15	8	2 640	2 190	269	224	27 000	40 000	**RNAO- 5×10×8T2**
6	+0.018 / +0.010	13	8	0.3	9	2 660	2 280	272	233	25 000	37 000	**RNAO- 6×13×8T2**
7	+0.022 / +0.013	14	8	0.3	10	2 670	2 350	272	239	23 000	34 000	**RNAO- 7×14×8T2**
8	+0.022 / +0.013	15	10	0.3	11	4 000	4 100	410	420	21 000	32 000	**RNAO -8×15×10T2**
		16	20	0.3	12	7 950	8 350	810	850	21 000	32 000	**RNAO- 8×16×20ZWT2**
10	+0.022 / +0.013	17	10	0.3	13	4 550	5 100	460	520	19 000	28 000	**RNAO-10×17×10T2**
		20	12	0.3	16	7 100	5 950	720	610	19 000	28 000	**RNAO-10×20×12**
12	+0.027 / +0.016	19	13.5	0.3	15	6 000	7 700	615	785	17 000	26 000	**RNAO-12×19×13.5**
		22	12	0.3	18	8 650	8 000	880	815	17 000	26 000	**RNAO-12×22×12**
14	+0.027 / +0.016	22	13	0.3	18	8 300	10 100	845	1 030	16 000	24 000	**RNAO-14×22×13**
		22	20	0.3	18	11 800	16 000	1 210	1 630	16 000	24 000	**RNAO-14×22×20ZW**
		26	12	0.3	20	9 350	9 150	955	930	16 000	24 000	**RNAO-14×26×12**
15	+0.027 / +0.016	23	13	0.3	19	8 250	10 200	840	1 040	15 000	23 000	**RNAO-15×23×13**
		23	20	0.3	19	11 700	16 100	1 200	1 640	15 000	23 000	**RNAO-15×23×20ZW**
16	+0.027 / +0.016	24	13	0.3	20	9 050	11 800	925	1 200	15 000	23 000	**RNAO-16×24×13**
		24	20	0.3	20	12 900	18 500	1 310	1 890	15 000	23 000	**RNAO-16×24×20ZW**
		28	12	0.3	22	11 700	12 500	1 190	1 280	15 000	23 000	**RNAO-16×28×12**
17	+0.027 / +0.016	25	13	0.3	21	9 400	12 600	960	1 280	15 000	22 000	**RNAO-17×25×13**
		25	20	0.3	21	12 800	18 600	1 300	1 900	15 000	22 000	**RNAO-17×25×20ZW**
		25	26	0.3	21	16 100	25 200	1 640	2 570	15 000	22 000	**RNAO-17×25×26ZW**
18	+0.027 / +0.016	26	13	0.3	22	8 900	11 900	910	1 210	14 000	21 000	**RNAO-18×26×13**
		26	20	0.3	22	12 700	18 800	1 290	1 910	14 000	21 000	**RNAO-18×26×20ZW**
		30	12	0.3	24	12 300	13 800	1 250	1 410	14 000	21 000	**RNAO-18×30×12**
		30	24	0.3	24	21 100	27 700	2 150	2 820	14 000	21 000	**RNAO-18×30×24ZW**
20	+0.033 / +0.020	28	13	0.3	24	10 000	14 300	1 020	1 460	13 000	20 000	**RNAO-20×28×13**
		28	26	0.3	24	17 100	28 600	1 750	2 910	13 000	20 000	**RNAO-20×28×26ZW**
		32	12	0.3	26	12 900	15 100	1 320	1 540	13 000	20 000	**RNAO-20×32×12**

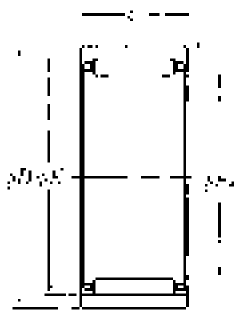
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



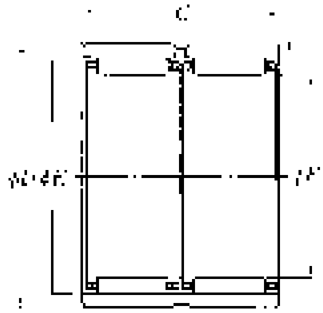
Abutment dimensions mm				Mass kg
d_b	D_a max	D_b	r_{as} max [2)]	(approx.)
7.7	8.8	5.3	0.15	0.003
8.7	11	6.3	0.3	0.006
9.7	12	7.3	0.3	0.006
10.7	13	8.3	0.3	0.008
11.7	14	8.3	0.3	0.017
12.7	15	10.3	0.3	0.010
15.7	18	10.3	0.3	0.018
14.7	17	12.3	0.3	0.015
17.6	20	12.3	0.3	0.019
17.6	20	14.4	0.3	0.018
17.6	20	14.4	0.3	0.027
19.6	24	14.4	0.3	0.029
18.6	21	15.4	0.3	0.020
18.6	21	15.4	0.3	0.031
19.6	22	16.4	0.3	0.021
19.6	22	16.4	0.3	0.032
21.6	26	16.4	0.3	0.032
20.6	23	17.4	0.3	0.022
20.6	23	17.4	0.3	0.034
20.6	23	17.4	0.3	0.044
21.6	24	18.4	0.3	0.022
21.6	24	18.4	0.3	0.033
23.6	28	18.4	0.3	0.035
23.6	28	18.4	0.3	0.069
23.6	26	20.4	0.3	0.025
23.6	26	20.4	0.3	0.050
25.6	30	20.4	0.3	0.038

Without inner ring

Type RNAO
Type RNAO··ZW



Type RNAO

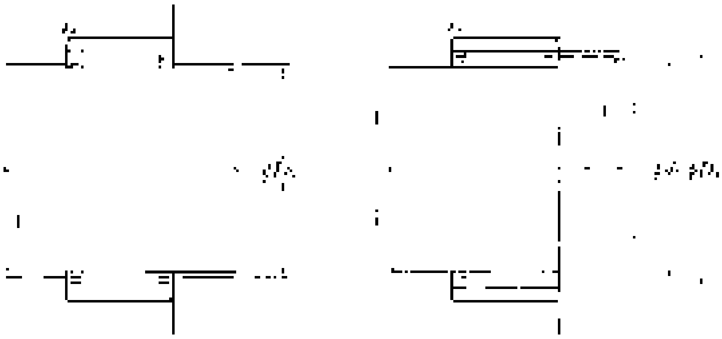


Type RNAO··ZW

F_W 20～40mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹)		Bearing numbers
F_W		D	C	$r_{s\,min}$ 1)	E	C_r	C_{or}	C_r	C_{or}	grease	oil	
20	+0.033 +0.020	32	24	0.3	26	22 100	30 000	2 260	3 100	13 000	20 000	**RNAO-20×32×24ZW**
22	+0.033 +0.020	30	13	0.3	26	10 200	15 200	1 040	1 550	12 000	18 000	**RNAO-22×30×13**
		30	26	0.3	26	17 500	30 500	1 790	3 100	12 000	18 000	**RNAO-22×30×26ZW**
		35	16	0.3	29	18 700	22 700	1 910	2 310	12 000	18 000	**RNAO-22×35×16**
		35	32	0.3	29	32 000	45 500	3 300	4 650	12 000	18 000	**RNAO-22×35×32ZW**
25	+0.033 +0.020	35	17	0.3	29	14 200	24 000	1 450	2 450	11 000	16 000	**RNAO-25×35×17**
		35	26	0.3	29	18 400	33 500	1 880	3 450	11 000	16 000	**RNAO-25×35×26ZW**
		37	16	0.3	32	19 500	24 700	1 990	2 520	11 000	16 000	**RNAO-25×37×16**
		37	32	0.3	32	33 500	49 500	3 400	5 050	11 000	16 000	**RNAO-25×37×32ZW**
26	+0.033 +0.020	39	13	0.3	30	11 800	19 200	1 200	1 960	10 000	15 000	**RNAO-26×39×13**
28	+0.033 +0.020	40	16	0.3	35	21 200	28 400	2 160	2 900	9 500	14 000	**RNAO-28×40×16**
		40	32	0.3	35	36 500	57 000	3 700	5 800	9 500	14 000	**RNAO-28×40×32ZW**
30	+0.033 +0.020	40	17	0.3	35	19 400	32 500	1 970	3 350	9 000	13 000	**RNAO-30×40×17**
		40	26	0.3	35	25 200	46 000	2 570	4 650	9 000	13 000	**RNAO-30×40×26ZW**
		42	16	0.3	37	21 900	30 500	2 230	3 100	9 000	13 000	**RNAO-30×42×16**
		42	32	0.3	37	37 500	60 500	3 850	6 200	9 000	13 000	**RNAO-30×42×32ZW**
32	+0.041 +0.025	42	13	0.3	37	14 500	23 000	1 480	2 350	8 500	13 000	**RNAO-32×42×13**
35	+0.041 +0.025	45	13	0.3	40	15 200	25 100	1 550	2 560	7 500	11 000	**RNAO-35×45×13**
		45	17	0.3	40	20 000	36 000	2 040	3 650	7 500	11 000	**RNAO-35×45×17**
		45	26	0.3	40	26 100	50 000	2 660	5 100	7 500	11 000	**RNAO-35×45×26ZW**
		47	16	0.3	42	24 100	36 000	2 450	3 650	7 500	11 000	**RNAO-35×47×16**
		47	18	0.3	42	24 700	37 000	2 510	3 750	7 500	11 000	**RNAO-35×47×18**
		47	32	0.3	42	41 500	71 500	4 200	7 300	7 500	11 000	**RNAO-35×47×32ZW**
37	+0.041 +0.025	47	13	0.3	42	15 900	27 100	1 620	2 770	7 000	11 000	**RNAO-37×47×13**
		52	18	0.3	44	26 300	41 000	2 680	4 150	7 000	11 000	**RNAO-37×52×18**
40	+0.041 +0.025	50	17	0.3	45	21 800	41 500	2 220	4 250	6 500	10 000	**RNAO-40×50×17**
		50	34	0.3	45	37 500	83 000	3 800	8 500	6 500	10 000	**RNAO-40×50×34ZW**
		55	20	0.3	47	31 000	51 500	3 150	5 250	6 500	10 000	**RNAO-40×55×20**

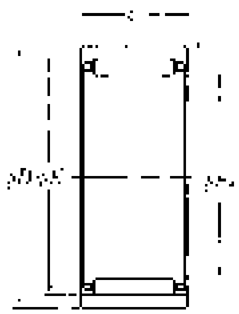
Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_a corner roundness on shaft/housing.

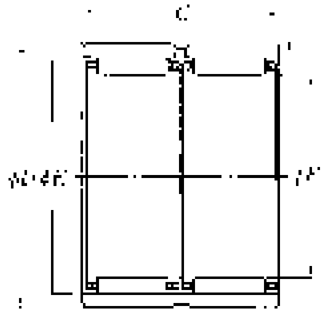


Abutment dimensions mm				Mass kg
d_b	D_a max	D_b	r_{as} 2) max	(approx.)
25.6	30	20.4	0.3	0.080
25.6	28	22.4	0.3	0.027
25.6	28	22.4	0.3	0.054
28.4	33	22.4	0.3	0.059
28.4	33	22.4	0.3	0.118
28.4	33	25.6	0.3	0.053
28.4	33	25.6	0.3	0.076
31.4	35	25.6	0.3	0.060
31.4	35	25.6	0.3	0.119
29.4	37	26.6	0.3	0.060
34.4	38	28.6	0.3	0.061
34.4	38	28.6	0.3	0.122
34.4	38	30.6	0.3	0.060
34.4	38	30.6	0.3	0.094
36.4	40	30.6	0.3	0.069
36.4	40	30.6	0.3	0.137
36.4	40	32.6	0.3	0.049
39.4	43	35.6	0.3	0.053
39.4	43	35.6	0.3	0.069
39.4	43	35.6	0.3	0.091
41.4	45	35.6	0.3	0.078
41.4	45	35.6	0.3	0.089
41.4	45	35.6	0.3	0.156
41.4	45	37.6	0.3	0.056
43.4	50	37.6	0.3	0.125
44.4	48	40.6	0.3	0.074
44.4	48	40.6	0.3	0.152
46.2	53	40.6	0.3	0.145

Without inner ring

Type RNAO
Type RNAO··ZW

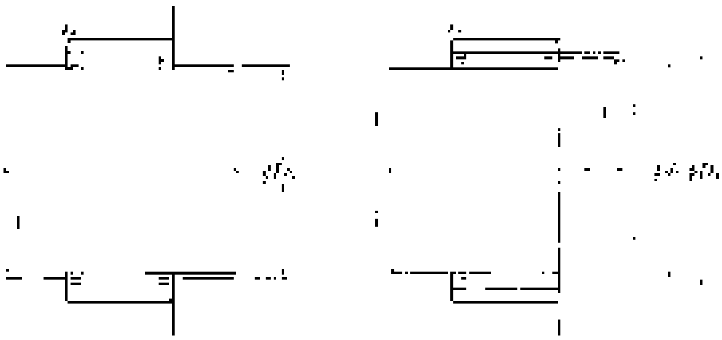

Type RNAO


Type RNAO··ZW

F_W 40～85mm

Boundary dimensions (mm) F_W		D	C	$r_{s\,min}$ 1)	E	Basic load ratings dynamic C_r (N)	static C_{or} (N)	dynamic C_r (kgf)	static C_{or} (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers
40	+0.041 +0.025	55	40	0.3	48	56 500	102 000	5 750	10 400	6 500	10 000	RNAO-40×55×40ZW
45	+0.041 +0.025	55	17	0.3	50	22 300	44 500	2 280	4 550	6 000	9 000	RNAO-45×55×17
		55	34	0.3	50	38 500	89 500	3 900	9 100	6 000	9 000	RNAO-45×55×34ZW
		62	20	0.3	53	36 000	59 000	3 650	6 000	6 000	9 000	RNAO-45×62×20
		62	40	0.3	53	61 500	118 000	6 250	12 000	6 000	9 000	RNAO-45×62×40ZW
50	+0.041 +0.025	62	20	0.3	55	27 900	62 000	2 850	6 300	5 500	8 000	RNAO-50×62×20
		62	40	0.3	55	48 000	124 000	4 900	12 600	5 500	8 000	RNAO-50×62×40ZW
		65	20	0.3	58	38 500	67 500	3 950	6 850	5 500	8 000	RNAO-50×65×20
		65	40	0.6	58	66 500	135 000	6 750	13 700	5 500	8 000	RNAO-50×65×40ZW
55	+0.049 +0.030	68	20	0.6	60	28 800	66 500	2 940	6 750	4 800	7 500	RNAO-55×68×20
		68	25	0.6	63	50 500	97 500	5 150	9 950	4 800	7 500	RNAO-55×68×25
		68	40	0.6	60	49 500	133 000	5 050	13 500	4 800	7 500	RNAO-55×68×40ZW
		72	20	0.6	63	39 000	70 000	3 950	7 100	4 800	7 500	RNAO-55×72×20
		72	40	0.6	63	66 500	140 000	6 800	14 200	4 800	7 500	RNAO-55×72×40ZW
60	+0.049 +0.030	75	46	1	68	76 000	170 000	7 750	17 400	4 400	6 500	RNAO-60×75×46ZW
		78	20	1	68	40 000	75 000	4 100	7 650	4 400	6 500	RNAO-60×78×20
		78	40	1	68	69 000	150 000	7 050	15 300	4 400	6 500	RNAO-60×78×40ZW
65	+0.049 +0.030	85	30	1	73	61 000	132 000	6 200	13 400	4 100	6 000	RNAO-65×85×30
		85	60	1	73	104 000	263 000	10 600	26 800	4 100	6 000	RNAO-65×85×60ZW
70	+0.049 +0.030	90	30	1	78	65 500	149 000	6 700	15 200	3 800	5 500	RNAO-70×90×30
		90	60	1	78	112 000	297 000	11 500	30 500	3 800	5 500	RNAO-70×90×60ZW
75	+0.049 +0.030	95	30	1	83	67 500	157 000	6 850	16 100	3 600	5 500	RNAO-75×95×30
		95	60	1	83	115 000	315 000	11 800	32 000	3 600	5 500	RNAO-75×95×60ZW
80	+0.049 +0.030	95	30	1	86	57 000	159 000	5 800	16 200	3 300	5 000	RNAO-80×95×30
		95	56	1	88	105 000	284 000	10 700	29 000	3 300	5 000	RNAO-80×95×56ZW
		100	30	1	88	69 000	166 000	7 050	17 000	3 300	5 000	RNAO-80×100×30
		100	60	1	88	119 000	335 000	12 100	34 000	3 300	5 000	RNAO-80×100×60ZW
85	+0.058 +0.036	105	25	1	93	61 500	146 000	6 250	14 900	3 100	4 700	RNAO-85×105×25

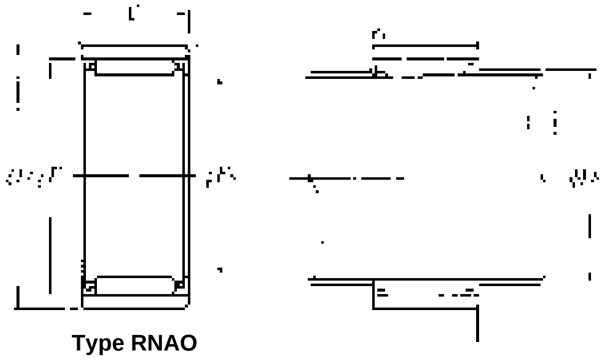
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius corner roundness on shaft/housing.



Abutment dimensions mm d_b	D_a max	D_b	r_{as} 2) max	Mass kg (approx.)
47.2	53	40.6	0.3	0.275
49.2	53	45.6	0.3	0.083
49.2	53	45.6	0.3	0.165
52.2	60	45.6	0.3	0.175
52.2	60	45.6	0.3	0.377
54.2	60	50.6	0.3	0.140
54.2	60	50.6	0.3	0.295
57.2	63	50.6	0.3	0.168
57.2	61	50.6	0.6	0.355
59.4	64	55.8	0.6	0.166
62.4	64	55.8	0.6	0.200
59.4	64	55.8	0.6	0.310
62.4	68	55.8	0.6	0.216
62.4	68	55.8	0.6	0.425
67.2	70	60.8	1	0.461
67.2	73	60.8	1	0.255
67.2	73	60.8	1	0.500
72.2	80	66	1	0.464
72.2	80	66	1	0.951
77.2	85	71	1	0.499
77.2	85	71	1	1.00
82.2	90	76	1	0.520
82.2	90	76	1	1.04
85.2	90	81	1	0.405
87.2	90	81	1	0.755
87.2	95	81	1	0.580
87.2	95	81	1	1.10
92.2	100	86	1	0.459

Without inner ring

Type RNAO

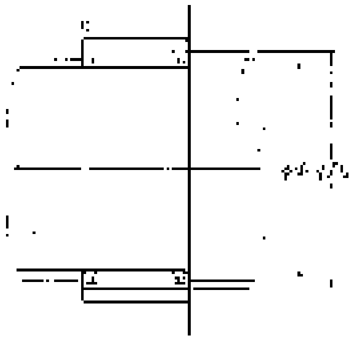


Type RNAO

F_W 85～100mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers
F_W		D	C	$r_{s\,min}$ 1)	E	C_r	C_{or}	C_r	C_{or}	grease	oil	
85	+0.058 +0.036	105	30	1	93	71 000	175 000	7 200	17 900	3 100	4 700	**RNAO- 85×105×30**
90	+0.058 +0.036	105	26	1	98	64 000	157 000	6 550	16 000	3 000	4 400	**RNAO- 90×105×26**
		110	30	1	98	72 500	184 000	7 400	18 800	3 000	4 400	**RNAO- 90×110×30**
95	+0.058 +0.036	115	30	1	103	74 000	193 000	7 550	19 600	2 800	4 200	**RNAO- 95×115×30**
100	+0.058 +0.035	120	30	1	108	76 000	201 000	7 700	20 500	2 700	4 000	**RNAO-100×120×30**

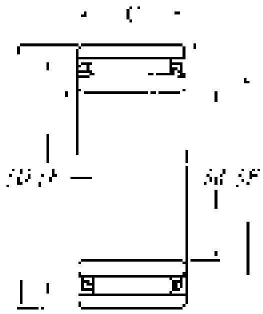
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius corner roundness on shaft/housing.



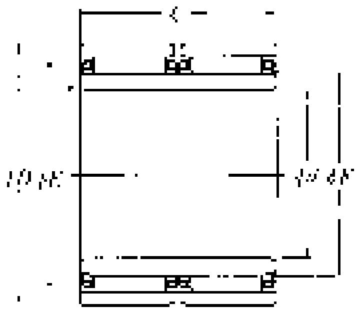
Abutment dimensions mm				Mass kg
d_b	D_a max	D_b	r_{as} 2) max	(approx.)
92.2	100	86	1	0.585
97.2	100	91	1	0.373
97.2	105	91	1	0.610
102.2	110	96	1	0.640
107.2	115	101	1	0.694

With inner ring

Type NAO
Type NAO··ZW



Type NAO

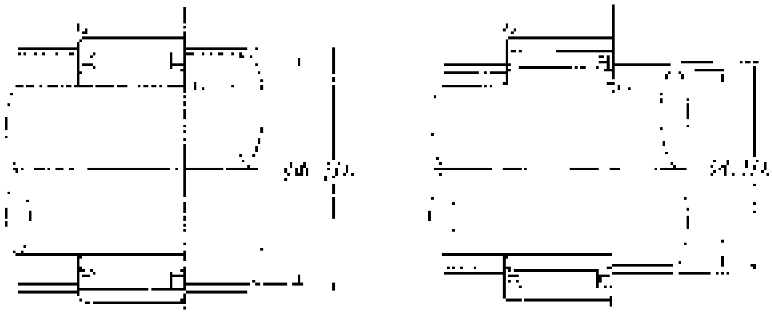


Type NAO··ZW

d 6～30mm

Boundary dimensions mm						Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ 1)	F	E	C_r	C_{or}	C_r	C_{or}			
6	17	10	0.3	10	13	4 550	5 100	460	520	19 000	28 000	**NAO-6×17×10T2**
7	20	12	0.3	10	16	7 100	5 950	720	610	19 000	28 000	**NAO-7×20×12**
9	22	12	0.3	12	18	8 650	8 000	880	815	17 000	26 000	**NAO-9×22×12**
10	22	13	0.3	14	18	8 300	10 100	845	1 030	16 000	24 000	**NAO-10×22×13**
	22	20	0.3	14	18	11 800	16 000	1 210	1 630	16 000	24 000	**NAO-10×22×20ZW**
	26	12	0.3	14	20	9 350	9 150	955	930	16 000	24 000	**NAO-10×26×12**
12	24	13	0.3	16	20	9 050	11 800	925	1 200	15 000	23 000	**NAO-12×24×13**
	24	20	0.3	16	20	12 900	18 500	1 310	1 890	15 000	23 000	**NAO-12×24×20ZW**
	28	12	0.3	16	22	11 700	12 500	1 190	1 280	15 000	23 000	**NAO-12×28×12**
15	28	13	0.3	20	24	10 000	14 300	1 020	1 460	13 000	20 000	**NAO-15×28×13**
	28	26	0.3	20	24	17 100	28 600	1 750	2 910	13 000	20 000	**NAO-15×28×26ZW**
	32	12	0.3	20	26	12 900	15 100	1 320	1 540	13 000	20 000	**NAO-15×32×12**
17	30	13	0.3	22	26	10 200	15 200	1 040	1 550	12 000	18 000	**NAO-17×30×13**
	30	26	0.3	22	26	17 500	30 500	1 790	3 100	12 000	18 000	**NAO-17×30×26ZW**
	35	16	0.3	22	29	18 700	22 700	1 910	2 310	12 000	18 000	**NAO-17×35×16**
	35	32	0.3	22	29	32 000	45 500	3 300	4 650	12 000	18 000	**NAO-17×35×32ZW**
20	35	17	0.3	25	29	14 200	24 000	1 450	2 450	11 000	16 000	**NAO-20×35×17**
	35	26	0.3	25	29	18 400	33 500	1 880	3 450	11 000	16 000	**NAO-20×35×26ZW**
	37	16	0.3	25	32	19 500	24 700	1 990	2 520	11 000	16 000	**NAO-20×37×16**
	37	32	0.3	25	32	33 500	49 500	3 400	5 050	11 000	16 000	**NAO-20×37×32ZW**
25	40	17	0.3	30	35	19 400	32 500	1 970	3 350	9 000	13 000	**NAO-25×40×17**
	40	26	0.3	30	35	25 200	46 000	2 570	4 650	9 000	13 000	**NAO-25×40×26ZW**
	42	16	0.3	30	37	21 900	30 500	2 230	3 100	9 000	13 000	**NAO-25×42×16**
	42	32	0.3	30	37	37 500	60 500	3 850	6 200	9 000	13 000	**NAO-25×42×32ZW**
29	42	13	0.3	32	37	14 500	23 000	1 480	2 350	8 500	13 000	**NAO-29×42×13**
30	45	13	0.3	35	40	15 200	25 100	1 550	2 560	7 500	11 000	**NAO-30×45×13**
	45	17	0.3	35	40	20 000	36 000	2 040	3 650	7 500	11 000	**NAO-30×45×17**
	45	26	0.3	35	40	26 100	50 000	2 660	5 100	7 500	11 000	**NAO-30×45×26ZW**

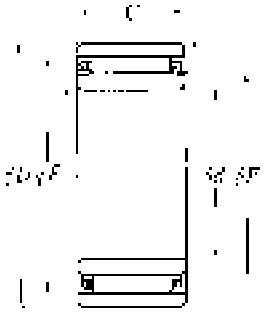
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

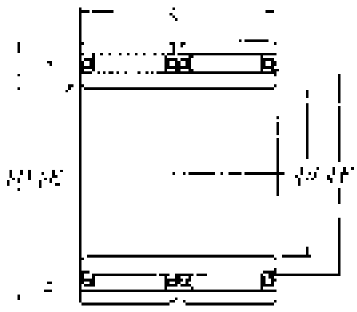


Abutment dimensions mm					Mass kg
d_a min	d_b	D_a max	D_b	r_{as} [2] max	(approx.)
8	12.7	15	10.3	0.3	0.014
9	15.7	18	10.3	0.3	0.022
11	17.6	20	12.3	0.3	0.024
12	17.6	20	14.4	0.3	0.026
12	17.6	20	14.4	0.3	0.039
12	19.6	24	14.4	0.3	0.036
14	19.6	22	16.4	0.3	0.030
14	19.6	22	16.4	0.3	0.044
14	21.6	26	16.4	0.3	0.040
17	23.6	26	20.4	0.3	0.029
17	23.6	26	20.4	0.3	0.075
17	25.6	30	20.4	0.3	0.050
19	25.6	28	22.4	0.3	0.042
19	25.6	28	22.4	0.3	0.081
19	28.4	33	22.4	0.3	0.078
19	28.4	33	22.4	0.3	0.148
22	28.4	33	25.6	0.3	0.076
22	28.4	33	25.6	0.3	0.112
22	31.4	35	25.6	0.3	0.082
22	31.4	35	25.6	0.3	0.155
27	34.4	38	30.6	0.3	0.088
27	34.4	38	30.6	0.3	0.130
27	36.4	40	30.6	0.3	0.086
27	36.4	40	30.6	0.3	0.190
31	36.4	40	32.6	0.3	0.062
32	39.4	43	35.6	0.3	0.077
32	39.4	43	35.6	0.3	0.102
32	39.4	43	35.6	0.3	0.157

With inner ring

Type NAO
Type NAO··ZW

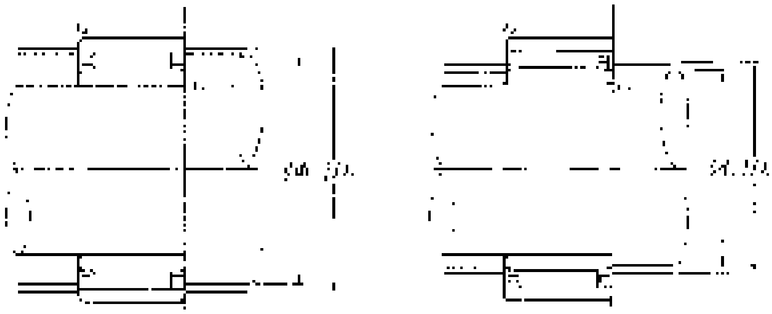

Type NAO


Type NAO··ZW

d 30～65mm

Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min⁻¹) grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ 1)	F	E	C_r	C_{or}	C_r	C_{or}	grease	oil	
30	47	16	0.3	35	42	24 100	36 000	2 450	3 650	7 500	11 000	NAO-30×47×16
	47	18	0.3	35	42	24 700	37 000	2 510	3 750	7 500	11 000	NAO-30×47×18
	47	32	0.3	35	42	41 500	71 500	4 200	3 700	7 500	11 000	NAO-30×47×32ZW
	52	18	0.3	37	44	26 300	41 000	2 680	4 150	7 000	11 000	NAO-30×52×18
33	47	13	0.3	37	42	15 900	27 100	1 620	2 770	7 000	11 000	NAO-33×47×13
35	50	17	0.3	40	45	21 800	41 500	2 220	4 250	6 500	10 000	NAO-35×50×17
	50	34	0.3	40	45	37 500	83 000	3 800	8 500	6 500	10 000	NAO-35×50×34ZW
	55	20	0.3	40	47	31 000	51 500	3 150	5 250	6 500	10 000	NAO-35×55×20
	55	40	0.3	40	48	56 500	102 000	5 750	10 400	6 500	10 000	NAO-35×55×40ZW
40	55	17	0.3	45	50	22 300	44 500	2 280	4 550	6 000	9 000	NAO-40×55×17
	55	34	0.3	45	50	38 500	89 500	3 900	9 100	6 000	9 000	NAO-40×55×34ZW
	62	20	0.3	45	53	36 000	59 000	3 650	6 000	6 000	9 000	NAO-40×62×20
	62	40	0.3	45	53	61 500	118 000	6 250	12 000	6 000	9 000	NAO-40×62×40ZW
	65	20	0.3	50	58	38 500	67 500	3 950	6 850	5 500	8 000	NAO-40×65×20
45	62	20	0.3	50	55	27 900	62 000	2 850	6 300	5 500	8 000	NAO-45×62×20
	62	40	0.3	50	55	48 000	124 000	4 900	12 600	5 500	8 000	NAO-45×62×40ZW
	72	20	0.6	55	63	39 000	70 000	3 950	7 100	4 800	7 500	NAO-45×72×20
	72	40	0.6	55	63	66 500	140 000	6 800	14 200	4 800	7 500	NAO-45×72×40ZW
50	68	20	0.6	55	60	28 800	66 500	2 940	6 750	4 800	7 500	NAO-50×68×20
	68	40	0.6	55	60	49 500	133 000	5 050	13 500	4 800	7 500	NAO-50×68×40ZW
	78	20	1	60	68	40 000	75 000	4 100	7 650	4 400	6 500	NAO-50×78×20
	78	40	1	60	68	69 000	150 000	7 050	15 300	4 400	6 500	NAO-50×78×40ZW
55	85	30	1	65	73	61 000	132 000	6 200	13 400	4 100	6 000	NAO-55×85×30
	85	60	1	65	73	104 000	263 000	10 600	26 800	4 100	6 000	NAO-55×85×60ZW
60	90	30	1	70	78	65 500	149 000	6 700	15 200	3 800	5 500	NAO-60×90×30
	90	60	1	70	78	112 000	297 000	11 500	30 500	3 800	5 500	NAO-60×90×60ZW
65	95	30	1	75	83	67 500	157 000	6 850	16 100	3 600	5 500	NAO-65×95×30
	95	60	1	75	83	115 000	315 000	11 800	32 000	3 600	5 500	NAO-65×95×60ZW

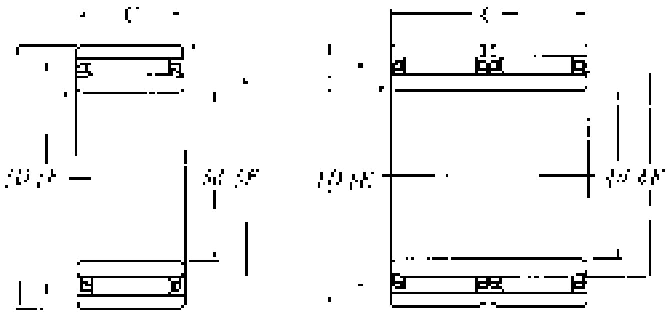
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



Abutment dimensions mm					Mass kg
d_a min	d_b	D_a max	D_b	r_{as} 2) max	(approx.)
32	41.4	45	35.6	0.3	0.109
32	41.4	45	35.6	0.3	0.119
32	41.4	45	35.6	0.3	0.205
32	43.4	50	37.6	0.3	0.177
35	41.4	45	37.6	0.3	0.085
37	44.4	48	40.6	0.3	0.113
37	44.4	48	40.6	0.3	0.225
37	46.2	53	40.6	0.3	0.190
37	47.2	53	40.6	0.3	0.360
42	49.2	53	45.6	0.3	0.127
42	49.2	53	45.6	0.3	0.250
42	52.2	60	45.6	0.3	0.230
42	52.2	60	45.6	0.3	0.385
42	57.2	63	50.6	0.3	0.279
47	54.2	60	50.6	0.3	0.192
47	54.2	60	50.6	0.3	0.385
49	62.4	68	55.8	0.6	0.335
49	62.4	68	55.8	0.6	0.660
54	59.4	64	55.8	0.6	0.230
54	59.4	64	55.8	0.6	0.440
55	67.2	73	60.8	1	0.410
55	67.2	73	60.8	1	0.755
60	72.2	80	66	1	0.680
60	72.2	80	66	1	1.35
65	77.2	85	71	1	0.720
65	77.2	85	71	1	1.45
70	82.2	90	76	1	0.770
70	82.2	90	76	1	1.54

With inner ring

Type NAO
Type NAO··ZW

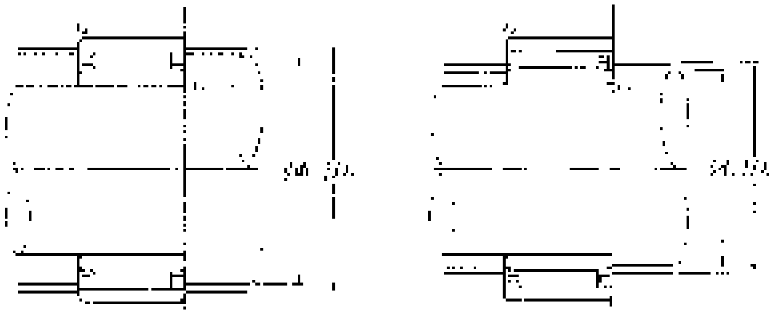


Type NAO   Type NAO··ZW

d 70〜90mm

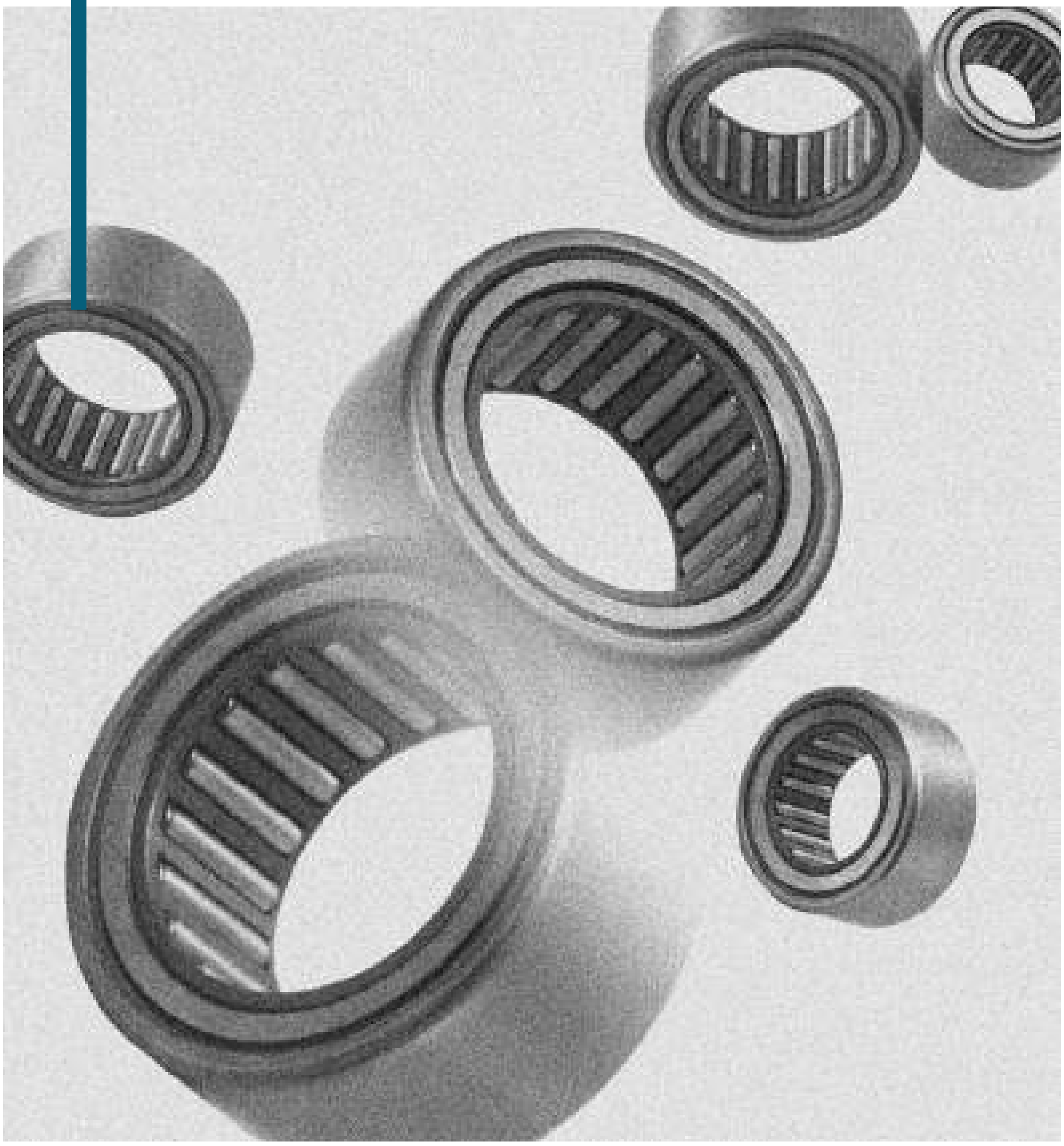
Boundary dimensions (mm)						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting speeds (min^{-1}) grease	oil	Bearing numbers
d	D	C	$r_{s\,min}$ [1]	F	E	C_r	C_{or}	C_r	C_{or}			
70	95	30	1	80	86	57 000	159 000	5 800	16 200	3 300	5 000	NAO-70× 95×30
	95	56	1	80	88	105 000	284 000	10 700	29 000	3 300	5 000	NAO-70× 95×56ZW
	100	30	1	80	88	69 000	166 000	7 050	17 000	3 300	5 000	NAO-70×100×30
	100	60	1	80	88	119 000	335 000	12 100	34 000	3 300	5 000	NAO-70×100×60ZW
75	105	25	1	85	93	61 500	146 000	6 250	14 900	3 100	4 700	NAO-75×105×25
	105	30	1	85	93	71 000	175 000	7 200	17 900	3 100	4 700	NAO-75×105×30
80	110	30	1	90	98	72 500	184 000	7 400	18 800	3 000	4 400	NAO-80×110×30
85	115	30	1	95	103	74 000	193 000	7 550	19 600	2 800	4 200	NAO-85×115×30
90	120	30	1	100	108	76 000	201 000	7 700	20 500	2 700	4 000	NAO-90×120×30

Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



Abutment dimensions mm					Mass kg
d_a min	d_b	D_a max	D_b	r_{as} 2) max	(approx.)
75	85.2	90	81	1	0.675
75	87.2	90	81	1	1.26
75	87.2	95	81	1	0.850
75	87.2	95	81	1	1.70
80	92.2	100	86	1	0.700
80	92.2	100	86	1	0.880
85	97.2	105	91	1	0.920
90	102.2	110	96	1	0.960
95	107.2	115	101	1	1.04

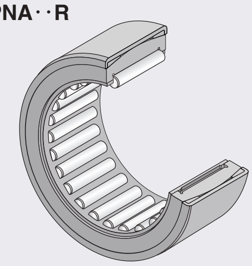
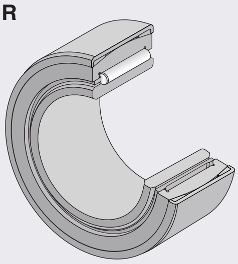
Self-Aligning Needle Roller Bearings



Self-Aligning Needle Roller Bearings

Self-aligning needle roller bearings each comprise an outer ring having spherical outside surface; a deep drawn steel collar around the outside surface of outer ring, and; a resin support ring situated between the outer ring and the collar so that the bearing can be automatically aligned; the inner ring alone can be separated from the bearing.

This bearing product has advantages that it can be used on a highly flexible shaft or in an area where alignment with the housing bore is difficult. Also, this bearing product is easy to handle: for example, it is axially positioned without using a snap ring by simply press-fitting into the housing bore in an appropriate fit mode.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type RPNA··R 	φ15– φ45	**RPNA 20 / 35 R** R: Suffix 35: Outer diameter 20: Roller set bore diameter RPNA: Type code **[Suffix]** R: Ribbed type	Maximum permissible temperature is limited to 100˚C because the bearing uses a resin-made support ring.
Type PNA··R 	φ12– φ40		

Bearing accuracy

The dimensional accuracy and profile accuracy of any **NTN** self-aligning needle roller bearing shall be per JIS Class 0 specified in JIS B 1514 "Rolling bearings—Tolerances". This does not apply to the outside diameter and width of precision drawn collar.

The dimensional tolerances of roller set bore diameter (F_w) of the type RPNA··R (w/o inner ring) shall fall in the range of ISO Tolerance Class F6.

Radial internal clearance and bearing fits

The **NTN** Type PNA··R self-aligning needle roller bearing (w/ inner ring) is manufactured to the tolerance range of radial internal clearance in **Table 5.1** in Sec. **5.1 "Bearing radial internal clearance"** (page A-30). As a self-aligning needle roller bearing is used after being press-fitted into a housing, the fits to the housing and shaft specified in **Table 1** in this page need to be satisfied so that the bearing can function correctly. The bore of this housing needs to satisfy the accuracy specified in **Table 2** in this page. For accuracy of a shaft that uses an inner ring, refer to **Table 8.3** in Sec. **8.3 "Accuracy of shaft and housing"** (page A-40); for accuracy of a shaft that is directly used as a raceway surface, refer to Table 8.4 in Sec. **8.4 "Accuracy of raceway surface"** (page A-40).

For material and hardness of the shaft that functions as raceway surface, refer to Sec. **8.5 "Material and hardness of raceway"** (page A-40).

Table 1 Fits with housing and shaft (recommended)

Housing		Shaft	
Iron	Light alloy	w/o inner ring	w/ inner ring
N6 (N7)	R6 (R7)	h5 (h6)	k5 (j6)

Table 2 Accuracy of housing bore (recommended)

Characteristic	Tolerance
Roundness (max.)	IT5/2
Cylindricity (max.)	IT5/2
Surface roughness (max.)	0.8a

Bearing mounting relation dimensions

Self-aligning needle roller bearing with an inner ring must be used within the permissible shift range **(S) (state where the rollers remain in contact with the inner ring in an effective contact length range).** The permissible shift (*S*) will be found in the relevant dimension table. When the axial shift of the intended bearing is large or a closing seal is used in close vicinity to this bearing, a wider inner ring needs to be adopted. Carefully use a closing seal as its sealing effect may be jeopardized when dimensional errors of fit and/or shaft deflection are large.

When installing a self-aligning needle roller bearing to a housing, place the jig on the marking side of the bearing, and then press-fit the bearing into the correct location in the housing bore.

When installing, NEVER directly hit the bearing with a hard tool such as a steel hammer. Instead, use the press-fit jig that is equipped with a mandrel fitted with an O-ring (see **Fig. 1** in this page). The bearing will be easily press-fitted as it will not be misaligned to the housing or fall.

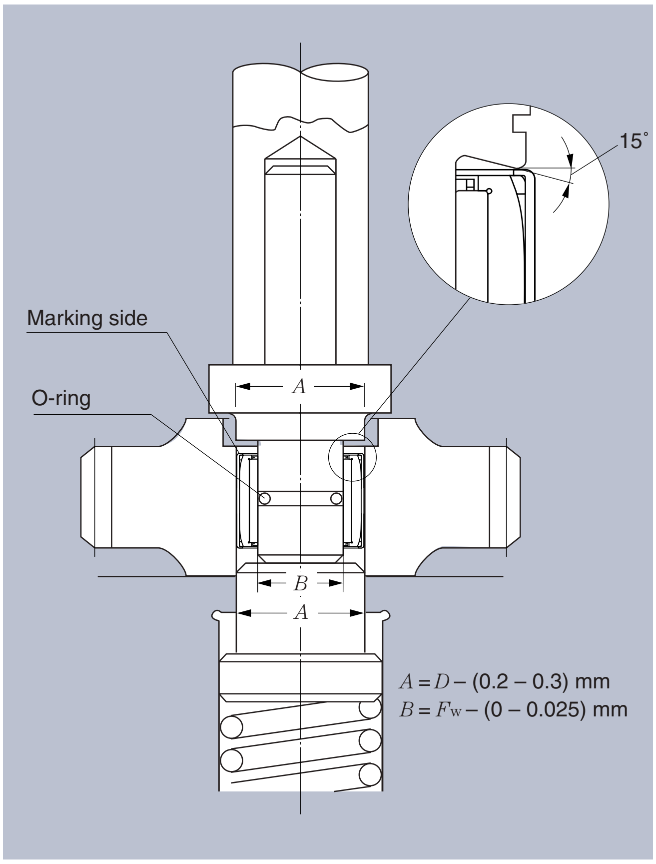
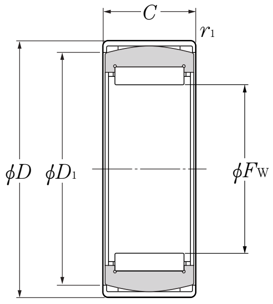


Fig. 1

Without inner ring

Type RPNA··R



Type RPNA··R

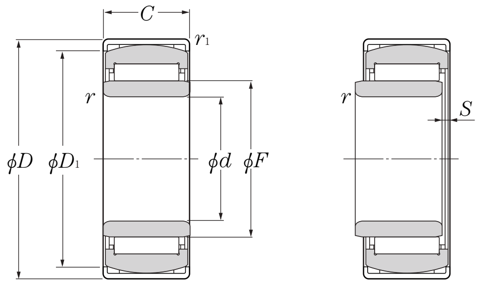
F_W 15～45mm

Boundary dimensions mm					Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min^{-1} grease	oil	Bearing numbers	Mass kg (approx.)
F_W	D	D_1	C ±0.5	r_1 min	C_r	C_{or}	C_r	C_{or}				
15 $^{+0.027}_{+0.016}$	28	24.5	12	0.8	7 050	7 850	715	800	14 000	24 000	**RPNA 15/28R**	0.032
18 $^{+0.027}_{+0.016}$	32	27	16	0.8	12 700	16 200	1 300	1 650	13 000	22 000	**RPNA 18/32R**	0.052
20 $^{+0.033}_{+0.020}$	35	30.5	16	0.8	13 200	17 500	1 340	1 790	12 500	21 000	**RPNA 20/35R**	0.062
25 $^{+0.033}_{+0.020}$	42	36.5	20	0.8	19 200	30 500	1 960	3 100	10 500	18 000	**RPNA 25/42R**	0.109
28 $^{+0.033}_{+0.020}$	44	38.5	20	0.8	22 300	34 000	2 280	3 450	9 500	16 000	**RPNA 28/44R**	0.112
30 $^{+0.033}_{+0.020}$	47	42	20	0.8	22 900	36 000	2 340	3 650	9 000	15 000	**RPNA 30/47R**	0.125
35 $^{+0.041}_{+0.025}$	52	47.5	20	0.8	24 800	41 500	2 520	4 250	7 800	13 000	**RPNA 35/52R**	0.131
40 $^{+0.041}_{+0.025}$	55	50.5	20	0.8	26 400	47 000	2 700	4 800	6 600	11 000	**RPNA 40/55R**	0.141
45 $^{+0.041}_{+0.025}$	62	58	20	0.8	28 000	52 500	2 860	5 400	6 000	10 000	**RPNA 45/62R**	0.176

Remarks: Type RPNA products are imports from INA (German company in Schaeffler Group).

With inner ring

Type PNA··R



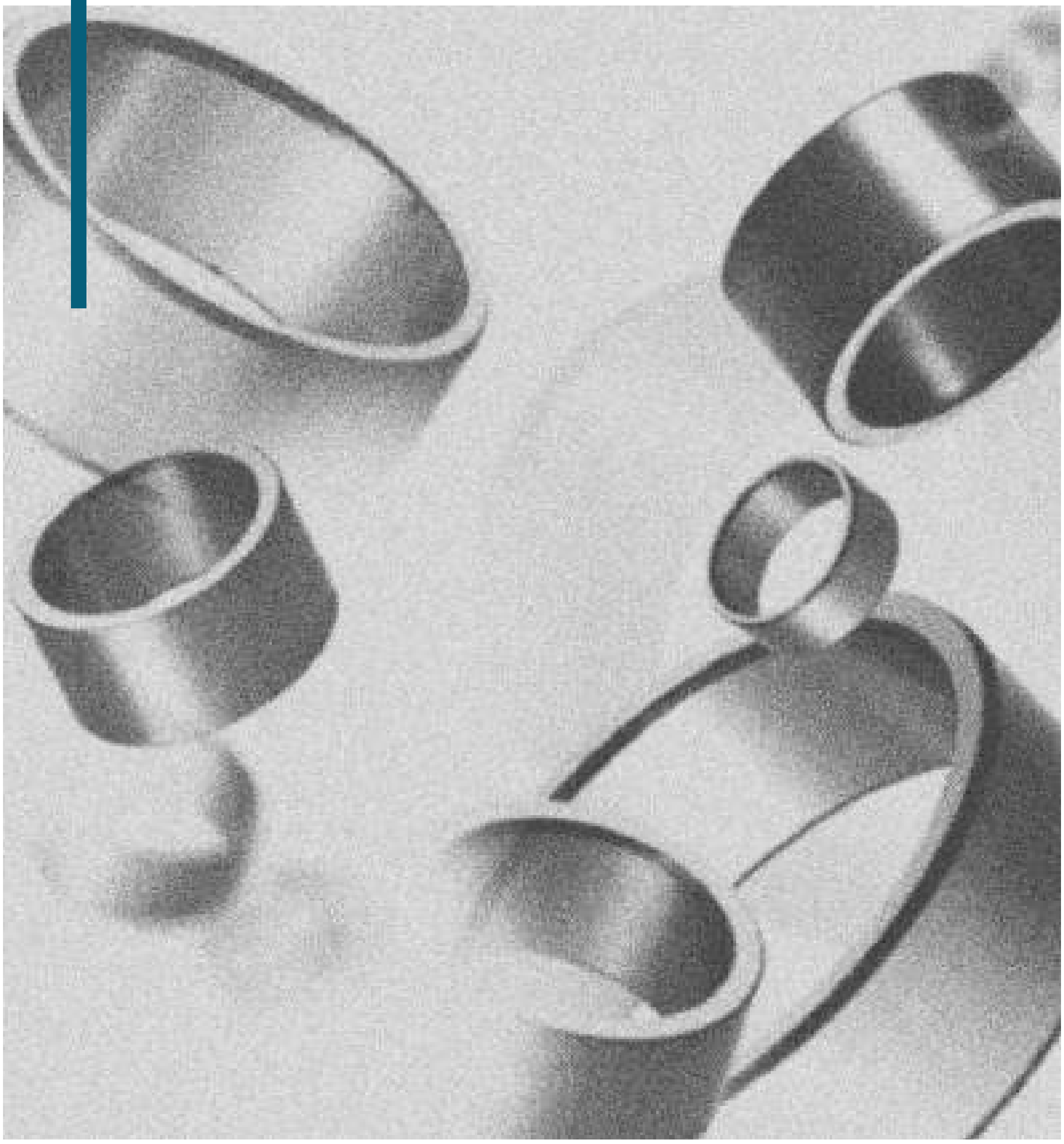
Type PNA··R

d 12～40mm

Boundary dimensions mm								Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers	Mass kg (approx.)
d	D	D_1	C ±0.5	$r_{s\,min}$ 1)	F	$r_{1\,min}$	s 2)	C_r	C_{or}	C_r	C_{or}				
12	28	24.5	12	0.3	15	0.8	0.5	7 050	7 850	715	800	14 000	24 000	**PNA 12/28R**	0.037
15	32	27	16	0.3	18	0.8	0.5	12 700	16 200	1 300	1 650	13 000	22 000	**PNA 15/32R**	0.062
17	35	30.5	16	0.3	20	0.8	0.5	13 200	17 500	1 340	1 790	12 500	21 000	**PNA 17/35R**	0.073
20	42	36.5	20	0.3	25	0.8	0.5	19 200	30 500	1 960	3 100	10 500	18 000	**PNA 20/42R**	0.136
22	44	38.5	20	0.3	28	0.8	0.5	22 300	34 000	2 280	3 450	9 500	16 000	**PNA 22/44R**	0.145
25	47	42	20	0.3	30	0.8	0.5	22 900	36 000	2 340	3 650	9 000	15 000	**PNA 25/47R**	0.157
30	52	47.5	20	0.3	35	0.8	0.5	24 800	41 500	2 520	4 250	7 800	13 000	**PNA 30/52R**	0.181
35	55	50.5	20	0.3	40	0.8	0.5	26 400	47 000	2 700	4 800	6 600	11 000	**PNA 35/55R**	0.177
40	62	58	20	0.3	45	0.8	0.5	28 000	52 500	2 860	5 400	6 000	10 000	**PNA 40/62R**	0.227

Note 1) Allowable minimum chamfer dimension. 2) Allowable axial stroking value of inner ring against outer ring.
Remarks: Type RPNA products are imports from INA (German company in Schaeffler Group).

Inner Rings



Inner Rings

Inner Rings

Many of the needle roller bearings use a shaft as the direct raceway surface without using inner ring. However, it is recommended to use any of the inner rings described hereunder, together with needle roller bearing, where applicable shaft can not be surface-hardened and surface-finished by grinding. Any inner rings are made of high carbon chrome bearing steel and finished by grinding after heat-treated.

It is desirable to use an inner ring of wide width, where the axial displacement of a shaft is great and also a seal is used at the outer side of bearing.

Types and Designs

NTN inner rings are available in both of **IR type** with boundary dimensions of metric system and **MI type** with boundary dimensions of inch system. Both edges of inner ring raceway are chamfered to form gentle tapers in order to facilitate fitting of the inner ring. In contrast, inner rings whose inner ring number is headed by an asterisk (*) are provided with slight-chamfering so that they will offer a greater axial travel. In addition to these inner rings, manufacture of special inner ring type (suffix D) with oil hole on its center is also available.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, **NTN** will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact **NTN** Engineering.

Composition of inner ring number

Inner ring number consists of type code (**IR** or **MI**), dimension code [bore dia. (d)×raceway dia. (F)×width (B)] and a suffix. Note that the dimensions of Type **MI** (inch series) inner rings measure in 1/16 increments.

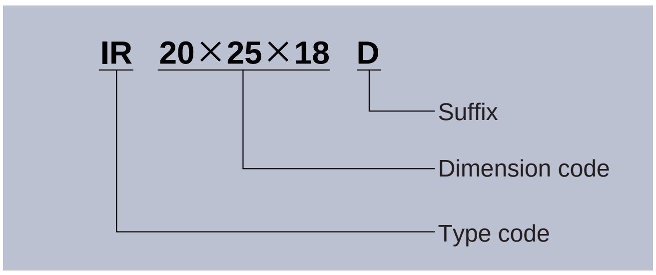


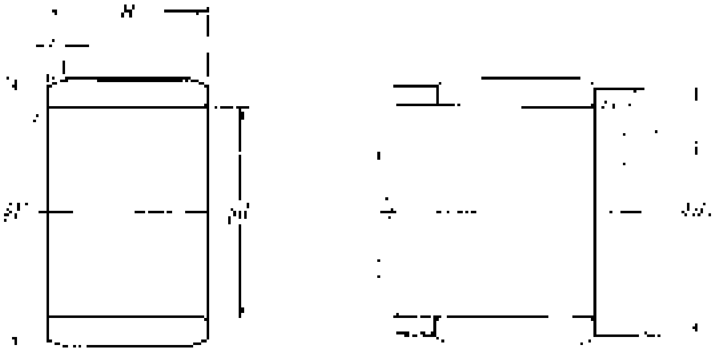
Fig. 1

Dimensional accuracy for inner ring

The dimensional accuracy (bore diameter "d", width "B" and chamfer dimension "$r_{s\,min}$"), profile accuracy and running accuracy of the inner rings are as shown in **Tables 4.3** and **4.5** of Section 4 "**Bearing accuracy**" (page A-26). And the standard accuracy class of these items conforms to JIS Class-0, but other inner rings conforming to JIS Class-5 and -4 are also offerable on request.

Each inner ring has been finished to the dimensional tolerance of its raceway diameter (F) in the relevant dimension table so that when the inner ring is combined with a needle roller bearing, the resultant radial internal clearance falls in a range of ordinary clearance (refer to **Table 5.1** in Sec. **5.2 "Running clearance"**.)

Type IR

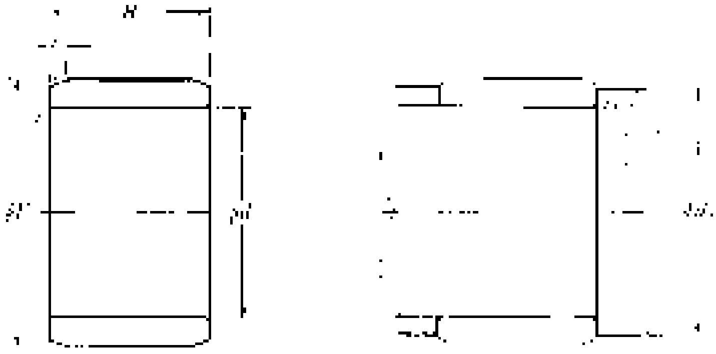


d 5～10mm

Boundary dimensions mm						Bearing numbers	Abutment dimensions mm		Mass kg
d	F [1)]		B	$r_{s\ min}$ [2)]	t		d_a min	r_{as} [3)] max	(approx.)
5	7		10	0.15	1	IR 5×7×10	6.2	0.15	0.0014
	8	0 / −0.006	12	0.3	1	IR 5×8×12	7	0.3	0.0028
	8		16	0.3	—	※IR 5×8×16	7	0.3	0.0038
6	8		10	0.15	1	IR 6×8×10	7.2	0.15	0.0017
	9		12	0.3	1	IR 6×9×12	8	0.3	0.0032
	9	0 / −0.006	16	0.3	1	IR 6×9×16	8	0.3	0.0043
	10		10	0.3	1	IR 6×10×10	8	0.3	0.0037
	10		12	0.3	—	※IR 6×10×12D	8	0.3	0.0046
	10		13	0.3	1	IR 6×10×13	8	0.3	0.0050
7	9		10	0.15	1	IR 7×9×10	8.2	0.15	0.0019
	10	0 / −0.006	10.5	0.3	1	IR 7×10×10.5	9	0.3	0.0031
	10		12	0.3	1	IR 7×10×12	9	0.3	0.0036
	10		16	0.3	1	IR 7×10×16	9	0.3	0.0049
	12	−0 / −0.008	16	0.3	1	IR 7×12×16	9	0.3	0.0093
8	10	0 / −0.006	11	0.15	1	IR 8×10×11	9.2	0.15	0.0024
	12		10	0.3	1	IR 8×12×10	10	0.3	0.0048
	12		10.5	0.3	1	IR 8×12×10.5	10	0.3	0.0050
	12	0 / −0.008	12	0.3	—	※IR 8×12×12D	10	0.3	0.0057
	12		12.5	0.3	1	IR 8×12×12.5	10	0.3	0.0059
	14		16	0.3	1	IR 8×14×16	10	0.3	0.013
9	12		11	0.3	1	IR 9×12×11	11	0.3	0.0041
	12	0 / −0.008	12	0.3	1	IR 9×12×12	11	0.3	0.0045
	12		16	0.3	1	IR 9×12×16	11	0.3	0.0061
	15		16	0.3	1	IR 9×15×16	11	0.3	0.014
10	13		12.5	0.3	1	IR10×13×12.5	12	0.3	0.0052
	14		12	0.3	1	IR10×14×12	12	0.3	0.0073
	14	0 / −0.008	13	0.3	1	IR10×14×13	12	0.3	0.0074
	14		14	0.3	—	※IR10×14×14D	12	0.3	0.0080
	14		16	0.3	—	※IR10×14×16	12	0.3	0.0092
	14		20	0.3	1	IR10×14×20	12	0.3	0.012

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

Type IR



d 10～15mm

d	F[1)]		*B*	$r_{s\,min}$[2)]	*t*	Bearing numbers	d_a min	r_{as}[3)] max	Mass kg (approx.)
10	15	0 / −0.008	15.5	0.3	1	**IR10×15×15.5**	12	0.3	0.012
	15		20.5	0.3	1	**IR10×15×20.5**	12	0.3	0.015
	16		16	0.3	1	**IR10×16×16**	12	0.3	0.015
12	15	0 / −0.008	12	0.3	1	**IR12×15×12**	14	0.3	0.0058
	15		12.5	0.3	1	**IR12×15×12.5**	14	0.3	0.0061
	15		16	0.3	1	**IR12×15×16**	14	0.3	0.0078
	15		16.5	0.3	—	**※IR12×15×16.5**	14	0.3	0.0080
	15		22.5	0.3	—	**※IR12×15×22.5**	14	0.3	0.011
	16		12	0.3	1.5	**IR12×16×12**	14	0.3	0.0079
	16		13	0.3	1.5	**IR12×16×13**	14	0.3	0.0087
	16		14	0.3	—	**※IR12×16×14D**	14	0.3	0.0095
	16		16	0.3	1.5	**IR12×16×16**	14	0.3	0.011
	16		20	0.3	1.5	**IR12×16×20**	14	0.3	0.014
	16		22	0.3	1.5	**IR12×16×22**	14	0.3	0.015
	17		20.5	0.3	1.5	**IR12×17×20.5**	14	0.3	0.019
	17		25.5	0.3	1.5	**IR12×17×25.5**	14	0.3	0.024
	18		16	0.3	1.5	**IR12×18×16**	14	0.3	0.018
14	17	0 / −0.008	17	0.3	1.5	**IR14×17×17**	16	0.3	0.0095
15	18	0 / −0.008	12.5	0.3	1.5	**IR15×18×12.5**	17	0.3	0.0072
	18		16	0.3	1.5	**IR15×18×16**	17	0.3	0.0093
	18		16.5	0.3	1.5	**IR15×18×16.5**	17	0.3	0.0096
	18		17.5	0.3	1.5	**IR15×18×17.5**	17	0.3	0.010
	18		20.5	0.3	1.5	**IR15×18×20.5**	17	0.3	0.012
	18		25.5	0.3	1.5	**IR15×18×25.5**	17	0.3	0.015
	19	0 / −0.009	16	0.3	1.5	**IR15×19×16**	17	0.3	0.013
	19		20	0.3	1.5	**IR15×19×20**	17	0.3	0.016
	20		12	0.3	1.5	**IR15×20×12**	17	0.3	0.012
	20		13	0.3	1.5	**IR15×20×13**	17	0.3	0.014
	20		14	0.3	—	**※IR15×20×14D**	17	0.3	0.015
	20		18	0.3	1.5	**IR15×20×18**	17	0.3	0.019
	20		20.5	0.3	1.5	**IR15×20×20.5**	17	0.3	0.021

Boundary dimensions in mm; abutment dimensions in mm.

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

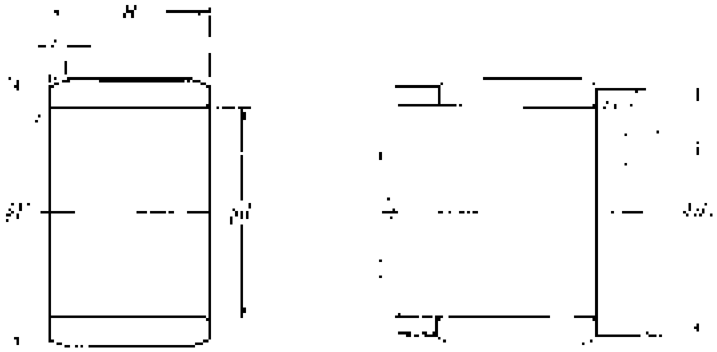
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

d 15～20mm

Boundary dimensions mm					Bearing numbers	Abutment dimensions mm		Mass kg
d	F [1)]	B	$r_{s\,min}$ [2)]	t		d_a min	r_{as} [3)] max	(approx.)
	20	23	0.3	—	※IR15×20×23	17	0.3	0.024
15	20 $^{0}_{-0.009}$	26	0.3	1.5	IR15×20×26	17	0.3	0.027
	20	30.5	0.3	1.5	IR15×20×30.5	17	0.3	0.032
	22	20	0.6	1.5	IR15×22×20	19	0.6	0.032
	20	16	0.3	1.5	IR17×20×16	19	0.3	0.011
	20	16.5	0.3	1.5	IR17×20×16.5	19	0.3	0.011
	20	20	0.3	1.5	IR17×20×20	19	0.3	0.014
	20	20.5	0.3	—	※IR17×20×20.5	19	0.3	0.014
	20	30.5	0.3	—	※IR17×20×30.5	19	0.3	0.021
	21	16	0.3	1.5	IR17×21×16	19	0.3	0.014
	21	20	0.3	—	※IR17×21×20	19	0.3	0.018
17	22 $^{0}_{-0.009}$	13	0.3	1.5	IR17×22×13	19	0.3	0.015
	22	14	0.3	—	※IR17×22×14D	19	0.3	0.016
	22	16	0.3	—	※IR17×22×16	19	0.3	0.019
	22	18	0.3	1.5	IR17×22×18	19	0.3	0.021
	22	20.5	0.3	1.5	IR17×22×20.5	19	0.3	0.024
	22	23	0.3	—	※IR17×22×23	19	0.3	0.027
	22	26	0.3	1.5	IR17×22×26	19	0.3	0.030
	22	32	0.3	1.5	IR17×22×32	19	0.3	0.036
	24	20	0.6	1.5	IR17×24×20	21	0.6	0.034
	24	16	0.3	1.8	IR20×24×16	22	0.3	0.017
	24	20	0.3	—	※IR20×24×20	22	0.3	0.021
	24	28.5	0.3	—	※IR20×24×28.5	22	0.3	0.030
	25	12.5	0.3	1.8	IR20×25×12.5	22	0.3	0.016
	25	16	0.3	—	※IR20×25×16	22	0.3	0.021
20	25 $^{0}_{-0.009}$	16.5	0.3	1.8	IR20×25×16.5	22	0.3	0.022
	25	17	0.3	1.8	IR20×25×17	22	0.3	0.022
	25	18	0.3	—	※IR20×25×18D	22	0.3	0.024
	25	20	0.3	—	※IR20×25×20	22	0.3	0.027
	25	20.5	0.3	1.8	IR20×25×20.5	22	0.3	0.028
	25	23	0.3	1.8	IR20×25×23	22	0.3	0.031

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

Type IR



d 20～28mm

d	F 1)	F tolerance	B	$r_{s\,min}$ 2)	t	Bearing numbers	d_a min	r_{as} 3) max	Mass kg (approx.)
	25		26	0.3	1.8	IR20×25×26	22	0.3	0.034
	25		26.5	0.3	—	※IR20×25×26.5	22	0.3	0.036
20	25	0 −0.009	30	0.3	1.8	IR20×25×30	22	0.3	0.041
	25		32	0.3	1.8	IR20×25×32	22	0.3	0.041
	25		38.5	0.3	—	※IR20×25×38.5	22	0.3	0.053
	28		20	0.6	1.8	IR20×28×20	24	0.6	0.045
	26		16	0.3	1.8	IR22×26×16	24	0.3	0.017
	26		20	0.3	—	※IR22×26×20	24	0.3	0.022
	28		17	0.3	1.8	IR22×28×17	24	0.3	0.030
22	28	0 −0.009	20	0.3	1.8	IR22×28×20	24	0.3	0.035
	28		20.5	0.3	1.8	IR22×28×20.5	24	0.3	0.036
	28		23	0.3	1.8	IR22×28×23	24	0.3	0.042
	28		30	0.3	—	※IR22×28×30	24	0.3	0.054
	29		20	0.3	—	※IR25×29×20	27	0.3	0.026
	29		30	0.3	1.8	IR25×29×30	27	0.3	0.039
	30		12.5	0.3	1.8	IR25×30×12.5	27	0.3	0.020
	30		16	0.3	1	IR25×30×16	27	0.3	0.024
	30		16.5	0.3	1.8	IR25×30×16.5	27	0.3	0.026
	30		17	0.3	1.8	IR25×30×17	27	0.3	0.027
	30		18	0.3	—	※IR25×30×18	27	0.3	0.030
	30	0 −0.009	20	0.3	1.8	IR25×30×20	27	0.3	0.033
25	30		20.5	0.3	1.8	IR25×30×20.5	27	0.3	0.034
	30		23	0.3	1.8	IR25×30×23	27	0.3	0.038
	30		26	0.3	1.8	IR25×30×26	27	0.3	0.041
	30		26.5	0.3	—	※IR25×30×26.5	27	0.3	0.043
	30		30	0.3	1.8	IR25×30×30	27	0.3	0.050
	30		32	0.3	1	IR25×30×32	27	0.3	0.054
	30		38.5	0.3	—	※IR25×30×38.5	27	0.3	0.064
	32	+0.008 −0.002	22	0.6	1.8	IR25×32×22	29	0.6	0.052
	32		30.5	0.6	1.8	IR25×32×30.5	29	0.6	0.072
28	32	−0.008 −0.002	17	0.3	1.8	IR28×32×17	30	0.3	0.025

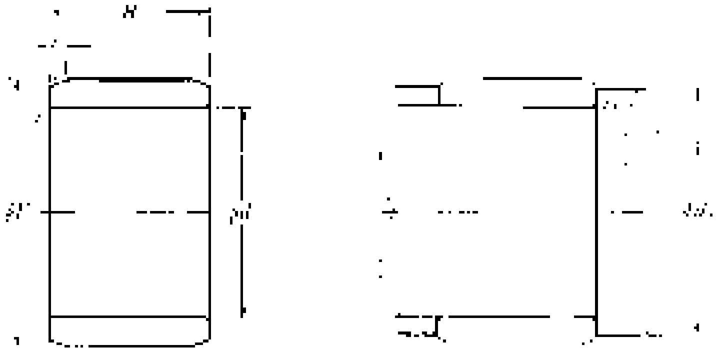
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

d 28～35mm

Boundary dimensions mm d	F [1]	B	$r_{s\,min}$ [2]	t	Bearing numbers	Abutment dimensions mm d_a min	r_{as} [3] max	Mass kg (approx.)
28	32	20	0.3	1.8	**IR28×32×20**	30	0.3	0.028
	32 $^{+0.008}_{-0.002}$	23	0.3	1.8	**IR28×32×23**	30	0.3	0.034
	32	30	0.3	—	**※IR28×32×30**	30	0.3	0.044
29	32 $^{+0.008}_{-0.002}$	13	0.3	1.8	**IR29×32×13**	31	0.3	0.015
30	35	12.5	0.3	1.8	**IR30×35×12.5**	32	0.3	0.024
	35	13	0.3	1.3	**IR30×35×13**	32	0.3	0.025
	35	16	0.3	—	**※IR30×35×16**	32	0.3	0.031
	35	16.5	0.3	1.8	**IR30×35×16.5**	32	0.3	0.032
	35	17	0.3	1.8	**IR30×35×17**	32	0.3	0.032
	35	18	0.3	—	**※IR30×35×18D**	32	0.3	0.035
	35	20	0.3	—	**※IR30×35×20**	32	0.3	0.038
	35 $^{+0.008}_{-0.002}$	20.5	0.3	1.8	**IR30×35×20.5**	32	0.3	0.039
	35	23	0.3	1.8	**IR30×35×23**	32	0.3	0.044
	35	26	0.3	1.8	**IR30×35×26**	32	0.3	0.050
	35	30	0.3	—	**※IR30×35×30**	32	0.3	0.059
	35	32	0.3	1.8	**IR30×35×32**	32	0.3	0.063
	37	18	0.3	1.8	**IR30×37×18**	32	0.3	0.050
	37	22	0.6	1.8	**IR30×37×22**	34	0.6	0.061
	38	20	0.6	—	**※IR30×38×20**	34	0.6	0.065
32	37	20	0.3	2	**IR32×37×20**	34	0.3	0.040
	37	30	0.3	—	**※IR32×37×30**	34	0.3	0.063
	38 $^{0}_{-0.011}$	32	0.3	2	**IR32×38×32**	34	0.3	0.082
	40	20	0.6	2	**IR32×40×20**	36	0.6	0.068
	40	27	0.6	2	**IR32×40×27**	36	0.6	0.092
	40	36	0.6	2	**IR32×40×36**	36	0.6	0.124
33	37 $^{0}_{-0.011}$	13	0.3	2	**IR33×37×13**	35	0.3	0.022
35	40	12.5	0.3	2	**IR35×40×12.5**	37	0.3	0.027
	40 $^{0}_{-0.011}$	16.5	0.3	2	**IR35×40×16.5**	37	0.3	0.037
	40	17	0.3	2	**IR35×40×17**	37	0.3	0.038
	40	20	0.3	2	**IR35×40×20**	37	0.3	0.044

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

Type IR



d 35～45mm

Boundary dimensions (mm)						Bearing numbers	Abutment dimensions (mm)		Mass (kg)
d	F [1)]		B	$r_{s\,min}$ [2)]	t		d_a min	r_{as} [3)] max	(approx.)
35	40		20.5	0.3	2	**IR35×40×20.5**	37	0.3	0.046
	40		30	0.3	—	**※IR35×40×30**	37	0.3	0.068
	40		34	0.3	1.8	**IR35×40×34**	37	0.3	0.079
	40		40	0.3	2	**IR35×40×40**	37	0.3	0.091
	42	0	20	0.6	1.8	**IR35×42×20**	39	0.6	0.064
	42	−0.011	21	0.6	—	**※IR35×42×21**	39	0.6	0.068
	42		23	0.6	—	**※IR35×42×23D**	39	0.6	0.074
	42		27	0.6	2	**IR35×42×27**	39	0.6	0.080
	42		36	0.6	2	**IR35×42×36**	39	0.6	0.117
	43		22	0.6	2	**IR35×43×22**	39	0.6	0.081
38	43	0	20	0.3	1.8	**IR38×43×20**	40	0.3	0.048
	43	−0.011	30	0.3	—	**※IR38×43×30**	40	0.3	0.074
40	45		16.5	0.3	2	**IR40×45×16.5**	42	0.3	0.042
	45		17	0.3	2	**IR40×45×17**	42	0.3	0.043
	45		20	0.3	2	**IR40×45×20**	42	0.3	0.051
	45		20.5	0.3	2	**IR40×45×20.5**	42	0.3	0.053
	45		26.5	0.3	—	**※IR40×45×26.5**	42	0.3	0.068
	45		30	0.3	2	**IR40×45×30**	42	0.3	0.077
	45	0	34	0.3	2	**IR40×45×34**	42	0.3	0.088
	45	−0.011	40	0.3	2	**IR40×45×40**	42	0.3	0.106
	48		22	0.6	2	**IR40×48×22**	44	0.6	0.092
	48		23	0.6	—	**※IR40×48×23**	44	0.6	0.097
	48		30	0.6	2	**IR40×48×30**	44	0.6	0.123
	48		40	0.6	2	**IR40×48×40**	44	0.6	0.170
	50		20	0.3	0.8	**IR40×50×20**	44	0.3	0.106
	50		22	1	2	**IR40×50×22**	45	1	0.118
42	47	0	20	0.3	2	**IR42×47×20**	44	0.3	0.053
	47	−0.011	30	0.3	2	**IR42×47×30**	44	0.3	0.080
45	50	0	20	0.3	2	**IR45×50×20**	47	0.3	0.057
	50	−0.011	25	0.6	2	**IR45×50×25**	49	0.6	0.071

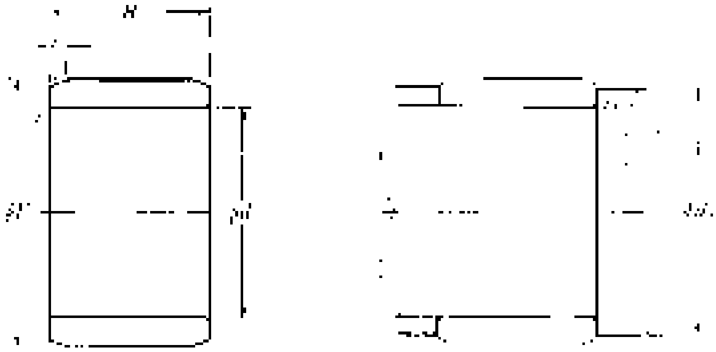
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

d 45〜55mm

Boundary dimensions						Bearing numbers	Abutment dimensions		Mass
mm							mm		kg
d	*F* [1)]		*B*	$r_{s\,min}$ [2)]	*t*		d_a min	r_{as} [3)] max	(approx.)
45	50		25.5	0.3	—	※IR45×50×25.5	47	0.3	0.074
	50	0 / −0.011	32	0.6	—	※IR45×50×32	49	0.6	0.092
	50		35	0.6	2	IR45×50×35	49	0.6	0.101
	50		40	0.3	1.5	IR45×50×40	47	0.3	0.115
	52		22	0.6	2	IR45×52×22	49	0.6	0.088
	52		23	0.6	—	※IR45×52×23D	49	0.6	0.093
	52		30	0.6	2	IR45×52×30	49	0.6	0.123
	52	+0.008 / −0.004	40	0.6	2	IR45×52×40	49	0.6	0.164
	55		20	0.6	2	IR45×55×20	49	0.6	0.116
	55		22	1	2	IR45×55×22	50	1	0.130
	55		40	0.6	2	IR45×55×40	49	0.6	0.173
50	55		20	0.6	2	IR50×55×20	54	0.6	0.063
	55		25	0.6	2	IR50×55×25	54	0.6	0.078
	55		35	0.6	2	IR50×55×35	54	0.6	0.112
	55		40	0.6	2	IR50×55×40	54	0.6	0.128
	58		22	0.6	2	IR50×58×22	54	0.6	0.113
	58	+0.008 / −0.004	23	0.6	—	※IR50×58×23D	54	0.6	0.119
	58		30	0.6	2	IR50×58×30	54	0.6	0.159
	58		40	0.6	2	IR50×58×40	54	0.6	0.209
	60		20	1	2	IR50×60×20	55	1	0.129
	60		25	1	2	IR50×60×25	55	1	0.163
	60		28	1.1	2	IR50×60×28	56.5	1	0.183
	60		40	1	2	IR50×60×40	55	1	0.262
55	60		25	0.6	2.2	IR55×60×25	59	0.6	0.086
	60		35	0.6	2	IR55×60×35	59	0.6	0.121
	63		25	1	2	IR55×63×25	60	1	0.141
	63	0 / −0.013	34	1	2.2	IR55×63×34	60	1	0.192
	63		45	1	2.2	IR55×63×45	60	1	0.256
	65		28	1.1	2.2	IR55×65×28	61.5	1	0.206
	65		30	1	2.2	IR55×65×30	60	1	0.220
	65		60	1	1.5	IR55×65×60	60	1	0.440

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus code "**D**" represents inner ring with oil hole.
2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

Type IR



d 60～75mm

Boundary dimensions mm					Bearing numbers	Abutment dimensions mm		Mass kg
d	F 1)	B	$r_{s\,min}$ 2)	t		d_a min	r_{as} 3) max	(approx.)
	68	25	1	2.2	IR60×68×25	65	1	0.152
	68	34	1	2.2	IR60×68×34	65	1	0.206
	68	35	0.6	2.2	IR60×68×35	64	0.6	0.213
	68 $^{0}_{-0.013}$	45	1	2.2	IR60×68×45	65	1	0.270
60	70	25	1	2.2	IR60×70×25	65	1	0.195
	70	28	1.1	2.2	IR60×70×28	66.5	1	0.216
	70	30	1	2.2	IR60×70×30	65	1	0.232
	70	60	1	2.2	IR60×70×60	65	1	0.463
	72	25	1	2.2	IR65×72×25	70	1	0.142
	72	34	1	2.2	IR65×72×34	70	1	0.193
	72	45	1	2.2	IR65×72×45	70	1	0.259
	73 $^{0}_{-0.013}$	25	0.6	2.2	IR65×73×25	69	0.6	0.164
65	73	35	0.6	2.2	IR65×73×35	69	0.6	0.232
	75	28	1.1	2.2	IR65×75×28	71.5	1	0.240
	75	30	1	2.2	IR65×75×30	70	1	0.256
	75	60	1	2.2	IR65×75×60	70	1	0.513
	80	25	1	2.2	IR70×80×25	75	1	0.224
	80	28	1.1	2.2	IR70×80×28	76.5	1	0.250
	80	30	1	2.2	IR70×80×30	75	1	0.267
	80 $^{0}_{-0.013}$	35	1	2.2	IR70×80×35	75	1	0.313
70	80	40	1	2.2	IR70×80×40	75	1	0.358
	80	54	1	2.2	IR70×80×54	75	1	0.483
	80	56	1	2.2	IR70×80×56	75	1	0.502
	80	60	1	2.2	IR70×80×60	75	1	0.540
	85	25	1	2.2	IR75×85×25	80	1	0.238
	85	30	1	2.2	IR75×85×30	80	1	0.287
75	85 $^{0}_{-0.015}$	35	1	2.2	IR75×85×35	80	1	0.336
	85	40	1	2.2	IR75×85×40	80	1	0.385
	85	54	1	2.2	IR75×85×54	80	1	0.515
	90	32	1.1	2.2	IR75×90×32	81.5	1	0.480

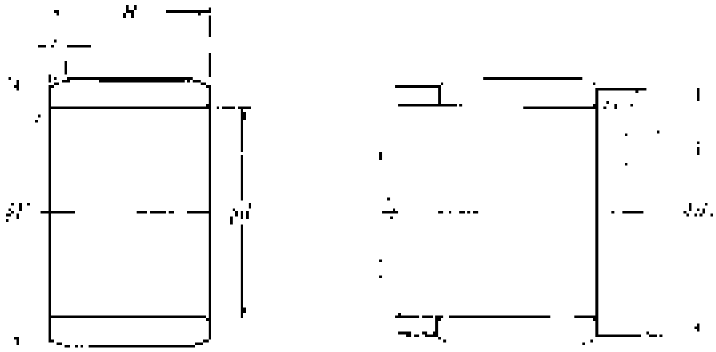
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

d 80～100mm

Boundary dimensions mm					Bearing numbers	Abutment dimensions mm		Mass kg
d	F 1)	B	$r_{s\,min}$ 2)	t		d_a min	r_{as} 3) max	(approx.)
	90	25	1	2.2	IR 80×90×25	85	1	0.254
	90	30	1	2.2	IR 80×90×30	85	1	0.304
	90 $^{0}_{-0.015}$	35	1	2.2	IR 80×90×35	85	1	0.355
80	90	40	1	2.2	IR 80×90×40	85	1	0.408
	90	54	1	2.2	IR 80×90×54	85	1	0.543
	95	32	1.1	2.2	IR 80×95×32	86.5	1	0.510
	95	26	1	2.5	IR 85×95×26	90	1	0.280
	95	30	1	2.5	IR 85×95×30	90	1	0.323
	95	36	1	2.5	IR 85×95×36	90	1	0.398
85	100 $^{0}_{-0.015}$	32	1.1	2.5	IR 85×100×32	91.5	1	0.530
	100	35	1.1	2.5	IR 85×100×35	91.5	1	0.580
	100	46	1.1	2.5	IR 85×100×46	91.5	1	0.760
	100	63	1.1	2.5	IR 85×100×63	91.5	1	1.05
	100	26	1	2.5	IR 90×100×26	95	1	0.294
	100	30	1	2.5	IR 90×100×30	95	1	0.340
	100	36	1	2.5	IR 90×100×36	95	1	0.406
90	105 $^{0}_{-0.015}$	32	1.1	2.5	IR 90×105×32	96.5	1	0.560
	105	35	1.1	2.5	IR 90×105×35	96.5	1	0.610
	105	46	1.1	2.5	IR 90×105×46	96.5	1	0.800
	105	63	1.1	2.5	IR 90×105×63	96.5	1	1.11
	105	26	1	2.5	IR 95×105×26	100	1	0.313
	105	36	1	2.5	IR 95×105×36	100	1	0.430
	110 $^{0}_{-0.015}$	32	1.1	2.5	IR 95×110×32	101.5	1	0.590
95	110	35	1.1	2.5	IR 95×110×35	101.5	1	0.640
	110	46	1.1	2.5	IR 95×110×46	101.5	1	0.850
	110	63	1.1	2.5	IR 95×110×63	101.5	1	1.17
	110	30	1.1	2.5	IR100×110×30	106.5	1	0.375
	110 $^{0}_{-0.015}$	40	1.1	2.5	IR100×110×40	106.5	1	0.505
100	115	32	1.1	2.5	IR100×115×32	106.5	1	0.620
	115	40	1.1	2.5	IR100×115×40	106.5	1	0.775

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

Type IR



d 100～160mm

Boundary dimensions mm						Bearing numbers	Abutment dimensions mm		Mass kg
d	*F* 1)		*B*	$r_{s\ min}$ 2)	*t*		d_a min	r_{as} 3) max	(approx.)
100	115	0 −0.015	54	1.1	2.5	**IR100×115×54**	106.5	1	1.09
110	120	0 −0.015	30	1	2.5	**IR110×120×30**	115	1	0.440
	120		40	1.1	2.5	**IR110×120×40**	116.5	1	0.580
	125	0 −0.018	40	1.1	2.5	**IR110×125×40**	116.5	1	0.840
	125		54	1.1	2.5	**IR110×125×54**	116.5	1	1.16
120	130		30	1	2.2	**IR120×130×30**	125	1	0.440
	130		40	1.1	2.5	**IR120×130×40**	126.5	1	0.590
	135	0 −0.018	40	2	2.5	**IR120×135×40**	129	2	0.870
	135		45	1.1	2.5	**IR120×135×45**	126.5	1	0.980
	135		60	1.1	2.5	**IR120×135×60**	126.5	1	1.25
130	145		32	1.5	3	**IR130×145×32**	138	1.5	0.780
	145		35	1.1	3	**IR130×145×35**	136.5	1	0.855
	145	0 −0.018	42	1.5	3	**IR130×145×42**	138	1.5	1.05
	150		50	1.5	3	**IR130×150×50**	138	1.5	1.69
	150		52	2	3	**IR130×150×52**	139	2	1.75
	150		67	1.5	3	**IR130×150×67**	138	1.5	2.25
140	155		32	1.5	3	**IR140×155×32**	148	1.5	0.840
	155		35	1.1	3	**IR140×155×35**	146.5	1	0.917
	155	0 −0.018	42	1.5	3	**IR140×155×42**	148	1.5	1.10
	160		50	1.5	3	**IR140×160×50**	148	1.5	1.70
	160		52	2	3	**IR140×160×52**	149	2	1.78
	160		67	1.5	3	**IR140×160×67**	148	1.5	2.30
150	165		32	1.5	3	**IR150×165×32**	158	1.5	0.900
	165		40	1.1	3	**IR150×165×40**	156.5	1	1.12
	165	−0.017 −0.035	42	1.5	3	**IR150×165×42**	158	1.5	1.18
	170		52	2	3	**IR150×170×52**	159	2	2.00
	170		60	2	3	**IR150×170×60**	159	2	2.35
160	175	−0.017 −0.035	40	1.1	3	**IR160×175×40**	166.5	1	1.20
	180		60	2	3	**IR160×180×60**	169	2	2.50

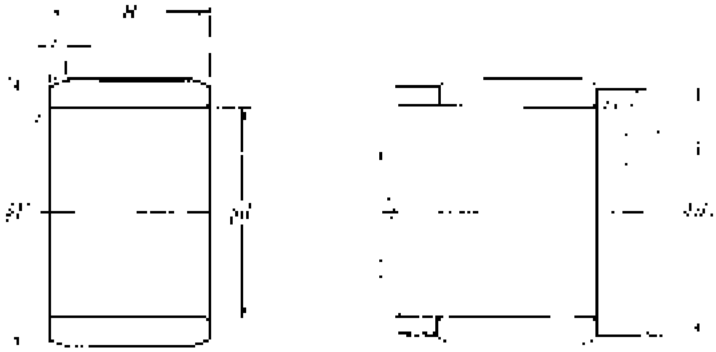
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

d 170～380mm

Boundary dimensions (mm)						Bearing numbers	Abutment dimensions (mm)		Mass (kg)
d	F [1]		B	$r_{s\,min}$ [2]	t		d_a min	r_{as} [3] max	(approx.)
170	185	−0.013 −0.043	45	1.1	3	**IR170×185× 45**	176.5	1	1.45
	190		60	2	3	**IR170×190× 60**	179	2	2.65
180	195	−0.013 −0.043	45	1.1	3	**IR180×195× 45**	186.5	1	1.51
	205		69	2	3	**IR180×205× 69**	189	2	4.10
190	210	−0.020 −0.050	50	1.5	3.5	**IR190×210× 50**	198	1.5	2.41
	215		69	2	3.5	**IR190×215× 69**	199	2	4.10
200	220	−0.020 −0.050	50	1.5	3.5	**IR200×220× 50**	208	1.5	2.49
	225		80	2.1	3.5	**IR200×225× 80**	211	2	5.10
220	240	−0.033 −0.063	50	1.5	3.5	**IR220×240× 50**	228	1.5	2.75
	245		80	2.1	3.5	**IR220×245× 80**	231	2	5.70
240	265	−0.037 −0.069	60	2	3.5	**IR240×265× 60**	249	2	4.60
	265		80	2.1	3.5	**IR240×265× 80**	251	2	6.30
260	285	−0.064 −0.092	60	2	4	**IR260×285× 60**	269	2	4.98
	290		100	2.1	4	**IR260×290×100**	271	2	10.0
280	305	−0.064 −0.092	69	2	4	**IR280×305× 69**	289	2	6.20
	310		100	2.1	4	**IR280×310×100**	291	2	10.8
300	330	−0.062 −0.098	80	2.1	4	**IR300×330× 80**	311	2	9.30
	340		118	3	4	**IR300×340×118**	313	2.5	18.5
320	350	−0.062 −0.098	80	2.1	5	**IR320×350× 80**	331	2	9.80
	360		118	3	5	**IR320×360×118**	333	2.5	20.0
340	370	−0.062 −0.098	80	2.1	5	**IR340×370× 80**	351	2	10.1
	380		118	3	5	**IR340×380×118**	353	2.5	22.0
360	390	−0.090 −0.126	80	2.1	5	**IR360×390× 80**	371	2	10.9
	400		118	3	5	**IR360×400×118**	373	2.5	22.0
380	415	−0.080 −0.120	100	2.1	5	**IR380×415×100**	391	2	18.5
	430		140	4	5	**IR380×430×140**	396	3	35.0

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

Type IR



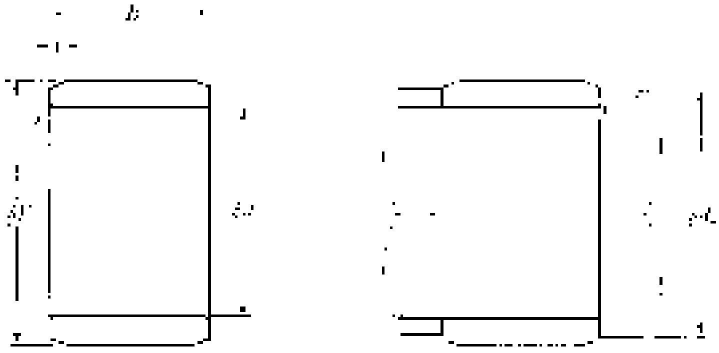
d 400～440mm

Boundary dimensions mm					Bearing numbers	Abutment dimensions mm		Mass kg
d	F[1)]	B	$r_{s\,min}$[2)]	t		d_a min	r_{as}[3)] max	(approx.)
400	450 $^{-0.080}_{-0.120}$	140	4	5	**IR400×450×140**	416	3	36.5
420	470 $^{-0.105}_{-0.145}$	140	4	5	**IR420×470×140**	436	3	38.2
440	490 $^{-0.105}_{-0.145}$	160	4	5	**IR440×490×160**	456	3	46.5

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

Inch series

Type MI



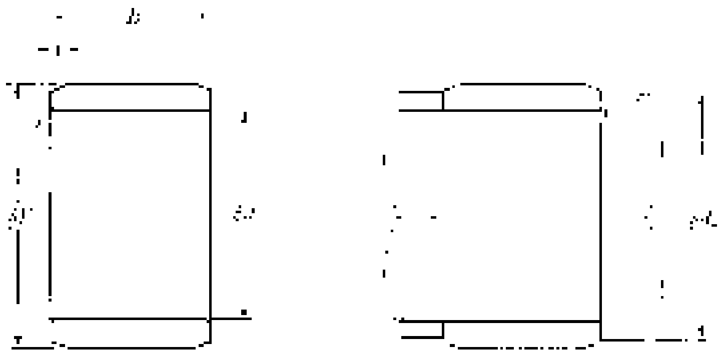
d 9.525～34.925mm

Boundary dimensions mm (1/25.4mm)						Bearing numbers	Abutment dimensions mm		Mass kg
d	F 1)		B	$r_{s\,min}$ 2)	t		d_a min	r_{as} 3) max	(approx.)
9.525(3/8)	14.288(9/16)	0 −0.008	12.95	0.6	—	**※MI-060908**	13.5	0.6	0.013
	15.875(5/8)		19.30	0.6	1	**MI-061012**	13.5	0.6	0.019
	15.875(5/8)		25.65	0.6	1	**MI-061016**	13.5	0.6	0.025
12.700(1/2)	19.050(3/4)	0 −0.009	16.13	1	—	**※MI-081210**	17.5	1	0.020
	19.050(3/4)		19.30	1	—	**※MI-081212**	17.5	1	0.024
	19.050(3/4)		25.65	1	—	**※MI-081216**	17.5	1	0.032
15.875(5/8)	22.225(7/8)	0 −0.009	9.78	1	—	**※MI-101406**	21	1	0.014
	22.225(7/8)		12.95	1	—	**※MI-101408**	21	1	0.018
	22.225(7/8)		19.30	1	—	**※MI-101412**	21	1	0.027
	22.225(7/8)		25.65	1	—	**※MI-101416**	21	1	0.036
19.050(3/4)	25.400(1)	0 −0.009	19.30	1	—	**※MI-121612**	24	1	0.034
	25.400(1)		25.65	1	—	**※MI-121616**	24	1	0.045
22.225(7/8)	28.575(1 1/8)	0 −0.009	12.95	1	—	**※MI-141808**	27	1	0.027
	28.575(1 1/8)		19.30	1	—	**※MI-141812**	27	1	0.040
	28.575(1 1/8)		25.65	1	—	**※MI-141816**	27	1	0.052
	28.575(1 1/8)		32.00	1	—	**※MI-141820**	27	1	0.066
25.400(1)	31.750(1 1/4)	+0.008 −0.002	19.30	1	—	**※MI-162012**	30.5	1	0.039
	31.750(1 1/4)		25.65	1	—	**※MI-162016**	30.5	1	0.052
	31.750(1 1/4)		32.00	1	—	**※MI-162020**	30.5	1	0.065
28.575(1 1/8)	34.925(1 3/8)	+0.008 −0.002	12.95	1	—	**※MI-182208**	33.5	1	0.032
	34.925(1 3/8)		25.65	1	—	**※MI-182216**	33.5	1	0.063
	34.925(1 3/8)		32.00	1	—	**※MI-182220**	33.5	1	0.079
31.750(1 1/4)	38.100(1 1/2)	0 −0.011	25.65	1.5	—	**※MI-202416**	37	1.5	0.075
	38.100(1 1/2)		32.00	1.5	—	**※MI-202420**	37	1.5	0.094
33.338(1 5/16)	41.275(1 5/8)	0 −0.011	25.65	1.5	2	**MI-212616**	40	1.5	0.093
	41.275(1 5/8)		32.00	1.5	2	**MI-212620**	40	1.5	0.116
34.925(1 3/8)	41.275(1 5/8)	0 −0.011	16.13	1.5	2	**MI-222610**	40	1.5	0.073
	44.450(1 3/4)		25.65	1.5	2	**MI-222816**	41.5	1.5	0.117

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: 1. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface. r

Inch series

Type MI



d 34.925～98.425mm

Boundary dimensions mm (1/25.4mm)						Bearing numbers	Abutment dimensions mm		Mass kg
d	F 1)		B	$r_{s\,min}$ 2)	t		d_a min	r_{as} 3) max	(approx.)
34.925(1 3/8)	44.450(1 3/4)	$^{0}_{-0.011}$	32.00	1.5	2	**MI-222820**	41.5	1.5	0.146
38.100(1 1/2)	44.450(1 3/4)	$^{0}_{-0.011}$	19.30	1.5	2	**MI-242812**	43	1.5	0.062
	44.450(1 3/4)		25.65	1.5	2	**MI-242816**	43	1.5	0.083
39.688(1 9/16)	47.625(1 7/8)	$^{0}_{-0.011}$	32.00	1.5	2	**MI-253020**	46	1.5	0.136
41.275(1 5/8)	50.800(2)	$^{+0.008}_{-0.004}$	25.65	1.5	2	**MI-263216**	48	1.5	0.140
	50.800(2)		32.00	1.5	2	**MI-263220**	48	1.5	0.175
44.450(1 3/4)	57.150(2 1/4)	$^{+0.008}_{-0.004}$	38.35	1.5	2	**MI-283624**	51	1.5	0.310
	57.150(2 1/4)		44.70	1.5	2	**MI-283628**	51	1.5	0.360
50.800(2)	63.500(2 1/2)	$^{0}_{-0.013}$	38.35	2	2	**MI-324024**	59	2	0.340
	63.500(2 1/2)		44.70	2	2	**MI-324028**	59	2	0.420
57.150(2 1/4)	69.850(2 3/4)	$^{0}_{-0.013}$	25.65	2	2.2	**MI-364416**	65	2	0.257
	69.850(2 3/4)		38.35	2	2.2	**MI-364424**	65	2	0.384
	69.850(2 3/4)		44.70	2	2.2	**MI-364428**	65	2	0.447
63.500(2 1/2)	76.200(3)	$^{0}_{-0.013}$	38.35	2	2.2	**MI-404824**	71.5	2	0.417
	76.200(3)		44.70	2	2.2	**MI-404828**	71.5	2	0.486
66.675(2 5/8)	82.550(3 1/4)	$^{0}_{-0.015}$	44.70	2	2.2	**MI-425228**	74.5	2	0.648
	82.550(3 1/4)		51.05	2	2.2	**MI-425232**	74.5	2	0.740
69.850(2 3/4)	82.550(3 1/4)	$^{0}_{-0.015}$	44.70	2	2.2	**MI-445228**	78	2	0.530
76.200(3)	88.900(3 1/2)	$^{0}_{-0.015}$	44.70	2	2.2	**MI-485628**	84	2	0.574
	88.900(3 1/2)		51.05	2	2.2	**MI-485632**	84	2	0.655
79.375(3 1/8)	95.250(3 3/4)	$^{0}_{-0.015}$	51.05	2.5	2.2	**MI-506032**	88.5	2.5	0.862
85.725(3 3/8)	101.600(4)	$^{0}_{-0.015}$	51.05	2.5	2.5	**MI-546432**	94.5	2.5	0.930
92.075(3 5/8)	107.950(4 1/4)	$^{0}_{-0.015}$	51.05	2.5	2.5	**MI-586832**	101	2.5	1.00
95.250(3 3/4)	114.300(4 1/2)	$^{0}_{-0.015}$	57.40	2.5	2.5	**MI-607236**	104	2.5	1.40
98.425(3 7/8)	114.300(4 1/2)	$^{0}_{-0.015}$	57.40	2.5	2.5	**MI-627236**	107.5	2.5	1.15
	114.300(4 1/2)		63.88	2.5	2.5	**MI-627240**	107.5	2.5	1.28

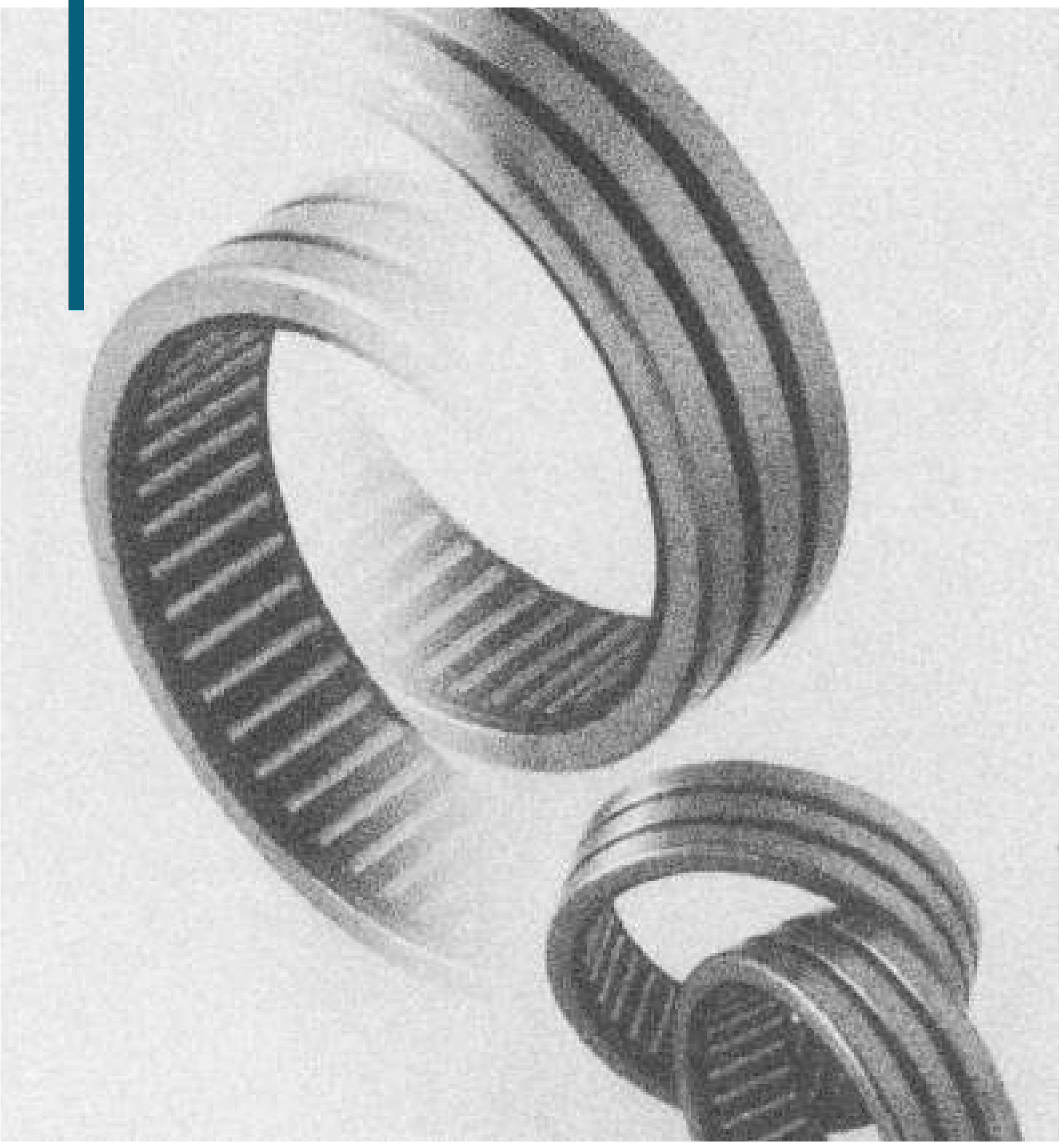
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

d 101.600～203.200mm

Boundary dimensions mm (1/25.4 mm)						Bearing numbers	Abutment dimensions mm		Mass kg
d	F 1)		B	$r_{s\,min}$ 2)	t		d_a min	r_{as} 3) max	(approx.)
101.600(4)	127.000(5)	0 / −0.018	51.05	2.5	2.5	**MI-648032**	110.5	2.5	1.82
	127.000(5)		57.40	2.5	2.5	**MI-648036**	110.5	2.5	2.05
	127.000(5)		63.88	2.5	2.5	**MI-648040**	110.5	2.5	2.28
114.300(4 ½)	139.700(5 ½)	0 / −0.018	63.88	2.5	2.5	**MI-728840**	123.5	2.5	2.58
	139.700(5 ½)		76.58	2.5	2.5	**MI-728848**	123.5	2.5	3.10
120.650(4 ¾)	146.050(5 ¾)	0 / −0.018	76.58	3	3	**MI-769248**	132	3	3.18
127.000(5)	152.400(6)	0 / −0.018	63.88	3	3	**MI-809640**	140	3	2.80
	152.400(6)		76.58	3	3	**MI-809648**	140	3	3.35
139.700(5 ½)	165.100(6 ½)	−0.010 / −0.028	63.88	3	3	**MI-8810440**	152.5	3	2.84
	165.100(6 ½)		76.58	3	3	**MI-8810448**	152.5	3	3.40
152.400(6)	184.150(7 ¼)	−0.013 / −0.033	76.58	3	3	**MI-9611648**	165.5	3	4.80
165.100(6 ½)	196.850(7 ¾)	−0.013 / −0.043	76.58	3	3	**MI-10412448**	178	3	5.30
177.800(7)	209.550(8 ¼)	−0.013 / −0.043	76.58	3	3	**MI-11213248**	191	3	5.60
190.500(7 ½)	222.250(8 ¾)	−0.020 / −0.050	76.58	4	3	**MI-12014048**	206.5	4	6.10
203.200(8)	234.950(9 ¼)	−0.033 / −0.063	76.58	4	3.5	**MI-12814848**	219	4	6.50

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.
2) Allowable minimum chamfer dimension r. 3) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.

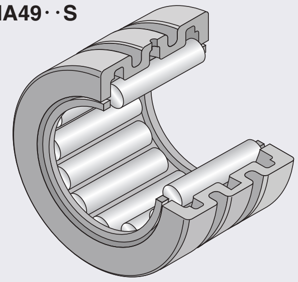
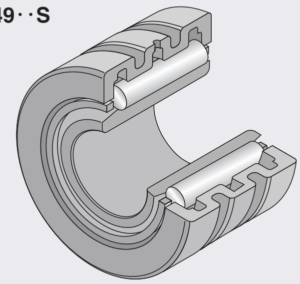
Adjustable-Clearance Needle Roller Bearings



Clearance-Adjustable Needle Roller Bearings

This bearing type comprises a solid outer ring with a unique cross-sections shape and needle rollers and cage built in the outer ring. The outer ring, needle rollers and cage are inseparable from each other. The outer ring raceway diameter is reduced by clamping the outer ring axially, which then reduces the roller inscribed circle diameter (F_w).

Axial clamping force on the bearing can be adjusted to alter the reduction on outer ring raceway diameter so that the radial clearance can be finely adjusted. The bearing is used on machine tools main spindle and other similar which require high speed rotational accuracy of JIS Class-4.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type RNA49··S 	ϕ30～ϕ125	**RNA 49 05 S** — Type code; Dimension series; Roller set bore diameter code; Suffix. **[Suffix]** S: Clearance-adjustable type	The dimensional accuracy, profile accuracy and running accuracy conform to JIS Class-4 so as to be available for applications requiring high running accuracy. Another inner ring type with grinding allowance for its raceway surface can also be supplied upon request.
Type NA49··S 	ϕ25～ϕ110		

Bearing accuracy

Application of this bearing type is limited to the portions of a machine which require high running accuracy. Therefore, the dimensional accuracy, profile accuracy and running accuracy of this bearing type conform to JIS Class-4. For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, NTN will supply a special inner ring whose raceway surface includes a grinding allowance.

Radial internal clearance and bearing fits

The radial internal clearance of Type **RNA49··S** with inner ring is smaller than ordinary clearance. While the tolerance of roller set bore diameter (F_w) of Type **NA49··S** without inner ring is listed in the relevant dimension table, the radial internal clearance of the bearing is determined once the applicable shaft diameter has been selected.

To be able to force the outer ring in the axial direction to shrink the raceway diameter, the fit of the outer ring to the housing bore needs to be "transition fit" or "interference fit" (interference of approximately 5μm).

Bearing fit on a shaft and in a housing shall be per **Table 1.**

Table 1 Bearing fit in shaft and housing (recommended)

Bearing type	Shaft	Housing
RNA49··S	m5	K4
NA49··S	k5	

Shaft and housing accuracy

This bearing type which is applied to the portions of a machine requiring high running accuracy is clamped with the outer ring inclination in installing restrained as less as possible. Therefore, the profile accuracy of the shaft and the housing must be made higher than that for general machined ring needle roller bearings. (**Table 2**)

Table 2 Shaft and housing accuracy (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT2	IT3
Cylindricality (max)	IT2	IT3
Tolerance of shoulder runout (max)	IT3	IT3

Method for adjusting radial internal clearance

The ratio of outer ring axial shrinkage to shrinkage of roller inscribed circle diameter (F_w) is nearly 3:1. In other words, to be able to decrease the radial internal clearance of the bearing by 1μm, it is necessary to tighten the outer ring by 3μm in the axial direction.

When adjusting the radial internal clearance of a bearing, be careful to uniformly tighten its outer ring along the centerline of the shaft.

In the case of adjustment by the method illustrated in **Fig. 1**, the spacer is put between the housing and the lid. Changing the thickness of the spacer by wrapping the spacer width or replacing the spacer, a certain amount of axial clamping can be obtained.

In **Fig. 2**, the fixed ring is fitted in the housing and, thereafter, the threaded lid is screwed in until it comes in contact with the outer ring for zero setting. Then, the threaded lid is further screwed in by the required value, after the fixed ring was loosened, and thereafter the fixed ring is retightened. Further, it is recommended to use a saw-toothed tightening screw as illustrated in **Fig. 3** because accuracy-down can be minimized by use of such a screw.

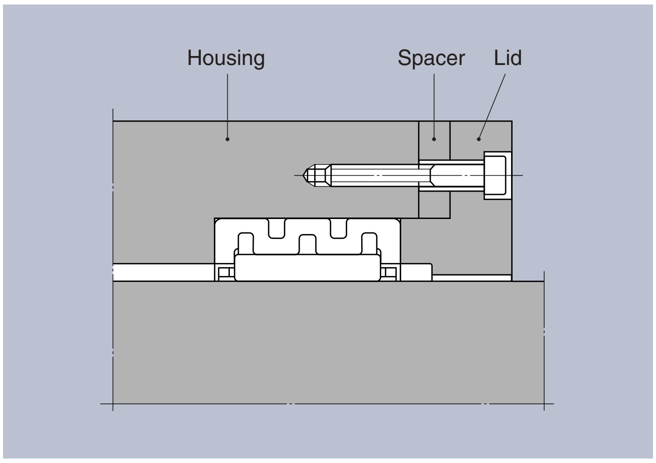


Fig. 1

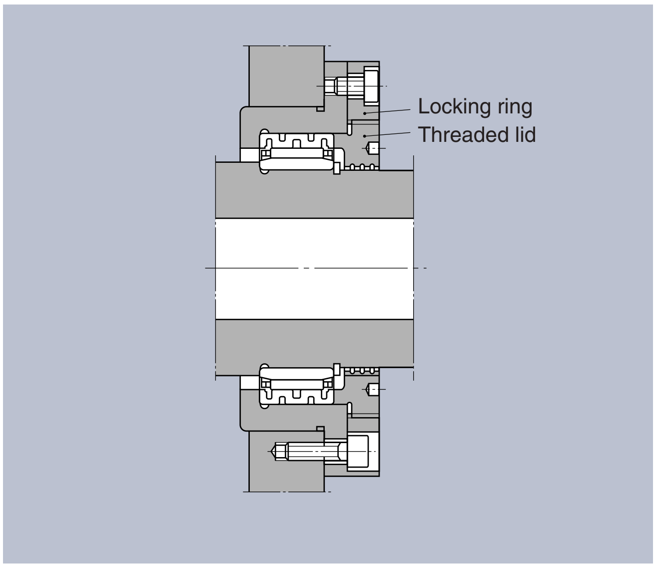


Fig. 2

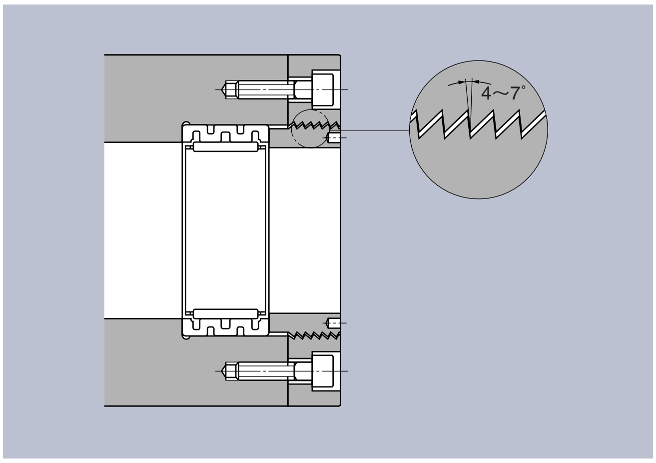
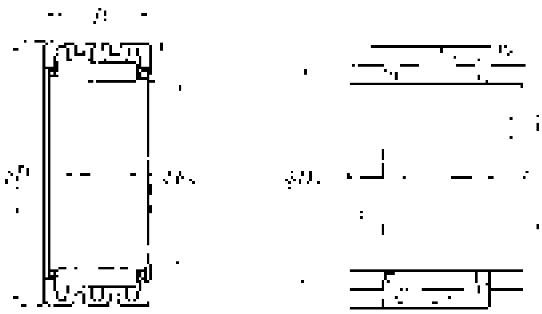


Fig. 3

Without inner ring

Type RNA49··S



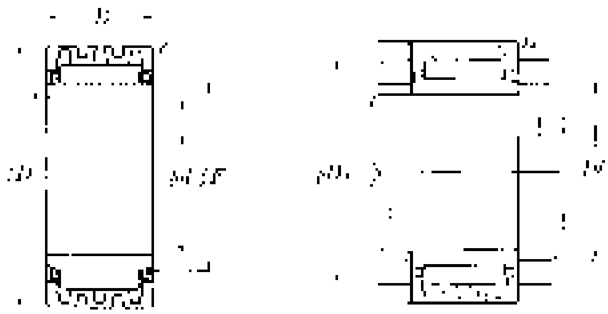
F_W 30～125mm

Boundary dimensions mm				Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹ grease	oil	Bearing numbers	Abutment dimensions mm		Mass kg
F_W	D	B	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}				D_a max	r_{as} 2) max	(approx.)
$30^{+0.031}_{+0.022}$	42	17	0.3	12 300	16 000	1 260	1 630	8 700	13 000	**RNA 4905S**	36	0.3	0.070
$35^{+0.038}_{+0.028}$	47	17	0.3	14 900	21 600	1 520	2 200	7 300	11 000	**RNA 4906S**	41	0.3	0.086
$40^{+0.038}_{+0.028}$	52	20	0.6	17 600	27 800	1 790	2 830	6 700	10 000	**RNA49/32S**	46	0.6	0.088
$42^{+0.038}_{+0.028}$	55	20	0.6	18 300	29 800	1 870	3 050	6 300	9 500	**RNA 4907S**	48	0.6	0.099
$48^{+0.038}_{+0.028}$	62	22	0.6	22 500	40 500	2 300	4 150	5 700	8 500	**RNA 4908S**	54	0.6	0.134
$52^{+0.045}_{+0.035}$	68	22	0.6	23 100	43 500	2 360	4 400	5 000	7 500	**RNA 4909S**	58	0.6	0.168
$58^{+0.045}_{+0.035}$	72	22	0.6	24 700	49 000	2 520	5 000	4 700	7 000	**RNA 4910S**	64	0.6	0.189
$63^{+0.045}_{+0.035}$	80	25	1	33 000	65 500	3 350	6 650	4 300	6 500	**RNA 4911S**	70	1	0.212
$68^{+0.045}_{+0.035}$	85	25	1	34 000	69 000	3 450	7 050	4 000	6 000	**RNA 4912S**	75	1	0.257
$72^{+0.045}_{+0.035}$	90	25	1	34 000	70 500	3 450	7 200	3 700	5 500	**RNA 4913S**	79	1	0.286
$80^{+0.045}_{+0.035}$	100	30	1	44 500	94 000	4 550	9 600	3 300	5 000	**RNA 4914S**	88	1	0.422
$85^{+0.055}_{+0.040}$	105	30	1	45 500	99 000	4 650	10 100	3 100	4 700	**RNA 4915S**	93	1	0.451
$90^{+0.055}_{+0.040}$	110	30	1	46 500	104 000	4 750	10 600	2 900	4 400	**RNA 4916S**	98	1	0.468
$100^{+0.055}_{+0.040}$	120	35	1.1	57 000	140 000	5 800	14 300	2 700	4 000	**RNA 4917S**	108	1	0.594
$105^{+0.055}_{+0.040}$	125	35	1.1	58 500	146 000	5 950	14 900	2 500	3 800	**RNA 4918S**	113	1	0.617
$110^{+0.055}_{+0.040}$	130	35	1.1	59 500	152 000	6 050	15 500	2 400	3 600	**RNA 4919S**	118	1	0.735
$115^{+0.055}_{+0.040}$	140	40	1.1	72 000	168 000	7 350	17 100	2 300	3 500	**RNA 4920S**	125	1	0.980
$125^{+0.065}_{+0.050}$	150	40	1.1	75 500	184 000	7 700	18 800	2 100	3 200	**RNA 4922S**	135	1	1.04

Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

With inner ring

Type NA49··S

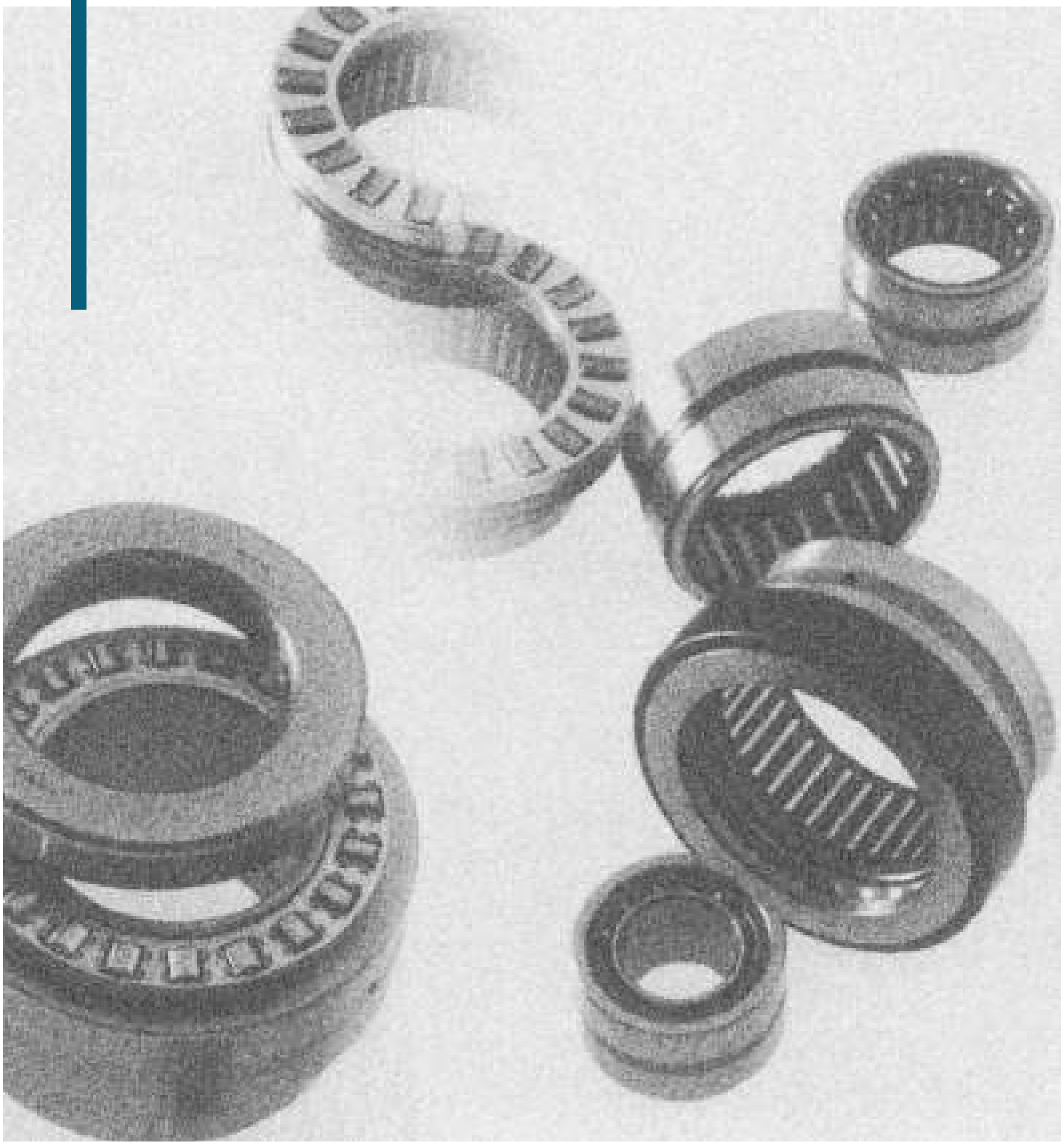


d 25～110mm

Boundary dimensions mm					Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Limiting speeds min⁻¹		Bearing numbers	Bearing clearanc before installation	Abutment dimensions mm			Mass kg
d	D	B	$r_{s\,min}$ [1]	F	C_r	C_{or}	C_r	C_{or}	grease	oil		μm	d_a min	D_a max	r_{as} [2] max	(approx.)
25	42	17	0.3	30	12 300	16 000	1 260	1 630	8 700	13 000	**NA 4905S**	10～25	27	36	0.3	0.084
30	47	17	0.3	35	14 900	21 600	1 520	2 200	7 300	11 000	**NA 4906S**	12～25	32	41	0.3	0.099
32	52	20	0.6	40	17 600	27 800	1 790	2 830	6 700	10 000	**NA49/32S**	12～25	36	46	0.6	0.157
35	55	20	0.6	42	18 300	29 800	1 870	3 050	6 300	9 500	**NA 4907S**	15～30	39	48	0.6	0.164
40	62	22	0.6	48	22 500	40 500	2 300	4 150	5 700	8 500	**NA 4908S**	15～30	44	54	0.6	0.227
45	68	22	0.6	52	23 100	43 500	2 360	4 400	5 000	7 500	**NA 4909S**	15～35	49	58	0.6	0.257
50	72	22	0.6	58	24 700	49 000	2 520	5 000	4 700	7 000	**NA 4910S**	15～35	54	64	0.6	0.271
55	80	25	1	63	33 000	65 500	3 350	6 650	4 300	6 500	**NA 4911S**	15～35	60	70	1	0.382
60	85	25	1	68	34 000	69 000	3 450	7 050	4 000	6 000	**NA 4912S**	20～40	65	75	1	0.410
65	90	25	1	72	34 000	70 500	3 450	7 200	3 700	5 500	**NA 4913S**	20～40	70	79	1	0.427
70	100	30	1	80	44 500	94 000	4 550	9 600	3 300	5 000	**NA 4914S**	20～40	75	88	1	0.689
75	105	30	1	85	45 500	99 000	4 650	10 100	3 100	4 700	**NA 4915S**	25～45	80	93	1	0.740
80	110	30	1	90	46 500	104 000	4 750	10 600	2 900	4 400	**NA 4916S**	25～45	85	98	1	0.774
85	120	35	1.1	100	57 000	140 000	5 800	14 300	2 700	4 000	**NA 4917S**	25～45	91.5	108	1	1.18
90	125	35	1.1	105	58 500	146 000	5 950	14 900	2 500	3 800	**NA 4918S**	25～50	96.5	113	1	1.23
95	130	35	1.1	110	59 500	152 000	6 050	15 500	2 400	3 600	**NA 4919S**	25～50	101.5	118	1	1.40
100	140	40	1.1	115	72 000	168 000	7 350	17 100	2 300	3 500	**NA 4920S**	25～50	106.5	125	1	1.91
110	150	40	1.1	125	75 500	184 000	7 700	18 800	2 100	3 200	**NA 4922S**	30～60	116.5	135	1	2.12

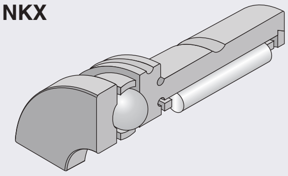
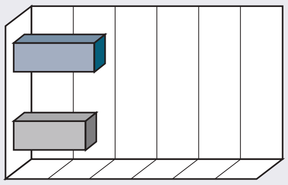
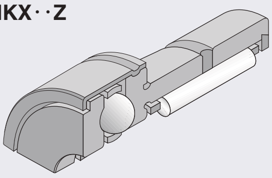
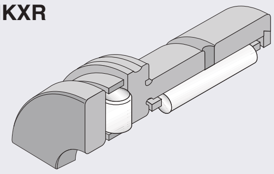
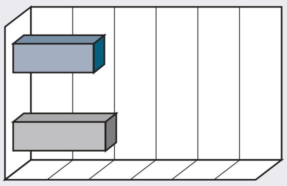
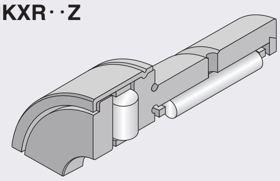
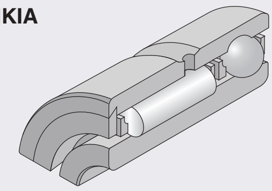
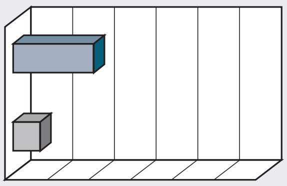
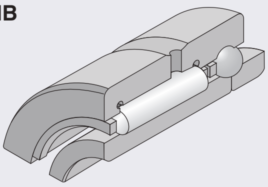
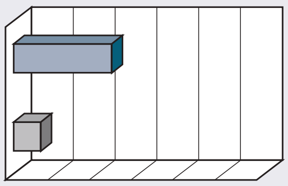
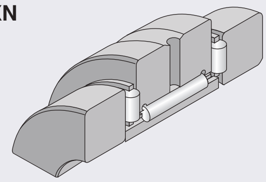
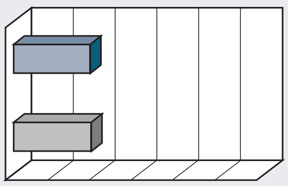
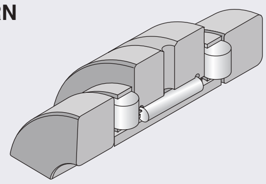
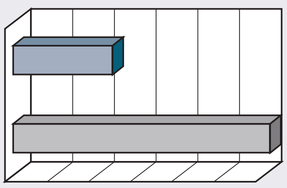
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.

Complex Bearings



Complex Bearings

NTN complex bearing is comprised of a needle roller bearing of supporting radial load and a thrust bearing for supporting axial load which are assembled integrally. Comparing with individual use of a radial bearing and a thrust bearing for the same purpose, this complex bearing saves the required installation space and thereby can contribute to making the overall construction of an equipment more compact.

Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
Type NKX 	φ10—φ70		**NKX 20 T2** Suffix T2: Resin cage Dimension code (shaft diameter) Type code
Type NKX··Z 			**NKX 20 T2 Z** Suffix T2: Resin cage Z: with dust-proof cover Dimension code (shaft diameter) Type code
Type NKXR 	φ15—φ50		**NKXR 20 T2** Suffix T2: Resin cage Dimension code (shaft diameter) Type code
Type NKXR··Z 			**NKXR 20 T2Z** Suffix T2: Resin cage Z: with dust-proof cover Dimension code (shaft diameter) Type code
Type NKIA 	φ15—φ70		**NKIA 59 04** Bore diameter code Dimension series code Type code
Type NKIB 	φ15—φ70		**NKIB 59 04 R** Suffix R: outer ring with rib Bore diameter code Dimension series code Type code
Type AXN 	φ20—φ50		**AXN 20 52** Outer diameter code Bore diameter code Type code
Type ARN 	φ20—φ70		**ARN 20 62** Outer diameter code Bore diameter code Type code

※Each listed load capacity is subject to reference bearing bore diameter of φ20.

Bearing components	Handling characteristic	Features
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Iron cage Thrust bearing : Ball type Resin cage Dust-proof cover : without Thrust plate : Separable	△ Separable thrust plate Without dust-proof cover	Can be applied to high speed running under light axial load, due to use of ball type thrust bearing.
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Iron cage Thrust bearing : Ball type Resin cage Dust-proof cover : with Thrust plate : Non-separable, integral type	○ Integral thrust plate With dust-proof cover	This type is identical to Type NKX except in that the thrust bearing is protected with a dust cover. Furthermore, the handling characteristic is good because the dust cover makes the thrust plate non-separable integral.
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Iron cage Thrust bearing : Cylindrical roller type Resin cage Dust-proof cover : without Thrust plate : Separable	△ Separable thrust plate Without dust-proof cover	Due to the use of needle roller bearing as its thrust bearing, this type can support greater axial load than NKX.
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Iron cage Thrust bearing : Cylindrical roller type Resin cage Dust-proof cover : with Thrust plate : Non-separable, integral type	○ Integral thrust plate With dust-proof cover	This type is identical to NKXR, but its thrust bearing is provided with dust-proof cover to prevent grease scattering. Furthermore, the handling characteristic is good because the dust-proof cover makes the thrust plate non-separable and integral.
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Thrust bearing : Angular type	◎ Integral angular bearing Inner ring separable	This type is composed of needle roller bearing and angular bearing which were integrated into one unit. The angular bearing supports axial load. Hence, this type can support one-way axial load only. Best-suited to high speed and light load application.
Inscribed circle diameter (shaft dia.) : φ20 Radial bearing : Needle roller type Outer ring with rib Thrust bearing : Three-point contact angular type	○ Double inner ring type Inner ring separable	This type is composed of needle roller bearing and three-point contact angular bearing which were integrated into one unit. Unlike KN1A, this type can support bi-directional axial load.
Inscribed circle diameter (shaft dia.) : φ20 Outer ring outer diameter : 52 Radial bearing : Needle roller type Thrust bearing : Needle roller type	△ Separable	This type is a special-purposed bearing to support a precision ball screw. This type uses the side face of the radial bearing as the raceway surface of thrust bearing. This can support axial load from both directions.
Inscribed circle diameter (shaft dia.) : φ20 Outer ring outer diameter : 62 Radial bearing : Needle roller type Thrust bearing : Cylindrical roller type	△ Separable	This type is a special-purposed bearing to support a precision ball screw. This can support bi-directional axial load. This type is identical to AXN, but its axial load capacity is greater.

Bearing Accuracy

Regarding the dimensional tolerances for radial needle roller bearing, refer to **Table 4.3** 4. "**Bearing Tolerances**" (page A-26) for others than the characteristics described in Dimensions Table and to **Table 4.4** (page A-26) for thrust bearing tolerances respectively. Manufacture of bearing **Type AXN** and **ARN** is limited to those of JIS accuracy class-5 and -4 only. (Allowable radial run-out values for Type AXN and ARN is as specified in **Table 1**.)

Table 1 Allowable radial run-out values for Type AXN and ARN

Unit: μm

Nominal bearing bore dia. d or nominal bearing outer dia. D (mm)		Radial runout of ❶ radial inner ring K_{ia}		Allowable radial ❷ run-out for outer ring K_{ea}	
Over	Incl.	Class 5	Class 4	Class 5	Class 4
18	30	4	3	—	—
30	50	5	4	—	—
50	80	5	4	8	5
80	120	—	—	10	6
120	150	—	—	11	7

❶ To be determined based on "d".
❷ To be determined based on "D".

Radial internal clearance

The radial internal clearance of **Type NKX+IR, NKXR+IR** and **NKIA** is in accordance with the interchangeable clearance information in **Table 5.1(1)** in Sec. **5.1 "Bearing radial internal clearance"** (page A-30). The standard bearings are manufactured subject to the regular clearances.

The radial internal clearance of **Types AXN** and **ARN** is unique to this type, and the clearance value specific to an intended bearing is found in the relevant dimension table.

Bearing fits

Radial needle roller bearings shall be fitted on shaft/in housing in compliance with **Table 2**. The thrust bearing washers of **Type NKX** and **NKXR** shall be fitted in a housing with hole diameter larger by 0.5mm or over than the washer outer diameter D_1 or D_2. For **Type NKIA** and **NKIB** it is not allowed to make the interference greater than k5/M6.

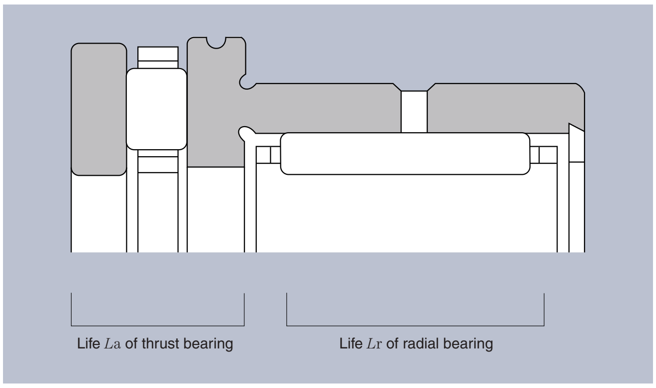
Table 2 Bearing fit on shaft and in housing (recommended)

Bearing type	Shaft	Housing
Series NKX, NKXR	k5	K6 (M6)
Series NKIA, NKIB	k5	M6
Series AXN, ARN	j5	J6

Remarks: The parenthesized housing code is applied, where high rigidity is required.

Calculation of rating life

The rating life (L) of any complex bearing is determined as follows. Determine individually the rating life (L_r) of radial needle roller bearing from radial load acting thereon and the rating life (L_a) of thrust bearing from axial load acting thereon. And determine the rating life (L) from these determined rating lives (L_r, L_a) using the following formula.

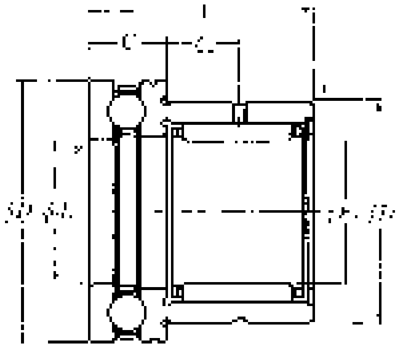


Rating life L of complex bearing

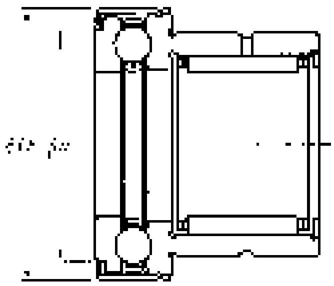
$$L=\frac{1}{\left(\frac{1}{L_r^{1.1}}+\frac{}{L_a^{1.1}}\right)^{0.91}} \quad \cdots\cdots(1)$$

Without inner ring

Type NKX
Type NKX··Z



Type NKX
(Open type)

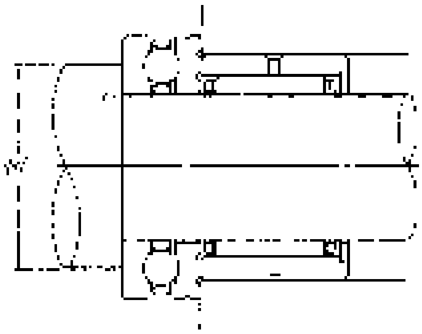


Type NKX··Z
(With cover)

F_w 10～70mm

Boundary dimensions (mm)												Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
F_w		d_w		D	D_1	D_2	C (0 / −0.25)	C_1 (0 / −0.20)	C_2	a	$r_{s\,min}$ 1)	Radial C_r	C_{or}	C_r	C_{or}
10	+0.022 / +0.013	10	+0.040 / +0.025	19	24	25	23	9	6.5	19.7	0.3	5 450	6 450	555	660
12	+0.027 / +0.016	12	+0.050 / +0.032	21	26	27	23	9	6.5	21.7	0.3	6 000	7 700	615	785
15	+0.027 / +0.016	15	+0.050 / +0.032	24	28	29	23	9	6.5	23.7	0.3	8 250	10 200	840	1 040
17	+0.027 / +0.016	17	+0.050 / +0.032	26	30	31	25	9	8	25.7	0.3	10 400	14 400	1 060	1 460
20	+0.033 / +0.020	20	+0.061 / +0.040	30	35	36	30	10	10.5	30.7	0.3	16 400	27 100	1 670	2 760
25	+0.033 / +0.020	25	+0.061 / +0.040	37	42	43	30	11	9.5	37.7	0.6	14 200	24 000	1 450	2 450
30	+0.033 / +0.020	30	+0.061 / +0.040	42	47	48	30	11	9.5	42.7	0.6	22 300	39 500	2 280	4 000
35	+0.041 / +0.025	35	+0.075 / +0.050	47	52	53	30	12	9	47.7	0.6	20 000	36 000	2 040	3 650
40	+0.041 / +0.025	40	+0.075 / +0.050	52	60	61	32	13	10	55.7	0.6	25 900	52 500	2 650	5 350
45	+0.041 / +0.025	45	+0.075 / +0.050	58	65	66.5	32	14	9	60.5	0.6	27 600	59 000	2 810	6 000
50	+0.041 / +0.025	50	+0.075 / +0.050	62	70	71.5	35	14	10	65.5	0.6	27 900	62 000	2 850	6 300
60	+0.049 / +0.030	60	+0.090 / +0.060	72	85	86.5	40	17	12	80.5	1	29 800	71 500	3 050	7 300
70	+0.049 / +0.030	70	+0.090 / +0.060	85	95	96.5	40	18	11	90.5	1	36 500	86 000	3 700	8 750

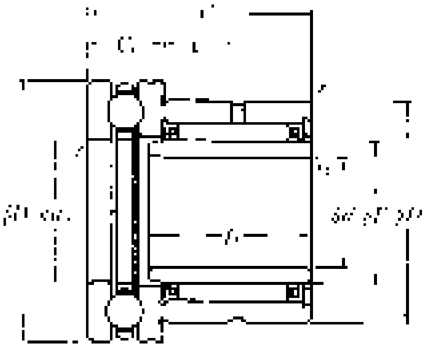
Note 1) Allowable minimum chamfer dimension r.
2) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.



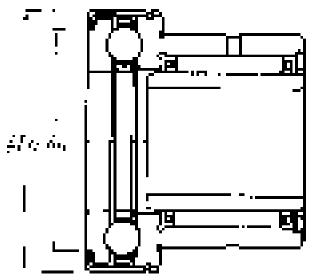
Basic load ratings dynamic N C_a	static N Axial C_{oa}	dynamic kgf C_a	static kgf C_{oa}	Limiting dimensions min⁻¹ grease	oil	Bearing numbers Type NKX	Type NKX··Z	Abutment dimensions mm d_a min	r_{as} 2) max	Mass (approx.) kg Type NKX	Type NKX··Z
10 000	14 000	1 020	1 420	6 700	9 500	**NKX10T2**	**NKX10T2Z**	18	0.3	0.037	0.039
10 300	15 400	1 050	1 570	6 400	9 200	**NKX12T2**	**NKX12T2Z**	20	0.3	0.042	0.044
10 500	16 800	1 070	1 710	6 200	8 800	**NKX15T2**	**NKX15T2Z**	23	0.3	0.044	0.048
10 800	18 200	1 100	1 850	6 000	8 500	**NKX17T2**	**NKX17T2Z**	25	0.3	0.051	0.056
14 200	24 700	1 450	2 520	5 200	7 500	**NKX20T2**	**NKX20T2Z**	29	0.3	0.085	0.090
19 600	37 000	1 990	3 800	4 600	6 500	**NKX25T2**	**NKX25T2Z**	35	0.6	0.125	0.132
20 400	42 000	2 080	4 300	4 300	6 200	**NKX30T2**	**NKX30T2Z**	40	0.6	0.140	0.148
20 400	44 500	2 080	4 550	3 900	5 600	**NKX35T2**	**NKX35T2Z**	45	0.6	0.167	0.175
26 900	63 000	2 740	6 400	3 500	5 000	**NKX40**	**NKX40Z**	52	0.6	0.216	0.225
27 900	69 000	2 840	7 050	3 200	4 600	**NKX45**	**NKX45Z**	57	0.6	0.252	0.265
28 800	75 500	2 930	7 700	3 100	4 500	**NKX50**	**NKX50Z**	62	0.6	0.302	0.318
41 500	113 000	4 200	11 500	2 600	3 700	**NKX60**	**NKX60Z**	75	1	0.465	0.484
43 000	127 000	4 400	12 900	2 400	3 400	**NKX70**	**NKX70Z**	85	1	0.612	0.635

With inner ring

Type NKX＋IR
Type NKX‥Z＋IR



Type NKX＋IR
(Open type)

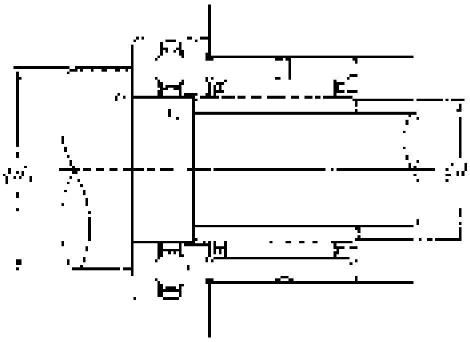


Type NKX‥Z＋IR
(With cover)

d 7～60mm

Boundary dimensions													Basic load ratings							
													Radial				Axial			
													dynamic N	static N	dynamic kgf	static kgf	dynamic N	static N	dynamic kgf	static kgf
d	d_w	D	D_1	D_2	B	C 0 −0.25	C_1 0 −0.20	C_2	F	a	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}
7	10 +0.040 +0.025	19	24	25	16	23	9	6.5	10	19.7	0.3	0.3	5 450	6 450	555	660	10 000	14 000	1 020	1 420
9	12 +0.050 +0.032	21	26	27	16	23	9	6.5	12	21.7	0.3	0.3	6 000	7 700	615	785	10 300	15 400	1 050	1 570
12	15 +0.050 +0.032	24	28	29	16	23	9	6.5	15	23.7	0.3	0.3	8 250	10 200	840	1 040	10 500	16 800	1 070	1 710
14	17 +0.050 +0.032	26	30	31	17	25	9	8	17	25.7	0.3	0.3	10 400	14 400	1 060	1 460	10 800	18 200	1 100	1 850
17	20 +0.061 +0.040	30	35	36	20	30	10	10.5	20	30.7	0.3	0.3	16 400	27 100	1 670	2 760	14 200	24 700	1 450	2 520
20	25 +0.061 +0.040	37	42	43	20	30	11	9.5	25	37.7	0.6	0.3	14 200	24 000	1 450	2 450	19 600	37 000	1 990	3 800
25	30 +0.061 +0.040	42	47	48	20	30	11	9.5	30	42.7	0.6	0.3	22 300	39 500	2 280	4 000	20 400	42 000	2 080	4 300
30	35 +0.075 +0.050	47	52	53	20	30	12	9	35	47.7	0.6	0.3	20 000	36 000	2 040	3 650	20 400	44 500	2 080	4 550
35	40 +0.075 +0.050	52	60	61	20	32	13	10	40	55.7	0.6	0.3	25 900	52 500	2 650	5 350	26 900	63 000	2 740	6 400
40	45 +0.075 +0.050	58	65	66.5	20	32	14	9	45	60.5	0.6	0.3	27 600	59 000	2 810	6 000	27 900	69 000	2 840	7 050
45	50 +0.075 +0.050	62	70	71.5	25	35	14	10	50	65.5	0.6	0.6	27 900	62 000	2 850	6 300	28 800	75 500	2 930	7 700
50	60 +0.090 +0.060	72	85	86.5	25	40	17	12	60	80.5	1	1	29 800	71 500	3 050	7 300	41 500	113 000	4 200	11 500
60	70 +0.090 +0.060	85	95	96.5	25	40	18	11	70	90.5	1	1	36 500	86 000	3 700	8 750	43 000	127 000	4 400	12 900

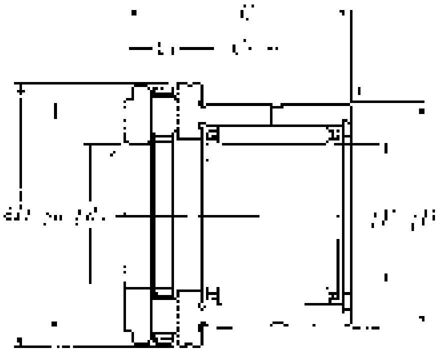
Note 1) Allowable minimum chamfer dimension r. 2) Max. allowable dimension of radius r_a or r_{1a} for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.



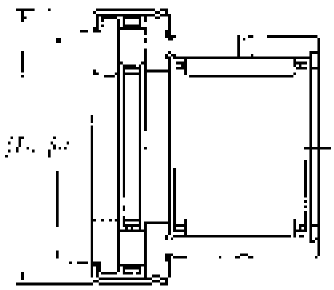
Limiting dimensions min⁻¹ grease	oil	Bearing numbers Type NKX+IR	Type NKX··Z+IR	Abutment dimensions mm d_a min	d_b min	r_{as} 2) max	r_{1as} 2) max	Mass (approx.) kg Type NKX+IR	Type NKX··Z+IR
6 700	9 500	NKX10T2+IR 7×10×16	NKX10T2Z+IR 7×10×16	18	9	0.3	0.3	0.042	0.044
6 400	9 200	NKX12T2+IR 9×12×16	NKX12T2Z+IR 9×12×16	20	11	0.3	0.3	0.048	0.050
6 200	8 800	NKX15T2+IR12×15×16	NKX15T2Z+IR12×15×16	23	14	0.3	0.3	0.052	0.056
6 000	8 500	NKX17T2+IR14×17×17	NKX17T2Z+IR14×17×17	25	16	0.3	0.3	0.061	0.066
5 200	7 500	NKX20T2+IR17×20×20	NKX20T2Z+IR17×20×20	29	19	0.3	0.3	0.099	0.104
4 600	6 500	NKX25T2+IR20×25×20	NKX25T2Z+IR20×25×20	35	22	0.6	0.3	0.152	0.159
4 300	6 200	NKX30T2+IR25×30×20	NKX30T2Z+IR25×30×20	40	27	0.6	0.3	0.173	0.181
3 900	5 600	NKX35T2+IR30×35×20	NKX35T2Z+IR30×35×20	45	32	0.6	0.3	0.205	0.213
3 500	5 000	NKX40 +IR35×40×20	NKX40Z +IR35×40×20	52	37	0.6	0.3	0.260	0.269
3 200	4 600	NKX45 +IR40×45×20	NKX45Z +IR40×45×20	57	42	0.6	0.3	0.293	0.316
3 100	4 500	NKX50 +IR45×50×25	NKX50Z +IR45×50×25	62	48	0.6	0.6	0.373	0.389
2 600	3 700	NKX60 +IR50×60×25	NKX60Z +IR50×60×25	75	55	1	1	0.635	0.654
2 400	3 400	NKX70 +IR60×70×25	NKX70Z +IR60×70×25	85	65	1	1	0.814	0.837

Without inner ring

Type NKXR
Type NKXR··Z



Type NKXR
(Open type)

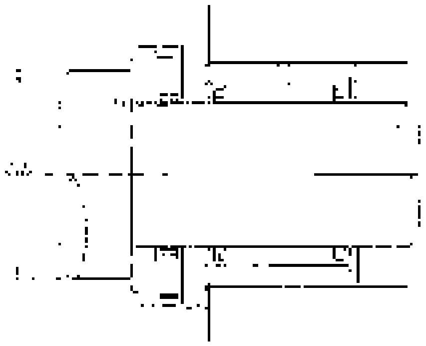


Type NKXR··Z
(With cover)

F_W 15～50mm

Boundary dimensions												Basic load ratings			
												dynamic	static	dynamic	static
mm												N		kgf	
												Radial			
F_W		d_W		D	D_1	D_2	C 0 −0.25	C_1 0 −0.20	C_2	a	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}
15	+0.027 +0.016	15	+0.050 +0.032	24	28	29	23	9	6.5	23.7	0.3	8 250	10 200	840	1 040
17	+0.027 +0.016	17	+0.050 +0.032	26	30	31	25	9	8	25.7	0.3	10 400	14 400	1 060	1 460
20	+0.033 +0.020	20	+0.061 +0.040	30	35	36	30	10	10.5	30.7	0.3	16 400	27 100	1 670	2 760
25	+0.033 +0.020	25	+0.061 +0.040	37	42	43	30	11	9.5	37.7	0.6	14 200	24 000	1 450	2 450
30	+0.033 +0.020	30	+0.061 +0.040	42	47	48	30	11	9.5	42.7	0.6	22 300	39 500	2 280	4 000
35	+0.041 +0.025	35	+0.075 +0.050	47	52	53	30	12	9	47.7	0.6	20 000	36 000	2 040	3 650
40	+0.041 +0.025	40	+0.075 +0.050	52	60	61	32	13	10	55.7	0.6	25 900	52 500	2 650	5 350
45	+0.041 +0.025	45	+0.075 +0.050	58	65	66.5	32	14	9	60.5	0.6	27 600	59 000	2 810	6 000
50	+0.041 +0.025	50	+0.075 +0.050	62	70	71.5	35	14	10	65.5	0.6	27 900	62 000	2 850	6 300

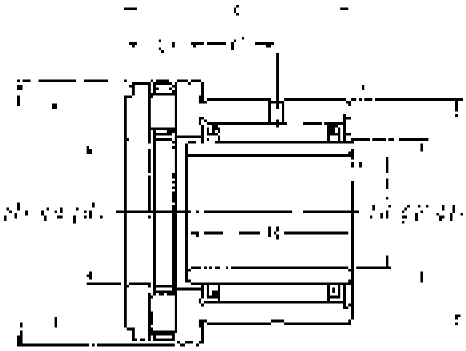
Note 1) Allowable minimum chamfer dimension r
2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.



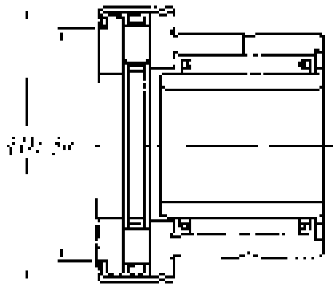
Basic load ratings dynamic (N) C_a	Basic load ratings static (N) C_{oa}	Basic load ratings dynamic (kgf) C_a	Basic load ratings static (kgf) C_{oa}	Limiting dimensions min^{-1} grease	Limiting dimensions min^{-1} oil	Bearing numbers Type NKXR	Bearing numbers Type NKXR··Z	Abutment dimensions mm d_a min	Abutment dimensions mm r_{as}[2)] max	Mass (approx.) kg Type NKXR	Mass (approx.) kg Type NKXR··Z
Axial											
12 200	26 800	1 250	2 730	2 800	11 000	**NKXR15T2**	**NKXR15T2Z**	25	0.3	0.048	0.052
12 700	29 000	1 300	2 960	2 500	10 000	**NKXR17T2**	**NKXR17T2Z**	27	0.3	0.050	0.053
20 200	46 500	2 060	4 700	2 100	8 500	**NKXR20T2**	**NKXR20T2Z**	32	0.3	0.090	0.095
27 300	68 000	2 790	6 900	1 800	7 000	**NKXR25T2**	**NKXR25T2Z**	39	0.6	0.128	0.135
27 800	72 500	2 840	7 400	1 500	6 000	**NKXR30T2**	**NKXR30T2Z**	44	0.6	0.162	0.169
31 000	87 000	3 150	8 900	1 400	5 500	**NKXR35T2**	**NKXR35T2Z**	49	0.6	0.184	0.195
43 000	121 000	4 350	12 400	1 200	4 800	**NKXR40T2**	**NKXR40T2Z**	56	0.6	0.226	0.237
45 500	135 000	4 650	13 800	1 100	4 400	**NKXR45T2**	**NKXR45T2Z**	61	0.6	0.267	0.286
48 500	150 000	4 900	15 300	1 000	4 000	**NKXR50T2**	**NKXR50T2Z**	66	0.6	0.309	0.329

With inner ring

Type NKXR＋IR
Type NKXR··Z＋IR



Type NKXR＋IR
(Open type)

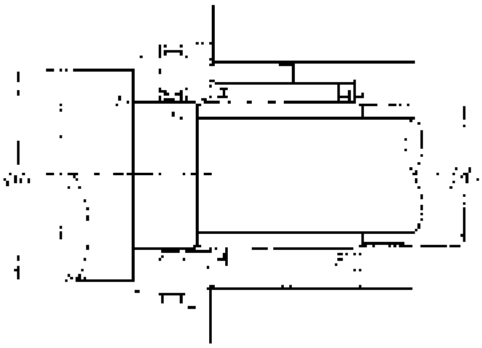


Type NKXR··Z＋IR
(With cover)

d 12～45mm

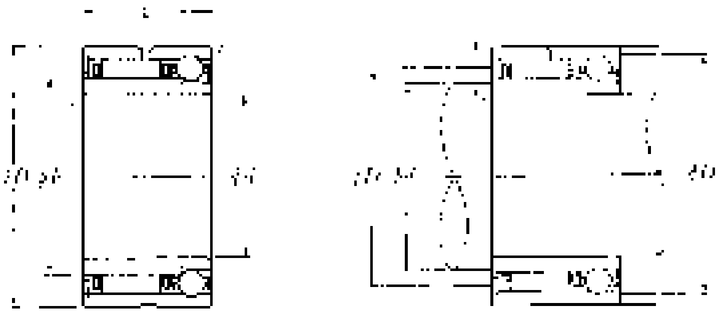
Boundary dimensions (mm)													Basic load ratings, Radial				Basic load ratings, Axial			
													dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	d_w	D	D_1	D_2	B	C (0 / −0.25)	C_1 (0 / −0.20)	C_2	F	a	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}
12	15 +0.050/+0.032	24	28	29	16	23	9	6.5	15	23.7	0.3	0.3	8 250	10 200	840	1 040	12 200	26 800	1 250	2 730
14	17 +0.050/+0.032	26	30	31	17	25	9	8	17	25.7	0.3	0.3	10 400	14 400	1 060	1 460	12 700	29 000	1 300	2 960
17	20 +0.061/+0.040	30	35	36	20	30	10	10.5	20	30.7	0.3	0.3	16 400	27 100	1 670	2 760	20 200	46 500	2 060	4 700
20	25 +0.061/+0.040	37	42	43	20	30	11	9.5	25	37.7	0.6	0.3	14 200	24 000	1 450	2 450	27 300	68 000	2 790	6 900
25	30 +0.061/+0.040	42	47	48	20	30	11	9.5	30	42.7	0.6	0.3	22 300	39 500	2 280	4 000	27 800	72 500	2 840	7 400
30	35 +0.075/+0.050	47	52	53	20	30	12	9	35	47.7	0.6	0.3	20 000	36 000	2 040	3 650	31 000	87 000	3 150	8 900
35	40 +0.075/+0.050	52	60	61	20	32	13	10	40	55.7	0.6	0.3	25 900	52 500	2 650	5 350	43 000	121 000	4 350	12 400
40	45 +0.075/+0.050	58	65	66.5	20	32	14	9	45	60.5	0.6	0.3	27 600	59 000	2 810	6 000	45 500	135 000	4 650	13 800
45	50 +0.075/+0.050	62	70	71.5	25	35	14	10	50	65.5	0.6	0.6	27 900	62 000	2 850	6 300	48 500	150 000	4 900	15 300

Note 1) Allowable minimum chamfer dimension r. 2) Max. allowable dimension of radius r_{as} or r_{1a} for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.



Limiting dimensions min^{-1} grease	oil	Bearing numbers Type NKXR+IR	Type NKXR··Z+IR	Abutment dimensions mm d_a min	d_b min	r_{as}[2)] max	r_{1as}[2)] max	Mass (approx.) kg Type NKXR+IR	Type NKXR··Z+IR
2 800	11 000	NKXR15T2+IR12×15×16	NKXR15T2Z+IR12×15×16	25	14	0.3	0.3	0.056	0.060
2 500	10 000	NKXR17T2+IR14×17×17	NKXR17T2Z+IR14×17×17	27	16	0.3	0.3	0.060	0.063
2 100	8 500	NKXR20T2+IR17×20×20	NKXR20T2Z+IR17×20×20	32	19	0.3	0.3	0.105	0.110
1 800	7 000	NKXR25T2+IR20×25×20	NKXR25T2Z+IR20×25×20	39	22	0.6	0.3	0.155	0.162
1 500	6 000	NKXR30T2+IR25×30×20	NKXR30T2Z+IR25×30×20	44	27	0.6	0.3	0.197	0.202
1 400	5 500	NKXR35T2+IR30×35×20	NKXR35T2Z+IR30×35×20	49	32	0.6	0.3	0.224	0.235
1 200	4 800	NKXR40T2+IR35×40×20	NKXR40T2Z+IR35×40×20	56	37	0.6	0.3	0.270	0.281
1 100	4 400	NKXR45T2+IR40×45×20	NKXR45T2Z+IR40×45×20	61	42	0.6	0.3	0.318	0.337
1 000	4 000	NKXR50T2+IR45×50×25	NKXR50T2Z+IR45×50×25	66	48	0.6	0.6	0.379	0.400

Type NKIA59



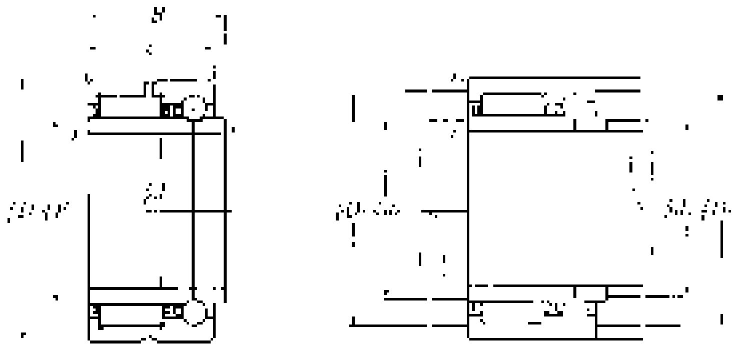
d 15～70mm

Boundary dimensions (mm)					Basic load ratings, Radial: dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Basic load ratings, Axial: dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Limiting dimensions (min^{-1})	
d	D	C	F	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}	grease	oil
15	28	18	20	0.3	9 500	13 400	970	1 370	2 340	3 050	239	310	13 000	20 000
17	30	18	22	0.3	10 100	14 900	1 030	1 520	2 530	3 550	258	360	12 000	18 000
20	37	23	25	0.3	16 500	22 100	1 680	2 250	4 700	6 150	480	625	11 000	16 000
22	39	23	28	0.3	17 500	24 800	1 790	2 530	4 900	6 750	500	690	9 500	14 000
25	42	23	30	0.3	18 600	27 400	1 900	2 790	5 100	7 350	520	750	8 500	13 000
30	47	23	35	0.3	19 400	30 500	1 980	3 100	5 400	8 550	550	870	7 500	11 000
35	55	27	42	0.6	25 700	46 000	2 630	4 700	7 400	12 300	755	1 260	6 500	9 500
40	62	30	48	0.6	31 000	61 000	3 150	6 250	7 750	14 000	790	1 430	5 500	8 500
45	68	30	55	0.6	33 000	69 500	3 350	7 100	8 500	17 100	870	1 740	5 000	7 500
50	72	30	60	0.6	33 500	73 500	3 450	7 500	8 800	18 700	900	1 910	4 300	6 500
55	80	34	63	1	44 500	95 500	4 500	9 700	14 300	33 000	1 460	3 350	4 300	6 500
60	85	34	68	1	45 500	101 000	4 600	10 300	14 800	36 000	1 510	3 650	4 000	6 000
65	90	34	75	1	46 000	106 000	4 700	10 800	15 200	39 000	1 550	4 000	3 700	5 500
70	100	40	80	1	62 500	146 000	6 350	14 900	18 600	47 500	1 890	4 850	3 300	5 000

Note 1) Allowable minimum chamfer dimension r. 2) Max. allowable dimension of radius r_a for corner roundness on shaft/housing.
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.

Bearing numbers	Abutment dimensions mm				Mass kg
	d_a min	D_a max	D_b max	r_{as}[2)] max	(approx.)
NKIA 5902A	17.5	22	25.5	0.3	0.050
NKIA 5903A	19.5	24	27.5	0.3	0.056
NKIA 5904A	22.5	28	34.5	0.3	0.111
NKIA59/22A	24.5	31	36.5	0.3	0.120
NKIA 5905A	27.5	33	39.5	0.3	0.130
NKIA 5906A	32.5	38	44.5	0.3	0.147
NKIA 5907A	40	45	50	0.6	0.243
NKIA 5908A	45	51	57	0.6	0.347
NKIA 5909A	50	58	63	0.6	0.401
NKIA 5910A	55	63	67	0.6	0.410
NKIA 5911A	61	66.5	74	1	0.590
NKIA 5912A	66	71.5	79	1	0.632
NKIA 5913A	71	78.5	84	1	0.708
NKIA 5914A	76	84	94	1	1.05

Type NKIB 59



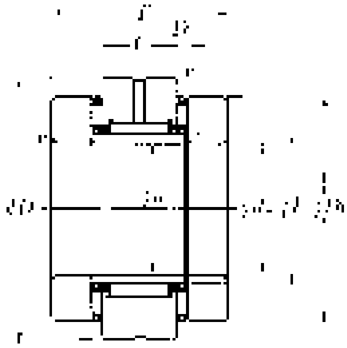
d 15～70mm

Boundary dimensions (mm)						Basic load ratings: Radial				Basic load ratings: Axial				Limiting speeds (min⁻¹)	
						dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	dynamic (N)	static (N)	dynamic (kgf)	static (kgf)		
d	D	B ($^{0}_{-0.3}$)	C	F	$r_{s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}	grease	oil
15	28	20	18	20	0.3	10 800	13 600	1 100	1 390	2 750	4 200	280	430	13 000	20 000
17	30	20	18	22	0.3	11 200	14 600	1 140	1 490	2 960	4 900	300	495	12 000	18 000
20	37	25	23	25	0.3	21 300	25 500	2 170	2 600	4 650	7 400	475	755	11 000	16 000
22	39	25	23	28	0.3	23 200	29 300	2 360	2 990	5 000	8 650	510	880	9 500	14 000
25	42	25	23	30	0.3	24 000	31 500	2 450	3 200	5 150	9 250	525	945	8 500	13 000
30	47	25	23	35	0.3	25 500	35 500	2 600	3 600	5 600	11 200	570	1 140	7 500	11 000
35	55	30	27	42	0.6	32 000	50 000	3 300	5 100	7 050	14 900	720	1 520	6 500	9 500
40	62	34	30	48	0.6	43 500	66 500	4 450	6 800	8 700	19 400	890	1 980	5 500	8 500
45	68	34	30	52	0.6	46 000	73 000	4 700	7 450	9 100	21 400	925	2 180	5 000	7 500
50	72	34	30	58	0.6	48 000	80 000	4 900	8 150	9 600	24 300	980	2 480	4 300	6 500
55	80	38	34	63	1	58 500	99 500	6 000	10 100	11 400	29 400	1 170	3 000	4 300	6 500
60	85	38	34	68	1	61 500	108 000	6 250	11 000	11 800	32 000	1 200	3 250	4 000	6 000
65	90	38	34	72	1	62 500	112 000	6 350	11 400	12 100	34 000	1 240	3 500	3 700	5 500
70	100	45	40	80	1	85 500	156 000	8 750	15 900	15 900	44 500	1 620	4 550	3 300	5 000

Note 1) Allowable minimum chamfer dimension r 2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.
Remarks: 1. This complex can support bi-directional axial load.
2. The ball bearing of this complex bearing is complete with a synthetic resin cage, and the allowable operating temperature shall be 120˚C and, under continuous running, 100˚C or les
3. This bearing type is the imported product from INA, Germany.

Bearing numbers	Abutment dimensions mm			Mass kg
	d_a min	D_a max	r_{as}[2)] max	(approx.)
NKIB 5902R	17.5	25.5	0.3	0.052
NKIB 5903R	19.5	27.5	0.3	0.058
NKIB 5904R	22.5	34.5	0.3	0.107
NKIB59/22R	24.5	36.5	0.3	0.122
NKIB 5905R	27.5	39.5	0.3	0.134
NKIB 5906R	32.5	44.5	0.3	0.151
NKIB 5907R	40	50	0.6	0.247
NKIB 5908R	45	57	0.6	0.320
NKIB 5909R	50	63	0.6	0.380
NKIB 5910R	55	67	0.6	0.385
NKIB 5911R	61	74	1	0.555
NKIB 5912R	66	79	1	0.595
NKIB 5913R	71	84	1	0.640
NKIB 5914R	76	94	1	0.985

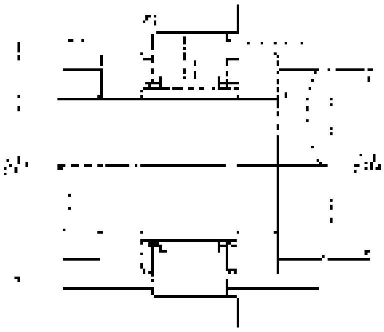
Type AXN



d 20～50mm

Boundary dimensions (mm)										Basic load ratings Radial dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Axial dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	d_w	D	D_1 $^{-0.20}_{-0.50}$	T $^{0}_{-0.370}$	C $^{0}_{-0.130}$	F	D_w	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}
20	20 $^{+0.061}_{+0.040}$	52	42	40	16	25	2	0.6	0.6	15 100	22 400	1 540	2 280	14 600	58 000	1 490	5 900
25	25 $^{+0.061}_{+0.040}$	57	47	44	20	30	2	0.6	0.6	22 100	34 000	2 260	3 500	16 300	69 500	1 660	7 100
30	30 $^{+0.061}_{+0.040}$	62	52	44	20	35	2	0.6	0.6	24 800	41 500	2 520	4 250	17 800	81 500	1 820	8 300
35	35 $^{+0.075}_{+0.050}$	70	60	48	20	40	3	1	0.6	26 400	47 000	2 700	4 800	27 400	110 000	2 790	11 300
40	40 $^{+0.075}_{+0.050}$	75	65	48	20	45	3	1	0.6	28 000	52 500	2 860	5 400	29 800	128 000	3 050	13 100
45	45 $^{+0.075}_{+0.050}$	80	70	54	25	50	3	1	0.6	38 500	74 500	3 950	7 550	31 500	143 000	3 250	14 500
50	50 $^{+0.075}_{+0.050}$	90	78	54	25	55	3	1	0.6	41 000	82 000	4 150	8 400	38 000	186 000	3 850	19 000

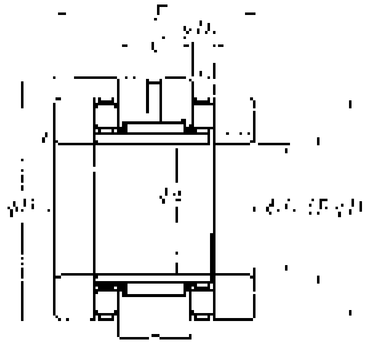
Note 1) Allowable minimum chamfer dimension r or r_1.



Limiting dimensions min⁻¹ grease	oil	Bearing numbers	Radial clearance μm min	max	Abutment dimensions mm d_a min	D_a max	r_{as} 2) max	r_{1as} 2) max	Preload N	kgf	Starting torque 3) N·mm	kgf·mm	Mass kg (approx.)
1 800	7 000	**AXN2052**	10	30	39	46	0.6	0.6	1 300	130	330	33	0.400
1 500	6 000	**AXN2557**	10	30	44	51	0.6	0.6	1 450	145	400	40	0.520
1 400	5 500	**AXN3062**	10	40	50	56	0.6	0.6	1 600	160	550	55	0.590
1 200	4 700	**AXN3570**	10	40	56	64	1	0.6	2 450	245	900	90	0.800
1 100	4 300	**AXN4075**	10	40	62	69	1	0.6	2 650	265	1 050	105	0.890
1 000	3 900	**AXN4580**	10	40	67	74	1	0.6	2 800	280	1 200	120	1.00
900	3 500	**AXN5090**	15	50	75	83	1	0.6	3 400	340	1 600	160	1.42

Note 2) Max. allowable dimension of radius r_{as} for corner roundness on shaft/housing.
3) Starting torque subject to standard preload.

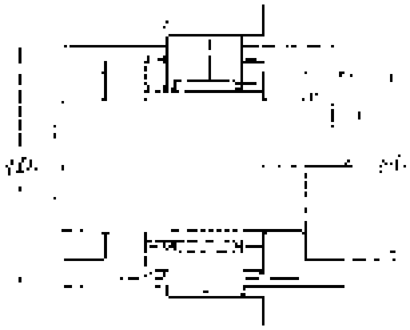
Type ARN



d 20～70mm

Boundary dimensions (mm)										Basic load ratings							
										Radial				Axial			
										dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d	d_w	D	D_1 $^{-0.20}_{-0.50}$	T $^{0}_{-0.370}$	C $^{0}_{-0.130}$	F	D_w	$r_{s\,min}$[1)]	$r_{1s\,min}$[1)]	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}	C_a	C_{oa}
20	20 $^{+0.061}_{+0.040}$	52	42	46	16	25	5	0.6	0.6	15 100	22 400	1 540	2 280	27 300	68 000	2 790	6 900
20	20 $^{+0.061}_{+0.040}$	62	52	60	20	30	7.5	1	0.6	22 100	34 000	2 260	3 500	53 500	129 000	5 450	13 100
25	25 $^{+0.061}_{+0.040}$	57	47	50	20	30	5	0.6	0.6	22 100	34 000	2 260	3 500	27 800	72 500	2 840	7 400
25	25 $^{+0.061}_{+0.040}$	72	62	60	20	35	7.5	1	0.6	24 800	41 500	2 520	4 250	54 500	139 000	5 550	14 200
30	30 $^{+0.061}_{+0.040}$	62	52	50	20	35	5	0.6	0.6	24 800	41 500	2 520	4 250	31 000	87 000	3 150	8 900
30	30 $^{+0.061}_{+0.040}$	80	68	66	20	40	9	1	0.6	26 400	47 000	2 700	4 800	74 500	190 000	7 600	19 400
35	35 $^{+0.075}_{+0.050}$	70	60	54	20	40	6	1	0.6	26 400	47 000	2 700	4 800	43 000	121 000	4 350	12 400
35	35 $^{+0.075}_{+0.050}$	85	73	66	20	45	9	1	0.6	28 000	52 500	2 860	5 400	82 000	222 000	8 350	22 600
40	40 $^{+0.075}_{+0.050}$	75	65	54	20	45	6	1	0.6	28 000	52 500	2 860	5 400	45 500	135 000	4 650	13 800
40	40 $^{+0.075}_{+0.050}$	90	78	75	25	50	9	1	0.6	38 500	74 500	3 950	7 550	85 000	238 000	8 650	24 200
45	45 $^{+0.075}_{+0.050}$	80	70	60	25	50	6	1	0.6	38 500	74 500	3 950	7 550	48 500	150 000	4 900	15 300
45	45 $^{+0.075}_{+0.050}$	105	90	82	25	55	11	1	0.6	41 000	82 000	4 150	8 400	121 000	340 000	12 300	34 500
50	50 $^{+0.075}_{+0.050}$	90	78	60	25	55	6	1	0.6	41 000	82 000	4 150	8 400	62 500	215 000	6 350	21 900
50	50 $^{+0.075}_{+0.050}$	110	95	82	25	60	11	1.1	0.6	41 000	85 000	4 200	8 700	125 000	365 000	12 800	37 000
55	55 $^{+0.090}_{+0.060}$	115	100	82	25	65	11	1.1	0.6	45 000	98 000	4 550	10 000	130 000	385 000	13 200	39 500
60	60 $^{+0.090}_{+0.060}$	120	105	82	25	70	11	1.1	0.6	45 000	91 500	4 600	9 350	134 000	410 000	13 700	42 000
65	65 $^{+0.090}_{+0.060}$	125	110	82	25	75	11	1.1	0.6	55 000	104 000	5 600	10 600	138 000	435 000	14 100	44 500
70	70 $^{+0.090}_{+0.060}$	130	115	82	25	80	11	1.1	0.6	57 000	119 000	5 800	12 200	142 000	460 000	14 500	47 000

Note 1) Allowable minimum chamfer dimension r or r_1.



Limiting dimensions min⁻¹ grease	oil	Bearing numbers	Radial clearance μm min	max	Abutment dimensions mm d_a min	D_a max	r_{as} [2] max	r_{1as} [2] max	Preload N	kgf	Starting torque[3] N·mm	kgf·mm	Mass kg (approx.)
1 800	7 000	ARN2052T2	10	30	39	46	0.6	0.6	2 500	250	430	43	0.440
1 500	6 000	ARN2062	10	30	48	56	1	0.6	4 950	495	1 150	115	0.910
1 500	6 000	ARN2557T2	10	30	44	51	0.6	0.6	2 600	260	500	50	0.560
1 200	4 900	ARN2572	10	40	56	66	1	0.6	5 050	505	1 400	140	1.22
1 400	5 500	ARN3062T2	10	40	49	56	0.6	0.6	2 900	290	650	65	0.630
1 100	4 400	ARN3080	10	40	63	73	1	0.6	6 900	690	2 100	210	1.54
1 200	4 800	ARN3570T2	10	40	56	64	1	0.6	3 950	395	1 050	105	0.850
1 000	4 100	ARN3585	10	40	68	77	1	0.6	7 600	760	2 500	250	1.67
1 100	4 400	ARN4075T2	10	40	61	69	1	0.6	4 200	420	1 250	125	0.930
950	3 800	ARN4090	10	40	73	87	1	0.6	7 850	785	2 850	285	2.15
1 000	4 000	ARN4580T2	10	40	66	74	1	0.6	4 450	445	1 550	155	1.16
850	3 300	ARN45105	15	50	83	96	1	0.6	11 200	1 120	4 350	435	3.16
900	3 600	ARN5090	15	50	75	83	1	0.6	5 800	580	2 050	205	1.48
800	3 100	ARN50110	15	50	88	101	1	0.6	11 600	1 160	4 900	490	3.38
750	2 900	ARN55115	15	50	93	106	1	0.6	12 000	1 200	5 500	550	3.61
700	2 700	ARN60120	15	50	98	111	1	0.6	12 400	1 240	6 000	600	3.81
650	2 600	ARN65125	15	50	103	116	1	0.6	12 800	1 280	6 500	650	4.00
650	2 500	ARN70130	15	50	106	121	1	0.6	13 200	1 320	7 000	700	4.25

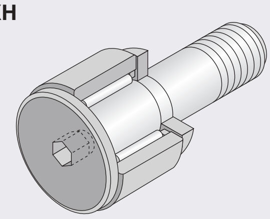
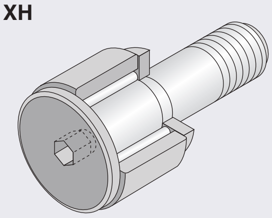
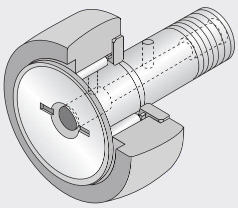
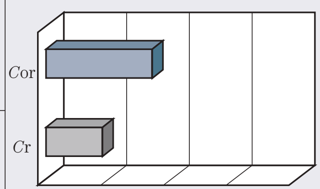
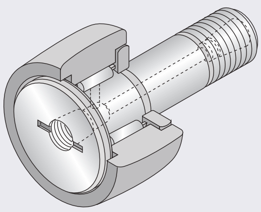
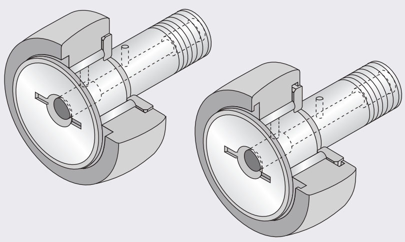
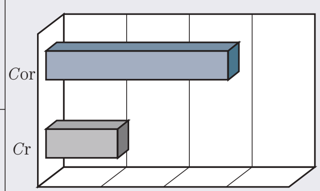
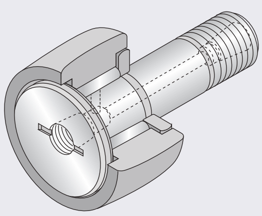
Note 2) Max. allowable dimension of radius for corner roundness on shaft/housing.
3) Starting torque subject to standard preload.

Cam Followers / Roller Followers

Cam Followers (Stud Type Track Roller)

This is a track roller complete with stud instead of inner ring, which is designed to operate with its outer ring rolling on the track. These NTN stud type track rollers are applied to eccentric roller, guide roller, rocker arm roller, etc. similarly to the roller followers. One end of the stud is threaded and the hexagonal nut is used to be mounted easily.

The cam follower types marked with a suffix including "F" are product per new standard specification. They are identically to the conventional products in terms of fitting method and lubrication method, but boast improved functionality through crowned rollers and special heat

Follower type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
KRM··XH 	ϕ1.5—ϕ6	—	**KRM 4 XT2H / 3AS** Suffix X: Cylinder outer diameter T2: Resin cage H: Hexagonal socket 3AS: Grease Dimension code Type code
KRMV··XH 	ϕ1.5—ϕ6		**KRMV 4 XH / 3AS** Suffix X: Cylinder outer diameter H: Hexagonal socket 3AS: Grease Dimension code Type code
KR **CR** 	**KR**: ϕ3—ϕ30 **CR**: ϕ4.826—ϕ22.225	 **KR90**	**KR 16 FD02H / L588** Suffix F: New standard specification D0: w/o oil hole T2: Resin cage H: Hexagonal socket L588: Grease Dimension code Type code
KRT 	ϕ6—ϕ30		**KRT 32 X** Suffix X: Cylinder outer diameter Dimension code Type code
KRV **CRV** 	**KRV**: ϕ3—ϕ30 **CRV**: ϕ4.826—ϕ63.5	 **KRV90**	**KRV 22 FXLLH / 3AS** Suffix F: New standard specification X: Cylinder outer diameter LL: Seal H: Hexagonal socket 3AS: Grease Dimension code Type code
KRVT 	ϕ6—ϕ30		**KRVT 52 XLL / 3AS** Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code

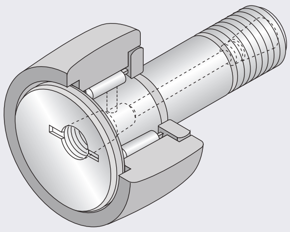
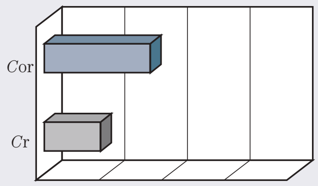
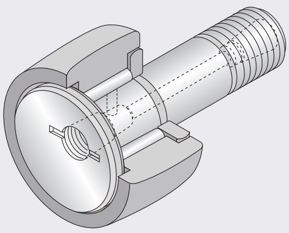
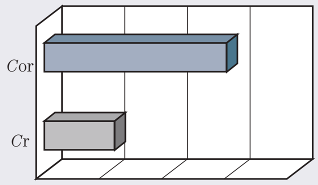
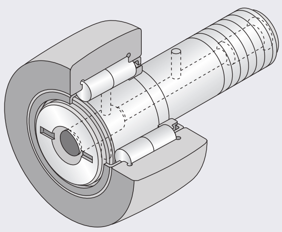
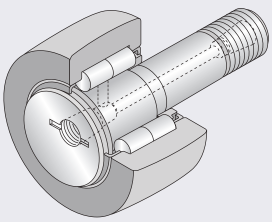
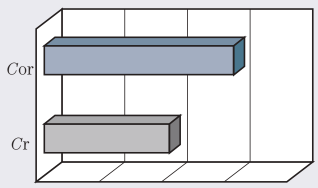
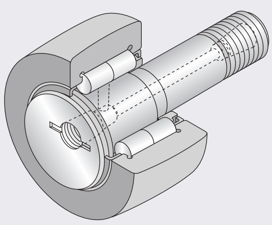
※Each listed load capacity is subject to the reference bearing diameter of ϕ30.

treatment. Note that the cam follower types having a suffix including “F” but lacking an oil hole are prefilled with urea-based high-functionality grease and are identified with a suffix including “DO”.

The outer ring is guided in the axial direction with a flange at the end of stud and the side plate press-fitted to the stud.

The outer ring has a thick wall and both of spherical outer profile and cylindrical outer surface (tail code: **X**) are available for it similarly to the outer ring of the roller follower.

Follower components	Features
Outer ring outer diameter: φ4 With metric series cage Outer profile: Cylindrical Stud head: Hexagonal socket Cage: Resin cage Grease: Prefilled	● Polyamide resin cage (T2 suffix) can operate at temperatures up to 120˚C (100˚C for continuous operation). ● Prelubricated (no relubrication hole)
Outer ring outer diameter: φ4 Metric series full complement roller type Outer profile: Cylindrical Stud head: Hexagonal socket Grease: Prefilled	● Better for heavy loads than KRM··XH type. ● Prelubricated (no relubrication hole)
Outer ring outer diameter: φ16 With metric series cage New standard specification Without oil hole Without seal Outer profile: Spherical Stud head: Hexagonal socket Cage: resin cage Grease: Prefilled	● Standard cage is pressed steel. ● Polyamide resin cage (T2 suffix) is also available. Allowable temperature: 120˚C max. Continuous operating temperature: 100˚C max ● Suited to high speed. ● Due to a high initial grease fill, this type can be used for a long period of time without additional greasing. ● The standard Type KRT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug. ● If there is no grease code, the follower is not prelubricated.
Outer ring outer diameter: φ32 With metric series cage Stud head: with recessed slot for screw-driver use and tapped hole Outer surface profile: Cylindrical Seal: w/o seal Grease: Not prefilled	
Outer ring outer diameter: φ22 Metric series full complement roller type New standard specification Stud head: Hexagonal socket Outer surface profile: Cylindrical Seal: w/ seal Grease: Prefilled	● Suited to high load. ● Lower allowable running speed than caged types. ● Grease replenishing interval must be shortened due to the small internal volume available for grease. ● The standard Type KRVT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.
Outer ring outer diameter: φ52 Metric series full complement roller type Stud head: with recessed slot for screw-driver use and tapped hole Outer surface profile: Cylindrical Seal: w/ seal Grease: Prefilled	

Follower type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
KRU 	ϕ6—ϕ30	 **KRU90**	**KRU 32 LL / 3AS** Suffix LL: seal 3AS: Grease Dimension code Type code
KRVU 	ϕ6—ϕ30	 **KRVU90**	**KRVU 62 X LL / 3AS** Suffix LL: seal 3AS: Grease Suffix X: Cylinder outer diameter Dimension code Type code
NUKR 	ϕ12—ϕ64		**NUKR 80 H / 3AS** Suffix H: with hexagon socket 3AS: Grease Dimension code Type code
NUKRT 	ϕ12—ϕ64	 **NUKR90**	**NUKRT 90 / 3AS** Suffix 3AS: Grease Dimension code Type code
NUKRU 	ϕ12—ϕ64		**NUKRU 140 X / 3AS** Suffix X: Cylinder outer diameter 3AS: Grease Dimension code Dimension code

※Each listed load capacity is subject to the reference bearing diameter of ϕ30.

<table>
<tr><th>Follower components</th><th>Features</th></tr>
<tr><td>Outer ring outer diameter: φ32
Eccentric stud w/ metric series cage
Stud head: with recessed slot for screw-driver use and tapped hole
Outer profile: Spherical
Seal: w/ seal
Grease: Prefilled</td><td rowspan="2">● Unlike Type KRT and KRVT, Type KRU and KRVU have the eccentric stud (eccentricity : 0.25 to 1.0mm) so as to enable to adjust positional variation of the stud mounting hole.
● Certain Type KRU cam followers, which lack a seal and whose suffix does not include grease code, are supplied without prefilled grease.</td></tr>
<tr><td>Outer ring outer diameter: φ62
Eccentric stud, metric series full complement roller type
Stud head: with recessed slot for screw-driver use and tapped hole
Outer profile: Cylindrical
Seal: w/ seal
Grease: Prefilled</td></tr>
<tr><td>Outer ring outer diameter: φ80
Metric series double-row cylindrical roller type
Shielded full-complement roller type
Stud head: Hexagonal socket
Outer profile: Spherical
Grease: Prefilled</td><td rowspan="3">● Highest rated load, best-suited to applications subjected to high load and shock load.
● The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical roller.
● Grease replenishing interval must be shortened due to the small spacing volume.
● Type NUKRU has the eccentric stud (eccentricity: 0.4 to 2.5mm) so as to enable to adjust positional variation of the stud mounting hole.</td></tr>
<tr><td>Outer ring outer diameter φf90
Metric series double-row cylindrical roller type
Shielded full-complement roller type
Stud head: with recessed slot for screw-driver use and tapped hole
Outer profile: Spherical
Grease: Prefilled</td></tr>
<tr><td>Outer ring outer diameter: φ140
Metric series double-row cylindrical roller type
Shielded full-complement roller type stud, eccentric type
Stud head: with recessed slot for screw-driver use and tapped hole
Outer profile: Cylindrical
Grease: Prefilled</td></tr>
</table>

Bearing accuracy

The dimensional accuracy and profile accuracy of cylindrical roller outer diameter (D) and outer ring width (C), and the running accuracy of bearing assy are as shown in **Tables 4.3** and 4.4 of Section 4 "**Bearing Tolerances**" (page A-26) and the accuracy class of each conforms to JIS Class-0. The dimensional accuracy of spherical outer diameter (D) and stud diameter (d_1) are as shown in applicable Dimensions Table.

Bearing fit and radial internal clearance

Table 1 shows the recommended fitting tolerance for the stud mounting hole.

And **Table 2** shows the radial internal clearance.

Table 1 Recommended tolerance

Classification	Tolerance range class for mounting hole
Metric series	H7
Inch series	F7

Note) When shock load acts on, make the stud - hole clearance as less as possible in assembling.

Table 2 Radial internal clearance

Unit : μm

Nominal roller inscribed circle diameter F_w (mm)		Clearance							
		C2		CN (ordinary)		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
—	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

Fitting relations

(1) Make the face height at the cam follower mount greater than "e" dimension given in applicable Dimension Table. (**Fig.1**)
Furthermore, chamfer the stud mounting hole at R as small as possible (around 0.5×45°) and bring the side faces of side face in precise contact.

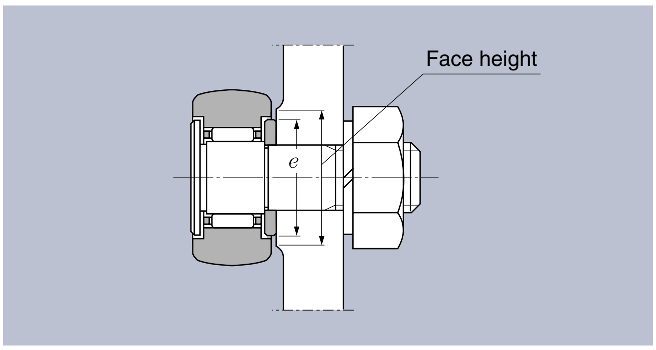


Fig. 1

(2) Don't hammer directly the cam follower rib. Doing so would cause breakdown and rotation failure of the rib.

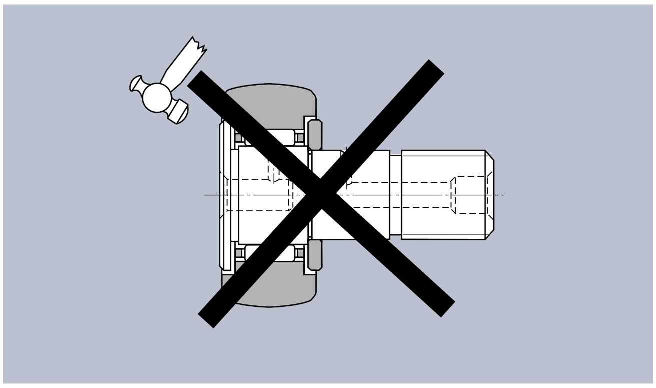


Fig. 2

(3) The oil hole position on the stud raceway surface is shown with **NTN** mark stamped on the stud rib surface. Mount the stud so the oil hole locates within the non-load area (non-load side). (**Fig. 3**) If the oil hole locates within the load area, it would cause shorter life of the follower.(4) Particularly where loose

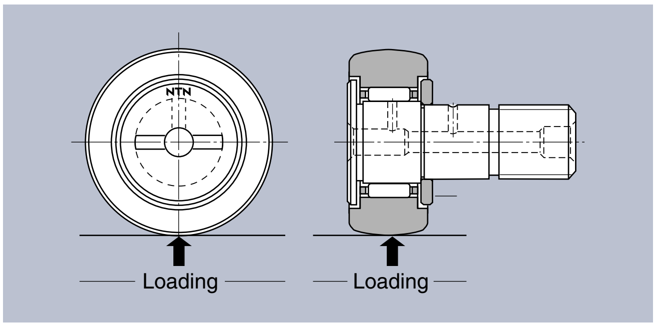


Fig. 3

of the mounting screw is forecast due to wide amplitude vibration during running, the mounting methods as illustrated in **Fig. 4** are available.

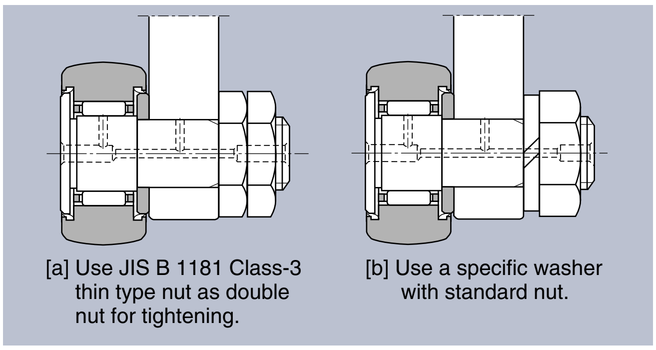


Fig. 4

(5) The stud is subjected to bending stress and tensile force arising from bearing load. Tighten the stud screws with tightening torque which does not exceed the torque value specified in applicable Dimension Table. **Too tight tightening torque could result in rupture of the threaded portion.**

(6) A hole is provided on the stud center at right angle to the shaft axial center, as illustrated in **Fig. 5**. Use this hole for locking or grease replenishment.

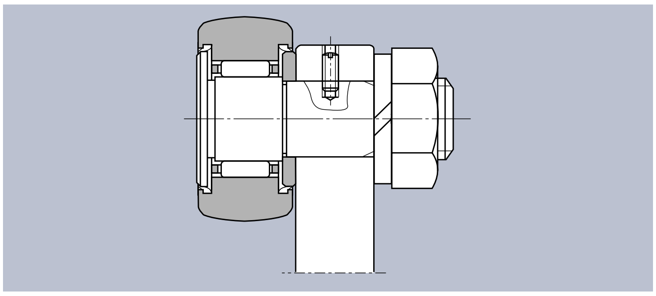


Fig. 5

(7) For mounting and adjusting the eccentric stud type cam follower, follow the sequence given hereunder.

1. Insert the stud into the mounting hole such that the **NTN** mark (oil hole position) is located relative to the load acting direction as shown in **Fig. 3**. Then, lightly tighten the nut. Be sure that the stud remains capable of turning.
2. Fit the tip of flat blade screwdriver into the slot on the stud head or insert an Allen key into the socket of the hexagonal socket head plug (included with the cam follower) fastened into the stud; then turn the stud to adjust the gap between the cam follower to the mating contact surface.
3. After completion of gap adjustment, tighten the nut to the tightening torque listed in the relevant dimension table in order to jam the stud.

Usually, NTN cam followers are each mounted in cantilever configuration: consequently, when used for a prolonged period, fit of a cam follower to a corresponding bearing can get loose, and a non-uniform load (biased load) can eventually act on the bearing. To keep the machinery having NTN cam followers, it is necessary to prevent excessive loosening of the cam followers.

Lubrication and how to feed and replenish grease into the follower

Lubrication

The types having a synthetic rubber seal (suffix LL) and the full complement roller types are prefilled with lithium soap grease (grease code: 3AS), while the new standard specification bearing (w/o oil hole) is prefilled with urea-based high-functionality grease (grease code: L588), thereby these bearing types may be used in a temperature range of -20 to +120˚C or can be continuously used at a temperature of 100°C or lower. When a bearing is always used a temperature of 0˚C or lower, use of a bearing prefilled with cold temperature grease. For more information, contact **NTN** Engineering.

Bearings having a cage, but lacking a seal, do not have prefilled grease. (This description does not apply to bearings whose stud lacks an oil hole.)

If a prefilled grease is needed, feel free to contact **NTN**.

Note that **NTN** offers its unique bearing products prefilled with solid grease: these bearings feature minimized outward leakage of lubricant.

For bearing applications that need to minimize possible release oil mist into the atmosphere, **NTN** will offer bearings prefilled with low dusting grease. For more information, contact **NTN** Engineering.

The outer ring outer surface of bearing and the track surface must both be lubricated. Lack of lubrication for these surfaces can lead to premature bearing failure.

How to feed and replenish grease

Use a tool such as a grease gun to inject grease into a grease nipple installed to the end face of flange or end face of threaded side of the stud. In this case, plug the grease-feed hole or the tapped hole at non-greasing side (with a special-purposed plug or a threaded plug with hexagon socket.)

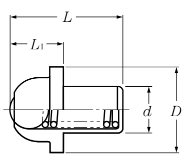
These grease nipple and plug are enclosed in each cam follower package. Screw-in them in specific position before mounting the cam follower.

Special grease nipple and that specified in JIS Standard as applicable are available for use. The dimensions thereof and the applicable bearing types are as specified in **Tables 3** and **4** respectively.

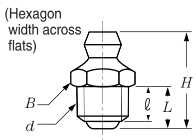
Furthermore, special press-fit type plug and threaded plug with hexagon socket are available for use. The dimensions thereof and the applicable bearing types are as specified in **Tables 5-1**, **2** and **Table 6** respectively.

When using the special-purposed press-fit plug, press-fit it in the grease feed hole using a mandrel of applicable dimension shown in **Table 7**.

Table 3 Grease nipple dimension



Nominal nipple number	Dimension mm d	D	L	L_1
NIP-B3	3	7.5	9	5.5
NIP-B4	4	7.5	10	5.5
NIP-B6	6	8	13	6
NIP-B8	8	10	16	7



Nominal nipple number	Dimension mm d	H	ℓ	L	B
NIP-X30	M4×0.7	13.9	4	5	7
JIS A-M6F	M6×0.75	13.5	4	5.4	7
JIS A-PT1/8	PT1/8	20	8	9.5	10

Table 4 Grease nipple applied bearing types and grease nipple dimension codes

Nominal nipple number	Nipple applied bearing types									
	KR, KRV	KR··H, KRV··H	CR, CRV	CR··H, CRV··H	NUKR	NUKR··H	KRT, KRVT	NUKRT	KRU, KRVU	NUKRU
NIP-B3	—	—			—	—	—	—	—	—
NIP-B4	16~26	22~26			—	—	—	—	—	—
NIP-B6	30~40	30~40	Refer to the accessories field in the relevant dimension table.		30~40	30~40	—	—	—	—
NIP-B8	47~90	47~90			47~90	47~90	—	—	—	—
NIP-X30	—	—			—	—	16~26	—	16~26	—
JIS Type 1 (A-M6F)	—	—			—	—	30~32	30	30~35	30~35
JIS Type 2 (A-PT1/8)	—	—			100~180 (Threaded side)	100~180 (Threaded side)	35~90	35~180	40~90	40~180

Special-purposed plug

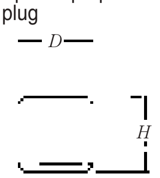


Table 5-1 Plug dimension

unit : mm

Nominal number	D	H
SEN 3	3	3
SEN 4	4	4
SEN 6	6	6
SEN 8	8	8

Threaded plug with hexagon socket

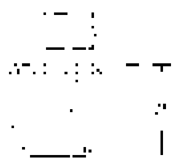


Table 5-2 Plug dimension

unit : mm

Nominal number	d	H	Width across flats h
M4X0.7X4 ℓ	M4X0.7	4	2
M6X0.75X6 ℓ	M6X0.75	6	3
PT1/8X7 ℓ	PT1/8	7	5

Table 6 Plug applied bearing types and plug dimension codes

Plug	Plug applied bearing types									
	KR, KRV	KR··H, KRV··H	CR, CRV	CR··H, CRV··H	NUKR	NUKR··H	KRT, KRVT	NUKRT	KRU, KRVU	NUKRU
SEN3	30~40	30~40			30~40	30~40	—	—	—	—
SEN4	16~26 47~90	22~26 47~90			47~90	47~90	—	—	—	—
SEN6	30~40	30~40	Refer to the accessories field in the relevant dimension table.		30~40	30~40	—	—	—	—
SEN8	47~90	47~90			47~180	47~90	—	—	—	—
M4X0.7X4 ℓ	—	—			—	—	16~26	—	16~26	—
M6X0.75X6 ℓ	—	—			—	—	30~32	30	30~35	30~35
PT1/8X7 ℓ	—	—			—	100~180	35~90	35~180	40~90	40~180

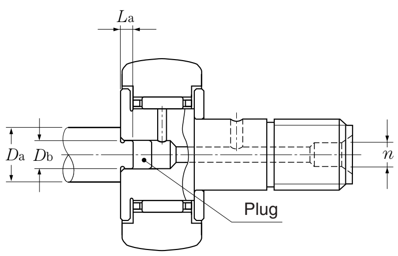


Table 7 Mandrels used for plug press-fitting

unit : mm

Grease feed hole dia. n	Mandrel dimension D_a	D_b $^{0}_{-0.1}$	L_a $^{0}_{-0.1}$
3	8	2.8	1.5
4	10	3.8	1.5
6	12	5.8	1.5
8	15	7.8	2.5

Track load capacity of cam follower and roller follower

The reference hardness (reference tensile stress) was set up from the relationship between the follower hardness and net tensile stress of the material and the track load capacity was determined from the relationship of the setup reference stress to hertz stress.

How to set up the reference hardness (tensile stress) differs a little bit depending on each bearing manufacturer. Herein, the relevant Table appended to "JIS Handbook for Irons and Steels" was used as the hardness - tensile stress relationship.

(Approximate values per Hardness Conversion Table SAE J 417)

For HRC40, σ = 1.245MPa (127kgf/mm^2) was adopted as the reference hardness (tensile stress).

<Track load capacity adjustment factor>

The tensile stress of a material for cam follower is greater with increase in material hardness, and, at the same time, the load capacity of the track will be greater. The resultant track load capacity can be determined by multiplying a track load capacity found in the relevant dimension table by an appropriate track load adjustment factor found in **Table** 8 "Track load adjustment factor". **If the calculated track load capacity exceeds the basic static load rating C_{or} of the cam follower in question, then take C_{or} as the track load capacity of that cam follower.**

Note) The track load capacity determined herein is based on net tensile stress as the reference, not allowable hertz stress. Generally stress (specific stress) resulting in creep of follower material is greater than the tensile stress. Particularly in the case of static load, this track load capacity comes to a safety side value.

[Ex.] Determination of load capacity T_c' of track with certain hardness by use of track load capacity adjustment factor.
Assuming track load capacity described in Dimensions Table as T_c and track load capacity adjustment factor at applicable hardness as G respectively, the track load capacity T_c' can be determined as follows.

$$T_c' = G \cdot T_c$$

For hardness HRC50 at KR35XH,

T_c = 11 900N (1 220kgf), G = 1.987

$\therefore T_c'$ = 1.987 × 11 900N (1 220kgf)

= 23 645N (2 424kgf)

Since the basic static load rating C_{or} of the KR35XH is 17,900 N (1,830 kgf), and, accordingly, $T_c' > C_{or}$, track load capacity is assumed to be the value of C_{or}, that is, 17,900 N (1,830 kgf).

Reference (Track load capacity calculation process)

● For a cylindrical outer ring

$$\sigma_{max} = 190.7 \sqrt{\frac{T_c \Sigma\rho}{B_{eff}}} \quad N$$

$$= 60.9 \sqrt{\frac{T_c \Sigma\rho}{B_{eff}}} \quad kgf$$

● For spherical R outer

$$\sigma_{max} = \frac{856.8}{\mu\nu} \sqrt[3]{(\Sigma\rho)^2 T_c} \quad N$$

$$= \frac{187}{\mu\nu} \sqrt[3]{(\Sigma\rho)^2 T_c} \quad kgf$$

σ_{max} = 1 245MPa (127kgf/mm^2)

T_c : Track load capacity N (kgf)

Σ_ρ : Sum of curvature

B_{eff} : Effective contact length mm
Herein (Outer ring width - chamfer)

$\mu\nu$: Factor being determined by curvature

Table 8 Track load capacity adjustment factor

Hardness HRC	Tensile strength MPa {kgf/mm^2}		Adjustment factor G	
			for cylindrical outer ring	for spherical outer ring
20	755	{77}	0.368	0.223
21	774	{79}	0.387	0.241
22	784	{80}	0.397	0.250
23	804	{82}	0.417	0.269
24	823	{84}	0.437	0.289
25	843	{86}	0.459	0.311
26	862	{88}	0.480	0.333
27	882	{90}	0.502	0.356
28	911	{93}	0.536	0.393
29	931	{95}	0.560	0.419
30	951	{97}	0.583	0.446
31	980	{100}	0.620	0.488
32	1 000	{102}	0.645	0.518
33	1 029	{105}	0.684	0.565
34	1 058	{108}	0.723	0.615
35	1 078	{110}	0.750	0.650
36	1 117	{114}	0.806	0.723
37	1 156	{118}	0.863	0.802
38	1 176	{120}	0.893	0.844
39	1 215	{124}	0.953	0.931
40	1 245	{127}	1.0	1.0
41	1 294	{132}	1.080	1.123
42	1 333	{136}	1.147	1.228
43	1 382	{141}	1.233	1.369
44	1 431	{146}	1.322	1.519
45	1 480	{151}	1.414	1.681
46	1 529	{156}	1.509	1.853
47	1 578	{161}	1.607	2.037
48	1 637	{167}	1.729	2.274
49	1 686	{172}	1.834	2.484
50	1 754	{179}	1.987	2.800
51	1 823	{186}	2.145	3.141
52	1 882	{192}	2.286	3.455
53	1 950	{199}	2.455	3.847
54	2 009	{205}	2.606	4.206
55	2 078	{212}	2.787	4.652

Outer ring strength

Generally any outer ring never breaks down as long as the load acting it is a usual operating load. This paragraph describes hereunder the strength calculation method to be used when the outer ring strength under shock load and heavy load is reviewed.

The outer ring strength can be determined using the formula given hereunder, assuming the respective outer ring profiles as illustrated in **Fig. 6**. In this case, the outer ring rupture strength means the bridged rupture strength of roller.

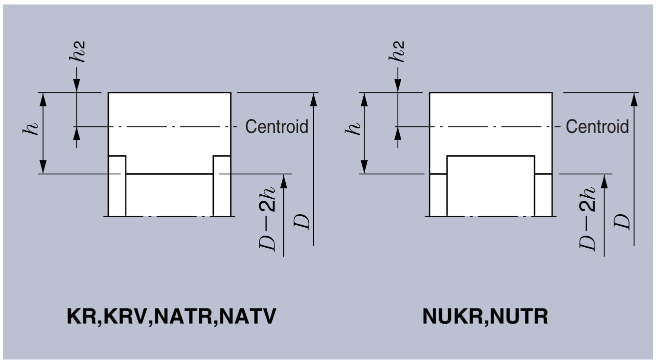


Fig. 6

Regarding how to set up breaking stress, in general 1760MPa [180kg/mm²] can be set up as the breaking stress for bearing steel, but it is desirable to set up the breaking strength with safety-side value (1170MPa [120kgf/mm²]), where stress concentration is taken into account. Generally any outer ring never break down as long as the load acting on it is usual operating load, but it necessary to check the rupture structure of outer ring, where shock load and heavy load act on it.

Incidentally, the stress acting on the outer ring in the bearing in ordinary use should be 196 MPa [20kgf/mm²] or smaller.

$$P=\frac{4\pi}{1+f(\alpha)}\times\frac{D-2h}{h(D-2h^2)^2}\times I\times\sigma$$

Where,

$$f(\alpha)=\frac{(\pi-\alpha)\sin\alpha-(1+\cos\alpha)}{2\cos\alpha}$$

$$\alpha=\frac{\pi}{Z}\ \text{(rad.)}$$

P : Breaking load (N)
I : Secondary moment of outer ring section (mm⁴)
Z : Number of rollers
σ = Breaking stress (MPa)
D, h, h_2 : per **Fig. 6** (mm)

Stud strength

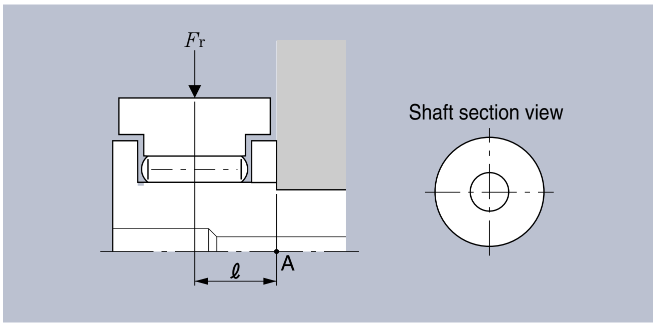


Fig. 7

When load Fr acts on the center point of outer ring as illustrated in **Fig.7**, bending moment $F_r\cdot\ell$ generates and consequently bending stress σ_1 (deemed as tensile stress) acts on the stud surface. In addition to this bending stress, tensile stress σ_2 generates from screw tightening because the stud itself is clamped to machine body with nuts. The stud strength can be reviewed from comparison of the sum ($\sigma_1+\sigma_2$) of these two tensile stresses with allowable stress σ for the stud material.

$$\sigma_1+\sigma_2<\sigma$$

$$\sigma_1=\frac{F_r\cdot\ell}{Z}$$

F_r : Maximum radial load
Z : Coefficient of shaft section through Point-A

$\sigma_2 \fallingdotseq 98$MPa (10kgf/mm²)
Tensile stress generating from maximum tightening torque described in "Dimensions Table"

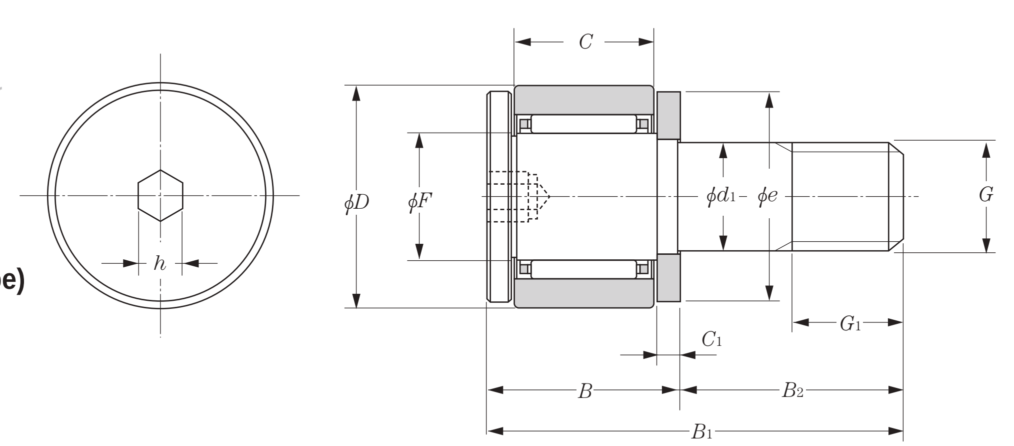
σ : Allowable stress for material
The following values are adopted from the repeated bending test result of the stud material.
Where the stud material is subjected to static bending stress;
σ = 1372MPa (140kgf/mm²)
Where the stud material is subjected to repeated bending stress (single direction)
σ = 784MPa (80kgf/mm²)
Where the stud material is subjected to repeated bending stress (double directions)
σ = 392MPa (40kgf/mm²)

Accordingly,

$$F_r<\frac{Z}{\ell}(\sigma-\sigma_2)$$

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

KRM··XH type
(with cage)
KRMV··XH type
(Full-complement roller type)

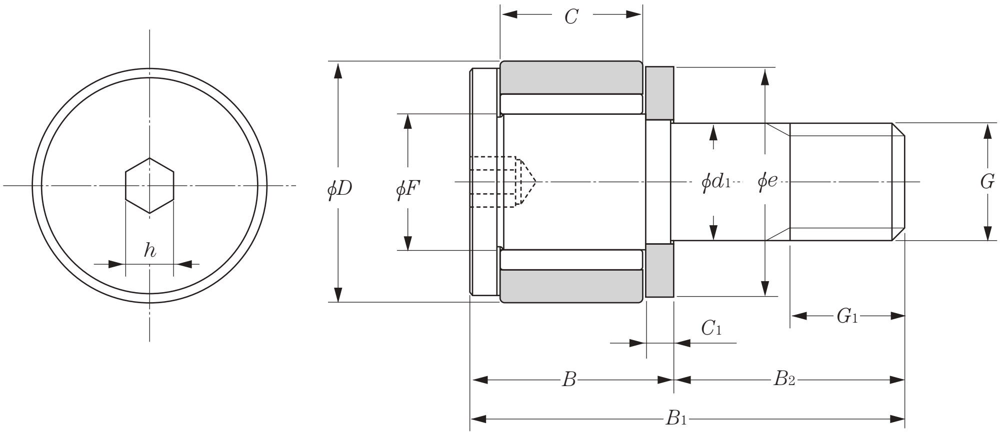


KRM··XH type
(with cage)

D 4～12mm

OD[1)] mm D	Boundary dimensions mm d_1		C	F	B	B_1	B_2	G	G_1	C_1	e	h	Basic load ratings dynamic N C_r	static N C_{or}	dynamic kgf C_r	static kgf C_{or}
4	1.5	0	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9	222	138	23	14
	1.5	−0.006	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9	505	480	51	49
4.5	2	0	2.5	2.25	4	8	4	M2×0.4	2	0.7	4.3	0.9	305	216	31	22
	2	−0.006	2.5	2.25	4	8	4	M2×0.4	2	0.7	4.3	0.9	695	765	71	78
5	2.5	0	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9	445	370	45	37
	2.5	−0.006	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9	905	1 110	92	114
6	3	0	4	3.4	5.5	11.5	6	M3×0.5	3	0.7	5.8	1.3	645	630	66	64
	3	−0.006	4	3.4	5.5	11.5	6	M3×0.5	3	0.7	5.8	1.3	1 280	1 840	130	187
8	4	0	5	4.5	7	15	8	M4×0.7	4	1	7.7	1.5	1 120	1 120	114	114
	4	−0.008	5	4.5	7	15	8	M4×0.7	4	1	7.7	1.5	2 120	3 050	216	310
10	5	0	6	5.9	8	18	10	M5×0.8	5	1	9.6	2	1 570	1 860	160	189
	5	−0.008	6	5.9	8	18	10	M5×0.8	5	1	9.6	2	2 820	4 800	288	490
12	6	0	7	6.7	9.5	21.5	12	M6×1	6	1.2	11.6	2.5	2 160	2 300	220	237
	6	−0.008	7	6.7	9.5	21.5	12	M6×1	6	1.2	11.6	2.5	4 150	6 450	425	655

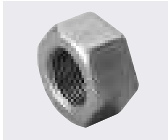
Note: 1. JIS Class 0 is the dimensional tolerance.



KRMV··XH type
(Full-complement roller type)

Accessories

Applicable bearing number	Applicable hexagonal nut
4	1M1.4×0.3
4.5	1M2×0.4
5	1M2.5×0.45
6	1M3×0.5
8	1M4×0.7
10	1M5×0.8
12	1M6×1

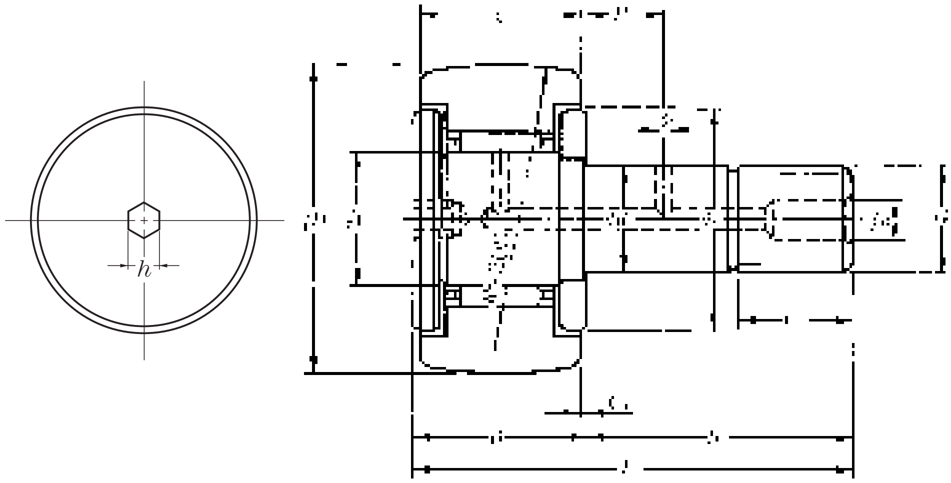


1M6×1

Track load capacity N	Track load capacity kgf	Maximum tightening torque N·m	Maximum tightening torque kgf·m	Bearing numbers with cage	Bearing numbers Full-complement roller type	Mass kg (approx.)	Stud dia. mm d_1
147	15	0.1	0.01	KRM4XT2H/3AS	—	0.0003	1.5
				—	KRMV4XH/3AS	0.0004	
216	22	0.1	0.01	KRM4.5XT2H/3AS	—	0.0005	2
				—	KRMV4.5XH/3AS	0.0006	
294	30	0.3	0.03	KRM5XT2H/3AS	—	0.0007	2.5
				—	KRMV5XH/3AS	0.0009	
480	49	0.5	0.05	KRM6XT2H/3AS	—	0.0013	3
				—	KRMV6XH/3AS	0.0014	
785	80	1	0.1	KRM8XT2H/3AS	—	0.0029	4
				—	KRMV8XH/3AS	0.0030	
1 190	121	2	0.2	KRM10XT2H/3AS	—	0.0055	5
				—	KRMV10XH/3AS	0.0059	
1 640	167	3	0.3	KRM12XT2H/3AS	—	0.0093	6
				—	KRMV12XH/3AS	0.0080	

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

KR··H type
KR··XH type
KR··LLH type
KR··XLLH type

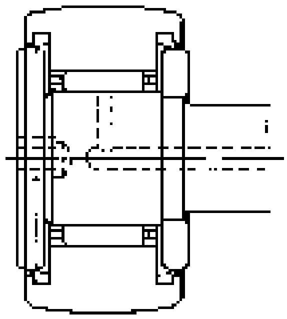


KR··H type
(with cage)

D 10～90mm

OD[1)] mm D $_{-0.05}^{0}$	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load ratings dynamic N kgf C_r	static N kgf C_{or}
10	3 $_{-0.010}^{0}$	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	1 640 168	1 270 130
12	4 $_{-0.012}^{0}$	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	2 170 221	1 690 172
13	5 $_{-0.012}^{0}$	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	2 650 270	2 260 231
16	6 $_{-0.012}^{0}$	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	4 050 415	4 200 430
19	8 $_{-0.015}^{0}$	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	4 750 480	5 400 555
22	10 $_{-0.015}^{0}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300 540	6 650 680
26	10 $_{-0.015}^{0}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300 540	6 650 680
30	12 $_{-0.018}^{0}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850 800	9 650 985
32	12 $_{-0.018}^{0}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850 800	9 650 985
35	16 $_{-0.018}^{0}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	12 200 1 240	17 900 1 830
40	18 $_{-0.018}^{0}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	14 000 1 430	22 800 2 330
47	20 $_{-0.021}^{0}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450
52	20 $_{-0.021}^{0}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450
62	24 $_{-0.021}^{0}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600
72	24 $_{-0.021}^{0}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600
80	30 $_{-0.021}^{0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050
85	30 $_{-0.021}^{0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050
90	30 $_{-0.021}^{0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KR··XH and KR··XLLH types whose outside surface form is cylindrical.



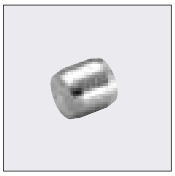
KR··LLH type
(with cage, sealed)

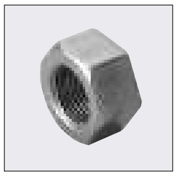
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
10～19	—	—	1M3×0.5～1M8×1.25
22～26	NIP-B4	SEN4	1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


NIP-B6


SEN6

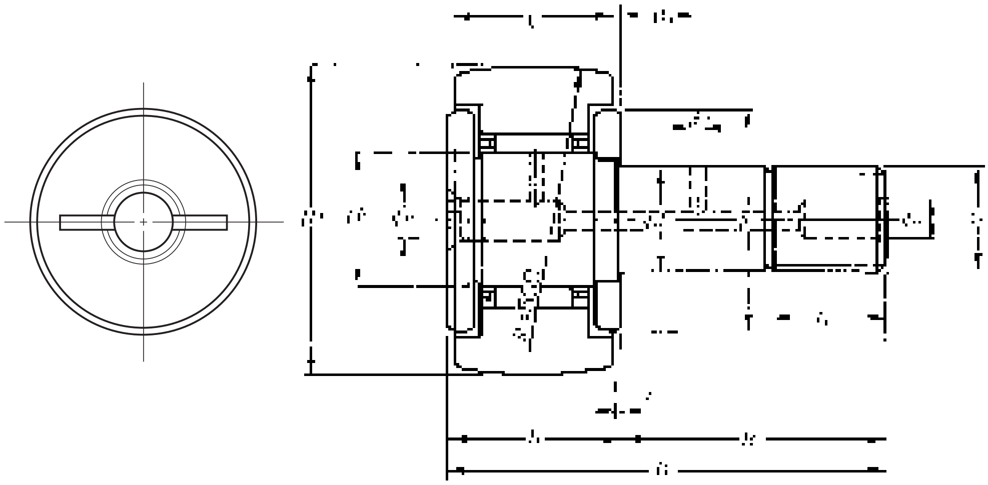

1M12

Track load capacity N kgf		Limiting speed min⁻¹		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
					Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
560 57	1 360 139	※27 000	※40 000	0.5 0.05	KR10T2H/3AS	KR10XT2H/3AS	KR10T2LLH/3AS	KR10XT2LLH/3AS	0.005	3
725 74	1 790 183	※25 000	※36 000	1 0.1	KR12T2H/3AS	KR12XT2H/3AS	KR12T2LLH/3AS	KR12XT2LLH/3AS	0.008	4
805 82	2 220 226	※23 000	※33 000	2 0.2	KR13T2H/3AS	KR13XT2H/3AS	KR13T2LLH/3AS	KR13XT2LLH/3AS	0.010	5
1 080 110	3 400 350	※19 000	※25 000	3 0.3	KR16FDOH/L588	KR16FXDOH/L588	KR16FLLDOH/L588	KR16FXLLDOH/L588	0.019	6
1 380 141	4 050 415	※15 000	※20 000	8 0.8	KR19FDOH/L588	KR19FXDOH/L588	KR19FLLDOH/L588	KR19FXLLDOH/L588	0.031	8
1 690 172	5 150 525	※12 000	※16 000	14 1.4	KR22FH	KR22FXH	KR22FLLH/3AS	KR22FXLLH/3AS	0.046	10
2 120 216	6 100 620	※12 000	※16 000	14 1.4	KR26FH	KR26FXH	KR26FLLH/3AS	KR26FXLLH/3AS	0.059	10
2 620 267	7 700 785	10 000	※13 000	20 2	KR30H	KR30XH	KR30LLH/3AS	KR30XLLH/3AS	0.087	12
2 860 291	8 200 835	10 000	※13 000	20 2	KR32H	KR32XH	KR32LLH/3AS	KR32XLLH/3AS	0.097	12
3 200 325	11 900 1 220	8 000	※11 000	52 5.3	KR35H	KR35XH	KR35LLH/3AS	KR35XLLH/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KR40H	KR40XH	KR40LLH/3AS	KR40XLLH/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KR47H	KR47XH	KR47LLH/3AS	KR47XLLH/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KR52H	KR52XH	KR52LLH/3AS	KR52XLLH/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KR62H	KR62XH	KR62LLH/3AS	KR62XLLH/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KR72H	KR72XH	KR72LLH/3AS	KR72XLLH/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KR80H	KR80XH	KR80LLH/3AS	KR80XLLH/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KR85H	KR85XH	KR85LLH/3AS	KR85XLLH/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KR90H	KR90XH	KR90LLH/3AS	KR90XLLH/3AS	1.95	30

Remarks: 1. The limiting speed of KR··LLH and KR··XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 min⁻¹
2. A bearing number with a T2 suffix indicates a bearing with a resin cage. Its maximum allowable temperature is 120˚C and continuous operation temperature is

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without seal	With seal

KR type
KR··X type
KR··LL type
KR··XLL type

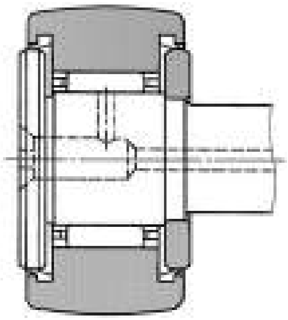


KR type (with cage)

D 16～90mm

OD[1)] mm D $^{0}_{-0.05}$	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	Basic load ratings dynamic (N / kgf) C_r	static (N / kgf) C_{or}
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	4[2)]	—	12	4 050 / 415	4 200 / 430
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	4[2)]	—	14	4 750 / 480	5 400 / 555
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300 / 540	6 650 / 680
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300 / 540	6 650 / 680
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850 / 800	9 650 / 985
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850 / 800	9 650 / 985
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	12 200 / 1 240	17 900 / 1 830
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	14 000 / 1 430	22 800 / 2 330
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700 / 2 110	33 500 / 3 450
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700 / 2 110	33 500 / 3 450
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900 / 2 950	55 000 / 5 600
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900 / 2 950	55 000 / 5 600
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 / 4 600	88 500 / 9 050
85	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 / 4 600	88 500 / 9 050
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 / 4 600	88 500 / 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KR··X and KR··XLL types whose outside surface form is cylindrical.
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



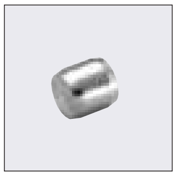
KR··LL type
(with cage, sealed)

Accessories

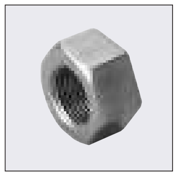
Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
16～26	NIP-B4	SEN4	1M 6×1 ～1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.

NIP-B6



SEN6



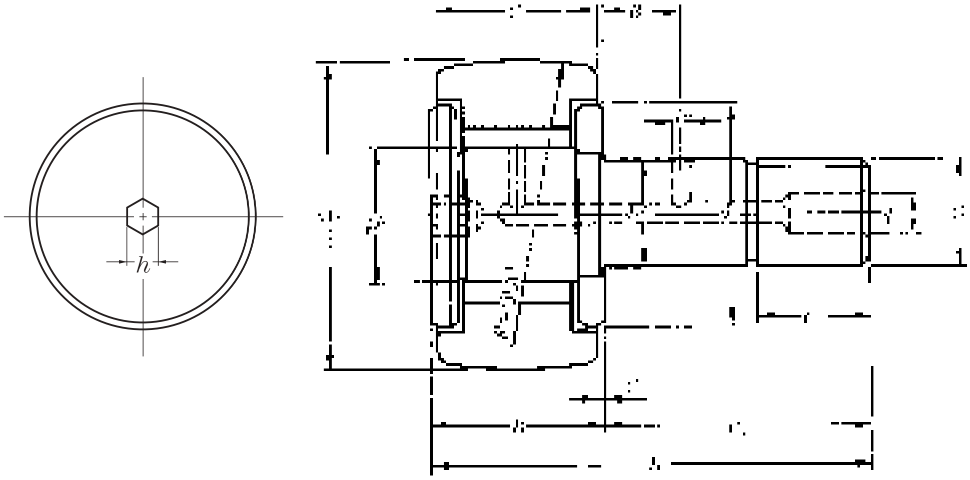
1M12

Track load capacity N / kgf		Limiting speed min^{-1}		Maximum tightening torque N·m / kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
					Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	※19 000	※25 000	3 0.3	**KR16F**	**KR16FX**	**KR16FLL/3AS**	**KR16FXLL/3AS**	0.019	**6**
1 380 141	4 050 415	※15 000	※20 000	8 0.8	**KR19F**	**KR19FX**	**KR19FLL/3AS**	**KR19FXLL/3AS**	0.031	**8**
1 690 172	5 150 525	※12 000	※16 000	14 1.4	**KR22F**	**KR22FX**	**KR22FLL/3AS**	**KR22FXLL/3AS**	0.046	**10**
2 120 216	6 100 620	※12 000	※16 000	14 1.4	**KR26F**	**KR26FX**	**KR26FLL/3AS**	**KR26FXLL/3AS**	0.059	**10**
2 620 267	7 700 785	10 000	※13 000	20 2	**KR30**	**KR30X**	**KR30LL/3AS**	**KR30FXLL/3AS**	0.087	**12**
2 860 291	8 200 835	10 000	※13 000	20 2	**KR32**	**KR32X**	**KR32LL/3AS**	**KR32XLL/3AS**	0.097	**12**
3 200 325	11 900 1 220	8 000	※11 000	52 5.3	**KR35**	**KR35X**	**KR35LL/3AS**	**KR35XLL/3AS**	0.169	**16**
3 850 390	14 500 1 480	7 000	9 000	76 7.8	**KR40**	**KR40X**	**KR40LL/3AS**	**KR40XLL/3AS**	0.248	**18**
4 700 480	21 000 2 150	6 000	8 000	98 10	**KR47**	**KR47X**	**KR47LL/3AS**	**KR47XLL/3AS**	0.386	**20**
5 550 565	23 300 2 370	6 000	8 000	98 10	**KR52**	**KR52X**	**KR52LL/3AS**	**KR52XLL/3AS**	0.461	**20**
6 950 710	34 500 3 500	5 000	6 500	178 18	**KR62**	**KR62X**	**KR62LL/3AS**	**KR62XLL/3AS**	0.790	**24**
8 050 820	38 500 3 900	5 000	6 500	178 18	**KR72**	**KR72X**	**KR72LL/3AS**	**KR72XLL/3AS**	1.04	**24**
9 800 1 000	53 000 5 400	4 000	5 500	360 37	**KR80**	**KR80X**	**KR80LL/3AS**	**KR80XLL/3AS**	1.55	**30**
10 400 1 060	56 000 5 750	4 000	5 500	360 37	**KR85**	**KR85X**	**KR85LL/3AS**	**KR85XLL/3AS**	1.74	**30**
11 400 1 160	59 000 6 100	4 000	5 500	360 37	**KR90**	**KR90X**	**KR90LL/3AS**	**KR90XLL/3AS**	1.95	**30**

Remarks: 1. The limiting speed of KR··LL and KR··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal

KRV··H type
KRV··XH type
KRV··LLH type
KRV··XLLH type

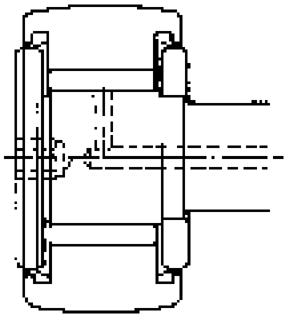


KRV··H type
(Full-complement roller type)

D 10～90mm

OD[1)] mm D 0 −0.05	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load ratings dynamic N kgf C_r	static C_{or}
10	3 $^{0}_{-0.010}$	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	2 500 255	2 610 267
12	4 $^{0}_{-0.012}$	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	3 500 360	3 800 385
13	5 $^{0}_{-0.012}$	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	4 650 475	5 550 570
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	6 500 665	9 350 955
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	7 450 760	11 700 1 190
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200 840	14 000 1 420
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200 840	14 000 1 420
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	17 600 1 790	34 000 3 500
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	19 400 1 980	42 000 4 250
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000 5 900	147 000 15 000
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRV··XH and KRV··XLLH types whose outside surface form is cylindrical.



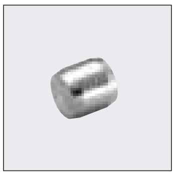
KRV··LLH type
(Full-complement roller type, with seal)

Accessories

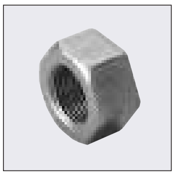
Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
10〜19	—	—	1M3×0.5〜1M8×1.25
22〜26	NIP-B4	SEN4	1M10×1.25
30〜40	NIP-B6	SEN3, SEN6	1M12×1.5〜1M18×1.5
47〜90	NIP-B8	SEN4, SEN8	1M20×1.5〜1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.

NIP-B6



SEN6



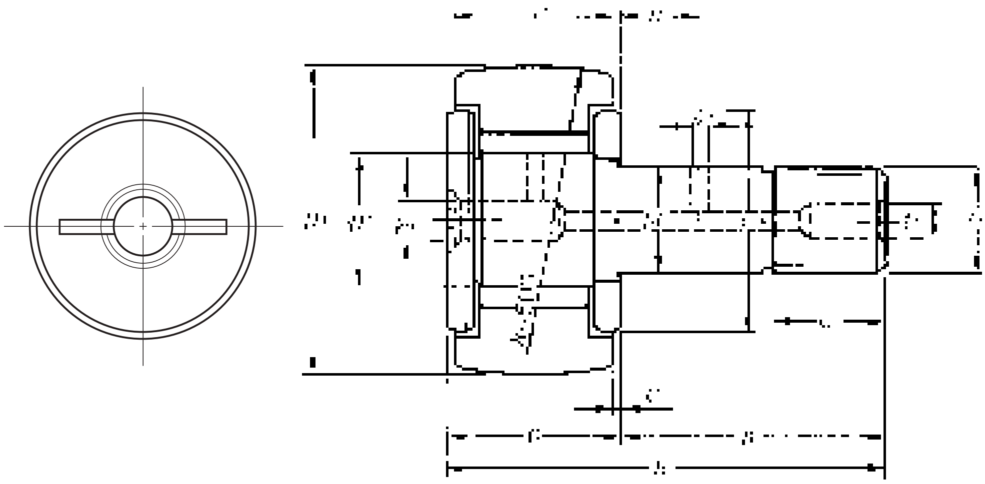
1M12

Track load capacity N kgf: Spherical outer ring	Track load capacity N kgf: Cylindrical outer ring	Limiting speed min⁻¹: Grease lubrication	Limiting speed min⁻¹: Oil lubrication	Maximum tightening torque N·m kgf·m	Cam Follower number, Without seal: Spherical outer rings	Without seal: Cylindrical outer rings	With seal: Spherical outer rings	With seal: Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
560 57	1 360 139	※25 000	※32 000	0.5 0.05	KRV10H/3AS	KRV10XH/3AS	KRV10LLH/3AS	KRV10XLLH/3AS	0.005	3
725 74	1 790 183	※20 000	※27 000	1 0.1	KRV12H/3AS	KRV12XH/3AS	KRV12LLH/3AS	KRV12XLLH/3AS	0.008	4
805 82	2 220 226	※17 000	※22 000	2 0.2	KRV13H/3AS	KRV13XH/3AS	KRV13LLH/3AS	KRV13XLLH/3AS	0.011	5
1 080 110	3 400 350	※13 000	※16 000	3 0.3	KRV16FDOH/L588	KRV16FXDOH/L588	KRV16FLLDOH/L588	KRV16FXLLDOH/L588	0.020	6
1 380 141	4 050 415	10 000	※13 000	8 0.8	KRV19FDOH/L588	KRV19FXDOH/L588	KRV19FLLDOH/L588	KRV19FXLLDOH/L588	0.032	8
1 690 172	5 150 525	8 500	※11 000	14 1.4	KRV22FH/3AS	KRV22FXH/3AS	KRV22FLLH/3AS	KRV22FXLLH/3AS	0.047	10
2 120 216	6 100 620	8 500	※11 000	14 1.4	KRV26FH/3AS	KRV26FXH/3AS	KRV26FLLH/3AS	KRV26FXLLH/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRV30H/3AS	KRV30XH/3AS	KRV30LLH/3AS	KRV30XLLH/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRV32H/3AS	KRV32XH/3AS	KRV32LLH/3AS	KRV32XLLH/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRV35H/3AS	KRV35XH/3AS	KRV35LLH/3AS	KRV35XLLH/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRV40H/3AS	KRV40XH/3AS	KRV40LLH/3AS	KRV40XLLH/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRV47H/3AS	KRV47XH/3AS	KRV47LLH/3AS	KRV47XLLH/3AS	0.392	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRV52H/3AS	KRV52XH/3AS	KRV52LLH/3AS	KRV52XLLH/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRV62H/3AS	KRV62XH/3AS	KRV62LLH/3AS	KRV62XLLH/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRV72H/3AS	KRV72XH/3AS	KRV72LLH/3AS	KRV72XLLH/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRV80H/3AS	KRV80XH/3AS	KRV80LLH/3AS	KRV80XLLH/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRV90H/3AS	KRV90XH/3AS	KRV90LLH/3AS	KRV90XLLH/3AS	1.97	30

Remarks: 1. The limiting speed of KRV··LLH and KRV··XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without seal	With seal

KRV type
KRV··X type
KRV··LL type
KRV··XLL type

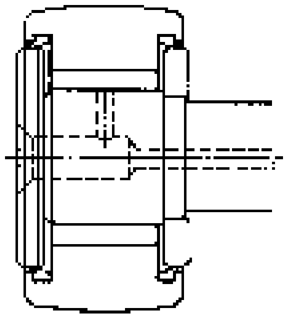


KRV type
(Full-complement roller type)

D 16～90mm

OD[1)] mm D 0 −0.05	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	Basic load ratings dynamic N / kgf C_r	static N / kgf C_{or}
16	$6^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	4[2)]	—	12	6 500 665	9 350 955
19	$8^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	4[2)]	—	14	7 450 760	11 700 1 190
22	$10^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200 840	14 000 1 420
26	$10^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200 840	14 000 1 420
30	$12^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000 1 230	20 300 2 070
32	$12^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000 1 230	20 300 2 070
35	$16^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	17 600 1 790	34 000 3 500
40	$18^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	19 400 1 980	42 000 4 250
47	$20^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800 2 940	61 000 6 250
52	$20^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800 2 940	61 000 6 250
62	$24^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500 4 000	98 500 10 000
72	$24^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500 4 000	98 500 10 000
80	$30^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000 5 900	147 000 15 000
90	$30^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRV··X and KRV··XLL types whose outside surface form is cylindrical.
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).

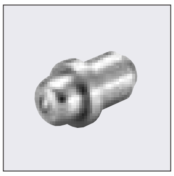


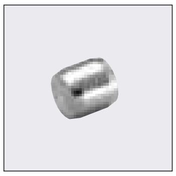
KRV··LL type
(Full-complement roller type, with seal)

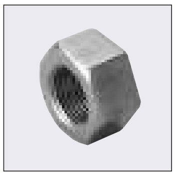
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
16～26	NIP-B4	SEN4	1M 6×1 ～1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


NIP-B6


SEN6

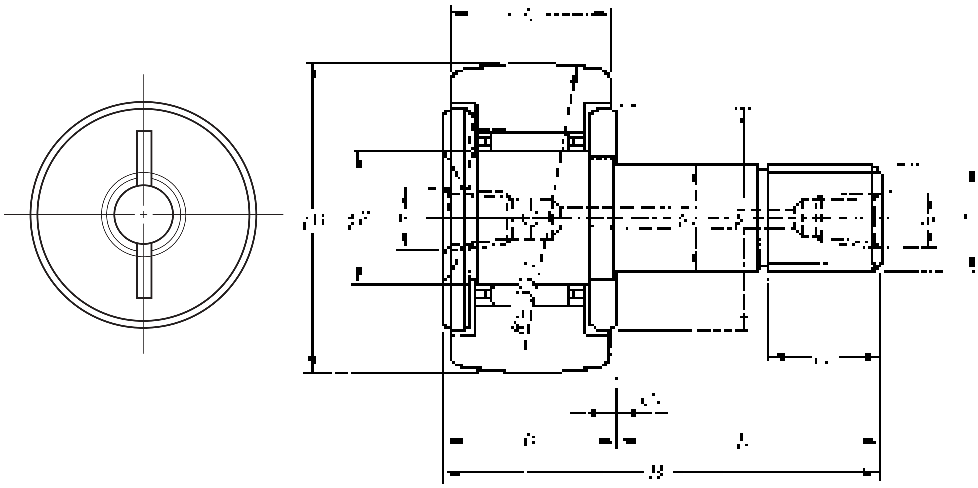

1M12

Track load capacity N / kgf		Limiting speed min^{-1}		Maximum tightening torque N·m / kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Without seal: Spherical outer rings	Without seal: Cylindrical outer rings	With seal: Spherical outer rings	With seal: Cylindrical outer rings		
1 080 110	3 400 350	※13 000	※16 000	3 0.3	KRV16F/3AS	KRV16FX/3AS	KRV16FLL/3AS	KRV16FXLL/3AS	0.020	**6**
1 380 141	4 050 415	10 000	※13 000	8 0.8	KRV19F/3AS	KRV19FX/3AS	KRV19FLL/3AS	KRV19FXLL/3AS	0.032	**8**
1 690 172	5 150 525	8 500	※11 000	14 1.4	KRV22F/3AS	KRV22FX/3AS	KRV22FLL/3AS	KRV22FXLL/3AS	0.047	**10**
2 120 216	6 100 620	8 500	※11 000	14 1.4	KRV26F/3AS	KRV26FX/3AS	KRV26FLL/3AS	KRV26FXLL/3AS	0.061	**10**
2 620 267	7 700 785	6 500	8 500	20 2	KRV30/3AS	KRV30X/3AS	KRV30LL/3AS	KRV30XLL/3AS	0.089	**12**
2 860 291	8 200 835	6 500	8 500	20 2	KRV32/3AS	KRV32X/3AS	KRV32LL/3AS	KRV32XLL/3AS	0.100	**12**
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRV35/3AS	KRV35X/3AS	KRV35LL/3AS	KRV35XLL/3AS	0.172	**16**
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRV40/3AS	KRV40X/3AS	KRV40LL/3AS	KRV40XLL/3AS	0.252	**18**
4 700 480	21 000 2 150	4 000	5 000	98 10	KRV47/3AS	KRV47X/3AS	KRV47LL/3AS	KRV47XLL/3AS	0.390	**20**
5 550 565	23 300 2 370	4 000	5 000	98 10	KRV52/3AS	KRV52X/3AS	KRV52LL/3AS	KRV52XLL/3AS	0.465	**20**
6 950 710	34 500 3 500	3 300	4 500	178 18	KRV62/3AS	KRV62X/3AS	KRV62LL/3AS	KRV62XLL/3AS	0.800	**24**
8 050 820	38 500 3 900	3 300	4 500	178 18	KRV72/3AS	KRV72X/3AS	KRV72LL/3AS	KRV72XLL/3AS	1.05	**24**
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRV80/3AS	KRV80X/3AS	KRV80LL/3AS	KRV80XLL/3AS	1.56	**30**
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRV90/3AS	KRV90X/3AS	KRV90LL/3AS	KRV90XLL/3AS	1.97	**30**

Remarks: 1. The limiting speed of KRV··LL and KRV··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal

KRT type
KRT··X type
KRT··LL type
KRT··XLL type

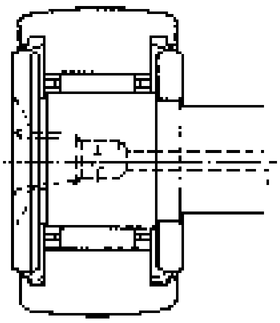


KRT type
(with cage)

D 16～90mm

OD[1)] mm D $^{0}_{-0.05}$	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	Basic load ratings dynamic N / kgf C_r	static N / kgf C_{or}
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	0.6	M4×0.7[2)]	12	4 050 415	4 200 430
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7[2)]	14	4 750 480	5 400 555
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300 540	6 650 680
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300 540	6 650 680
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850 800	9 650 985
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850 800	9 650 985
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	0.8	PT⅛	27	12 200 1 240	17 900 1 830
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	0.8	PT⅛	32	14 000 1 430	22 800 2 330
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT⅛	37	20 700 2 110	33 500 3 450
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT⅛	37	20 700 2 110	33 500 3 450
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT⅛	44	28 900 2 950	55 000 5 600
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT⅛	44	28 900 2 950	55 000 5 600
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	PT⅛	53	45 000 4 600	88 500 9 050
85	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	PT⅛	53	45 000 4 600	88 500 9 050
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	PT⅛	53	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRT··X and KRT··XLL types whose outside surface form is cylindrical.
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



KRT··LL type
(with cage, sealed)

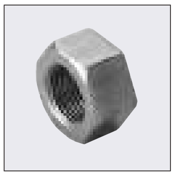
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16～26	NIP-X30	M4×0.7 ×4ℓ	1M 6×1 ～1M10×1.25
30～32	JIS 1 (A-M6F)	M6×0.75×6ℓ	1M12×1.5
35～90	JIS 2 (A-PT$\frac{1}{8}$)	PT$\frac{1}{8}$×7ℓ	1M16×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT$\frac{1}{8}$)


PT$\frac{1}{8}$

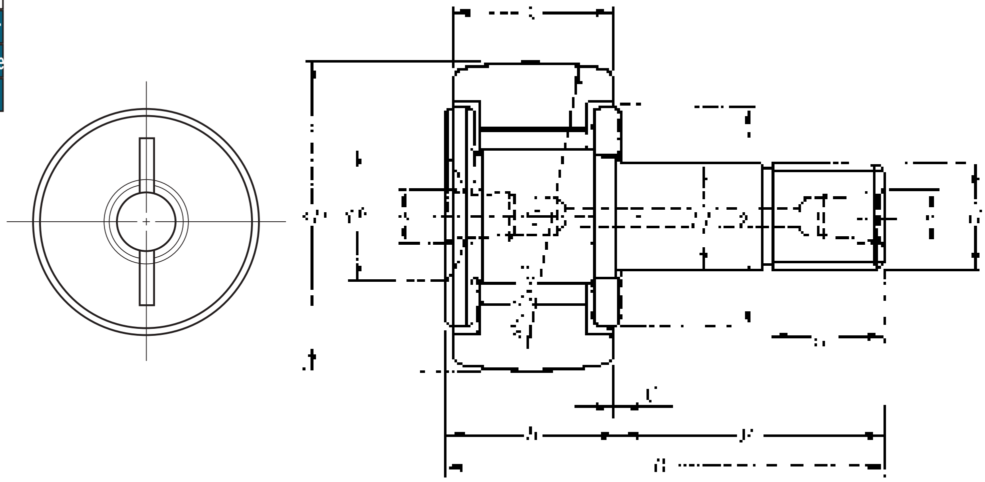

1M12

Track load capacity N / kgf		Limiting speed min^{-1}		Maximum tightening torque N·m / kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
					Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	※19 000	※25 000	3 0.3	KRT16	KRT16X	KRT16LL/3AS	KRT16XLL/3AS	0.019	6
1 380 141	4 050 415	※15 000	※20 000	8 0.8	KRT19	KRT19X	KRT19LL/3AS	KRT19XLL/3AS	0.031	8
1 690 172	5 150 525	※12 000	※16 000	14 1.4	KRT22	KRT22X	KRT22LL/3AS	KRT22XLL/3AS	0.046	10
2 120 216	6 100 620	※12 000	※16 000	14 1.4	KRT26	KRT26X	KRT26LL/3AS	KRT26XLL/3AS	0.059	10
2 620 267	7 700 785	10 000	※13 000	20 2	KRT30	KRT30X	KRT30LL/3AS	KRT30XLL/3AS	0.087	12
2 860 291	8 200 835	10 000	※13 000	20 2	KRT32	KRT32X	KRT32LL/3AS	KRT32XLL/3AS	0.097	12
3 200 325	11 900 1 220	8 000	※11 000	52 5.3	KRT35	KRT35X	KRT35LL/3AS	KRT35XLL/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KRT40	KRT40X	KRT40LL/3AS	KRT40XLL/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KRT47	KRT47X	KRT47LL/3AS	KRT47XLL/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KRT52	KRT52X	KRT52LL/3AS	KRT52XLL/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KRT62	KRT62X	KRT62LL/3AS	KRT62XLL/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KRT72	KRT72X	KRT72LL/3AS	KRT72XLL/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KRT80	KRT80X	KRT80LL/3AS	KRT80XLL/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KRT85	KRT85X	KRT85LL/3AS	KRT85XLL/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KRT90	KRT90X	KRT90LL/3AS	KRT90XLL/3AS	1.95	30

Remarks: 1. The limiting speed of KRT··LL and KRT··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

KRVT type
KRVT··X type
KRVT··LL type
KRVT··XLL type

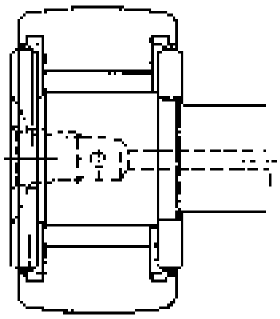


KRVT type
(Full-complement roller type)

D 16～90mm

OD[1)] mm D (0 / −0.05)	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	Basic load ratings dynamic C_r N	static C_{or} N	dynamic C_r kgf	static C_{or} kgf
16	$6_{-0.012}^{0}$	11	8	12	28	16	M6×1	8	0.6	M4×0.7[2)]	12	6 500	9 350	665	955
19	$8_{-0.015}^{0}$	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7[2)]	14	7 450	11 700	760	1 190
22	$10_{-0.015}^{0}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200	14 000	840	1 420
26	$10_{-0.015}^{0}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200	14 000	840	1 420
30	$12_{-0.018}^{0}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000	20 300	1 230	2 070
32	$12_{-0.018}^{0}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000	20 300	1 230	2 070
35	$16_{-0.018}^{0}$	18	18	19.5	52	32.5	M16×1.5	17	0.8	PT1/8	27	17 600	34 000	1 790	3 500
40	$18_{-0.018}^{0}$	20	22	21.5	58	36.5	M18×1.5	19	0.8	PT1/8	32	19 400	42 000	1 980	4 250
47	$20_{-0.021}^{0}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	37	28 800	61 000	2 940	6 250
52	$20_{-0.021}^{0}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	37	28 800	61 000	2 940	6 250
62	$24_{-0.021}^{0}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	44	39 500	98 500	4 000	10 000
72	$24_{-0.021}^{0}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	44	39 500	98 500	4 000	10 000
80	$30_{-0.021}^{0}$	35	38	37	100	63	M30×1.5	32	1	PT1/8	53	58 000	147 000	5 900	15 000
90	$30_{-0.021}^{0}$	35	38	37	100	63	M30×1.5	32	1	PT1/8	53	58 000	147 000	5 900	15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRVT··X and KRVT··XLL types whose outside surface form is cylindrical.
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



KRVT··LL type
(Full-complement roller type, with seal)

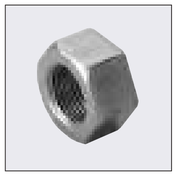
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～32	JIS 1 (A-M6F)	M6×0.75×6 ℓ	1M12×1.5
35～90	JIS 2 (A-PT⅛)	PT⅛×7 ℓ	1M16×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT⅛)


PT⅛

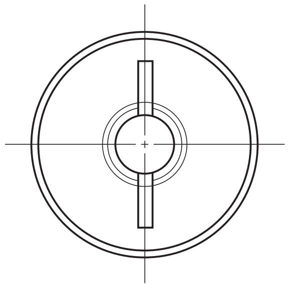

1M12

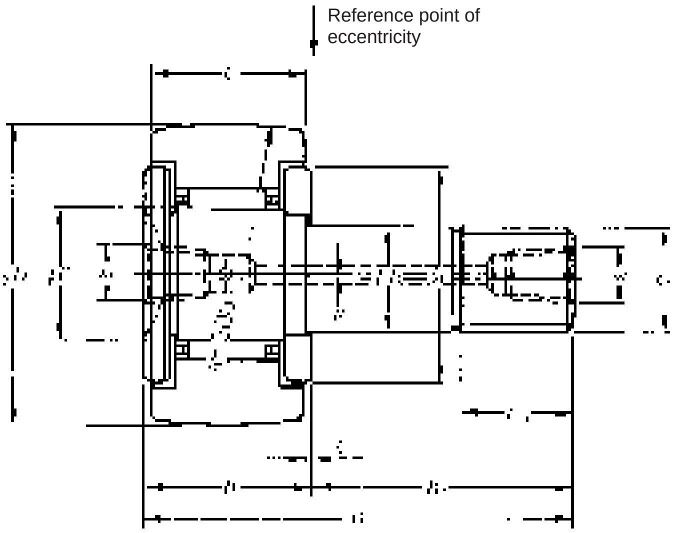
Track load capacity N / kgf: Spherical outer ring	Track load capacity N / kgf: Cylindrical outer ring	Limiting speed min^{-1}: Grease lubrication	Limiting speed min^{-1}: Oil lubrication	Maximum tightening torque N·m / kgf·m	Cam Follower number: Without seal, Spherical outer rings	Without seal, Cylindrical outer rings	With seal, Spherical outer rings	With seal, Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
1 080 110	3 400 350	※13 000	※16 000	3 0.3	KRVT16/3AS	KRVT16X/3AS	KRVT16LL/3AS	KRVT16XLL/3AS	0.020	**6**
1 380 141	4 050 415	10 000	※13 000	8 0.8	KRVT19/3AS	KRVT19X/3AS	KRVT19LL/3AS	KRVT19XLL/3AS	0.032	**8**
1 690 172	5 150 525	8 500	※11 000	14 1.4	KRVT22/3AS	KRVT22X/3AS	KRVT22LL/3AS	KRVT22XLL/3AS	0.047	**10**
2 120 216	6 100 620	8 500	※11 000	14 1.4	KRVT26/3AS	KRVT26X/3AS	KRVT26LL/3AS	KRVT26XLL/3AS	0.061	**10**
2 620 267	7 700 785	6 500	8 500	20 2	KRVT30/3AS	KRVT30X/3AS	KRVT30LL/3AS	KRVT30XLL/3AS	0.089	**12**
2 860 291	8 200 835	6 500	8 500	20 2	KRVT32/3AS	KRVT32X/3AS	KRVT32LL/3AS	KRVT32XLL/3AS	0.100	**12**
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRVT35/3AS	KRVT35X/3AS	KRVT35LL/3AS	KRVT35XLL/3AS	0.172	**16**
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRVT40/3AS	KRVT40X/3AS	KRVT40LL/3AS	KRVT40XLL/3AS	0.252	**18**
4 700 480	21 000 2 150	4 000	5 000	98 10	KRVT47/3AS	KRVT47X/3AS	KRVT47LL/3AS	KRVT47XLL/3AS	0.390	**20**
5 550 565	23 300 2 370	4 000	5 000	98 10	KRVT52/3AS	KRVT52X/3AS	KRVT52LL/3AS	KRVT52XLL/3AS	0.465	**20**
6 950 710	34 500 3 500	3 300	4 500	178 18	KRVT62/3AS	KRVT62X/3AS	KRVT62LL/3AS	KRVT62XLL/3AS	0.800	**24**
8 050 820	38 500 3 900	3 300	4 500	178 18	KRVT72/3AS	KRVT72X/3AS	KRVT72LL/3AS	KRVT72XLL/3AS	1.05	**24**
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRVT80/3AS	KRVT80X/3AS	KRVT80LL/3AS	KRVT80XLL/3AS	1.56	**30**
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRVT90/3AS	KRVT90X/3AS	KRVT90LL/3AS	KRVT90XLL/3AS	1.97	**30**

Remarks: 1. The limiting speed of KRVT··LL and KRVT··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series | Inch series
With cage | Full-complement roller
Hexagonal socket | Tapped hole | Slot for screwdriver
Without seal | With seal
Eccentric stud

KRU type
KRU··X type
KRU··LL type
KRU··XLL type



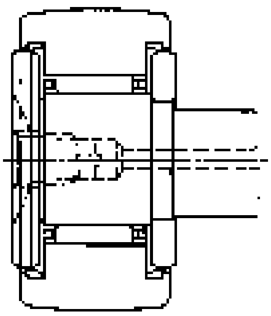


KRU type (with cage)

D 16～90mm

OD[1)] mm *D* 0/−0.05	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	Eccentricity E	C_1	m	e	Basic load ratings dynamic N / kgf C_r	static N / kgf C_{or}
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	0.25	0.6	M4×0.7[2)]	12	4 050 415	4 200 430
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	0.25	0.6	M4×0.7[2)]	14	4 750 480	5 400 555
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	5 300 540	6 650 680
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	5 300 540	6 650 680
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	7 850 800	9 650 985
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	7 850 800	9 650 985
35	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	0.5	0.8	M6×0.75	27	12 500 1 280	18 900 1 930
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	0.6	0.8	PT1/8	32	14 000 1 430	22 800 2 330
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT1/8	37	20 700 2 110	33 500 3 450
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT1/8	37	20 700 2 110	33 500 3 450
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT1/8	44	28 900 2 950	55 000 5 600
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT1/8	44	28 900 2 950	55 000 5 600
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050
85	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRU··X and KRU··XLL types whose outside surface form is cylindrical.
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



KRU··LL type
(with cage)

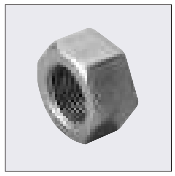
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16~26	NIP-X30	M4×0.7 ×4ℓ	1M 6×1 ~1M10×1.25
30~35	JIS 1 (A-M6F)	M6×0.75×6ℓ	1M12×1.5~1M16×1.5
40~90	JIS 2 (A-PT1/8)	PT1/8×7ℓ	1M18×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT1/8)


PT1/8

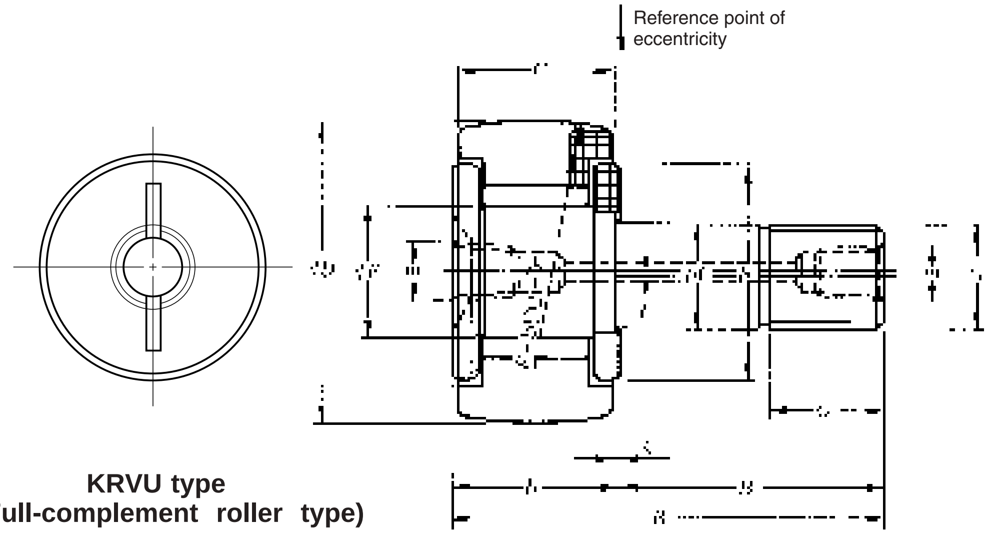

1M12

Track load capacity N kgf		Limiting speed min^{-1}		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
					Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	※19 000	※25000	3 0.3	KRU16	KRU16X	KRU16LL/3AS	KRU16XLL/3AS	0.019	6
1 380 141	4 050 415	※15 000	※20 000	8 0.8	KRU19	KRU19X	KRU19LL/3AS	KRU19XLL/3AS	0.031	8
1 690 172	5 150 525	※12 000	※16 000	14 1.4	KRU22	KRU22X	KRU22LL/3AS	KRU22XLL/3AS	0.046	10
2 120 216	6 100 620	※12 000	※16 000	14 1.4	KRU26	KRU26X	KRU26LL/3AS	KRU26XLL/3AS	0.059	10
2 620 267	7 700 785	10 000	※13 000	20 2	KRU30	KRU30X	KRU30LL/3AS	KRU30XLL/3AS	0.087	12
2 860 291	8 200 835	10 000	※13 000	20 2	KRU32	KRU32X	KRU32LL/3AS	KRU32XLL/3AS	0.097	12
3 200 325	11 900 1 220	8 000	※11 000	52 5.3	KRU35	KRU35X	KRU35LL/3AS	KRU35XLL/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KRU40	KRU40X	KRU40LL/3AS	KRU40XLL/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KRU47	KRU47X	KRU47LL/3AS	KRU47XLL/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KRU52	KRU52X	KRU52LL/3AS	KRU52XLL/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KRU62	KRU62X	KRU62LL/3AS	KRU62XLL/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KRU72	KRU72X	KRU72LL/3AS	KRU72XLL/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KRU80	KRU80X	KRU80LL/3AS	KRU80XLL/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KRU85	KRU85X	KRU85LL/3AS	KRU85XLL/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KRU90	KRU90X	KRU90LL/3AS	KRU90XLL/3AS	1.95	30

Remarks: 1. The limiting speed of KRU··LL and KRU··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without seal	With seal
Eccentric stud	

KRVU type
KRVU··X type
KRVU··LL type
KRVU··XLL type

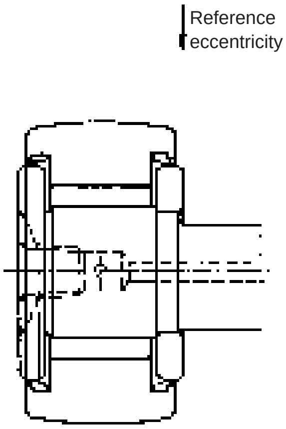


KRVU type
(Full-complement roller type)

D 16～90mm

OD[1)] mm D $^{0}_{-0.05}$	d_1	C	F	B	B_1	B_2	G	G_1	Eccentricity E	C_1	m	e	Basic load ratings dynamic C_r N / kgf	Basic load ratings static C_{or} N / kgf
16	$6\,^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	0.25	0.6	M4×0.7[2)]	12	6 500 665	9 350 955
19	$8\,^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	0.25	0.6	M4×0.7[2)]	14	7 450 760	11 700 1 190
22	$10\,^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	8 200 840	14 000 1 420
26	$10\,^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	8 200 840	14 000 1 420
30	$12\,^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
32	$12\,^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
35	$16\,^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	0.5	0.8	M6×0.75	27	18 000 1 840	36 500 3 700
40	$18\,^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	0.6	0.8	PT1/8	32	19 400 1 980	42 000 4 250
47	$20\,^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT1/8	37	28 800 2 940	61 000 6 250
52	$20\,^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT1/8	37	28 800 2 940	61 000 6 250
62	$24\,^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT1/8	44	39 500 4 000	98 500 10 000
72	$24\,^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT1/8	44	39 500 4 000	98 500 10 000
80	$30\,^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1.0	1	PT1/8	53	58 000 5 900	147 000 15 000
90	$30\,^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1.0	1	PT1/8	53	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRVU··X and KRVU··XLL types whose outside surface form is cylindrical
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



KRVU··LL type
(Full-complement roller type, with seal)

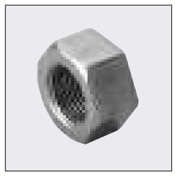
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16～26	NIP-X30	M4×0.7 ×4ℓ	1M 6×1 ～1M10×1.25
30～35	JIS 1 (A-M6F)	M6×0.75×6ℓ	1M12×1.5～1M16×1.5
40～90	JIS 2 (A-PT1/8)	PT1/8×7ℓ	1M18×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT1/8)


PT1/8

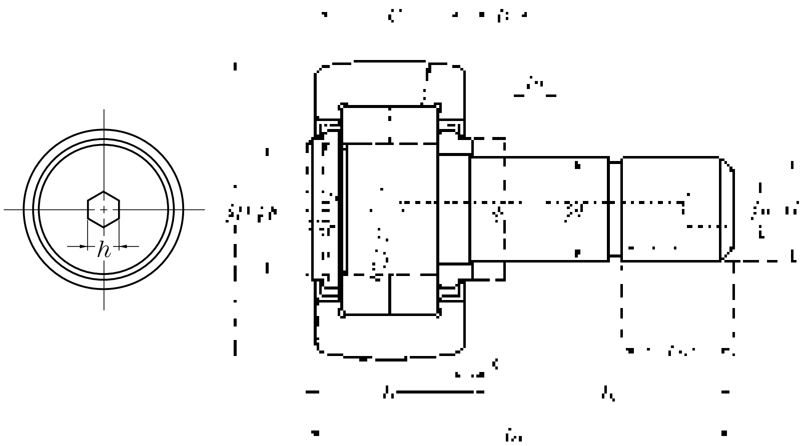

1M12

Track load capacity N / kgf		Limiting speed min^{-1}		Maximum tightening torque N·m / kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Without seal: Spherical outer rings	Without seal: Cylindrical outer rings	With seal: Spherical outer rings	With seal: Cylindrical outer rings		
1 080 110	3 400 350	※13 000	※16 000	3 0.3	KRVU16/3AS	KRVU16X/3AS	KRVU16LL/3AS	KRVU16XLL/3AS	0.020	6
1 380 141	4 050 415	10 000	※13 000	8 0.8	KRVU19/3AS	KRVU19X/3AS	KRVU19LL/3AS	KRVU19XLL/3AS	0.032	8
1 690 172	5 150 525	8 500	※11 000	14 1.4	KRVU22/3AS	KRVU22X/3AS	KRVU22LL/3AS	KRVU22XLL/3AS	0.047	10
2 120 216	6 100 620	8 500	※11 000	14 1.4	KRVU26/3AS	KRVU26X/3AS	KRVU26LL/3AS	KRVU26XLL/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRVU30/3AS	KRVU30X/3AS	KRVU30LL/3AS	KRVU30XLL/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRVU32/3AS	KRVU32X/3AS	KRVU32LL/3AS	KRVU32XLL/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRVU35/3AS	KRVU35X/3AS	KRVU35LL/3AS	KRVU35XLL/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRVU40/3AS	KRVU40X/3AS	KRVU40LL/3AS	KRVU40XLL/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRVU47/3AS	KRVU47X/3AS	KRVU47LL/3AS	KRVU47XLL/3AS	0.390	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRVU52/3AS	KRVU52X/3AS	KRVU52LL/3AS	KRVU52XLL/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRVU62/3AS	KRVU62X/3AS	KRVU62LL/3AS	KRVU62XLL/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRVU72/3AS	KRVU72X/3AS	KRVU72LL/3AS	KRVU72XLL/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRVU80/3AS	KRVU80X/3AS	KRVU80LL/3AS	KRVU80XLL/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRVU90/3AS	KRVU90X/3AS	KRVU90LL/3AS	KRVU90XLL/3AS	1.97	30

Remarks: 1. The limiting speed of KRVU··LL and KRVU··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without shield	With shield	

NUKR··H type
NUKR··XH type

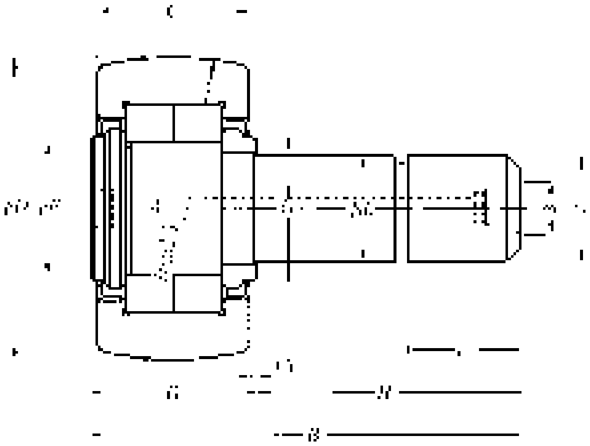


NUKR··H type (D◁100mm)
(Shielded full-complement double-row cylindrical roller type)

D 30～180mm

OD[1)] mm D $^{\ 0}_{-0.05}$	Boundary dimensions mm														
	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	m	a	e	h
30	$12^{\ 0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15	6
35	$16^{\ 0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21	6
40	$18^{\ 0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23	6
47	$20^{\ 0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27	8
52	$20^{\ 0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31	8
62	$24^{\ 0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38	8
72	$24^{\ 0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44	8
80	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8
90	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8
100	$36^{\ 0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	—	PT⅛	—	53	14
120	$42^{\ 0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	—	PT⅛	—	66	14
140	$48^{\ 0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	—	1.5	—	PT⅛	—	72.5	14
150	$52^{\ 0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	—	PT⅛	—	85.5	17
160	$56^{\ 0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	—	2	—	PT⅛	—	89.5	17
170	$60^{\ 0}_{-0.030}$	66	86	70	190	120	M60×3	58	—	2	—	PT⅛	—	96.5	17
180	$64^{\ 0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	—	2	—	PT⅛	—	103.5	17

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KUKR··XH types whose outside surface form is cylindrical.



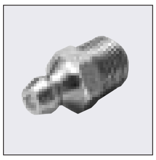
NUKR··H type (D≧100mm)

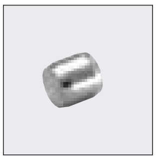
Accessories

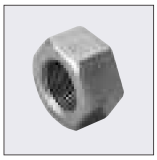
Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5
100～180	JIS 2 (A-PT1/8)	—	M36×1.5～ M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


NIP-B6


JIS 2 (A-PT1/8)

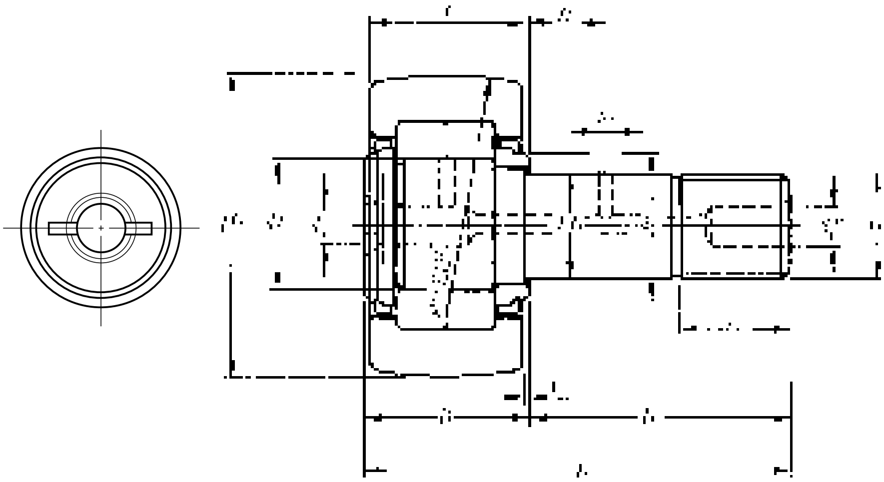

SEN6


1M12

Basic load ratings dynamic C_r N / kgf	Basic load ratings static C_{or} N / kgf	Track load capacity Spherical outer rings N / kgf	Track load capacity Cylindrical outer rings N / kgf	Limiting speed min^{-1} Grease lubrication	Maximum tightening torque N·m / kgf·m	Cam Follower number Spherical outer rings	Cam Follower number Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	NUKR30H/3AS	NUKR30XH/3AS	0.088	12
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	NUKR35H/3AS	NUKR35XH/3AS	0.165	16
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	NUKR40H/3AS	NUKR40XH/3AS	0.242	18
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	NUKR47H/3AS	NUKR47XH/3AS	0.380	20
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	NUKR52H/3AS	NUKR52XH/3AS	0.450	20
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	NUKR62H/3AS	NUKR62XH/3AS	0.795	24
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	NUKR72H/3AS	NUKR72XH/3AS	1.01	24
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	NUKR80H/3AS	NUKR80XH/3AS	1.54	30
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	NUKR90H/3AS	NUKR90XH/3AS	1.96	30
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	NUKR100H/3AS	NUKR100XH/3AS	3.08	36
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	NUKR120H/3AS	NUKR120XH/3AS	5.17	42
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	NUKR140H/3AS	NUKR140XH/3AS	7.98	48
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	NUKR150H/3AS	NUKR150XH/3AS	9.70	52
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	NUKR160H/3AS	NUKR160XH/3AS	11.7	56
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	NUKR170H/3AS	NUKR170XH/3AS	13.9	60
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	NUKR180H/3AS	NUKR180XH/3AS	17.0	64

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without shield	With shield	

NUKR type
NUKR··X type

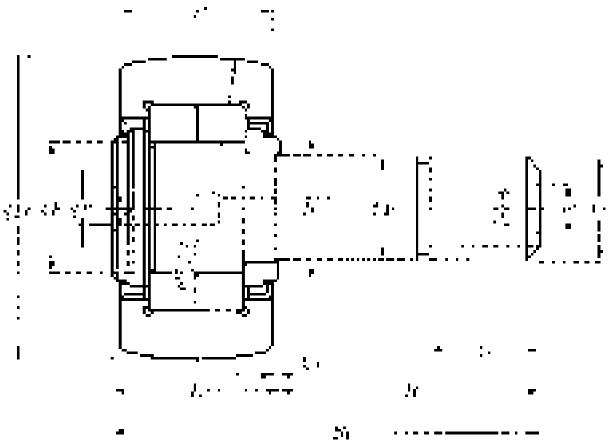


NUKR type (D<100mm)
(Shielded full-complement double-row cylindrical roller type)

D 30～180mm

OD[1] mm D $_{-0.05}^{\ 0}$	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	m	a	e
30	$12\ _{-0.018}^{\ 0}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15
35	$16\ _{-0.018}^{\ 0}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21
40	$18\ _{-0.018}^{\ 0}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23
47	$20\ _{-0.021}^{\ 0}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27
52	$20\ _{-0.021}^{\ 0}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31
62	$24\ _{-0.021}^{\ 0}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38
72	$24\ _{-0.021}^{\ 0}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44
80	$30\ _{-0.021}^{\ 0}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51
90	$30\ _{-0.021}^{\ 0}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51
100	$36\ _{-0.025}^{\ 0}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	8	PT1/8	—	53
120	$42\ _{-0.025}^{\ 0}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	8	PT1/8	—	66
140	$48\ _{-0.025}^{\ 0}$	57	65	60	160	100	M48×1.5	52	—	1.5	8	PT1/8	—	72.5
150	$52\ _{-0.030}^{\ 0}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	8	PT1/8	—	85.5
160	$56\ _{-0.030}^{\ 0}$	63	80.5	67	180	113	M56×3	58	—	2	8	PT1/8	—	89.5
170	$60\ _{-0.030}^{\ 0}$	66	86	70	190	120	M60×3	58	—	2	8	PT1/8	—	96.5
180	$64\ _{-0.030}^{\ 0}$	72	91.5	76	200	124	M64×3	65	—	2	8	PT1/8	—	103.5

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KUKR··X types whose outside surface form is cylindrical.



NUKR type（D≧100mm）

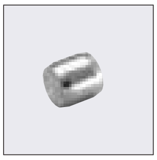
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
30〜40	NIP-B6	SEN3, SEN6	1M12×1.5〜1M18×1.5
47〜90	NIP-B8	SEN4, SEN8	1M20×1.5〜1M30×1.5
100〜180	JIS 2 (A-PT⅛)	SEN8	M36×1.5〜 M64×3

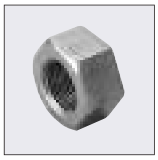
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.

NIP-B6

JIS 2 (A-PT⅛)



SEN6

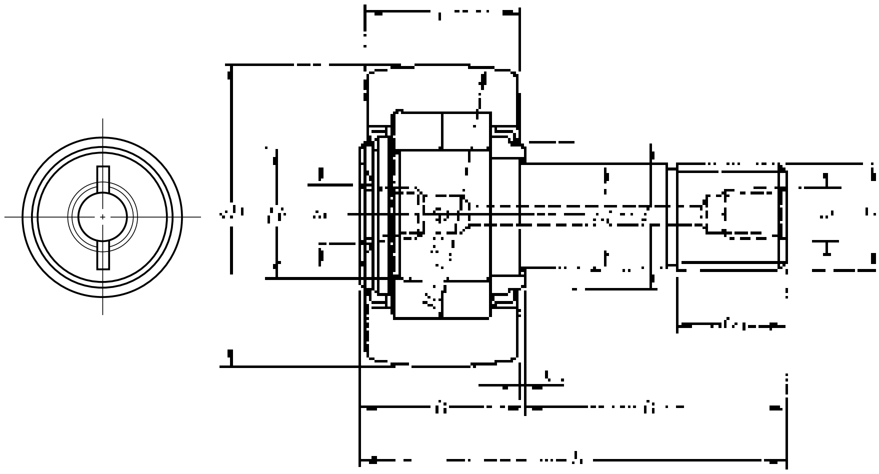


1M12

Basic load ratings dynamic C_r (N / kgf)	Basic load ratings static C_{or} (N / kgf)	Track load capacity Spherical outer rings (N / kgf)	Track load capacity Cylindrical outer rings (N / kgf)	Limiting speed min⁻¹ Grease lubrication	Maximum tightening torque N·m / kgf·m	Cam Follower number Spherical outer rings	Cam Follower number Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	**NUKR 30/3AS**	**NUKR 30X/3AS**	0.088	**12**
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	**NUKR 35/3AS**	**NUKR 35X/3AS**	0.165	**16**
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	**NUKR 40/3AS**	**NUKR 40X/3AS**	0.242	**18**
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	**NUKR 47/3AS**	**NUKR 47X/3AS**	0.380	**20**
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	**NUKR 52/3AS**	**NUKR 52X/3AS**	0.450	**20**
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	**NUKR 62/3AS**	**NUKR 62X/3AS**	0.795	**24**
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	**NUKR 72/3AS**	**NUKR 72X/3AS**	1.01	**24**
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	**NUKR 80/3AS**	**NUKR 80X/3AS**	1.54	**30**
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	**NUKR 90/3AS**	**NUKR 90X/3AS**	1.96	**30**
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	**NUKR 100/3AS**	**NUKR 100X/3AS**	3.08	**36**
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	**NUKR 120/3AS**	**NUKR 120X/3AS**	5.17	**42**
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	**NUKR 140/3AS**	**NUKR 140X/3AS**	7.98	**48**
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	**NUKR 150/3AS**	**NUKR 150X/3AS**	9.70	**52**
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	**NUKR 160/3AS**	**NUKR 160X/3AS**	11.7	**56**
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	**NUKR 170/3AS**	**NUKR 170X/3AS**	13.9	**60**
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	**NUKR 180/3AS**	**NUKR 180X/3AS**	17.0	**64**

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without shield	With shield

NUKRT type
NUKRT··X type



NUKRT type
(Shielded full-complement double-row cylindrical roller type)

D 30～180mm

OD[1)] mm *D* 0 −0.05	Boundary dimensions mm *d*₁		*C*	*F*	*B*	*B*₁	*B*₂	*G*	*G*₁	*C*₁	*m*	*e*	Basic load ratings dynamic N / kgf *C*r	static N / kgf *C*or
30	12	0 / −0.018	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	13 300 / 1 360	13 500 / 1 380
35	16	0 / −0.018	18	19	19.5	52	32.5	M16×1.5	17	0.8	PT1/8	21	22 300 / 2 280	25 700 / 2 620
40	18	0 / −0.018	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT1/8	23	24 100 / 2 450	29 100 / 2 970
47	20	0 / −0.021	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	27	38 500 / 3 950	48 000 / 4 900
52	20	0 / −0.021	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	31	42 500 / 4 350	57 500 / 5 850
62	24	0 / −0.021	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	38	56 500 / 5 750	72 500 / 7 400
72	24	0 / −0.021	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	44	62 000 / 6 350	85 500 / 8 700
80	30	0 / −0.021	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51	101 000 / 10 300	151 000 / 15 400
90	30	0 / −0.021	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51	101 000 / 10 300	151 000 / 15 400
100	36	0 / −0.025	43	48.5	46	120	74	M36×1.5	38	1.5	PT1/8	53	119 000 / 12 100	167 000 / 17 000
120	42	0 / −0.025	50	60.5	53	140	87	M42×1.5	44	1.5	PT1/8	66	172 000 / 17 600	266 000 / 27 100
140	48	0 / −0.025	57	65	60	160	100	M48×1.5	52	1.5	PT1/8	72.5	201 000 / 20 500	294 000 / 30 000
150	52	0 / −0.030	60	75.5	63	170	107	M52×1.5	52	1.5	PT1/8	85.5	258 000 / 26 300	380 000 / 39 000
160	56	0 / −0.030	63	80.5	67	180	113	M56×3	58	2	PT1/8	89.5	274 000 / 27 900	400 000 / 41 000
170	60	0 / −0.030	66	86	70	190	120	M60×3	58	2	PT1/8	96.5	320 000 / 32 500	475 000 / 48 500
180	64	0 / −0.030	72	91.5	76	200	124	M64×3	65	2	PT1/8	103.5	365 000 / 37 500	555 000 / 56 500

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KUKRT··X types whose outside surface form is cylindrical.

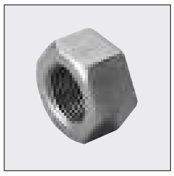
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
30	JIS 1 (A-M6F)	M6×0.75×6 ℓ	1M12×1.5
35～180	JIS 2 (A-PT$\frac{1}{8}$)	PT$\frac{1}{8}$×7 ℓ	1M16×1.5～1M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT$\frac{1}{8}$)

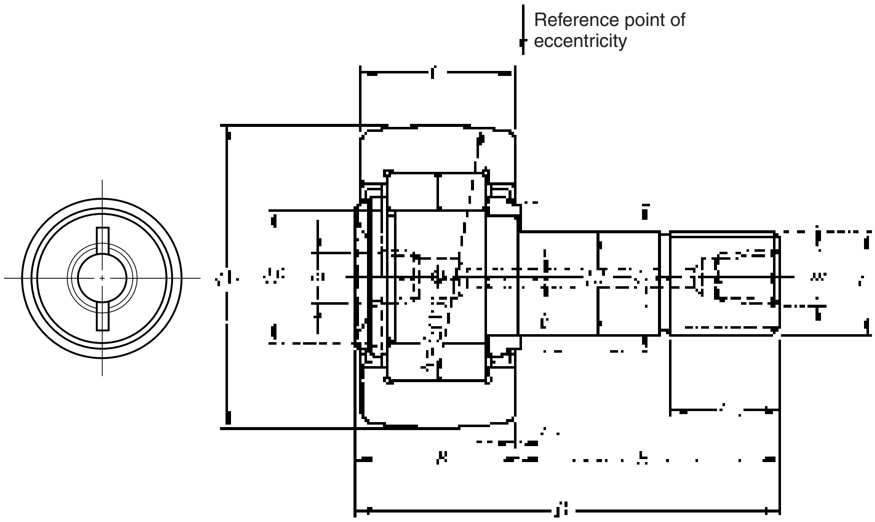

PT$\frac{1}{8}$


1M12

Track load capacity N kgf		Limiting speed min^{-1}	Maximum tightening torque N·m kgf·m	Cam Follower number		Mass kg (approx.)	Stud dia. mm
Spherical outer rings	Cylindrical outer rings	Grease lubrication		Spherical outer rings	Cylindrical outer rings		
2 620 267	7 700 785	6 900	20 2	**NUKRT 30/3AS**	**NUKRT 30X/3AS**	0.088	**12**
3 200 325	11 900 1 220	5 500	52 5.3	**NUKRT 35/3AS**	**NUKRT 35X/3AS**	0.165	**16**
3 850 390	14 500 1 480	4 700	76 7.8	**NUKRT 40/3AS**	**NUKRT 40X/3AS**	0.242	**18**
4 700 480	21 000 2 150	4 000	98 10	**NUKRT 47/3AS**	**NUKRT 47X/3AS**	0.380	**20**
5 550 565	23 300 2 370	3 300	98 10	**NUKRT 52/3AS**	**NUKRT 52X/3AS**	0.450	**20**
6 950 710	34 500 3 500	2 900	178 18	**NUKRT 62/3AS**	**NUKRT 62X/3AS**	0.795	**24**
8 050 820	38 500 3 900	2 400	178 18	**NUKRT 72/3AS**	**NUKRT 72X/3AS**	1.01	**24**
9 800 1 000	53 000 5 400	2 100	360 37	**NUKRT 80/3AS**	**NUKRT 80X/3AS**	1.54	**30**
11 400 1 160	59 000 6 100	2 100	360 37	**NUKRT 90/3AS**	**NUKRT 90X/3AS**	1.96	**30**
13 000 1 300	79 000 8 050	2 000	630 65	**NUKRT 100/3AS**	**NUKRT 100X/3AS**	3.08	**36**
16 400 1 670	113 000 11 500	1 700	1 020 105	**NUKRT 120/3AS**	**NUKRT 120X/3AS**	5.17	**42**
20 000 2 040	152 000 15 500	1 500	1 540 160	**NUKRT 140/3AS**	**NUKRT 140X/3AS**	7.98	**48**
22 000 2 250	173 000 17 600	1 300	1 950 200	**NUKRT 150/3AS**	**NUKRT 150X/3AS**	9.70	**52**
24 000 2 450	194 000 19 800	1 200	2 480 250	**NUKRT 160/3AS**	**NUKRT 160X/3AS**	11.7	**56**
26 000 2 650	218 000 22 200	1 100	3 030 310	**NUKRT 170/3AS**	**NUKRT 170X/3AS**	13.9	**60**
27 900 2 840	253 000 25 800	1 000	3 670 375	**NUKRT 180/3AS**	**NUKRT 180X/3AS**	17.0	**64**

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without shield	With shield	
Eccentric stud		

NUKRU type
NUKRU··X type

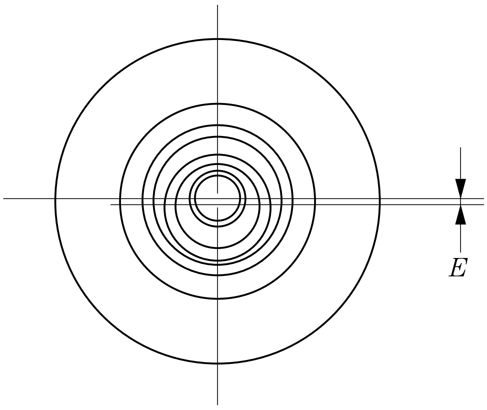


NUKRU type
(Shielded full-complement double-row cylindrical roller type)

D 30～180mm

OD[1)] mm D 0 −0.05	Boundary dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	Eccentricity E	Basic load ratings dynamic N kgf C_r	static N kgf C_{or}
30	12 $^{0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	0.4	13 300 1 360	13 500 1 380
35	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	0.8	M6×0.75	21	0.5	22 300 2 280	25 700 2 620
40	18 $^{0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT1/8	23	0.6	24 100 2 450	29 100 2 970
47	20 $^{0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	27	0.7	38 500 3 950	48 000 4 900
52	20 $^{0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	31	0.7	42 500 4 350	57 500 5 850
62	24 $^{0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	38	0.8	56 500 5 750	72 500 7 400
72	24 $^{0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	44	1.0	62 000 6 350	85 500 8 700
80	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51	1.0	101 000 10 300	151 000 15 400
90	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51	1.0	101 000 10 300	151 000 15 400
100	36 $^{0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	1.5	PT1/8	53	1.5	119 000 12 100	167 000 17 000
120	42 $^{0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	1.5	PT1/8	66	1.5	172 000 17 600	266 000 27 100
140	48 $^{0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	1.5	PT1/8	72.5	2	201 000 20 500	294 000 30 000
150	52 $^{0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	1.5	PT1/8	85.5	2	258 000 26 300	380 000 39 000
160	56 $^{0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	2	PT1/8	89.5	2	274 000 27 900	400 000 41 000
170	60 $^{0}_{-0.030}$	66	86	70	190	120	M60×3	58	2	PT1/8	96.5	2.5	320 000 32 500	475 000 48 500
180	64 $^{0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	2	PT1/8	103.5	2.5	365 000 37 500	555 000 56 500

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KUKRU··X types whose outside surface form is cylindrical.



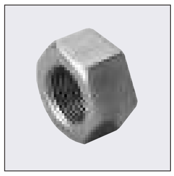
Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
30～35	JIS 1 (A-M6F)	M6×0.75×6 ℓ	1M12×1.5～1M16×1.5
40～180	JIS 2 (A-PT1/8)	PT1/8×7 ℓ	1M18×1.5～1M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


JIS 2 (A-PT1/8)

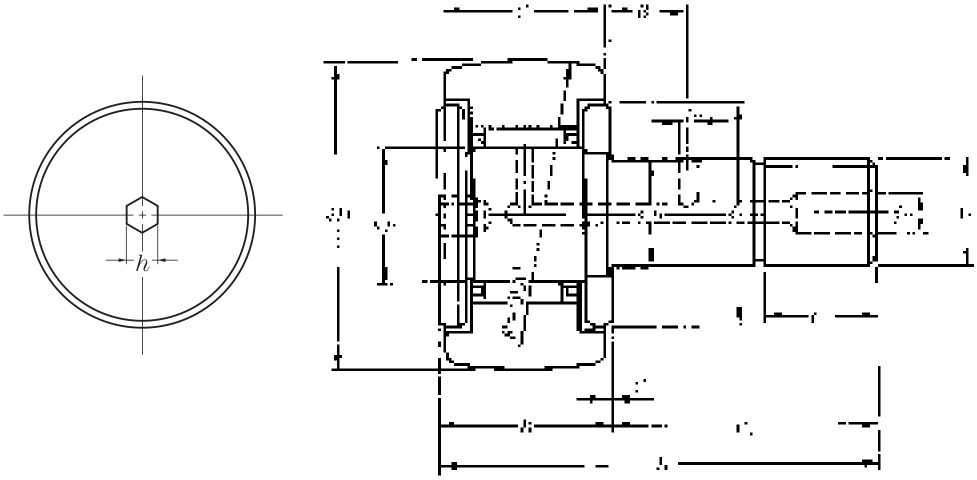

PT1/8


1M12

Track load capacity N kgf Spherical outer rings	Track load capacity N kgf Cylindrical outer rings	Limiting speed min^{-1} Grease lubrication	Maximum tightening torque N·m kgf·m	Cam Follower number Spherical outer rings	Cam Follower number Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
2 620 267	7 700 785	6 900	20 2	**NUKRU 30/3AS**	**NUKRU 30X/3AS**	0.088	**12**
3 200 325	11 900 1 220	5 500	52 5.3	**NUKRU 35/3AS**	**NUKRU 35X/3AS**	0.165	**16**
3 850 390	14 500 1 480	4 700	76 7.8	**NUKRU 40/3AS**	**NUKRU 40X/3AS**	0.242	**18**
4 700 480	21 000 2 150	4 000	98 10	**NUKRU 47/3AS**	**NUKRU 47X/3AS**	0.380	**20**
5 550 565	23 300 2 370	3 300	98 10	**NUKRU 52/3AS**	**NUKRU 52X/3AS**	0.450	**20**
6 950 710	34 500 3 500	2 900	178 18	**NUKRU 62/3AS**	**NUKRU 62X/3AS**	0.795	**24**
8 050 820	38 500 3 900	2 400	178 18	**NUKRU 72/3AS**	**NUKRU 72X/3AS**	1.01	**24**
9 800 1 000	53 000 5 400	2 100	360 37	**NUKRU 80/3AS**	**NUKRU 80X/3AS**	1.54	**30**
11 400 1 160	59 000 6 100	2 100	360 37	**NUKRU 90/3AS**	**NUKRU 90X/3AS**	1.96	**30**
13 000 1 300	79 000 8 050	2 000	630 65	**NUKRU 100/3AS**	**NUKRU 100X/3AS**	3.08	**36**
16 400 1 670	113 000 11 500	1 700	1 020 105	**NUKRU 120/3AS**	**NUKRU 120X/3AS**	5.17	**42**
20 000 2 040	152 000 15 500	1 500	1 540 160	**NUKRU 140/3AS**	**NUKRU 140X/3AS**	7.98	**48**
22 000 2 250	173 000 17 600	1 300	1 950 200	**NUKRU 150/3AS**	**NUKRU 150X/3AS**	9.70	**52**
24 000 2 450	194 000 19 800	1 200	2 480 250	**NUKRU 160/3AS**	**NUKRU 160X/3AS**	11.7	**56**
26 000 2 650	218 000 22 200	1 100	3 030 310	**NUKRU 170/3AS**	**NUKRU 170X/3AS**	13.9	**60**
27 900 2 840	253 000 25 800	1 000	3 670 375	**NUKRU 180/3AS**	**NUKRU 180X/3AS**	17.0	**64**

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

CR··H type
CR··XH type
CR··LLH type
CR··XLLH type

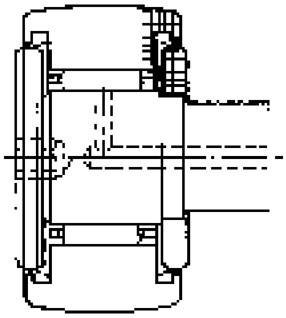


CR··H type (with cage)

D 12.700～57.150mm

OD[1)] mm D 0 −0.05	Boundary dimensions mm d_1 $^{+0.025}_{0}$	C $^{0}_{-0.130}$	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load ratings dynamic N / kgf C_r	static N / kgf C_{or}
12.700 (1/2)	4.762 (3/8)	8.731 (11/32)	6	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	2 820 / 287	2 450 / 250
12.700 (1/2)	4.762 (3/8)	9.525 (3/8)	6	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	2 820 / 287	2 450 / 250
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	4 050 / 415	4 200 / 430
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	4 050 / 415	4 200 / 430
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	3/16	5 300 / 540	6 650 / 680
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	3/16	5 300 / 540	6 650 / 680
25.400 (1)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	1/4	7 250 / 740	8 350 / 850
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	1/4	7 250 / 740	8 350 / 850
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	11 400 / 1 160	15 900 / 1 620
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	11 400 / 1 160	15 900 / 1 620
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	5/16	13 300 / 1 360	20 800 / 2 120
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	5/16	13 300 / 1 360	20 800 / 2 120
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	20 700 / 2 110	33 500 / 3 450
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	20 700 / 2 110	33 500 / 3 450
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	42	7/16	28 900 / 2 950	55 000 / 5 600
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	42	7/16	28 900 / 2 950	55 000 / 5 600

Note 1) $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CR··XH and CR··XLLH types whose outside surface form is cylindric

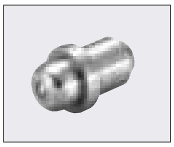


CR··LLH type (with cage, sealed)

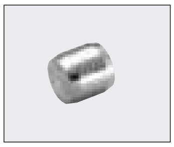
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8,8-1	NIP-B3	SEN3	No. 10-32UNF
10,10-1	NIP-B4	SEN4	1/4-28UNF
12～18	NIP-B4	SEN3. SEN4	3/8-24UNF～7/16-20UNF
20～22	NIP-B6	SEN3. SEN6	1/2-20UNF
24～30	NIP-B6	SEN4. SEN6	5/8-18UNF～3/4-16UNF
32～36	NIP-B6	SEN5. SEN8	7/8-14UNF

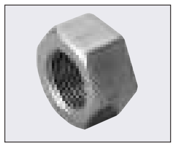
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



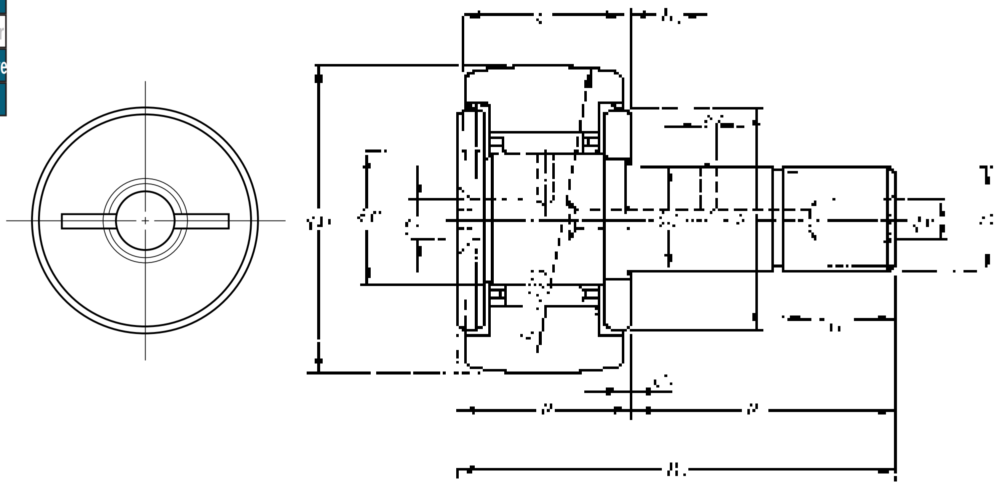
1/2-20UNF

Track load capacity N kgf Spherical outer rings	Track load capacity N kgf Cylindrical outer rings	Limiting speed min^{-1} Grease lubrication	Limiting speed min^{-1} Oil lubrication	Maximum tightening torque N·m kgf·m	Cam Follower number Without seal Spherical outer rings	Without seal Cylindrical outer rings	With seal Spherical outer rings	With seal Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
790 81	2 090 213	20 000	28 000	2 0.2	CR8T2H/3AS	CR8XT2H/3AS	———	———	0.009	**4.762** (3/18)
790 81	2 310 235	20 000	28 000	2 0.2	CR8-1T2H/3AS	CR8-1XT2H/3AS	———	———	0.010	**4.762** (3/18)
1 080 110	3 000 310	18 000	25 000	4 0.4	CR10H/3AS	CR10XH/3AS	———	———	0.020	**6.350** (1/4)
1 080 110	3 300 335	※18 000	※25 000	4 0.4	CR10-1H/3AS	CR10-1XH/3AS	CR10-1LLH/3AS	CR10-1XLLH/3AS	0.022	**6.350** (1/4)
1 380 140	4 600 470	13 000	※16 000	13 1.3	CR12H	CR12XH	CR12LLH/3AS	CR12XLLH/3AS	0.037	**9.525** (3/8)
1 710 174	5 350 545	13 000	※16 000	13 1.3	CR14H	CR14XH	CR14LLH/3AS	CR14XLLH/3AS	0.048	**9.525** (3/8)
2 060 210	7 400 755	12 000	15 000	18 1.9	CR16H	CR16XH	CRV16LLH/3AS	CR16XLLH/3AS	0.087	**11.112** (7/16)
2 430 248	8 350 850	12 000	15 000	18 1.9	CR18H	CR18XH	CR18LLH/3AS	CR18XLLH/3AS	0.100	**11.112** (7/16)
2 840 290	11 400 1 160	9 000	13 000	24 2.4	CR20H	CR20XH	CR20LLH/3AS	CR20XLLH/3AS	0.150	**12.700** (1/2)
3 250 330	12 500 1 280	9 000	13 000	24 2.4	CR22H	CR22XH	CR22LLH/3AS	CR22XLLH/3AS	0.166	**12.700** (1/2)
3 600 365	16 300 1 660	7 500	10 000	51 5.2	CR24H	CR24XH	CR24LLH/3AS	CR24XLLH/3AS	0.225	**15.875** (5/8)
4 050 410	17 600 1 800	7 500	10 000	51 5.2	CR26H	CR26XH	CR26LLH/3AS	CR26XLLH/3AS	0.265	**15.875** (5/8)
4 400 450	21 600 2 200	6 000	8 000	92 9.3	CR28H	CR28XH	CR28LLH/3AS	CR28XLLH/3AS	0.375	**19.050** (3/4)
4 850 495	23 200 2 360	6 000	8 000	92 9.3	CR30H	CR30XH	CR30LLH/3AS	CR30XLLH/3AS	0.420	**19.050** (3/4)
5 300 540	31 000 3 150	5 000	6 600	150 15	CR32H	CR32XH	CR32LLH/3AS	CR32XLLH/3AS	0.505	**22.225** (7/8)
6 200 635	35 000 3 550	5 000	6 600	150 15	CR36H	CR36XH	CR36LLH/3AS	CR36XLLH/3AS	0.750	**22.225** (7/8)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdrive
Without seal	With seal	

CR type
CR··X type
CR··LL type
CR··XLL type

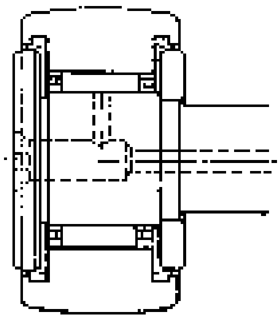


CR type (with cage)

D 12.700～57.150mm

OD[1)] mm *D* 0 −0.05	Boundary dimensions mm													Basic load ratings dynamic C_r N kgf	static C_{or}
12.700 (1/2)	4.762 (3/8)	8.731 (11/32)	6	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	3[2)]	—	10	2 820 287	2 450 250
12.700 (1/2)	4.762 (3/8)	9.525 (3/8)	6	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	3[2)]	—	10	2 820 287	2 450 250
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	4[2)]	—	12.5	4 050 415	4 200 430
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	4[2)]	—	12.5	4 050 415	4 200 430
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680
25.400 (1)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	7 250 740	8 350 850
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	7 250 740	8 350 850
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	13 300 1 360	20 800 2 120
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	13 300 1 360	20 800 2 120
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600

Notes 1) $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter *D* of the outer rings of the CR··X and CR··XLL types whose outside surface form is cylindrical.
2) The grease port is situated only in the front (in the left side face in the diagram above).

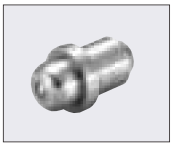


CR··LL type (with cage, sealed)

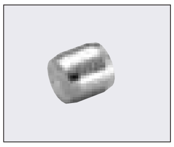
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8,8-1	NIP-B3	SEN3	No. 10-32UNF
10,10-1	NIP-B4	SEN4	1/4-28UNF
12～18	NIP-B4	SEN3. SEN4	3/8-24UNF～7/16-20UNF
20～22	NIP-B6	SEN3. SEN6	1/2-20UNF
24～30	NIP-B6	SEN4. SEN6	5/8-18UNF～3/4-16UNF
32～36	NIP-B6	SEN5. SEN8	7/8-14UNF

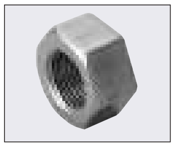
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



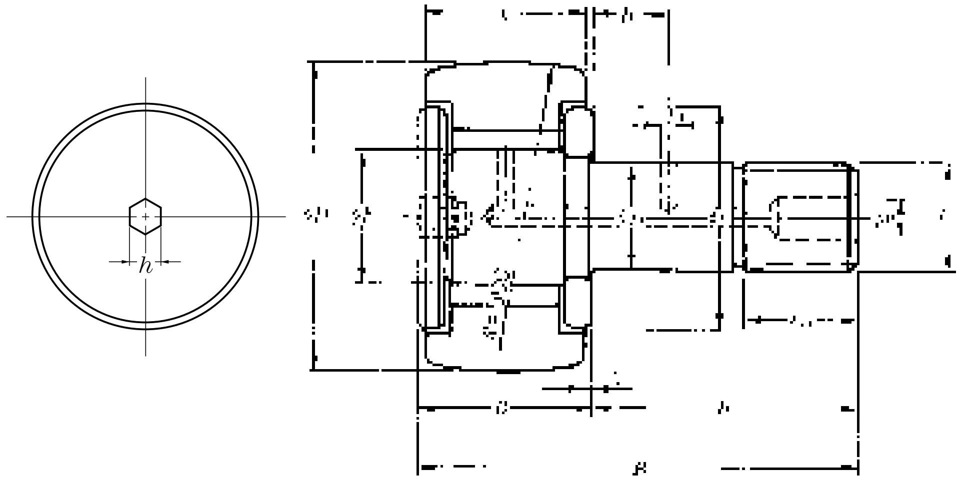
1/2-20UNF

Track load capacity N kgf		Limiting speed min^{-1}		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
					Without seal		With seal			
Spherical outer rings	Cylindrical outer rings	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
790 81	2 090 213	20 000	28 000	2 0.2	**CR8T2**	**CR8XT2**	———	———	0.009	**4.762** (3/18)
790 81	2 310 235	20 000	28 000	2 0.2	**CR8-1T2**	**CR8-1XT2**	———	———	0.010	**4.762** (3/18)
1 080 110	3 000 310	18 000	25 000	4 0.4	**CR10**	**CR10X**	———	———	0.020	**6.350** (1/4)
1 080 110	3 300 335	※18 000	※25 000	4 0.4	**CR10-1**	**CR10-1X**	**CR10-1LL/3AS**	**CR10-1XLL/3AS**	0.022	**6.350** (1/4)
1 380 140	4 600 470	13 000	※16 000	13 1.3	**CR12**	**CR12X**	**CR12LL/3AS**	**CR12XLL/3AS**	0.037	**9.525** (3/8)
1 710 174	5 350 545	13 000	※16 000	13 1.3	**CR14**	**CR14X**	**CR14LL/3AS**	**CR14XLL/3AS**	0.048	**9.525** (3/8)
2 060 210	7 400 755	12 000	15 000	18 1.9	**CR16**	**CR16X**	**CRV16LL/3AS**	**CR16XLL/3AS**	0.087	**11.112** (7/16)
2 430 248	8 350 850	12 000	15 000	18 1.9	**CR18**	**CR18X**	**CR18LL/3AS**	**CR18XLL/3AS**	0.100	**11.112** (7/16)
2 840 290	11 400 1 160	9 000	13 000	24 2.4	**CR20**	**CR20X**	**CR20LL/3AS**	**CR20XLL/3AS**	0.150	**12.700** (1/2)
3 250 330	12 500 1 280	9 000	13 000	24 2.4	**CR22**	**CR22X**	**CR22LL/3AS**	**CR22XLL/3AS**	0.166	**12.700** (1/2)
3 600 365	16 300 1 660	7 500	10 000	51 5.2	**CR24**	**CR24X**	**CR24LL/3AS**	**CR24XLL/3AS**	0.225	**15.875** (5/8)
4 050 410	17 600 1 800	7 500	10 000	51 5.2	**CR26**	**CR26X**	**CR26LL/3AS**	**CR26XLL/3AS**	0.265	**15.875** (5/8)
4 400 450	21 600 2 200	6 000	8 000	92 9.3	**CR28**	**CR28X**	**CR28LL/3AS**	**CR28XLL/3AS**	0.375	**19.050** (3/4)
4 850 495	23 200 2 360	6 000	8 000	92 9.3	**CR30**	**CR30X**	**CR30LL/3AS**	**CR30XLL/3AS**	0.420	**19.050** (3/4)
5 300 540	31 000 3 150	5 000	6 600	150 15	**CR32**	**CR32X**	**CR32LL/3AS**	**CR32XLL/3AS**	0.505	**22.225** (7/8)
6 200 635	35 000 3 550	5 000	6 600	150 15	**CR36**	**CR36X**	**CR36LL/3AS**	**CR36XLL/3AS**	0.750	**22.225** (7/8)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

CRV‥H type
CRV‥XH type
CRV‥LLH type
CRV‥XLLH type

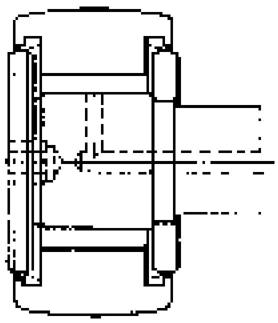


CRV‥H type (Full-complement roller type)

D 12.700～152.400mm

OD[1)] mm D $^{0}_{-0.05}$	d_1 $^{+0.025}_{0}$	C $^{0}_{-0.130}$	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load ratings dynamic C_r N / kgf	static C_{or} N / kgf
12.700 (1/2)	4.826 (—)	8.731 (11/32)	5.75	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	3 400 350	3 750 385
12.700 (1/2)	4.826 (—)	9.525 (3/8)	5.75	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	3 950 405	4 550 465
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	5 550 565	7 600 770
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	6 200 630	8 700 885
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360
25.400 (1)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	5/16	41 000 4 200	87 500 8 950
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	5/16	41 000 4 200	87 500 8 950
63.500 (2 1/2)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200
69.850 (2 3/4)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200
76.200 (3)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000
82.550 (3 1/4)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000
88.900 (3 1/2)	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF	34.9	17.46	0.8	8	5	60	5/8	84 500 8 650	214 000 21 800
101.600 (4)	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF	38.1	19.05	0.8	8	5	63	3/4	106 000 10 800	244 000 24 900
127.000 (5)	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF	65.1	22.23	0.8	8	5	89	7/8	189 000 19 300	520 000 53 000
152.400 (6)	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF	76.2	25.4	0.8	8	5	110	1	260 000 26 500	675 000 68 500

Notes 1) $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CR‥X and CR‥XLL types whose outside surface form is cylindrical.

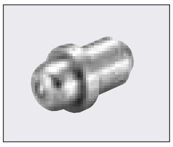


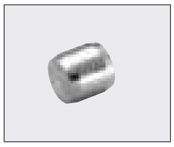
CRV··LLH type
(Full-complement roller type, with seal)

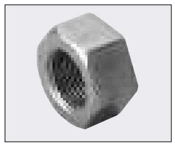
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8~10-1	—	—	No. 10-32UNF~1/4-28UNF
12~18	NIP-B4	SEN3. SEN4	3/8-24UNF~7/16-20UNF
20~22	NIP-B6	SEN3. SEN6	1/2-20UNF
24~30	NIP-B6	SEN4. SEN6	5/8-18UNF~3/4-16UNF
32~44	NIP-B6	SEN5. SEN6	7/8-14UNF~1-14UNF
48~96	NIP-B8	SEN5. SEN8	1 1/4-12UNF~2 1/2-12UNF

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.


NIP-B6


SEN6

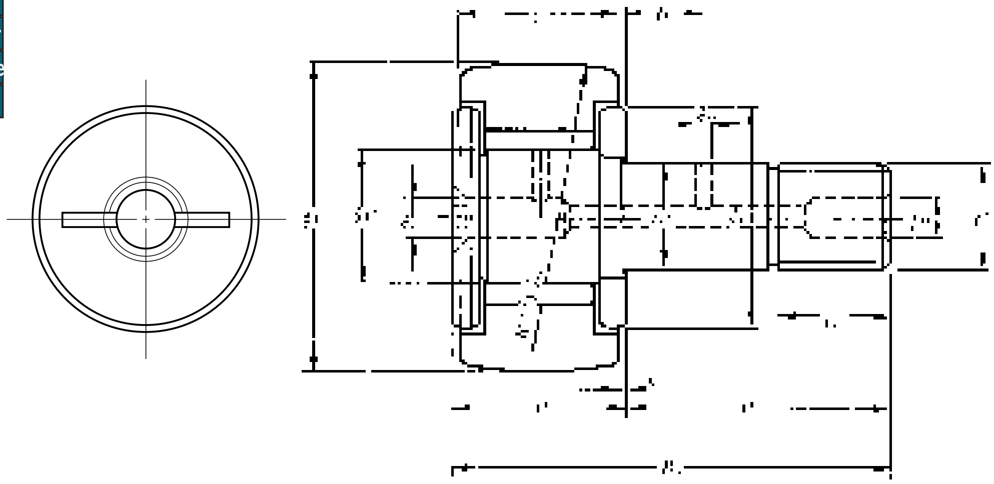

1/2-20UNF

Track load capacity N / kgf: Spherical outer rings	Track load capacity N / kgf: Cylindrical outer rings	Limiting speed min⁻¹: Grease lubrication	Limiting speed min⁻¹: Oil lubrication	Maximum tightening torque N·m / kgf·m	Cam Follower number: Without seal, Spherical outer rings	Without seal, Cylindrical outer rings	With seal, Spherical outer rings	With seal, Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
790 81	2 090 213	※17 000	※22 000	2 0.2	CRV8H/3AS	CRV8XH/3AS	CRV8LLH/3AS	CRV8XLLH/3AS	0.010	**4.826** (—)
790 81	2 310 235	※17 000	※22 000	2 0.2	CRV8-1H/3AS	CRV8-1XH/3AS	CRV8-1LLH/3AS	CRV8-1XLLH/3AS	0.011	**4.826** (—)
1 080 110	3 000 310	※12 000	※15 000	4 0.4	CRV10H/3AS	CRV10XH/3AS	CRV10LLH/3AS	CRV10XLLH/3AS	0.020	**6.350** (1/4)
1 080 110	3 300 335	※12 000	※15 000	4 0.4	CRV10-1H/3AS	CRV10-1XH/3AS	CRV10-1LLH/3AS	CRV10-1XLLH/3AS	0.022	**6.350** (1/4)
1 380 140	4 600 470	9 000	※11 000	13 1.3	CRV12H/3AS	CRV12XH/3AS	CRV12LLH/3AS	CRV12XLLH/3AS	0.038	**9.525** (3/8)
1 710 174	5 350 545	9 000	※11 000	13 1.3	CRV14H/3AS	CRV14XH/3AS	CRV14LLH/3AS	CRV14XLLH/3AS	0.048	**9.525** (3/8)
2 060 210	7 400 755	7 100	9 200	18 1.9	CRV16H/3AS	CRV16XH/3AS	CRV16LLH/3AS	CRV16XLLH/3AS	0.080	**11.112** (7/16)
2 430 248	8 350 850	7 100	9 200	18 1.9	CRV18H/3AS	CRV18XH/3AS	CRV18LLH/3AS	CRV18XLLH/3AS	0.096	**11.112** (7/16)
2 840 290	11 400 1 160	5 400	7 000	24 2.4	CRV20H/3AS	CRV20XH/3AS	CRV20LLH/3AS	CRV20XLLH/3AS	0.140	**12.700** (1/2)
3 250 330	12 500 1 280	5 400	7 000	24 2..4	CRV22H/3AS	CRV22XH/3AS	CRV22LLH/3AS	CRV22XLLH/3AS	0.165	**12.700** (1/2)
3 600 365	16 300 1 660	4 800	6 200	51 5.2	CRV24H/3AS	CRV24XH/3AS	CRV24LLH/3AS	CRV24XLLH/3AS	0.240	**15.875** (5/8)
4 050 410	17 600 1 800	4 800	6 200	51 5.2	CRV26H/3AS	CRV26XH/3AS	CRV26LLH/3AS	CRV26XLLH/3AS	0.280	**15.875** (5/8)
4 400 450	21 600 2 200	4 100	5 300	92 9.3	CRV28H/3AS	CRV28XH/3AS	CRV28LLH/3AS	CRV28XLLH/3AS	0.400	**19.050** (3/4)
4 850 495	23 200 2 360	4 100	5 300	92 9.3	CRV30H/3AS	CRV30XH/3AS	CRV30LLH/3AS	CRV30XLLH/3AS	0.440	**19.050** (3/4)
5 300 540	31 000 3 150	3 700	4 800	150 15	CRV32H/3AS	CRV32XH/3AS	CRV32LLH/3AS	CRV32XLLH/3AS	0.650	**22.225** (7/8)
6 200 635	35 000 3 550	3 700	4 800	150 15	CRV36H/3AS	CRV36XH/3AS	CRV36LLH/3AS	CRV36XLLH/3AS	0.780	**22.225** (7/8)
7 200 735	44 500 4 550	3 200	4 100	230 23	CRV40H/3AS	CRV40XH/3AS	CRV40LLH/3AS	CRV40XLLH/3AS	1.20	**25.400** (1)
8 250 840	49 000 5 000	3 200	4 100	230 23	CRV44H/3AS	CRV44XH/3AS	CRV44LLH/3AS	CRV44XLLH/3AS	1.34	**25.400** (1)
9 150 935	64 000 6 500	2 700	3 500	435 45	CRV48H/3AS	CRV48XH/3AS	CRV48LLH/3AS	CRV48XLLH/3AS	1.92	**31.750** (1 1/4)
10 000 1 020	69 000 7 050	2 700	3 500	435 45	CRV52H/3AS	CRV52XH/3AS	CRV52LLH/3AS	CRV52XLLH/3AS	2.20	**31.750** (1 1/4)
11 100 1 130	86 500 8 800	2 200	2 800	580 60	CRV56H/3AS	CRV56XH/3AS	CRV56LLH/3AS	CRV56XLLH/3AS	2.92	**34.925** (1 3/8)
13 200 1 350	113 000 11 500	2 200	2 800	760 78	CRV64H/3AS	CRV64XH/3AS	CRV64LLH/3AS	CRV64XLLH/3AS	4.32	**38.100** (1 1/2)
17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	CRV80H/3AS	CRV80XH/3AS	CRV80LLH/3AS	CRV80XLLH/3AS	8.80	**50.800** (2)
22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	CRV96H/3AS	CRV96XH/3AS	CRV96LLH/3AS	CRV96XLLH/3AS	15.3	**63.500** (2 1/2)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

CRV type
CRV··X type
CRV··LL type
CRV··XLL type

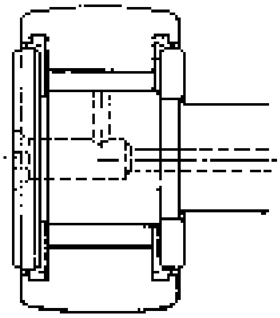


CRV type (Full-complement roller type)

D 12.700〜152.400mm

OD[1)] mm D 0 −0.05	d_1 +0.025 0	C 0 −0.130	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	Basic load ratings dynamic C_r N kgf	static C_{or}
12.700 (1/2)	4.826 (—)	8.731 (11/32)	5.75	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	3[2)]	—	10	3 400 350	3 750 385
12.700 (1/2)	4.826 (—)	9.525 (3/8)	5.75	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	3[2)]	—	10	3 950 405	4 550 465
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	4[2)]	—	12.5	5 550 565	7 600 770
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	4[2)]	—	12.5	6 200 630	8 700 885
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360
25.400 (1)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950
63.500 (2 1/2)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200
69.850 (2 3/4)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200
76.200 (3)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000
82.550 (3 1/4)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000
88.900 (3 1/2)	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF	34.9	17.46	0.8	8	5	60	84 500 8 650	214 000 21 800
101.600 (4)	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF	38.1	19.05	0.8	8	5	63	106 000 10 800	244 000 24 900
127.000 (5)	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF	65.1	22.23	0.8	8	5	89	189 000 19 300	520 000 53 000
152.400 (6)	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF	76.2	25.4	0.8	8	5	110	260 000 26 500	675 000 68 500

Notes 1) $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CRV and CRV··XLL types whose outside surface form is cylindrical.
2) The grease port is situated only in the front (in the left side face in the diagram above).

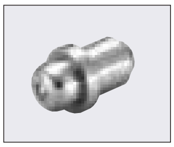


CRV··LL type
(Full-complement roller type, with seal)

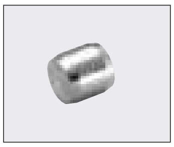
Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8, 8-1	NIP-B3	SEN3	No. 10-32UNF
10, 10-1	NIP-B4	SEN4	¼-28UNF
12～18	NIP-B4	SEN3. SEN4	⅜-24UNF～7/16-20UNF
20～22	NIP-B6	SEN3. SEN6	½-20UNF
24～30	NIP-B6	SEN4. SEN6	⅝-18UNF～¾-16UNF
32～44	NIP-B6	SEN5. SEN6	⅞-14UNF～1-14UNF
48～96	NIP-B8	SEN5. SEN8	1¼-12UNF～2½-12UNF

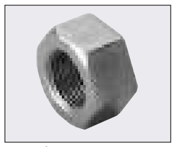
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



½-20UNF

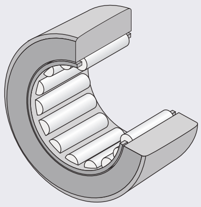
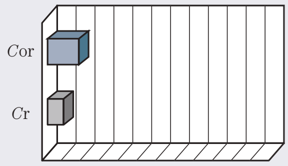
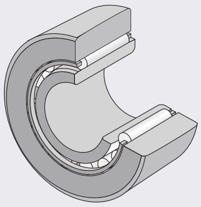
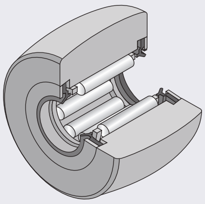
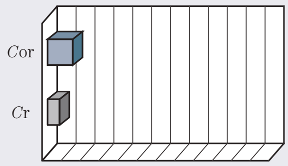
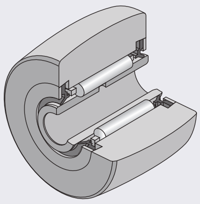
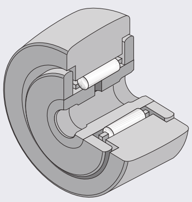
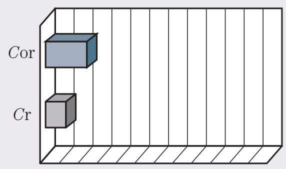
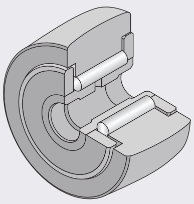
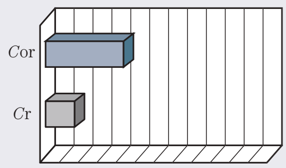
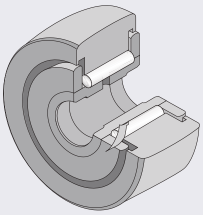
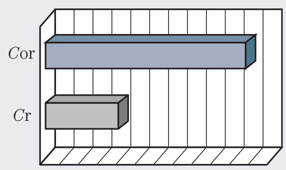
Track load capacity N / kgf: Spherical outer rings	Cylindrical outer rings	Limiting speed min^{-1}: Grease lubrication	Oil lubrication	Maximum tightening torque N·m / kgf·m	Cam Follower number: Without seal, Spherical outer rings	Without seal, Cylindrical outer rings	With seal, Spherical outer rings	With seal, Cylindrical outer rings	Mass kg (approx.)	Stud dia. mm
790 81	2 090 213	※17 000	※22 000	2 0.2	CRV8/3AS	CRV8X/3AS	CRV8LL/3AS	CRV8XLL/3AS	0.010	**4.826** (—)
790 81	2 310 235	※17 000	※22 000	2 0.2	CRV8-1/3AS	CRV8-1X/3AS	CRV8-1LL/3AS	CRV8-1XLL/3AS	0.011	**4.826** (—)
1 080 110	3 000 310	※12 000	※15 000	4 0.4	CRV10/3AS	CRV10X/3AS	CRV10LL/3AS	CRV10XLL/3AS	0.020	**6.350** (¼)
1 080 110	3 300 335	※12 000	※15 000	4 0.4	CRV10-1/3AS	CRV10-1X/3AS	CRV10-1LL/3AS	CRV10-1XLL/3AS	0.022	**6.350** (¼)
1 380 140	4 600 470	9 000	※11 000	13 1.3	CRV12/3AS	CRV12X/3AS	CRV12LL/3AS	CRV12XLL/3AS	0.038	**9.525** (⅜)
1 710 174	5 350 545	9 000	※11 000	13 1.3	CRV14/3AS	CRV14X/3AS	CRV14LL/3AS	CRV14XLL/3AS	0.048	**9.525** (⅜)
2 060 210	7 400 755	7 100	9 200	18 1.9	CRV16/3AS	CRV16X/3AS	CRV16LL/3AS	CRV16XLL/3AS	0.080	**11.112** (7/16)
2 430 248	8 350 850	7 100	9 200	18 1.9	CRV18/3AS	CRV18X/3AS	CRV18LL/3AS	CRV18XLL/3AS	0.096	**11.112** (7/16)
2 840 290	11 400 1 160	5 400	7 000	24 2.4	CRV20/3AS	CRV20X/3AS	CRV20LL/3AS	CRV20XLL/3AS	0.140	**12.700** (½)
3 250 330	12 500 1 280	5 400	7 000	24 2.4	CRV22/3AS	CRV22X/3AS	CRV22LL/3AS	CRV22XLL/3AS	0.165	**12.700** (½)
3 600 365	16 300 1 660	4 800	6 200	51 5.2	CRV24/3AS	CRV24X/3AS	CRV24LL/3AS	CRV24XLL/3AS	0.240	**15.875** (⅝)
4 050 410	17 600 1 800	4 800	6 200	51 5.2	CRV26/3AS	CRV26X/3AS	CRV26LL/3AS	CRV26XLL/3AS	0.280	**15.875** (⅝)
4 400 450	21 600 2 200	4 100	5 300	92 9.3	CRV28/3AS	CRV28X/3AS	CRV28LL/3AS	CRV28XLL/3AS	0.400	**19.050** (¾)
4 850 495	23 200 2 360	4 100	5 300	92 9.3	CRV30/3AS	CRV30X/3AS	CRV30LL/3AS	CRV30XLL/3AS	0.440	**19.050** (¾)
5 300 540	31 000 3 150	3 700	4 800	150 15	CRV32/3AS	CRV32X/3AS	CRV32LL/3AS	CRV32XLL/3AS	0.650	**22.225** (⅞)
6 200 635	35 000 3 550	3 700	4 800	150 15	CRV36/3AS	CRV36X/3AS	CRV36LL/3AS	CRV36XLL/3AS	0.780	**22.225** (⅞)
7 200 735	44 500 4 550	3 200	4 100	230 23	CRV40/3AS	CRV40X/3AS	CRV40LL/3AS	CRV40XLL/3AS	1.20	**25.400** (1)
8 250 840	49 000 5 000	3 200	4 100	230 23	CRV44/3AS	CRV44X/3AS	CRV44LL/3AS	CRV44XLL/3AS	1.34	**25.400** (1)
9 150 935	64 000 6 500	2 700	3 500	435 45	CRV48/3AS	CRV48X/3AS	CRV48LL/3AS	CRV48XLL/3AS	1.92	**31.750** (1¼)
10 000 1 020	69 000 7 050	2 700	3 500	435 45	CRV52/3AS	CRV52X/3AS	CRV52LL/3AS	CRV52XLL/3AS	2.20	**31.750** (1¼)
11 100 1 130	86 500 8 800	2 200	2 800	580 60	CRV56/3AS	CRV56X/3AS	CRV56LL/3AS	CRV56XLL/3AS	2.92	**34.925** (1⅜)
13 200 1 350	113 000 11 500	2 200	2 800	760 78	CRV64/3AS	CRV64X/3AS	CRV64LL/3AS	CRV64XLL/3AS	4.32	**38.100** (1½)
17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	CRV80/3AS	CRV80X/3AS	CRV80LL/3AS	CRV80XLL/3AS	8.80	**50.800** (2)
22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	CRV96/3AS	CRV96X/3AS	CRV96LL/3AS	CRV96XLL/3AS	15.3	**63.500** (2½)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}

Roller Followers (Yoke Type Track Rollers)

NTN Yoke Type Track Rollers are the rolling mechanisms whose outer ring rolls on a track. For example, these track rollers are applied to eccentric roller, guide roller, rocker arm roller, cam roller and pressure roller. For that, the outer ring is designed to a wall thickness so as to be resistible to high load and shock load.

load. Both spherical outer surface (rolling surface) and cylindrical outer surface are available for the outer rin The spherical outer ring can withstand edge-load actin on the contact surface between the track and the tr roller, while the cylindrical outer ring (Tail code: X) track load capacity greater than the spherical outer ri

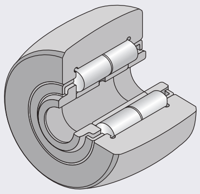
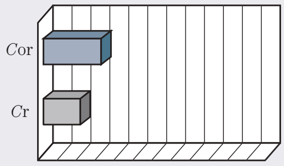
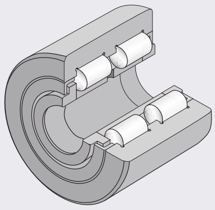
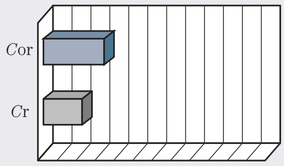
Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
RNAB2 	ϕ7—ϕ60	 **NAB210**	**RNAB 2 02** Dimension code Dimension series code Type code
NAB2 	ϕ6—ϕ50		**NAB 2 06 X** Suffix Dimension code Dimension series code Type code
RNA22 	ϕ10—ϕ58	 **NA2210LL**	**RNA 22 / 6 LL / 3AS** Suffix LL: Seal 3AS: Grease Dimension code Dimension series code Type code
NA22 	ϕ6—ϕ50		**NA 22 06 X LL / 3AS** Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Dimension series code Type code
NATR 	ϕ5—ϕ50	 **NATR50**	**NATR 30 X LL / 3AS** Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code
NATV 	ϕ5—ϕ50	 **NATV50**	**NATV 25 LL / 3AS** Suffix LL: Seal 3AS: Grease Dimension code Type code
NACV 	ϕ6.35—ϕ57.15	 **NACV80**	**NACV 32 X LL / 3AS** Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code

Listed load capacity values are based on basic bearing bore diameter of ϕ50 (ϕ44.45 for Type NACV).

Continued onto next page→

Track roller components	Features
Inscribed circle diameter: φ20 Type with cage Inner ring: w/o inner ring Outer profile: Spherical	● Inner ring (NAB2 type only) is separable from outer ring, needle rollers, and cage. ● The cage guides needle rollers. ● Use a shaft (pin) with a flange or a thrust washer to guide the outer ring. ● The accuracy and hardness of the shaft (pin) impact the performance of the RNAB2 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (Page A-40).
Inscribed circle diameter: φ30 Type with cage Inner ring: w/ inner ring Outer profile: Cylindrical	
Inscribed circle diameter: φ6 Type with cage Inner ring: w/o inner ring Outer profile: Spherical Seal: w/ seal Grease: Prefilled	● The needle rollers and the cage are retained in the outer ring by a steel-plate-reinforced synthetic rubber seal. ● The cage guides needle rollers. ● Use a shaft (pin) with a flange or a thrust washer to guide the outer ring. ● The accuracy and hardness of the shaft (pin) impact the performance of the RNA22 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (Page A-40).
Inscribed circle diameter: φ30 Type with cage Inner ring: w/ inner ring Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	
Inscribed circle diameter: φ30 Type with cage Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	● Needle rollers guided by cage. ● Outer ring is guided in axial direction by thrust washer press-fit into inner ring. ● Labyrinth is formed between the outer ring and the thrust washer.
Inscribed circle diameter: φ25 Full complement roller type Outer profile: Spherical Seal: w/ seal Grease: Prefilled	● Outer ring is guided in axial direction by thrust washer press-fit into inner ring. ● High load rating due to the full complement of needle rollers. ● Lower allowable running speed than bearing with cage. ● Labyrinth is formed between the outer ring and the thrust washer.
Inscribed circle diameter: φ15.875 Full complement roller type Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	

Continued from previous page

Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
NUTR 	ϕ15—ϕ50	 NUTR310	NUTR 3 10 / 3AS Suffix 3AS: Grease Dimension code Dimension series code Type code
NUTW 	ϕ15—ϕ50	 NUTW210	NUTW 2 05 X / 3AS Suffix X: Cylinder outer diameter 3AS: Grease Dimension code Dimension series code Type code

Bearing Tolerances

The dimensional accuracy, and profile accuracy and running accuracy about the bearing bore diameter (d), cylindrical roller outside diameter (D), outer rind width (C), and inner ring width (B) of the **Types NAB2 and NAB22** are as listed in **Table 4.3 Sec. 4 "Bearing accuracy"** (page A-26) (JIS Accuracy Class 0). The accuracies, and tolerances of assembled inner ring width (B), and spherical outside surface diameter (D) of the Type NACV, as well as the dimensional tolerances of roller set bore diameter (F) of the **Types RNAB2 and RNA22** are listed in the relevant dimension table.

Radial internal clearance and bearing fits

The tolerance class of a shaft to which a bearing having inner ring is installed shall be g6 (h6): when the shaft is directly used as a raceway surface (Types **RNAB2** and **RNA22**), the tolerance class of the shaft shall be k5 (k6). In general, the outer ring is not fitted in a housing. Mounting relations

Table 1 Radial internal clearance Unit: μm

Nominal roller inscribed circle dia. F_w (mm)		Clearance							
		C2		Ordinary		C3		C4	
over	Incl.	min	max	min	max	min	max	min	max
3	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

Installation

(1) The side face height in the roller follower mount must be made larger than "e" dimension described in applicable Dimensions Table. (**Fig.1**) In mounting, chamfer the mounting surface at R as small as possible (around 0.5×45°) and bring the inner ring and the end face of side plate in precise contact one another.

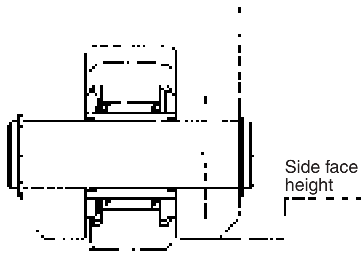


Fig.1

(2) Where the roller follower is mounted, locate the ring oil hole within the non-load area (load free (**Fig. 2**)
If the oil hole locates within the load area, it wo cause shorter life.

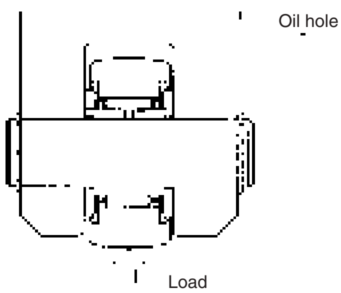


Fig.2

(3) The **Types RNAB2, NAB2, RNA22 and NA22** feature separable configuration. Their outer ring is guided a flange or thrust washer mounted onto the shaft (pin). Therefore, the guide surface needs to be finished at quality better than that obtained from turning: also, burrs must be thoroughly removed to achieve much smoother surface.Therefore, the guide surface must be finished more precisely than by turning and deburred completely for surface

Track roller components	Features
Inscribed circle diameter : ϕ50 Double-row cylindrical Full-complement roller type Labyrinth seal Outer profile spherical Grease: Prefilled	● High load rating, best-suited to applications subjected to high load and shock load. ● A steel plate is press-fit into the outer ring to form a labyrinth with the side plates on both sides of the inner ring, and the side plates are held so as not to separate from one another and make a good seal. ● The inner ring and the side plates are tightened together in axial direction to prevent axial movement. ● The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical rollers. Type NUTW provides the following additional features.
Inscribed circle diameter : ϕ25 Double-row cylindrical Full-complement roller type with center rib Labyrinth seal Outer profile : spherical Grease: Prefilled	● The highest load rating of all roller follower types. ● Due to the outer ring with inner rib, this type is good for axial and moment loads and runs smoothly depending on actual operating conditions. ● Good lubrication and longer life can be expected due to increase grease fill volume.

smoothing. In addition, when the guide surface is hardened the outer ring must be guided at A-dimension shown in **Fig.3**. When it is hardened, a little smaller guide surface can be used.

During assembly of the **Types RNA22** and **NA22**, be very carefully not to curl the lip of seal or damage the seal.

$A \geqq \frac{1}{2}(D+e)$

For D and e dimensions refer to applicable Dimensions Table.

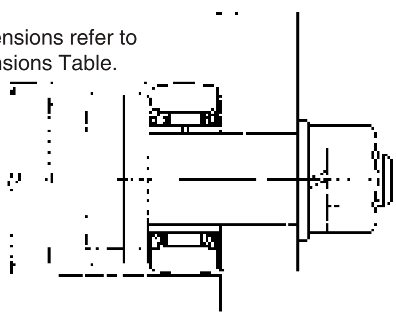


Fig.3

Where any of NTN roller followers was stub-mounted, non-uniform load (bias load) could act on the bearing, inversely affected by fitting loose arising from further continued running.
Good care must be exercised of such fitting loose, for stable running of the equipment.

Lubrication

The types having a synthetic rubber seal (suffix LL) and the full complement roller type are prefilled with lithium soap grease, thereby these bearing types can be used in a temperature range of -20 to +120°C or can be continuously used at a temperature of 100°C or lower. When a bearing is always used a temperature of 0°C or lower, use of a bearing prefilled with cold temperature grease. For more information, contact **NTN** Engineering.

Lubricant feeding and replenishing into the bearing are done through an oil hole provided on the inner ring. In case, even the inner ring must be fitted so the oil hole located within non-load area. For the full complement roller type roller followers **NATV**, **NACV**, **NUTR** and **NUTW** with no cage, it is necessary to shorten the grease replenishing interval.

Further, a roller follower with cage and without seal is not filled up with lubrication grease. When needing a follower with grease-filled cage, feel free to contact **NTN**.

Note that **NTN** offers its unique bearing products prefilled with solid grease: these bearings feature minimized of lubricant leakage.

If low dust-emission characteristics in the atmosphere is necessary, **NTN** will offer bearings prefilled with low dust-emission grease. For more information, contact **NTN** Engineering.

The outer ring outer surface of bearing and the track surface must both be lubricated. Lack of lubrication for these surfaces can lead to premature bearing failure.

Track load capacity

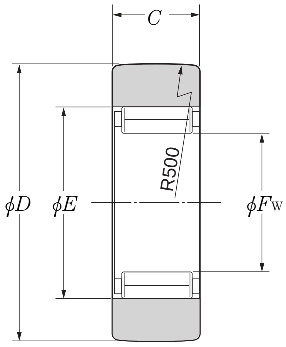
Refer to the track load capacity data in page B-181.

Outer ring strength

Refer to the outer ring strength data in page B-182.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

RNAB2 type
RNAB2··X type



RNAB2 type

D 16～90mm

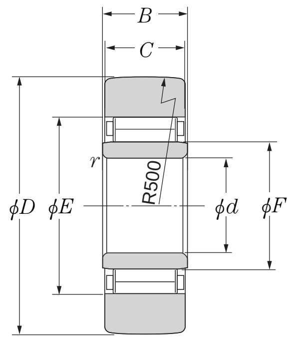
OD[1)] mm *D* 0 −0.05	Dimensions mm F_w		C	E	Basic load ratings dynamic N kgf C_r	static C_{or}	Track load capacity N kgf Spherical outer ring	Cylindrical outer ring
16	7	+0.022 +0.013	7.8	10	2 820 287	2 520 257	1 080 110	2 320 237
19	10	+0.022 +0.013	9.8	13	4 700 480	5 350 550	1 370 140	3 570 364
24	12	+0.027 +0.016	9.8	15	5 200 530	6 400 655	1 890 193	4 500 459
30	14	+0.027 +0.016	11.8	20	9 700 990	9 550 975	2 600 265	6 910 705
32	16	+0.027 +0.016	11.8	22	12 100 1 230	13 100 1 330	2 850 291	7 360 751
35	20	+0.033 +0.020	11.8	26	13 300 1 360	15 700 1 610	3 210 327	8 060 822
40	22	+0.033 +0.020	15.8	29	19 500 1 980	23 800 2 430	3 820 390	12 700 1 290
47	25	+0.033 +0.020	15.8	32	20 300 2 070	25 900 2 640	4 760 485	14 800 1 510
52	30	+0.033 +0.020	15.8	37	22 700 2 320	32 000 3 250	5 470 558	16 400 1 670
62	38	+0.041 +0.025	19.8	46	35 000 3 550	54 000 5 500	6 920 706	23 500 2 400
72	42	+0.041 +0.025	19.8	50	35 000 3 550	56 000 5 700	8 400 857	27 400 2 790
80	50	+0.041 +0.025	19.8	58	39 500 4 050	69 500 7 100	9 660 985	28 600 2 920
85	55	+0.049 +0.030	19.8	63	40 000 4 100	72 500 7 400	10 600 1 080	30 500 3 110
90	60	+0.049 +0.030	19.8	68	41 500 4 250	78 000 8 000	11 400 1 160	32 300 3 290

Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the RNAB2··X type whose outside surface form is cylindrical.

Limiting speed min⁻¹ Grease lubrication	Limiting speed min⁻¹ Oil lubrication	Roller Follower number Spherical outer ring	Roller Follower number Cylindrical outer ring	Mass kg (approx.)	OD[1)] mm D $\begin{smallmatrix}0\\-0.05\end{smallmatrix}$
21 000	27 000	**RNAB 2/5T2**	**RNAB 2/5XT2**	0.0085	16
15 000	20 000	**RNAB 2/6T2**	**RNAB 2/6XT2**	0.013	19
12 000	16 000	**RNAB 2/8**	**RNAB 2/8X**	0.021	24
11 000	14 000	**RNAB 200**	**RNAB 200X**	0.042	30
9 500	12 500	**RNAB 201**	**RNAB 201X**	0.049	32
7 500	10 000	**RNAB 202**	**RNAB 202X**	0.05	35
6 800	9 000	**RNAB 203**	**RNAB 203X**	0.088	40
6 000	8 000	**RNAB 204**	**RNAB 204X**	0.13	47
5 000	6 500	**RNAB 205**	**RNAB 205X**	0.15	52
4 000	5 500	**RNAB 206**	**RNAB 206X**	0.255	62
3 500	4 600	**RNAB 207**	**RNAB 207X**	0.375	72
3 000	4 000	**RNAB 208**	**RNAB 208X**	0.42	80
2 700	3 600	**RNAB 209**	**RNAB 209X**	0.435	85
2 500	3 300	**RNAB 210**	**RNAB 210X**	0.481	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NAB2 type
NAB2··X type



NAB2 type

D 19〜90mm

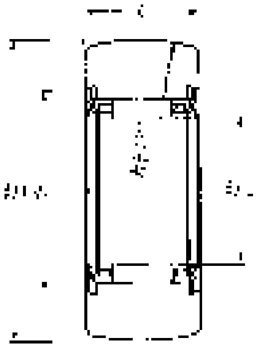
OD[1)] mm D 0 −0.05	Dimensions mm d	B	C	E	F	$r_{s\,min}$[2)]	Basic load ratings dynamic N / kgf C_r	static N / kgf C_{or}	Track load capacity N / kgf Spherical outer ring	Cylindrical outer ring
19	6	10	9.8	13	10	0.5	4 700 480	5 350 550	1 370 140	3 570 364
24	8	10	9.8	15	12	0.5	5 200 530	6 400 655	1 890 193	4 500 459
30	10	12	11.8	20	14	0.5	9 700 990	9 550 975	2 600 265	6 910 705
32	12	12	11.8	22	16	0.5	12 100 1 230	13 100 1 330	2 850 291	7 360 751
35	15	12	11.8	26	20	0.5	13 300 1 360	15 700 1 610	3 210 327	8 060 822
40	17	16	15.8	29	22	0.5	19 500 1 980	23 800 2 430	3 820 390	12 700 1 290
47	20	16	15.8	32	25	0.5	20 300 2 070	25 900 2 640	4 760 485	14 800 1 510
52	25	16	15.8	37	30	0.5	22 700 2 320	32 000 3 250	5 470 558	16 400 1 670
62	30	20	19.8	46	38	1	35 000 3 550	54 000 5 500	6 920 706	23 500 2 400
72	35	20	19.8	50	42	1	35 000 3 550	56 000 5 700	8 400 857	27 400 2 790
80	40	20	19.8	58	50	1.5	39 500 4 050	69 500 7 100	9 660 985	28 600 2 920
85	45	20	19.8	63	55	1.5	40 000 4 100	72 500 7 400	10 600 1080	30 500 3 110
90	50	20	19.8	68	60	1.5	41 500 4 250	78 000 8 000	11 400 1160	32 300 3 290

Notes:1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NAB2··X type whose outside surface form is cylindrical.
2) The minimum value of chamfer dimension r.

Limiting speed min^{-1}		Roller Follower number		Mass	OD[1)] mm
Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring	kg (approx.)	D 0 −0.05
15 000	20 000	**NAB 2/6T2**	**NAB 2/6XT2**	0.017	19
12 000	16 000	**NAB 2/8**	**NAB 2/8X**	0.026	24
11 000	14 000	**NAB 200**	**NAB 200X**	0.049	30
9 500	12 500	**NAB 201**	**NAB 201X**	0.057	32
7 500	10 000	**NAB 202**	**NAB 202X**	0.062	35
6 800	9 000	**NAB 203**	**NAB 203X**	0.107	40
6 000	8 000	**NAB 204**	**NAB 204X**	0.151	47
5 000	6 500	**NAB 205**	**NAB 205X**	0.174	52
4 000	5 500	**NAB 206**	**NAB 206X**	0.32	62
3 500	4 600	**NAB 207**	**NAB 207X**	0.439	72
3 000	4 000	**NAB 208**	**NAB 208X**	0.526	80
2 700	3 600	**NAB 209**	**NAB 209X**	0.551	85
2 500	3 300	**NAB 210**	**NAB 210X**	0.61	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

RNA22··LL type
RNA22··XLL type



RNA22··LL type

D 19～90mm

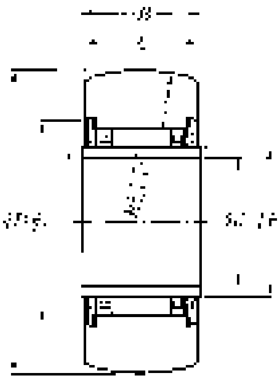
OD[1)] mm D 0 −0.05	Dimensions mm F_w		C	E	Basic load ratings N kgf dynamic C_r	static C_{or}	Track load capacity N kgf Spherical outer ring	Cylindrical outer ring
19	10	+0.022 +0.013	11.8	16	4 550 460	4 250 435	1 380 141	4 400 445
24	12	+0.027 +0.016	11.8	18	5 150 525	5 250 535	1 900 193	5 500 565
30	14	+0.027 +0.016	13.8	20	7 550 770	9 000 915	2 620 267	7 550 770
32	16	+0.027 +0.016	13.8	22	8 100 830	10 300 1 050	2 860 291	8 050 820
35	20	+0.033 +0.020	13.8	26	9 850 1 010	14 100 1 440	3 200 325	8 800 900
40	22	+0.033 +0.020	15.8	28	10 400 1 060	15 600 1 590	3 850 390	10 900 1 110
47	25	+0.033 +0.020	17.8	33	16 900 1 730	22 900 2 340	4 700 480	14 800 1 510
52	30	+0.033 +0.020	17.8	38	17 900 1 820	25 900 2 640	5 550 565	16 400 1 670
62	35	+0.041 +0.025	19.8	43	21 400 2 190	34 500 3 500	6 950 710	22 200 2 260
72	42	+0.041 +0.025	22.7	50	26 300 2 690	47 500 4 850	8 050 820	28 700 2 930
80	48	+0.041 +0.025	22.7	57	28 400 2 900	55 000 5 600	9 800 1 000	32 000 3 250
85	52	+0.049 +0.030	22.7	62	29 300 2 990	58 500 5 950	10 400 1 060	34 000 3 450
90	58	+0.049 +0.030	22.7	68	31 000 3 200	66 000 6 700	11 400 1 160	36 000 3 650

Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the RNA22··XLL type whose outside surface form is cylindrical.

Limiting speed min⁻¹ Grease lubrication	Roller Follower number Spherical outer ring	 Cylindrical outer ring	Mass kg (approx.)	OD[1)] mm D $^{0}_{-0.05}$
10 000	**RNA22/6LL/3AS**	**RNA22/6XLL/3AS**	0.018	**19**
10 000	**RNA22/8LL/3AS**	**RNA22/8XLL/3AS**	0.027	**24**
10 000	**RNA2200LL/3AS**	**RNA2200XLL/3AS**	0.052	**30**
9 500	**RNA2201LL/3AS**	**RNA2201XLL/3AS**	0.057	**32**
7 500	**RNA2202LL/3AS**	**RNA2202XLL/3AS**	0.060	**35**
7 000	**RNA2203LL/3AS**	**RNA2203XLL/3AS**	0.094	**40**
6 000	**RNA2204LL/3AS**	**RNA2204XLL/3AS**	0.152	**47**
5 000	**RNA2205LL/3AS**	**RNA2205XLL/3AS**	0.179	**52**
4 300	**RNA2206LL/3AS**	**RNA2206XLL/3AS**	0.284	**62**
3 600	**RNA2207LL/3AS**	**RNA2207XLL/3AS**	0.432	**72**
3 100	**RNA2208LL/3AS**	**RNA2208XLL/3AS**	0.530	**80**
2 900	**RNA2209LL/3AS**	**RNA2209XLL/3AS**	0.545	**85**
2 600	**RNA2210LL/3AS**	**RNA2210XLL/3AS**	0.563	**90**

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NA22··LL type
NA22··XLL type



NA22··LL type

D 19～90mm

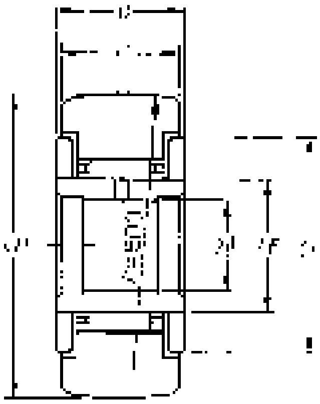
OD[1)] mm *D* 0 −0.05	Dimensions mm *d*	*B*	*C*	*e*	*F*	$r_{s\,min}$[2)]	Basic load ratings dynamic N kgf C_r	static C_{or}	Track load capacity N kgf Spherical outer ring	Cylindrical outer ring
19	6	12	11.8	16	10	0.3	4 550 460	4 250 435	1 380 141	4 400 445
24	8	12	11.8	18	12	0.3	5 150 525	5 250 535	1 900 193	5 500 565
30	10	14	13.8	20	14	0.3	7 550 770	9 000 915	2 620 267	7 550 770
32	12	14	13.8	22	16	0.3	8 100 830	10 300 1 050	2 860 291	8 050 820
35	15	14	13.8	26	20	0.3	9 850 1 010	14 100 1 440	3 200 325	8 800 900
40	17	16	15.8	28	22	0.3	10 400 1 060	15 600 1 590	3 850 390	10 900 1 110
47	20	18	17.8	33	25	0.3	16 900 1 730	22 900 2 340	4 700 480	14 800 1 510
52	25	18	17.8	38	30	0.3	17 900 1 820	25 900 2 640	5 550 565	16 400 1 670
62	30	20	19.8	43	35	0.3	21 400 2 190	34 500 3 500	6 950 710	22 200 2 260
72	35	23	22.7	50	42	0.6	26 300 2 690	47 500 4 850	8 050 820	28 700 2 930
80	40	23	22.7	57	48	0.6	28 400 2 900	55 000 5 600	9 800 1 000	32 000 3 250
85	45	23	22.7	62	52	0.6	29 300 2 990	58 500 5 950	10 400 1 060	34 000 3 450
90	50	23	22.7	68	58	0.6	31 000 3 200	66 000 6 700	11 400 1 160	36 000 3 650

Notes:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NA22··XLL type whose outside surface form is cylindrical.
2) The minimum value of chamfering dimension *r*.

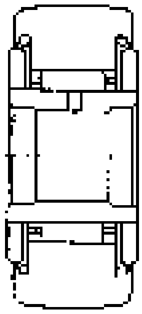
Limiting speed min⁻¹ Grease lubrication	Roller Follower number Spherical outer ring	Roller Follower number Cylindrical outer ring	Mass kg (approx.)	OD[1)] mm D 0 −0.05
10 000	**NA22/6LL/3AS**	**NA22/6XLL/3AS**	0.023	**19**
10 000	**NA22/8LL/3AS**	**NA22/8XLL/3AS**	0.035	**24**
10 000	**NA2200LL/3AS**	**NA2200XLL/3AS**	0.060	**30**
9 500	**NA2201LL/3AS**	**NA2201XLL/3AS**	0.067	**32**
7 500	**NA2202LL/3AS**	**NA2202XLL/3AS**	0.075	**35**
7 000	**NA2203LL/3AS**	**NA2203XLL/3AS**	0.113	**40**
6 000	**NA2204LL/3AS**	**NA2204XLL/3AS**	0.176	**47**
5 000	**NA2205LL/3AS**	**NA2205XLL/3AS**	0.209	**52**
4 300	**NA2206LL/3AS**	**NA2206XLL/3AS**	0.322	**62**
3 600	**NA2207LL/3AS**	**NA2207XLL/3AS**	0.506	**72**
3 100	**NA2208LL/3AS**	**NA2208XLL/3AS**	0.623	**80**
2 900	**NA2209LL/3AS**	**NA2209XLL/3AS**	0.638	**85**
2 600	**NA2210LL/3AS**	**NA2210XLL/3AS**	0.682	**90**

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NATR type
NATR··X type
NATR··LL type
NATR··XLL type



NATR type
(with cage)



NATR··LL type
(sealed, with cage)

D 16～90mm

OD[1)] mm *D* 0 −0.05	Dimensions mm *d*	*B*		*C*	*e*	*F*	Basic load ratings N / kgf dynamic C_r	static C_{or}	Track load capacity N / kgf Spherical outer ring	Cylindrical outer ring
16	5	12	0 −0.180	11	12	8	4 050 415	4 200 430	1 080 110	3 400 350
19	6	12	0 −0.180	11	14	10	4 750 480	5 400 555	1 380 141	4 050 415
24	8	15	0 −0.180	14	19	12	6 900 705	7 700 785	1 900 193	6 650 680
30	10	15	0 −0.180	14	23	15	7 850 800	9 650 985	2 620 267	7 700 785
32	12	15	0 −0.180	14	25	17	8 050 820	10 300 1 050	2 860 291	8 200 835
35	15	19	0 −0.210	18	27	20	13 300 1 360	2 0800 2 120	3 200 325	11 900 1 220
40	17	21	0 −0.210	20	32	22	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480
47	20	25	0 −0.210	24	37	25	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150
52	25	25	0 −0.210	24	42	30	22 800 2 320	40 500 4 100	5 500 565	23 300 2 370
62	30	29	0 −0.210	28	51	38	36 000 3 650	66 000 6 750	6 950 710	33 000 3 350
72	35	29	0 −0.210	28	58	44.5	39 000 3 950	77 000 7 850	8 050 820	37 000 3 750
80	40	32	0 −0.250	30	66	50	49 500 5 050	92 500 9 400	9 800 1 000	44 500 4 500
85	45	32	0 −0.250	30	71	55	51 500 5 250	100 000 10 200	10 400 1 060	47 000 4 800
90	50	32	0 −0.250	30	76	60	53 000 5 450	108 000 11 000	11 400 1 160	50 000 5 100

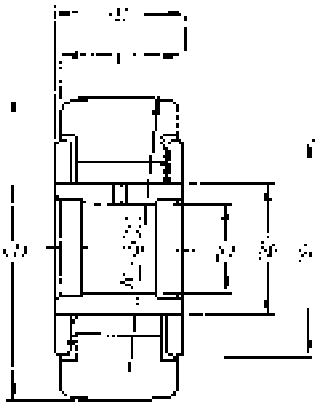
Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NATR··X and NATR··XLL types whose outside surface form is cylindrical.

Limiting speed min^{-1}		Roller Follower number				Mass	OD[1)] mm
		Without seal		With seal		kg	D
Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring	Spherical outer ring	Cylindrical outer ring	(approx.)	0 −0.05
※19 000	※25 000	**NATR5**	**NATR5X**	**NATR5LL/3AS**	**NATR5XLL/3AS**	0.018	**16**
※15 000	※20 000	**NATR6**	**NATR6X**	**NATR6LL/3AS**	**NATR6XLL/3AS**	0.025	**19**
※12 000	※16 000	**NATR8**	**NATR8X**	**NATR8LL/3AS**	**NATR8XLL/3AS**	0.042	**24**
10 000	※13 000	**NATR10**	**NATR10X**	**NATR10LL/3AS**	**NATR10XLL/3AS**	0.061	**30**
9 000	※12 000	**NATR12CT**	**NATR12XCT**	**NATR12CLLT/3AS**	**NATR12XCLLT/3AS**	0.069	**32**
7 500	10 000	**NATR15**	**NATR15X**	**NATR15LL/3AS**	**NATR15XLL/3AS**	0.098	**35**
7 000	9 000	**NATR17**	**NATR17X**	**NATR17LL/3AS**	**NATR17XLL/3AS**	0.140	**40**
6 000	8 000	**NATR20**	**NATR20X**	**NATR20LL/3AS**	**NATR20XLL/3AS**	0.246	**47**
5 000	6 500	**NATR25**	**NATR25X**	**NATR25LL/3AS**	**NATR25XLL/3AS**	0.275	**52**
4 000	5 500	**NATR30**	**NATR30X**	**NATR30LL/3AS**	**NATR30XLL/3AS**	0.470	**62**
3 300	4 500	**NATR35**	**NATR35X**	**NATR35LL/3AS**	**NATR35XLL/3AS**	0.635	**72**
3 000	4 000	**NATR40**	**NATR40X**	**NATR40LL/3AS**	**NATR40XLL/3AS**	0.875	**80**
2 700	3 600	**NATR45**	**NATR45X**	**NATR45LL/3AS**	**NATR45XLL/3AS**	0.910	**85**
2 500	3 300	**NATR50**	**NATR50X**	**NATR50LL/3AS**	**NATR50XLL/3AS**	0.960	**90**

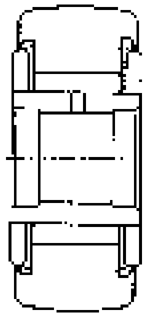
Remark: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min^{-1}.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NATV type
NATV··X type
NATV··LL type
NATV··XLL type



NATV type
(Full-complement roller type)



NATV··LL type
(Full-complement roller type, sealed)

D 16～90mm

OD[1)] mm *D* 0 −0.05	Dimensions mm *d*	*B*		*C*	*e*	*F*	Basic load ratings N kgf dynamic C_r	static C_{or}	Track load capacity N kgf Spherical outer ring	Cylindrical outer ring
16	5	12	0 −0.180	11	12	8	6 500 665	9 350 955	1 080 110	3 400 350
19	6	12	0 −0.180	11	14	10	7 450 760	11 700 1 190	1 380 141	4 050 415
24	8	15	0 −0.180	14	19	12	10 700 1 090	16 200 1 650	1 900 193	6 650 680
30	10	15	0 −0.180	14	23	15	12 000 1 230	20 300 2 070	2 620 267	7 700 785
32	12	15	0 −0.180	14	25	17	13 000 1 330	23 000 2 350	2 860 291	8 200 835
35	15	19	0 −0.210	18	27	20	18 400 1 870	38 000 3 900	3 200 325	11 900 1 220
40	17	21	0 −0.210	20	32	22	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480
47	20	25	0 −0.210	24	37	25	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150
52	25	25	0 −0.210	24	42	30	31 500 3 200	73 500 7 500	5 500 565	23 300 2 370
62	30	29	0 −0.210	28	51	38	47 500 4 850	115 000 11 700	6 950 710	33 000 3 350
72	35	29	0 −0.210	28	58	44.5	52 000 5 300	134 000 13 600	8 050 820	37 000 3 750
80	40	32	0 −0.250	30	66	50	68 500 7 000	171 000 17 500	9 800 1 000	44 500 4 500
90	50	32	0 −0.250	30	76	60	76 000 7 750	205 000 20 900	11 400 1 160	50 000 5 100

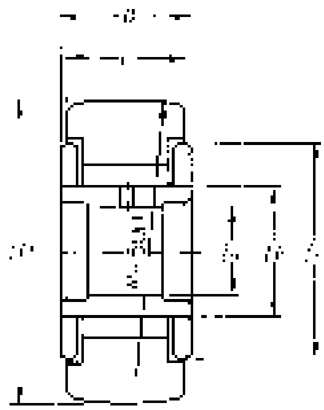
Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter of the outer rings of the NATV··X and NATV··XLL types whose outside surface form is cylindrical.

Limiting speed min^{-1}		Roller Follower number				Mass	OD[1)] mm
		Without seal		With seal		kg	D
Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring	Spherical outer ring	Cylindrical outer ring	(approx.)	0 −0.05
※13 000	※16 000	NATV5/3AS	NATV5X/3AS	NATV5LL/3AS	NATV5XLL/3AS	0.020	**16**
10 000	※13 000	NATV6/3AS	NATV6X/3AS	NATV6LL/3AS	NATV6XLL/3AS	0.027	**19**
8 500	※11 000	NATV8/3AS	NATV8X/3AS	NATV8LL/3AS	NATV8XLL/3AS	0.044	**24**
6 500	8 500	NATV10/3AS	NATV10X/3AS	NATV10LL/3AS	NATV10XLL/3AS	0.065	**30**
6 000	7 500	NATV12/3AS	NATV12X/3AS	NATV12LL/3AS	NATV12XLL/3AS	0.074	**32**
5 000	6 500	NATV15/3AS	NATV15X/3AS	NATV15LL/3AS	NATV15XLL/3AS	0.102	**35**
4 500	6 000	NATV17/3AS	NATV17X/3AS	NATV17LL/3AS	NATV17XLL/3AS	0.145	**40**
4 000	5 000	NATV20/3AS	NATV20X/3AS	NATV20LL/3AS	NATV20XLL/3AS	0.254	**47**
3 300	4 500	NATV25/3AS	NATV25X/3AS	NATV25LL/3AS	NATV25XLL/3AS	0.285	**52**
2 600	3 500	NATV30/3AS	NATV30X/3AS	NATV30LL/3AS	NATV30XLL/3AS	0.481	**62**
2 200	2 900	NATV35/3AS	NATV35X/3AS	NATV35LL/3AS	NATV35XLL/3AS	0.647	**72**
2 000	2 600	NATV40/3AS	NATV40X/3AS	NATV40LL/3AS	NATV40XLL/3AS	0.890	**80**
1 600	2 100	NATV50/3AS	NATV50X/3AS	NATV50LL/3AS	NATV50XLL/3AS	0.990	**90**

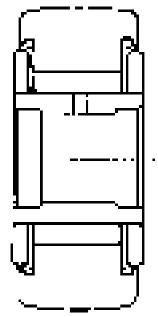
Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately^{1}10,000 min

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NACV type
NACV··X type
NACV··LL type
NACV··XLL type



NACV type
(Full-complement roller type)



NACV··LL type
(Full-complement roller type, sealed)

D 19.050～152.400mm

OD[1)] mm(1/25.4mm) *D* $^{0}_{-0.05}$	Dimensions mm (1/25.4mm) *d*	*B* $^{0}_{-0.250}$	*C* $^{0}_{-0.130}$	*e*	*F*	Basic load ratings dynamic N / kgf C_r	static C_{or}
19.050 (3/4)	6.350 (1/4) $^{+0.005}_{-0.010}$	14.288 (9/16)	12.700 (1/2)	15.5	11	8 050 825	13 300 1 360
22.225 (7/8)	6.350 (1/4) $^{+0.005}_{-0.010}$	14.288 (9/16)	12.700 (1/2)	15.5	11	8 050 825	13 300 1 360
25.400 (1)	7.938 (5/16) $^{+0.005}_{-0.010}$	17.462 (11/16)	15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920
28.575 (1 1/8)	7.938 (5/16) $^{+0.005}_{-0.010}$	17.462 (11/16)	15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920
31.750 (1 1/4)	9.525 (3/8) $^{+0.005}_{-0.010}$	20.638 (13/16)	19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600
34.925 (1 3/8)	9.525 (3/8) $^{+0.005}_{-0.010}$	20.638 (13/16)	19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600
38.100 (1 1/2)	11.112 (7/16) $^{+0.005}_{-0.010}$	23.812 (15/16)	22.225 (7/8)	27	21	21 100 2 150	45 500 4 650
41.275 (1 5/8)	11.112 (7/16) $^{+0.005}_{-0.010}$	23.812 (15/16)	22.225 (7/8)	27	21	21 100 2 150	45 500 4 650
44.450 (1 3/4)	12.700 (1/2) $^{+0.005}_{-0.010}$	26.988 (1 1/16)	25.400 (1)	27	24.65	28 400 2 900	60 500 6 150
47.625 (1 7/8)	12.700 (1/2) $^{+0.005}_{-0.010}$	26.988 (1 1/16)	25.400 (1)	27	24.65	28 400 2 900	60 500 6 150
50.800 (2)	15.875 (5/8) $^{+0.005}_{-0.010}$	33.338 (1 5/16)	31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950
57.150 (2 1/4)	15.875 (5/8) $^{+0.005}_{-0.010}$	33.338 (1 5/16)	31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950
63.500 (2 1/2)	19.050 (3/4) $^{+0.005}_{-0.010}$	39.688 (1 9/16)	38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200
69.850 (2 3/4)	19.050 (3/4) $^{+0.005}_{-0.010}$	39.688 (1 9/16)	38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200
76.200 (3)	25.400 (1) $^{+0.002}_{-0.013}$	46.038 (1 13/16)	44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000
82.550 (3 1/4)	25.400 (1) $^{+0.002}_{-0.013}$	46.038 (1 13/16)	44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000
88.900 (3 1/2)	28.575 (1 1/8) $^{+0.002}_{-0.013}$	52.388 (2 1/16)	50.800 (2)	60	44.5	84 500 8 650	214 000 21 800
101.600 (4)	31.750 (1 1/4) $^{+0.002}_{-0.013}$	58.738 (2 5/16)	57.150 (2 1/4)	63	44.5	106 000 10 800	244 000 24 900
127.000 (5)	44.450 (1 3/4) $^{+0.002}_{-0.013}$	73.025 (2 7/8)	69.850 (2 3/4)	89	68.7	189 000 19 300	520 000 53 000
152.400 (6)	57.150 (2 1/4) $^{+0.002}_{-0.013}$	85.725 (3 3/8)	82.550 (3 1/4)	110	81.35	260 000 26 500	675 000 68 500

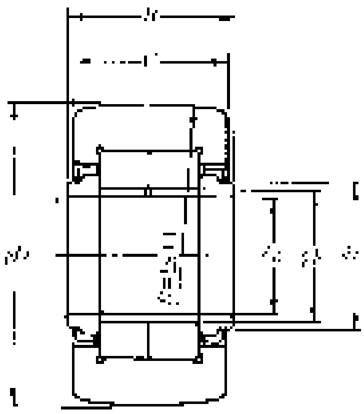
Note:1. $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter *D* of the outer rings of the NACV··X and NACV··XLL types whose outside surface form is cylindrical

Track load capacity N kgf Spherical outer ring	Track load capacity N kgf Cylindrical outer ring	Limiting speed min^{-1} Grease lubrication	Limiting speed min^{-1} Oil lubrication	Roller Follower number Without seal Spherical outer ring	Roller Follower number Without seal Cylindrical outer ring	Roller Follower number With seal Spherical outer ring	Roller Follower number With seal Cylindrical outer ring	Mass kg (approx.)	OD[1)] mm(1/25.4mm) D 0 −0.05
1 380 140	4 600 470	9 000	※11 000	NACV12/3AS	NACV12X/3AS	NACV12LL/3AS	NACV12XLL/3AS	0.027	**19.050** (3/4)
1 710 174	5 350 545	9 000	※11 000	NACV14/3AS	NACV14X/3AS	NACV14LL/3AS	NACV14XLL/3AS	0.036	**22.225** (7/8)
2 060 210	7 400 755	7 100	9 200	NACV16/3AS	NACV16X/3AS	NACV16LL/3AS	NACV16XLL/3AS	0.059	**25.400** (1)
2 430 248	8 350 850	7 100	9 200	NACV18/3AS	NACV18X/3AS	NACV18LL/3AS	NACV18XLL/3AS	0.073	**28.575** (1 1/8)
2 840 290	11 400 1 160	5 400	7 000	NACV20/3AS	NACV20X/3AS	NACV20LL/3AS	NACV20XLL/3AS	0.109	**31.750** (1 1/4)
3 250 330	12 500 1 280	5 400	7 000	NACV22/3AS	NACV22X/3AS	NACV22LL/3AS	NACV22XLL/3AS	0.132	**34.925** (1 3/8)
3 600 365	16 300 1 660	4 800	6 200	NACV24/3AS	NACV24X/3AS	NACV24LL/3AS	NACV24XLL/3AS	0.177	**38.100** (1 1/2)
4 050 410	17 600 1 800	4 800	6 200	NACV26/3AS	NACV26X/3AS	NACV26LL/3AS	NACV26XLL/3AS	0.218	**41.275** (1 5/8)
4 400 450	21 600 2 200	4 100	5 300	NACV28/3AS	NACV28X/3AS	NACV28LL/3AS	NACV28XLL/3AS	0.281	**44.450** (1 3/4)
4 850 495	23 200 2 360	4 100	5 300	NACV30/3AS	NACV30X/3AS	NACV30LL/3AS	NACV30XLL/3AS	0.327	**47.625** (1 7/8)
5 300 540	31 000 3 150	3 700	4 800	NACV32/3AS	NACV32X/3AS	NACV32LL/3AS	NACV32XLL/3AS	0.454	**50.800** (2)
6 200 635	35 000 3 550	3 700	4 800	NACV36/3AS	NACV36X/3AS	NACV36LL/3AS	NACV36XLL/3AS	0.585	**57.150** (2 1/4)
7 200 735	44 500 4 550	3 200	4 100	NACV40/3AS	NACV40X/3AS	NACV40LL/3AS	NACV40XLL/3AS	0.902	**63.500** (2 1/2)
8 250 840	49 000 5 000	3 200	4 100	NACV44/3AS	NACV44X/3AS	NACV44LL/3AS	NACV44XLL/3AS	1.05	**69.850** (2 3/4)
9 150 935	64 000 6 500	2 700	3 500	NACV48/3AS	NACV48X/3AS	NACV48LL/3AS	NACV48XLL/3AS	1.39	**76.200** (3)
10 000 1 020	69 000 7 050	2 700	3 500	NACV52/3AS	NACV52X/3AS	NACV52LL/3AS	NACV52XLL/3AS	1.66	**82.550** (3 1/4)
11 100 1 130	86 000 8 800	2 200	2 800	NACV56/3AS	NACV56X/3AS	NACV56LL/3AS	NACV56XLL/3AS	2.19	**88.900** (3 1/2)
13 200 1 350	112 500 11 500	2 200	2 800	NACV64/3AS	NACV64X/3AS	NACV64LL/3AS	NACV64XLL/3AS	3.22	**101.600** (4)
17 900 1 830	165 500 16 900	1 500	1 900	NACV80/3AS	NACV80X/3AS	NACV80LL/3AS	NACV80XLL/3AS	6.08	**127.000** (5)
22 100 2 250	239 500 24 400	1 200	1 500	NACV96/3AS	NACV96X/3AS	NACV96LL/3AS	NACV96XLL/3AS	10.0	**152.400** (6)

Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately^{1}10,000 min

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without shield	with shield

NUTR2 type
NUTR2··X type
NUTR3 type
NUTR3··X type



NUTR2 type
NUTR3 type

D 35～110mm

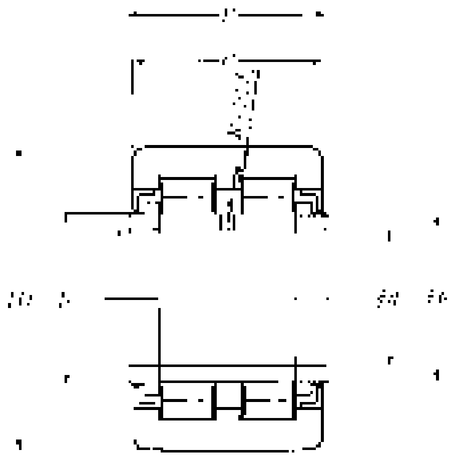
OD[1)] mm *D* 0 −0.05	Dimensions mm *d*	*B*	*C*	*e*	*F*	$r_{s\,min}$[2)]	Basic load ratings dynamic N / kgf C_r	static C_{or}	Track load capacity N / kgf Spherical outer ring	Cylindrical outer ring
35	15	19 $^{0}_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620	3 200 325	11 900 1 220
40	17	21 $^{0}_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970	3 850 390	14 500 1 480
42	15	19 $^{0}_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620	4 100 415	14 300 1 460
47	17	21 $^{0}_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970	4 700 480	17 000 1 740
	20	25 $^{0}_{-0.210}$	24	27	25.5	0.3	38 500 3 950	48 000 4 900	4 700 480	21 000 2 150
52	20	25 $^{0}_{-0.210}$	24	27	25.5	0.3	38 500 3 950	48 000 4 900	5 550 565	23 300 2 370
	25	25 $^{0}_{-0.210}$	24	31	30	0.3	42 500 4 350	57 500 5 850	5 550 565	23 300 2 370
62	25	25 $^{0}_{-0.210}$	24	31	30	0.3	42 500 4 350	57 500 5 850	6 950 710	27 800 2 830
	30	29 $^{0}_{-0.210}$	28	38	35	0.3	56 500 5 750	72 500 7 400	6 950 710	33 000 3 350
72	30	29 $^{0}_{-0.210}$	28	38	35	0.3	56 500 5 750	72 500 7 400	8 050 820	38 500 3 900
	35	29 $^{0}_{-0.210}$	28	44	41.5	0.6	62 000 6 350	85 500 8 700	8 050 820	37 000 3 750
80	35	29 $^{0}_{-0.210}$	28	44	41.5	0.6	62 000 6 350	85 500 8 700	9 800 1 000	41 000 4 150
	40	32 $^{0}_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700	9 800 1 000	44 500 4 500
85	45	32 $^{0}_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000	10 400 1 060	47 000 4 800
90	40	32 $^{0}_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700	11 400 1 160	50 000 5 100
	50	32 $^{0}_{-0.250}$	30	60	57	0.6	96 500 9 800	150 000 15 300	11 400 1 160	50 000 5 100
100	45	32 $^{0}_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000	13 000 1 330	55 500 5 650
110	50	32 $^{0}_{-0.250}$	30	60	57	0.6	96 500 9 800	150 000 15 300	14 700 1 500	61 000 6 200

Notes:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NUTR2·X and NUTR3·X types whose outside surface form is cylindrical.
2) The minimum value of chamfer dimension *r*.

Limiting speed min^{-1} Grease lubrication	Roller Follower number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	OD[1)] mm D 0 −0.05
5 500	**NUTR202/3AS**	**NUTR202X/3AS**	0.100	**35**
4 700	**NUTR203/3AS**	**NUTR203X/3AS**	0.147	**40**
5 500	**NUTR302/3AS**	**NUTR302X/3AS**	0.160	**42**
4 700	**NUTR303/3AS**	**NUTR303X/3AS**	0.222	**47**
4 000	**NUTR204/3AS**	**NUTR204X/3AS**	0.245	
4 000	**NUTR304/3AS**	**NUTR304X/3AS**	0.321	**52**
3 300	**NUTR205/3AS**	**NUTR205X/3AS**	0.281	
3 300	**NUTR305/3AS**	**NUTR305X/3AS**	0.450	**62**
2 900	**NUTR206/3AS**	**NUTR206X/3AS**	0.466	
2 900	**NUTR306/3AS**	**NUTR306X/3AS**	0.697	**72**
2 400	**NUTR207/3AS**	**NUTR207X/3AS**	0.630	
2 400	**NUTR307/3AS**	**NUTR307X/3AS**	0.840	**80**
2 100	**NUTR208/3AS**	**NUTR208X/3AS**	0.817	
1 900	**NUTR209/3AS**	**NUTR209X/3AS**	0.883	**85**
2 100	**NUTR308/3AS**	**NUTR308X/3AS**	1.13	**90**
1 800	**NUTR210/3AS**	**NUTR210X/3AS**	0.950	
1 900	**NUTR309/3AS**	**NUTR309X/3AS**	1.40	**100**
1 800	**NUTR310/3AS**	**NUTR310X/3AS**	1.69	**110**

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without shield	with shield

NUTW type
NUTW··X type



NUTW2 type

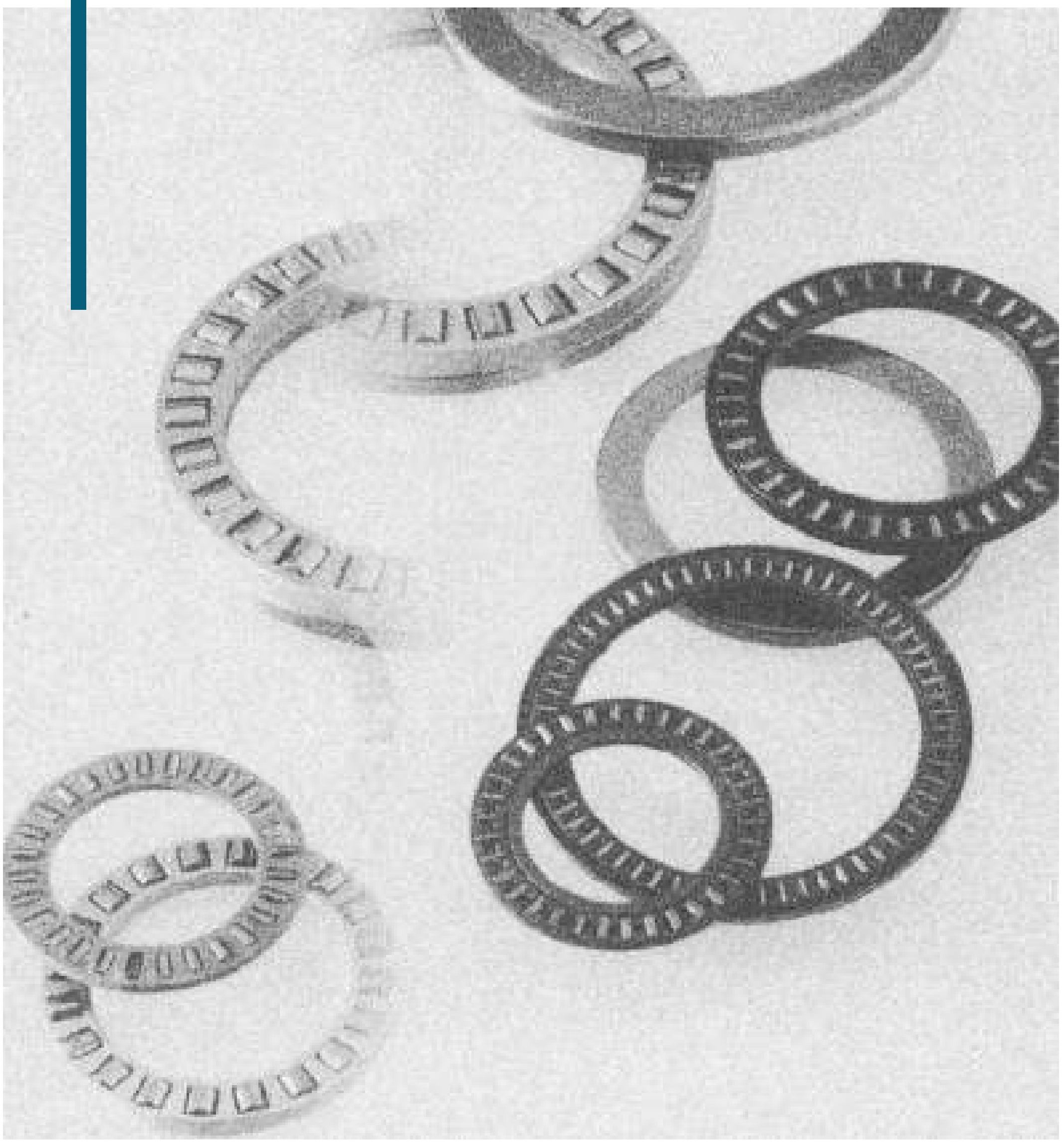
D 35～90mm

OD[1)] mm *D* 0 −0.05	Dimensions mm *d*	*B*	*C*	*e*	*F*	$r_{s\,min}$[2)]	Basic load ratings N kgf dynamic C_r	static C_{or}	Track load capacity N kgf Spherical outer ring	Cylindrical outer ring
35	15	22 $^{0}_{-0.210}$	21	20	19	0.3	24 100 2 460	28 300 2 880	3 200 325	14 200 1 450
40	17	24 $^{0}_{-0.210}$	23	22	21.5	0.3	26 000 2 650	32 000 3 250	3 850 390	17 100 1 740
47	20	29 $^{0}_{-0.210}$	28	27	25.5	0.3	40 500 4 150	51 500 5 250	4 700 480	25 100 2 560
52	25	29 $^{0}_{-0.210}$	28	31	30	0.3	45 000 4 600	61 500 6 250	5 550 565	27 700 2 830
62	30	35 $^{0}_{-0.210}$	34	38	35	0.3	59 500 6 050	77 000 7 900	6 950 710	41 000 4 200
72	35	35 $^{0}_{-0.210}$	34	44	41.5	0.6	65 000 6 650	91 000 9 250	8 050 820	46 000 4 700
80	40	38 $^{0}_{-0.250}$	36	51	47.5	0.6	90 500 9 250	131 000 13 400	9 800 1 000	54 500 5 550
85	45	38 $^{0}_{-0.250}$	36	55	52.5	0.6	95 500 9 750	144 000 14 700	10 400 1 060	58 000 5 900
90	50	38 $^{0}_{-0.250}$	36	60	57	0.6	100 000 10 200	158 000 16 100	11 400 1 160	61 500 6 250

Notes:1) The bearing numbers of bearings whose outer ring surface is cylindrical have the suffix "X" JIS Class 0 is the dimensional tolerance of the outside dia of the outer rings of the bearings whose outside surface form is cylindrical. Example: NUTW203X
2) The minimum value of chamfer dimension *r*

Limiting speed min-1	Roller Follower number		Mass	OD[1)] mm D
Grease lubrication	Spherical outer ring	Cylindrical outer ring	kg (approx.)	0 −0.05
5500	**NUTW202/3AS**	**NUTW202X/3AS**	0.115	**35**
4700	**NUTW203/3AS**	**NUTW203X/3AS**	0.167	**40**
4000	**NUTW204/3AS**	**NUTW204X/3AS**	0.280	**47**
3300	**NUTW205/3AS**	**NUTW205X/3AS**	0.322	**52**
2900	**NUTW206/3AS**	**NUTW206X/3AS**	0.549	**62**
2400	**NUTW207/3AS**	**NUTW207X/3AS**	0.747	**72**
2100	**NUTW208/3AS**	**NUTW208X/3AS**	0.953	**80**
1900	**NUTW209/3AS**	**NUTW209X/3AS**	1.03	**85**
1800	**NUTW210/3AS**	**NUTW210X/3AS**	1.11	**90**

Thrust Roller Bearings

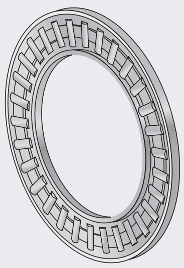
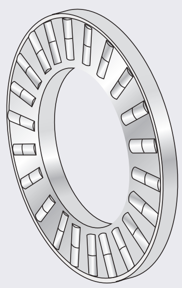
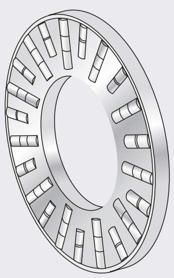


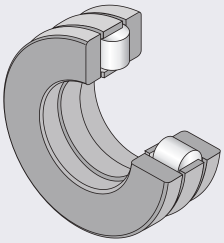
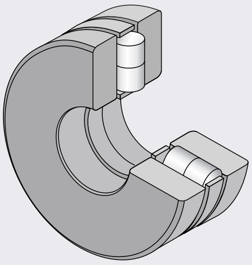
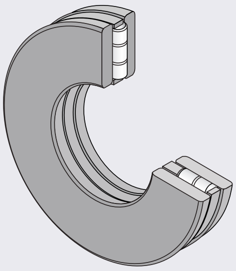
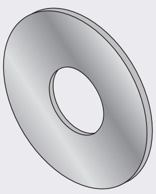
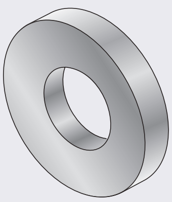
Thrust Roller Bearings

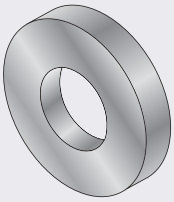
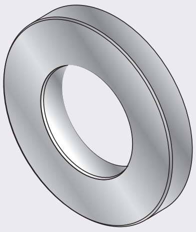
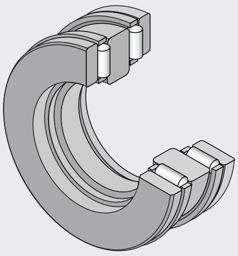
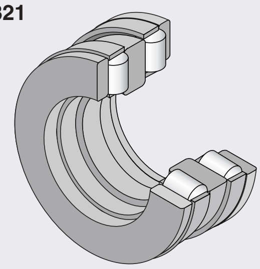
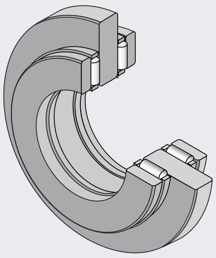
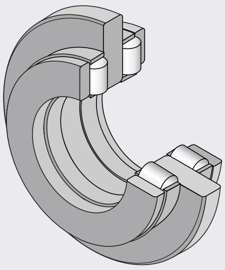
This thrust roller bearing composed of a thrust roller and cage assembly, wherein needle rollers or cylindrical rollers are configured radially in the cage, and a bearing ring of disc form is intended to support one-directional axial load.

In mounting, it is possible to use a shaft or a housing as the direct raceway surface without using the bearing ring, whereby design of a low height and lightweight compact construction is enabled.

This type of thrust roller bearing results in slipping on raceway surface because theoretically it can't roll perfectly, but in most cases it is practically trouble-free and can rotates at comparatively high speed.

Bearing type	Cage type	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
AXK 	Pressed steel cage	φ10—φ120	**AXK 11 04** Bore diameter code Dimension series code Type code	**AXK1104**	The type can be used together with theType AS bearing ring with the lower limit of safety factor S_0 is 3
	High strength brass cage	φ130—φ160			
K811 K812 	Standard type Polyamide resin cage	**Type K811** φ10—φ120 **Type K812** φ30—φ80	**K8 11 10 T2** Suffix Bore diameter code Dimension series code Type code	**K81110T2**	The suffix T2 means that this bearing uses a polyamide resin cage. Therefore, use this bearing at a temperature 120˚C or lower; or at 100˚C or lower for continuous operation. Feel free to contact NTN for the detail of the pressed steel cage. Possible to use in combination with GS and WS bearing rings. K811 conforms to the Dimension Series 11 specified in JIS B 1512. K812 conforms to the Dimension Series 12 specified in JIS B 1512.
	Aluminum alloy cage	**Type K811** φ130—φ160 **Type K812** φ85—φ140			
	Pressed steel cage	φ10—φ90	**[Suffix]** T2: resin cage JW: Pressed steel cage		
K893 	Aluminum alloy cage	φ30—φ110	**K8 93 10** Bore diameter code Dimension series code Type code	**K89310**	K893 conforms to the Dimension Series 93 specified in JIS B 1512.
K874 	Aluminum alloy cage	φ40—φ90	**K8 74 10** Bore diameter code Dimension series code Type code	**K87410**	K893 conforms to the Dimension Series 93 specified in JIS B 1512.

Bearing type		Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
811 812 		ϕ10—ϕ160	8 11 10 T2 Suffix Bore diameter code Dimension series code Type code [Suffix] T2: resin cage J: Punched steel plate cage	81110T2	The suffix T2 means that this bearing uses a polyamide resin cage. Therefore, use this bearing at a temperature 120˚C or lower; or at 100˚C or lower for continuous operation. WS and GS bearing rings are used in set. 811 conforms to the Dimension Series 11 specified in JIS B 1512. 812 conforms to the Dimension Series 12 specified in JIS B 1512.
893 		ϕ30—ϕ110	8 93 10 Bore diameter code Dimension series code Type code	89310	WS and GS bearing rings are used in set. 893 conforms to the Dimension Series 93 specified in JIS B 1512.
874 		ϕ40—ϕ90	8 74 10 Bore diameter code Dimension series code Type code	87410	WS and GS bearing rings are used in set. 874 conforms to the Dimension Series 74 specified in JIS B 1512.
AS 	Pressed steel ring	ϕ10—ϕ160	AS 11 04 Bore diameter code Dimension series code Type code	AS1104	Because of its 1mm thick steel plate ring, this thrust bearing needs adequate rigidity and profile accuracy of machine parts adjacent to the bearing. As an individual, on occasion this thrust bearing results in slight camber, but it is flattened when specific thrust load acts thereon, having no problem in practical use. The lower limit of safety factor S_0 is 3.
WS811 WS893 WS812 WS874 	Machined type, for inner ring land riding	ϕ10—ϕ160	WS8 11 04 Bore diameter code Dimension series code Type code	WS81104	Higher rigidity and higher running accuracy than AS bearing ring .

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
GS811 GS893 **GS812 GS874**  Machined type, for outer ring land riding	φ10—φ160	**GS8 11 04** 04: Bore diameter code 11: Dimension series code GS8: Type code	**GS81104**	Higher rigidity and higher running accuracy than AS bearing ring .
ZS (Central washer) 	φ10—φ160	**ZS 15 34** 34: Outside diameter 15: Dimension series code ZS: Type code	**ZS1534**	The central washer is used as an outer ring or inner ring in a double-direction thrust roller bearing. This washer can be used in combination with needle roller and cage thrust assembly AXK, or cylindrical roller and cage thrust assembly K811, or locking ring (outer ring) GS811 for locking the bearing to a housing or locking ring (inner ring) WS811 for locking the bearing to a shaft.
AXA21 	φ10—φ140 (Central washer)	**AXA21 04** 04: Bore diameter code AXA21: Type code	**AXA2104**	This is a double-direction thrust roller bearing that comprises two needle roller and cage thrust assemblies AXK, two housing-side locking rings (outer rings) GS811 and one central ring ZS.
ARA821 	φ10—φ140 (Central washer)	**ARA821 04 T2** T2: Suffix 04: Bore diameter code ARA821: Type code [Suffix] T2: resin cage	**ARA82104T2**	The suffix T2 means that this bearing uses a polyamide molded cage. Therefore, use this bearing at a temperature 120˚C or lower; or at 100˚C or lower for continuous operation. This is a double-direction thrust cylindrical roller bearing that comprises two cylindrical roller and cage thrust assemblies K811, two housing-side locking rings (outer rings) GS811 and one central ring ZS.
AXB21 	φ15—φ160 (Central washer)	**AXB21 04** 04: Bore diameter code AXB21: Type code	**AXB2104**	This is a double-direction thrust needle roller bearing that comprises two needle roller and cage thrust assemblies AXK, two shaft-side locking rings (inner rings) WS811 and one central ring ZS.
ARB821 	φ15—φ160 (Central washer)	**ARB821 04 T2** T2: Suffix 04: Bore diameter code ARB821: Type code [Suffix] T2: resin cage	**ARB82104T2**	The suffix T2 means that this bearing uses a polyamide molded cage. Therefore, use this bearing at a temperature 120˚C or lower; or at 100˚C or lower for continuous operation. This is a double-direction thrust cylindrical roller bearing that comprises two cylindrical roller and cage thrust assemblies K811, two shaft-side locking rings (inner rings) WS811 and one central ring ZS.

Bearing accuracy

The dimensional accuracy, profile accuracy and running accuracy of **Types 811, 812, 893** and **874** thrust cylindrical roller bearings shall be as specified in **Table 4.4** in Sec. **4. "Bearing accuracy"** (page A-28).

The thrust roller and cage assembly **Types AXK, K881, K812, K893** and **K874** are machined to the following dimensional tolerances: E11 (or E12 for bearing marked with T2) for bore diameter (D_{c1}) and c12 for outside diameter (D_c) on **Type AXK**, and a13 for **Types K811, K81, K893** and **K874**.

Raceway surface requirements:

Where the plane portion of a shaft/a housing is used as the direct raceway surface of thrust roller and cage assembly, the raceway surface must meet the requirements specified as a guideline in **Table 1**.

Table 1 Raceway surface requirements (recommended)

Characteristics	Specified requirements
Perpendicularity (Max)	IT5 (IT4)
Surface roughness	0.2a
Surface hardness	HRC58～64
Effective case depth	Refer to Formula (8.1) on page A-40.

Reference : The parenthesized value shall be applied for high running accuracy.

Cage guiding

To be able to center a running thrust roller and cage assembly (Type **AXK, K811, K812, K893 K874**), it is necessary to guide it on its bore (shaft side) or outside surface (housing side).

In general, the bore-side guide of low relative speed against the cage is mostly used. It should be used particularly for high speed running. The dimensional tolerances for shaft and housing, when the cage is guided thereby, shall be h8 for shaft diameter (bore guide) and H9 for housing bore diameter (outer surface guide) respectively, which of the guide surface shall be fine-finished by grinding.

Bearing fit in bearing ring

Table 2 shows the tolerances for fitting of the thrust bearing rings (**AS**, **WS** and **GS**) on shaft or in housing.

Table 2 Bearing ring fit in shaft and housing (recommended)

Bearing ring		Shaft	Housing
Type AS	Locking to shaft	h10	Clearance to housing
	Locking to housing	Clearance to shaft	H11
Type WS (inner ring)		h6	—
Type GS (outer ring)		—	H7
Type ZS (central ring)	Locking to shaft	h6	—
	Locking to housing	—	H7

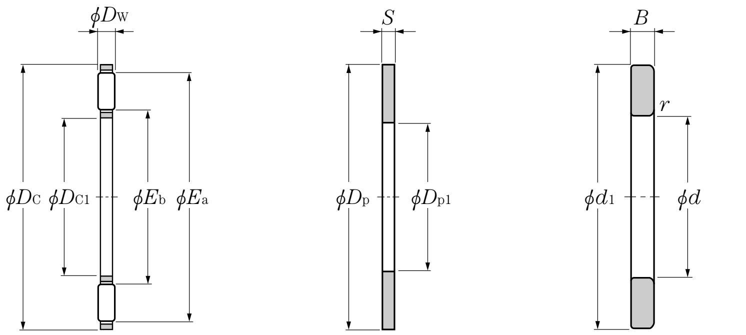
Mounting related dimensions

The mounting dimensions for bearing ring **Types WS, GS** and **ZS** relative to a shaft or housing are listed in the relevant dimension table.

The fitting surface of **AS** bearing ring must be flat and have the rigidity sufficient to support thrust load throughout its entire surface.

The bearing ring has to be installed in correct orientation so that its raceway surface is seated onto the rolling elements. (As shown in the diagram in the relevant dimension table, the narrower chamfering on the bearing ring marks the raceway surface.)

Type AXK11
Type AS11
Type WS811
Type GS811

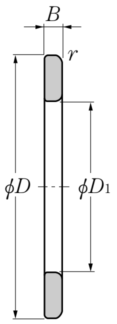


Type AXK (Thrust needle roller and cage assy) **AS bearing ring (washer)** **WS bearing ring (Inner ring)**

D_{c1} 10～140mm

Boundary dimensions mm												Basic load ratings dynamic N	static N	dynamic kgf	static kgf
D_{c1}	D_c	D_w	D_p	D_{p1}	S [2]	d	d_1	D	D_1	B	$r_{s\,min}$ [1]	C_a	C_{oa}	C_a	C_{oa}
E11	c12	0 -0.01	e13	E12	0.05		-0.2 -0.5		+0.5 +0.2						
10	24	2	24	10	1	10	24	24	10	$2.75_{-0.060}^{0}$	0.3	9 150	25 300	935	2 580
12	26	2	26	12	1	12	26	26	12	$2.75_{-0.060}^{0}$	0.3	9 850	28 900	1 010	2 940
15	28	2	28	15	1	15	28	28	16	$2.75_{-0.060}^{0}$	0.3	11 300	36 000	1 150	3 700
17	30	2	30	17	1	17	30	30	18	$2.75_{-0.060}^{0}$	0.3	11 900	39 500	1 220	4 050
20	35	2	35	20	1	20	35	35	21	$2.75_{-0.060}^{0}$	0.3	13 200	46 500	1 340	4 750
25	42	2	42	25	1	25	42	42	26	$3_{-0.060}^{0}$	0.6	14 600	58 000	1 490	5 900
30	47	2	47	30	1	30	47	47	32	$3_{-0.060}^{0}$	0.6	16 300	69 500	1 660	7 100
35	52	2	52	35	1	35	52	52	37	$3.5_{-0.075}^{0}$	0.6	17 800	81 500	1 820	8 300
40	60	3	60	40	1	40	60	60	42	$3.5_{-0.075}^{0}$	0.6	27 400	110 000	2 790	11 300
45	65	3	65	45	1	45	65	65	47	$4_{-0.075}^{0}$	0.6	29 800	128 000	3 050	13 100
50	70	3	70	50	1	50	70	70	52	$4_{-0.075}^{0}$	0.6	31 500	143 000	3 250	14 500
55	78	3	78	55	1	55	78	78	57	$5_{-0.075}^{0}$	0.6	38 000	186 000	3 850	19 000
60	85	3	85	60	1	60	85	85	62	$4.75_{-0.075}^{0}$	1	44 500	234 000	4 550	23 900
65	90	3	90	65	1	65	90	90	67	$5.25_{-0.075}^{0}$	1	46 500	254 000	4 750	25 900
70	95	4	95	70	1	70	95	95	72	$5.25_{-0.075}^{0}$	1	53 500	253 000	5 500	25 800
75	100	4	100	75	1	75	100	100	77	$5.75_{-0.075}^{0}$	1	55 000	266 000	5 650	27 100
80	105	4	105	80	1	80	105	105	82	$5.75_{-0.075}^{0}$	1	56 500	279 000	5 750	28 400
85	110	4	110	85	1	85	110	110	87	$5.75_{-0.075}^{0}$	1	57 500	291 000	5 850	29 700
90	120	4	120	90	1	90	120	120	92	$6.5_{-0.090}^{0}$	1	70 500	390 000	7 200	39 500
100	135	4	135	100	1	100	135	135	102	$7_{-0.090}^{0}$	1	90 000	550 000	9 200	56 500
110	145	4	145	110	1	110	145	145	112	$7_{-0.090}^{0}$	1	93 500	590 000	9 550	60 500
120	155	4	155	120	1	120	155	155	122	$7_{-0.090}^{0}$	1	99 000	650 000	10 100	66 500
130	170	5	170	130	1	130	170	170	132	$9_{-0.090}^{0}$	1	140 000	900 000	14 300	92 000
140	180	5	180	140	1	140	178	180	142	$9.5_{-0.090}^{0}$	1	145 000	960 000	14 800	97 500

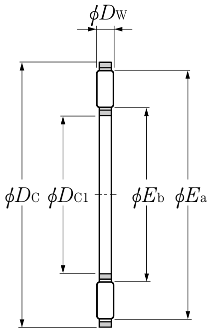
Note 1) Allowable minimum chamfer dimension r.
2) Subject to measured thrust load of 20kg or more.



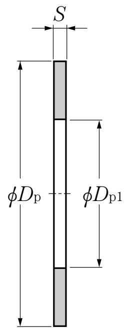
GS bearing ring
(Outer ring)

Limiting speeds min⁻¹ grease	oil	Bearing numbers thrust needle roller and cage assembly	washer	inner ring	outer ring	Reference dimensions mm E_b	E_a	Mass kg (approx.) AXK11	AS11	WS811 GS811
3 500	14 000	**AXK1100**	**AS1100**	**WS81100**	**GS81100**	12.3	21.7	0.0028	0.003	0.008
3 300	13 000	**AXK1101**	**AS1101**	**WS81101**	**GS81101**	14.3	23.7	0.003	0.0033	0.009
2 800	11 000	**AXK1102**	**AS1102**	**WS81102**	**GS81102**	17.2	26.5	0.0035	0.0035	0.01
2 500	10 000	**AXK1103**	**AS1103**	**WS81103**	**GS81103**	19.2	28.5	0.004	0.0038	0.011
2 100	8 500	**AXK1104**	**AS1104**	**WS81104**	**GS81104**	21.3	31.3	0.005	0.0051	0.014
1 800	7 000	**AXK1105**	**AS1105**	**WS81105**	**GS81105**	29.5	39.4	0.007	0.007	0.021
1 500	6 000	**AXK1106**	**AS1106**	**WS81106**	**GS81106**	34.5	44.4	0.008	0.008	0.025
1 400	5 500	**AXK1107**	**AS1107**	**WS81107**	**GS81107**	39.5	49.4	0.01	0.0091	0.033
1 200	4 700	**AXK1108**	**AS1108**	**WS81108**	**GS81108**	44.2	56.2	0.0185	0.0123	0.044
1 100	4 300	**AXK1109**	**AS1109**	**WS81109**	**GS81109**	50.5	62.4	0.0205	0.0136	0.055
1 000	3 900	**AXK1110**	**AS1110**	**WS81110**	**GS81110**	55.5	67.4	0.0235	0.0148	0.06
900	3 500	**AXK1111**	**AS1111**	**WS81111**	**GS81111**	61.0	74.9	0.0308	0.0189	0.095
800	3 200	**AXK1112**	**AS1112**	**WS81112**	**GS81112**	66.0	81.9	0.0390	0.0223	0.101
750	3 000	**AXK1113**	**AS1113**	**WS81113**	**GS81113**	71.0	86.9	0.04	0.0239	0.125
750	2 900	**AXK1114**	**AS1114**	**WS81114**	**GS81114**	75.5	91.4	0.06	0.0254	0.134
700	2 700	**AXK1115**	**AS1115**	**WS81115**	**GS81115**	80.5	96.4	0.061	0.027	0.155
650	2 600	**AXK1116**	**AS1116**	**WS81116**	**GS81116**	84.4	100.3	0.063	0.0284	0.163
600	2 400	**AXK1117**	**AS1117**	**WS81117**	**GS81117**	90.5	106.4	0.0668	0.0301	0.175
600	2 300	**AXK1118**	**AS1118**	**WS81118**	**GS81118**	96.5	116.4	0.086	0.0388	0.25
500	2 000	**AXK1120**	**AS1120**	**WS81120**	**GS81120**	107.5	131.4	0.112	0.0505	0.35
480	1 900	**AXK1122**	**AS1122**	**WS81122**	**GS81122**	115.5	139.4	0.122	0.0549	0.385
430	1 700	**AXK1124**	**AS1124**	**WS81124**	**GS81124**	125.5	149.4	0.131	0.0592	0.415
400	1 600	**AXK1126**	**AS1126**	**WS81126**	**GS81126**	136.0	164.0	0.205	0.074	0.663
380	1 500	**AXK1128**	**AS1128**	**WS81128**	**GS81128**	146.0	174.0	0.219	0.079	0.749

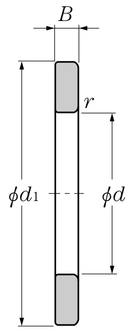
Type AXK11
Type AS11
Type WS811
Type GS811



Type AXK
(Thrust needle roller and cage assy)



AS bearing ring
(washer)

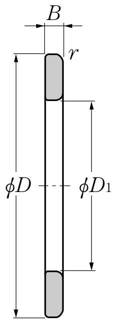


WS bearing ring
(Inner ring)

D_{c1} 150～160mm

Boundary dimensions mm												Basic load ratings			
												dynamic N	static N	dynamic kgf	static kgf
D_{c1}	D_c	D_w	D_p	D_{p1}	S [2]	d	d_1	D	D_1	B	$r_{s\,min}$ [1]	C_a	C_{oa}	C_a	C_{oa}
E11	c12	0 / -0.01	e13	E12	0.05		-0.2 / -0.5		+0.5 / +0.2						
150	190	5	190	150	1	150	188	190	152	9.5 $^{0}_{-0.090}$	1	149 000	1 020 000	15 200	104 000
160	200	5	200	160	1	160	198	200	162	9.5 $^{0}_{-0.090}$	1	154 000	1 070 000	15 700	110 000

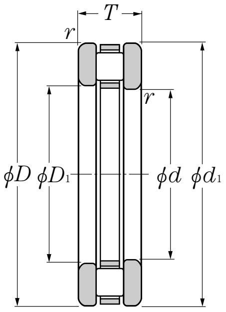
Note 1) Allowable minimum chamfer dimension r.
2) Subject to measured thrust load of 20kg or more.



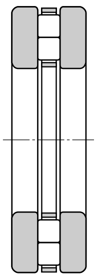
GS bearing ring
(Outer ring)

Limiting speeds min^{-1}		Bearing numbers				Reference dimensions mm		Mass kg (approx.)		
grease	oil	thrust needle roller and cage assembly	washer	inner ring	outer ring	E_b	E_a	AXK11	AS11	WS811 GS811
350	1 400	**AXK1130**	**AS1130**	**WS81130**	**GS81130**	156.0	184.2	0.232	0.084	0.796
330	1 300	**AXK1132**	**AS1132**	**WS81132**	**GS81132**	166.0	194.2	0.246	0.089	0.842

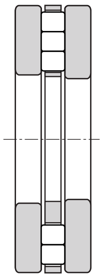
Type 811
Type 812
Type 893
Type 874



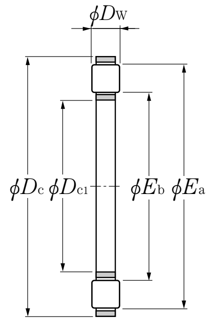
Type 811
Type 812
(Bearing)



Type 893
(Bearing)



Type 874

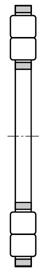


Type K811, type K812
(Thrust needle roller and cage assy)

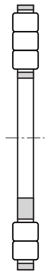
d 10〜55mm

Boundary dimensions										Basic load ratings				Limiting speeds	
mm										dynamic	static	dynamic	static	min-1	
										N		kgf			
d	*D*	d_1	D_1	*T*	D_{c1}	D_c	D_w	*B*	$r_{s\,min}$ 1)	C_a	C_{oa}	C_a	C_{oa}	grease	oil
		$^{-0.2}_{-0.5}$	$^{+0.5}_{+0.2}$		E11	a13	$^{0}_{-0.010}$	h11							
10	24	24	10	9	10	24	3.5	2.75	0.3	10 800	21 500	1 110	2 190	3 400	13 000
12	26	26	12	9	12	26	3.5	2.75	0.3	11 500	23 900	1 170	2 430	3 000	12 000
15	28	28	16	9	15	28	3.5	2.75	0.3	12 200	26 800	1 250	2 730	2 800	11 000
17	30	30	18	9	17	30	3.5	2.75	0.3	12 700	29 000	1 300	2 960	2 500	10 000
20	35	35	21	10	20	35	4.5	2.75	0.3	20 200	46 500	2 060	4 700	2 100	8 500
25	42	42	26	11	25	42	5	3	0.6	27 300	68 000	2 790	6 900	1 800	7 000
30	47	47	32	11	30	47	5	3	0.6	27 800	72 500	2 840	7 400	1 500	6 000
	52	52	32	16	30	52	7.5	4.25	0.6	53 000	129 000	5 450	13 100	1 500	6 000
	60	60	32	18	30	60	5.5	6.25	1	54 000	166 000	5 500	16 900	1 300	5 000
35	52	52	37	12	35	52	5	3.5	0.6	31 000	87 000	3 150	8 900	1 400	5 500
	62	62	37	18	35	62	7.5	5.25	1	54 500	139 000	5 550	14 200	1 200	4 900
	68	68	37	20	35	68	6	7	1	66 500	214 000	6 750	21 800	1 200	4 600
40	60	60	42	13	40	60	6	3.5	0.6	43 000	121 000	4 350	12 400	1 200	4 800
	68	68	42	19	40	68	9	5	1	74 500	190 000	7 600	19 400	1 100	4 400
	78	78	42	22	40	78	7	7.5	1	85 000	277 000	8 700	28 300	1 000	4 000
	90	90	42	23	40	90	6.5	8.25	1.1	111 000	435 000	11 400	44 000	900	3 600
45	65	65	47	14	45	65	6	4	0.6	45 500	135 000	4 650	13 800	1 100	4 400
	73	73	47	20	45	73	9	5.5	1	82 000	222 000	8 400	22 600	1 000	4 100
	85	85	47	24	45	85	7.5	8.25	1	102 000	345 000	10 400	35 000	900	3 600
	100	100	47	25	45	100	7	9	1.1	128 000	510 000	13 100	52 000	800	3 200
50	70	70	52	14	50	70	6	4	0.6	48 500	150 000	4 900	15 300	1 000	4 000
	78	78	52	22	50	78	9	6.5	1	85 000	238 000	8 650	24 200	950	3 800
	95	95	52	27	50	95	8	9.5	1.1	125 000	445 000	12 700	45 000	800	3 200
	110	110	52	27	50	110	8	9.5	1.5	168 000	680 000	17 200	69 000	730	2 900
55	78	78	57	16	55	78	6	5	0.6	62 500	215 000	6 350	21 900	900	3 600
	90	90	57	25	55	90	11	7	1	121 000	340 000	12 400	34 500	830	3 300
	105	105	57	30	55	105	9	10.5	1.1	158 000	570 000	16 100	58 000	730	2 900
	120	120	57	29	55	120	8	10.5	1.5	186 000	800 000	19 000	81 500	650	2 600

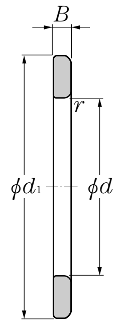
Note 1) Allowable minimum chamfer dimension.
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



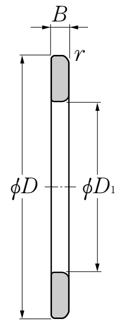
Type K893
(Thrust needle roller
and cage assy)



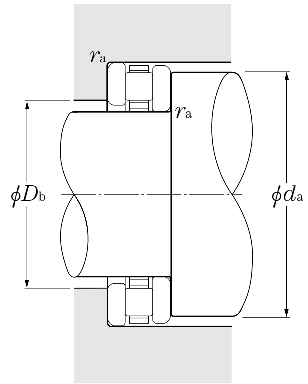
Type K874



WS bearing ring
(Inner ring)

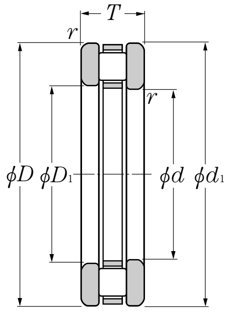


GS bearing ring
(Outer ring)

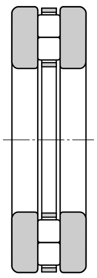


Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass kg		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	E_b	E_a	d_a min	D_b max	r_{as} max	811 812 893 874	K811 K812 K893 K874	WS GS
81100T2	**K81100T2**	**WS81100**	**GS81100**	13.5	21.3	21	14	0.3	0.0195	0.0035	0.008
81101T2	**K81101T2**	**WS81101**	**GS81101**	15.5	23.3	23	16	0.3	0.022	0.004	0.009
81102T2	**K81102T2**	**WS81102**	**GS81102**	17.2	25.0	25	18	0.3	0.026	0.006	0.010
81103T2	**K81103T2**	**WS81103**	**GS81103**	19.2	27.0	27	20	0.3	0.030	0.008	0.011
81104T2	**K81104T2**	**WS81104**	**GS81104**	22.4	32.3	32	23	0.3	0.040	0.012	0.014
81105T2	**K81105T2**	**WS81105**	**GS81105**	27.6	38.7	39	28	0.6	0.060	0.018	0.021
81106T2	**K81106T2**	**WS81106**	**GS81106**	33.1	43.9	44	33	0.6	0.070	0.020	0.025
81206T2	**K81206T2**	**WS81206**	**GS81206**	32.8	49.0	48	33	0.6	0.140	0.050	0.045
89306	**K89306**	**WS89306**	**GS89306**	34.0	56.4	56	34	1	0.250	0.046	0.100
81107T2	**K81107T2**	**WS81107**	**GS81107**	38.0	48.9	49	38	0.6	0.090	0.024	0.033
81207T2	**K81207T2**	**WS81207**	**GS81207**	39.8	56.0	56	41	1	0.235	0.065	0.085
89307	**K89307**	**WS89307**	**GS89307**	40.0	64.4	64	40	1	0.360	0.064	0.150
81108T2	**K81108T2**	**WS81108**	**GS81108**	43.2	56.4	56	44	0.6	0.135	0.035	0.044
81208T2	**K81208T2**	**WS81208**	**GS81208**	43.7	62.9	63	44	1	0.265	0.085	0.090
89308	**K89308**	**WS89308**	**GS89308**	46.0	74.4	74	46	1	0.520	0.100	0.210
87408	**K87408**	**WS87408**	**GS87408**	46	87	88	45	1.1	0.78	0.12	0.33
81109T2	**K81109T2**	**WS81109**	**GS81109**	48.4	61.6	61	49	0.6	0.150	0.040	0.055
81209T2	**K81209T2**	**WS81209**	**GS81209**	48.8	68.0	68	49	1	0.310	0.100	0.105
89309	**K89309**	**WS89309**	**GS89309**	50.9	81.3	81	51	1	0.670	0.140	0.270
87409	**K87409**	**WS87409**	**GS87409**	53	96	97	52	1.1	1.05	0.17	0.44
81110T2	**K81110T2**	**WS81110**	**GS81110**	53.2	66.4	66	54	0.6	0.165	0.045	0.060
81210T2	**K81210T2**	**WS81210**	**GS81210**	53.7	73.1	73	54	1	0.385	0.105	0.140
89310	**K89310**	**WS89310**	**GS89310**	58.0	90.4	90	58	1	0.940	0.180	0.380
87410	**K87410**	**WS87410**	**GS87410**	56	106	107	55	1.5	1.38	0.26	0.56
81111T2	**K81111T2**	**WS81111**	**GS81111**	57.8	75.2	75	58	0.6	0.250	0.060	0.095
81211T2	**K81211T2**	**WS81211**	**GS81211**	60.1	83.4	83	61	1	0.610	0.190	0.210
89311	**K89311**	**WS89311**	**GS89311**	63.9	100.3	100	64	1	1.270	0.240	0.520
87411	**K87411**	**WS87411**	**GS87411**	66	116	117	65	1.5	1.77	0.3	0.74

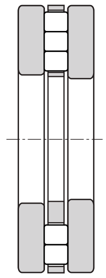
Type 811
Type 812
Type 893
Type 874



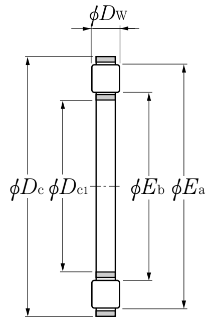
Type 811
Type 812
(Bearing)



Type 893
(Bearing)



Type 874

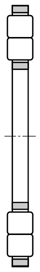


Type K811, type K812
(Thrust needle roller
and cage assy)

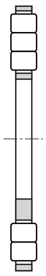
d 60～100mm

Boundary dimensions mm										Basic load ratings				Limiting speeds min⁻¹	
										dynamic (N)	static (N)	dynamic (kgf)	static (kgf)		
d	D	d_1 $^{-0.2}_{-0.5}$	D_1 $^{+0.5}_{+0.2}$	T	D_{c1} E11	D_c a13	D_w $^{0}_{-0.010}$	B h11	$r_{s\,min}$ 1)	C_a	C_{oa}	C_a	C_{oa}	grease	oil
60	85	85	62	17	60	85	7.5	4.75	1	69 000	215 000	7 000	21 900	830	3 300
	95	95	62	26	60	95	11	7.5	1	126 000	365 000	12 800	37 000	780	3 100
	110	110	62	30	60	110	9	10.5	1.1	162 000	600 000	16 500	61 500	680	2 700
	130	130	62	32	60	130	9	11.5	1.5	223 000	950 000	22 700	97 000	630	2 500
65	90	90	67	18	65	90	7.5	5.25	1	73 000	236 000	7 450	24 100	780	3 100
	100	100	67	27	65	100	11	8	1	130 000	385 000	13 300	39 500	730	2 900
	115	115	67	30	65	115	9	10.5	1.1	167 000	635 000	17 000	64 500	650	2 600
	140	140	68	34	65	140	10	12	2	258000	1 090 000	26 300	111 000	580	2 300
70	95	95	72	18	70	95	7.5	5.25	1	76 500	257 000	7 800	26 200	730	2 900
	105	105	72	27	70	105	11	8	1	134 000	410 000	13 700	42 000	680	2 700
	125	125	72	34	70	125	10	12	1.1	205 000	790 000	20 900	81 000	600	2 400
	150	150	73	36	70	150	11	12.5	2	315 000	1 330 000	32 000	136 000	550	2 200
75	100	100	77	19	75	100	7.5	5.75	1	78 000	268 000	7 950	27 300	680	2 700
	110	110	77	27	75	110	11	8	1	138 000	435 000	14 100	44 500	650	2 600
	135	135	77	36	75	135	11	12.5	1.5	239 000	920 000	24 400	94 000	550	2 200
	160	160	78	38	75	160	12	13	2	370 000	1 600 000	38 000	163 000	500	2 000
80	105	105	82	19	80	105	7.5	5.75	1	79 500	279 000	8 100	28 400	650	2 600
	115	115	82	28	80	115	11	8.5	1	143 000	460 000	14 500	47 000	630	2 500
	140	140	82	36	80	140	11	12.5	1.5	246 000	970 000	25 100	98 500	530	2 100
	170	170	83	41	80	170	12	14.5	2.1	390 000	1 740 000	40 000	178 000	480	1 900
85	110	110	87	19	85	110	7.5	5.75	1	83 000	300 000	8 450	30 500	630	2 500
	125	125	88	31	85	125	12	9.5	1	169 000	550 000	17 200	56 500	580	2 300
	150	150	88	39	85	150	12	13.5	1.5	281 000	1 100 000	28 700	113 000	500	2 000
	180	180	88	42	85	180	13	14.5	2.1	430 000	1 890 000	44 000	192 000	450	1 800
90	120	120	92	22	90	120	9	6.5	1	112 000	395 000	11 400	40 500	580	2 300
	135	135	93	35	90	135	14	10.5	1.1	213 000	680 000	21 700	69 500	530	2 100
	155	155	93	39	90	155	12	13.5	1.5	289 000	1 160 000	29 500	118 000	480	1 900
	190	190	93	45	90	190	13	16	2.1	450 000	2 060 000	46 000	210 000	430	1 700
100	135	135	102	25	100	135	11	7	1	158 000	555 000	16 100	57 000	500	2 000

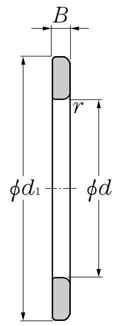
Note 1) Allowable minimum chamfer dimension *r*.
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



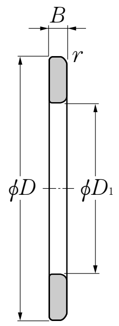
Type K893
(Thrust needle roller
and cage assy)



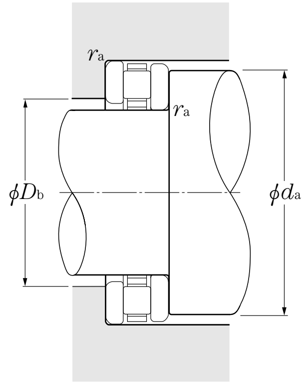
Type K874



WS bearing ring
(Inner ring)

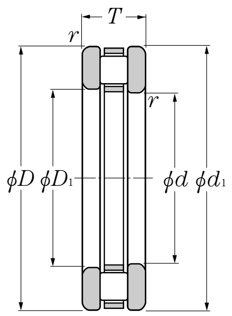


GS bearing ring
(Outer ring)

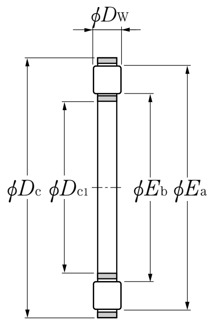


Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass kg		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	E_b	E_a	d_a min	D_b max	r_{as} max	811 812 893 874	K811 K812 K893 K874	WS GS
81112T2	**K81112T2**	**WS81112**	**GS81112**	63.7	80.1	80	65	1	0.285	0.083	0.101
81212T2	**K81212T2**	**WS81212**	**GS81212**	64.9	88.4	88	66	1	0.660	0.200	0.230
89312	**K89312**	**WS89312**	**GS89312**	68.9	105.3	105	69	1	1.350	0.250	0.550
87412	**K87412**	**WS87412**	**GS87412**	70	126	127	69	1.5	2.27	0.38	0.94
81113T2	**K81113T2**	**WS81113**	**GS81113**	68.8	85.2	85	70	1	0.340	0.090	0.125
81213T2	**K81213T2**	**WS81213**	**GS81213**	69.9	93.3	93	71	1	0.775	0.215	0.280
89313	**K89313**	**WS89313**	**GS89313**	73.9	110.3	110	74	1	1.430	0.260	0.580
87413	**K87413**	**WS87413**	**GS87413**	74	136	137	73	2	2.75	0.47	1.14
81114T2	**K81114T2**	**WS81114**	**GS81114**	73.7	90.1	90	74	1	0.365	0.097	0.135
81214T2	**K81214T2**	**WS81214**	**GS81214**	75.0	98.4	98	76	1	0.815	0.225	0.295
89314	**K89314**	**WS89314**	**GS89314**	79.8	120.2	120	80	1	1.930	0.340	0.800
87414	**K87414**	**WS87414**	**GS87414**	77	145	146	76	2	3.37	0.65	1.36
81115T2	**K81115T2**	**WS81115**	**GS81115**	78.7	95.1	95	80	1	0.425	0.115	0.155
81215T2	**K81215T2**	**WS81215**	**GS81215**	80.1	103.7	103	81	1	0.860	0.240	0.310
89315	**K89315**	**WS89315**	**GS89315**	84.7	129.2	129	85	1.5	2.410	0.470	0.970
87415	**K87415**	**WS87415**	**GS87415**	81	155	156	80	2	4.02	0.8	1.61
81116T2	**K81116T2**	**WS81116**	**GS81116**	83.7	100.1	100	85	1	0.445	0.119	0.165
81216T2	**K81216T2**	**WS81216**	**GS81216**	84.8	108.4	106	86	1	0.950	0.250	0.350
89316	**K89316**	**WS89316**	**GS89316**	89.8	134.2	134	90	1.5	2.530	0.490	1.020
87416	**K87416**	**WS87416**	**GS87416**	91	165	166	90	2.1	5.32	0.88	2.02
81117T2	**K81117T2**	**WS81117**	**GS81117**	88.7	105.3	105	89	1	0.475	0.125	0.175
81217	**K81217**	**WS81217**	**GS81217**	92.2	116.9	116	92	1	1.280	0.300	0.490
89317	**K89317**	**WS89317**	**GS89317**	95.8	144.2	144	96	1.5	3.140	0.590	1.280
87417	**K87417**	**WS87417**	**GS87417**	94	174	175	93	2.1	5.53	1.03	2.25
81118T2	**K81118T2**	**WS81118**	**GS81118**	94.7	114.3	114	95	1	0.670	0.170	0.250
81218J	**K81218J**	**WS81218**	**GS81218**	97.9	126.7	126	97	1	1.820	0.540	0.640
89318	**K89318**	**WS89318**	**GS89318**	100.8	149.2	149	101	1.5	3.280	0.620	1.330
87418	**K87418**	**WS87418**	**GS87418**	104	183	184	103	2.1	6.65	1.13	2.76
81120T2	**K81120T2**	**WS81120**	**GS81120**	105.1	128.7	128	106	1	1.000	0.300	0.350

Type 811
Type 812



Type 811
Type 812
(Bearing)

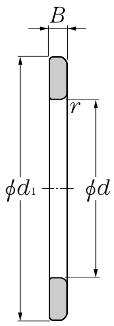


Type K811, type K812
(Thrust needle roller and cage assy)

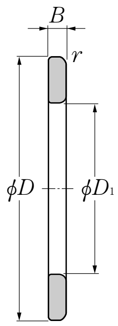
d 100～160mm

Boundary dimensions										Basic load ratings				Limiting speeds	
mm										dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	min^{-1}	
d	D	d_1 $^{-0.2}_{-0.5}$	D_1 $^{+0.5}_{+0.2}$	T	D_{c1} E11	D_c a13	D_w $^{0}_{-0.010}$	B h11	$r_{s\,min}$ 1)	C_a	C_{oa}	C_a	C_{oa}	grease	oil
100	150	150	103	38	100	150	15	11.5	1.1	243 000	795 000	24 800	81 000	480	1 900
	170	170	103	42	100	170	13	14.5	1.5	335 000	1 370 000	34 500	140 000	430	1 700
110	145	145	112	25	110	145	11	7	1	165 000	605 000	16 800	61 500	480	1 900
	160	160	113	38	110	160	15	11.5	1.1	258 000	885 000	26 400	90 000	450	1 800
	190	190	113	48	110	190	15	16.5	2	430 000	1 770 000	44 000	180 000	400	1 600
120	155	155	122	25	120	155	11	7	1	172 000	655 000	17 500	66 500	450	1 800
	170	170	123	39	120	170	15	12	1.1	264 000	930 000	26 900	94 500	430	1 700
130	170	170	132	30	130	170	12	9	1	197 000	755 000	20 100	77 000	400	1 600
	190	187	133	45	130	190	19	13	1.5	360 000	1 210 000	36 500	123 000	380	1 500
140	180	178	142	31	140	180	12	9.5	1	206 000	815 000	21 000	83 000	380	1 500
	200	197	143	46	140	200	19	13.5	1.5	370 000	1 280 000	38 000	130 000	350	1 400
150	190	188	152	31	150	190	12	9.5	1	214 000	870 000	21 800	89 000	350	1 400
160	200	198	162	31	160	200	12	9.5	1	221 000	930 000	22 600	95 000	330	1 300

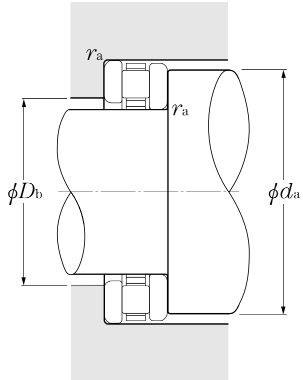
Note 1) Allowable minimum chamfer dimension r.



WS bearing ring
(Inner ring)

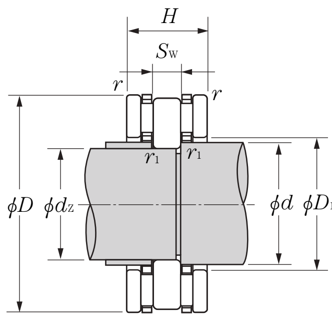


GS bearing ring
(Outer ring)

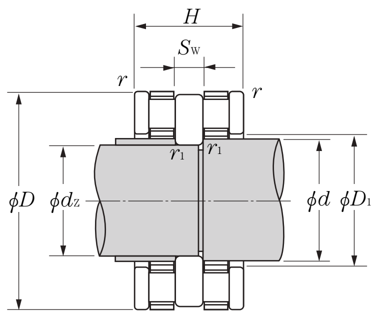


Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass kg		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	E_b	E_a	d_a min	D_b max	r_{as} max	811 812 893 874	K811 K812 K893 K874	WS GS
81220	**K81220**	**WS81220**	**GS81220**	109.2	140.0	139	109	1	2.240	0.620	0.810
89320	**K89320**	**WS89320**	**GS89320**	110.6	163.0	163	110	1.5	4.190	0.810	1.690
81122T2	**K81122T2**	**WS81122**	**GS81122**	115.0	138.8	138	116	1	1.100	0.325	0.385
81222	**K81222**	**WS81222**	**GS81222**	119.2	150.0	149	119	1	2.450	0.685	0.880
89322	**K89322**	**WS89322**	**GS89322**	122.5	183.0	183	122	2	6.030	1.150	2.440
81124T2	**K81124T2**	**WS81124**	**GS81124**	125.0	148.8	148	126	1	1.170	0.340	0.415
81224	**K81224**	**WS81224**	**GS81224**	129.2	160.0	159	129	1	2.690	0.730	0.980
81126	**K81126**	**WS81126**	**GS81126**	137.7	162.4	162	137	1	1.740	0.415	0.663
81226	**K81226**	**WS81226**	**GS81226**	140.1	179.0	178	140	1.5	4.200	1.140	1.530
81128	**K81128**	**WS81128**	**GS81128**	147.8	172.5	172	147	1	1.950	0.450	0.750
81228	**K81228**	**WS81228**	**GS81228**	150.1	189.0	188	150	1.5	4.570	1.200	1.690
81130	**K81130**	**WS81130**	**GS81130**	157.7	182.4	182	157	1	2.070	0.470	0.800
81132	**K81132**	**WS81132**	**GS81132**	167.8	192.5	192	167	1	2.190	0.500	0.840

Type AXA21
Type ARA821



Type AXA

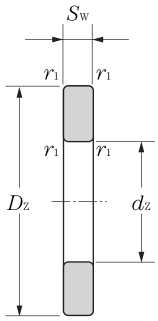


Type ARA

d 15～160mm

Shaft dia. d mm	Boundary dimensions d_z +0.5/+0.3	D_z -0.1/-0.2	D_1 +0.5/+0.2	D	H Type AXA	H Type ARA	S_w h11	$r_{s\,min}$ 3)	$r_{1s\,min}$ 4)	Type AXA 1) Basic load ratings dynamic C_a N	static C_{oa} N	dynamic C_a kgf	static C_{oa} kgf	Type ARA 2) Basic load ratings dynamic C_a N	static C_{oa} N
15	10	27	16	28	15	18	5.5	0.3	0.3	11 300	36 000	1 150	3 700	12 200	26 800
17	12	29	18	30	15	18	5.5	0.3	0.3	11 900	39 500	1 220	4 050	12 700	29 000
20	15	34	21	35	15	20	5.5	0.3	0.3	13 200	46 500	1 340	4 750	20 200	46 500
25	20	41	26	42	16	22	6	0.6	0.3	14 600	58 000	1 490	5 900	27 300	68 000
30	25	46	32	47	17	23	7	0.6	0.3	16 300	69 500	1 660	7 100	27 800	72 500
35	30	51	37	52	19	25	8	0.6	0.3	17 800	81 500	1 820	8 300	31 000	87 000
40	30	59	42	60	21	27	8	0.6	0.6	27 400	110 000	2 790	11 300	43 000	121 000
45	35	64	47	65	23	29	9	0.6	0.6	29 800	128 000	3 050	13 100	45 500	135 000
50	40	69	52	70	24	30	10	0.6	0.6	31 500	143 000	3 250	14 500	48 500	150 000
55	45	77	57	78	26	32	10	0.6	0.6	38 000	186 000	3 850	19 000	62 500	215 000
60	50	84	62	85	27	36	11.5	1	0.6	44 500	234 000	4 550	23 900	69 000	215 000
65	55	89	67	90	28.5	37.5	12	1	0.6	46 500	254 000	4 750	25 900	73 000	236 000
70	55	94	72	95	31	38	12.5	1	1	53 500	253 000	5 500	25 800	76 500	257 000
75	60	99	77	100	32	39	12.5	1	1	55 000	266 000	5 650	27 100	78 000	268 000
80	65	104	82	105	32	39	12.5	1	1	56 500	279 000	5 750	28 400	79 500	279 000
85	70	109	87	110	34	41	14.5	1	1	57 500	291 000	5 850	29 700	83 000	300 000
90	75	119	92	120	37	47	16	1	1	70 500	390 000	7 200	39 500	112 000	395 000
100	85	134	102	135	40	54	18	1	1	90 000	550 000	9 200	56 500	158 000	555 000
110	95	144	112	145	42	56	20	1	1	93 500	590 000	9 550	60 500	165 000	605 000
120	100	154	122	155	44	58	22	1	1	99 000	650 000	10 100	66 500	172 000	655 000
130	110	169	132	170	50	64	22	1	1	140 000	900 000	14 300	92 000	197 000	755 000
140	120	179	142	180	52	66	23	1	1	145 000	960 000	14 800	97 500	206 000	815 000
150	130	189	152	190	53	67	24	1	1	149 000	1 020 000	15 200	104 000	214 000	870 000
160	140	199	162	200	54	68	25	1	1	154 000	1 070 000	15 700	110 000	221 000	930 000

Note 1) AXA21 (Arrangement bearing) = AXK11 (Thrust needle roller bearing with cage (2)) + GS811 (Outer ring (2)) + ZS (Central washer (1))
2) ARA21 (Arrangement bearing) = K811 (Thrust cylindlical roller bearing with cage (2)) + GS811 (Outer ring (2)) + ZS (Central washer (1))

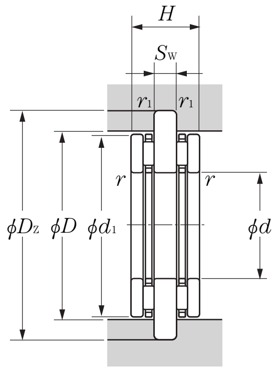


Type ZS

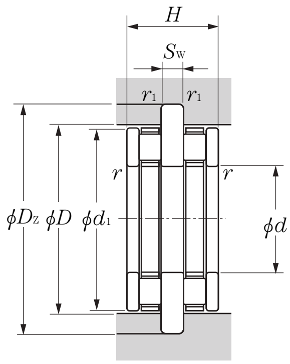
Type ARA[2] Basic load ratings dynamic kgf C_a	static kgf C_{oa}	Limiting speeds min^{-1} grease	oil	Bearing numbers Type AXA[1]	Type ARA[2]	Central washer Type ZS	Mass kg (approx.) Type AXA	Type ARA	Central washer Type ZS
1 250	2 730	2 800	11 000	AXA 2102	ARA 82102T2	ZS 1027	0.047	0.053	0.021
1 300	2 960	2 500	10 000	AXA 2103	ARA 82103T2	ZS 1229	0.052	0.061	0.023
2 060	4 700	2 100	8 500	AXA 2104	ARA 82104T2	ZS 1534	0.069	0.083	0.031
2 790	6 900	1 800	7 000	AXA 2105	ARA 82105T2	ZS 2041	0.102	0.124	0.046
2 840	7 400	1 500	6 000	AXA 2106	ARA 82106T2	ZS 2546	0.126	0.152	0.062
3 150	8 900	1 400	5 500	AXA 2107	ARA 82107T2	ZS 3051	0.165	0.195	0.081
4 350	12 400	1 200	4 700	AXA 2108	ARA 82108T2	ZS 3059	0.248	0.307	0.125
4 650	13 800	1 100	4 300	AXA 2109	ARA 82109T2	ZS 3564	0.305	0.346	0.156
4 900	15 300	1 000	3 900	AXA 2110	ARA 82110T2	ZS 4069	0.356	0.4	0.19
6 350	21 900	900	3 500	AXA 2111	ARA 82111T2	ZS 4577	0.485	0.545	0.235
7 000	21 900	800	3 200	AXA 2112	ARA 82112T2	ZS 5084	0.596	0.684	0.316
7 450	24 100	750	3 000	AXA 2113	ARA 82113T2	ZS 5589	0.692	0.79	0.36
7 800	26 200	750	2 900	AXA 2114	ARA 82114T2	ZS 5594	0.828	0.9	0.44
7 950	27 300	700	2 700	AXA 2115	ARA 82115T2	ZS 6099	0.902	1.01	0.47
8 100	28 400	650	2 600	AXA 2116	ARA 82116T2	ZS 65104	0.992	1.06	0.5
8 450	30 500	600	2 400	AXA 2117	ARA 82117T2	ZS 70109	1.09	1.21	0.612
11 400	40 500	600	2 300	AXA 2118	ARA 82118T2	ZS 75119	1.5	1.67	0.828
16 100	57 000	500	2 000	AXA 2120	ARA 82120T2	ZS 85134	2.11	2.48	1.18
16 800	61 500	480	1 900	AXA 2122	ARA 82122T2	ZS 95144	2.44	2.85	1.43
17 500	66 500	430	1 700	AXA 2124	ARA 82124T2	ZS 100154	2.92	3.34	1.83
20 100	77 000	400	1 600	AXA 2126	ARA 82126	ZS 110169	3.95	4.37	2.21
21 000	83 000	380	1 500	AXA 2128	ARA 82128	ZS 120179	4.4	4.85	2.46
21 800	89 000	350	1 400	AXA 2130	ARA 82130	ZS 130189	4.79	5.08	2.74
22 600	95 000	330	1 300	AXA 2132	ARA 82132	ZS 140199	5.21	5.72	3.03

Note 3) Allowable minimum chamfer dimension r.
4) Allowable minimum chamfer dimension r_1 .

Type AXB21
Type ARA821



Type AXB

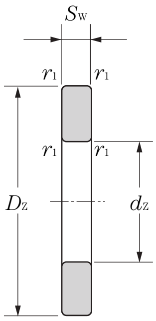


Type ARB

d_z 15～160mm

Shaft dia. d mm	Boundary dimensions d_z +0.5 +0.3	D_z -0.1 -0.2	d_1	d_1 -0.2 -0.5	H Type AXB	H Type ARB	S_w h11	$r_{s\,min}$ 3)	$r_{1s\,min}$ 4)	Type AXA 1) Basic load ratings dynamic C_a (N)	static C_{oa} (N)	dynamic C_a (kgf)	static C_{oa} (kgf)	Type ARA 2) Basic load ratings dynamic C_a (N)	static C_{oa} (N)
15	15	34	15	28	15	18	5.5	0.3	0.3	11 300	36 000	1 150	3 700	12 200	26 800
20	20	41	20	35	15.5	20.5	6	0.3	0.3	13 200	46 500	1 340	4 750	20 200	46 500
25	25	46	25	42	17	23	7	0.6	0.3	14 600	58 000	1 490	5 900	27 300	68 000
30	30	51	30	47	18	24	8	0.6	0.3	16 300	69 500	1 660	7 100	27 800	72 500
35	35	64	35	52	20	26	9	0.6	0.6	17 800	81 500	1 820	8 300	31 000	87 000
40	40	69	40	60	23	29	10	0.6	0.6	27 400	110 000	2 790	11 300	43 000	121 000
45	45	77	45	65	24	30	10	0.6	0.6	29 800	128 000	3 050	13 100	45 500	135 000
50	50	84	50	70	25.5	31.5	11.5	0.6	0.6	31 500	143 000	3 250	14 500	48 500	150 000
55	55	89	55	78	28	34	12	0.6	0.6	38 000	186 000	3 850	19 000	62 500	215 000
60	60	99	60	85	28	37	12.5	1	1	44 500	234 000	4 550	23 900	69 000	215 000
65	65	104	65	90	29	38	12.5	1	1	46 500	254 000	4 750	25 900	73 000	236 000
70	70	109	70	95	33	40	14.5	1	1	53 500	253 000	5 500	25 800	76 500	257 000
75	75	119	75	100	35.5	42.5	16	1	1	55 000	266 000	5 650	27 100	78 000	268 000
85	85	134	85	110	37.5	44.5	18	1	1	57 500	291 000	5 850	29 700	83 000	300 000
100	100	154	100	135	44	58	22	1	1	90 000	550 000	9 200	56 500	158 000	555 000
110	110	169	110	145	44	58	22	1	1	93 500	590 000	9 550	60 500	165 000	605 000
120	120	179	120	155	45	59	23	1	1	99 000	650 000	10 100	66 500	172 000	655 000
130	130	189	130	170	52	66	24	1	1	140 000	900 000	14 300	92 000	197 000	755 000
140	140	199	140	178	54	68	25	1	1	145 000	960 000	14 800	97 500	206 000	815 000
150	150	214	150	188	56	70	27	1	1	149 000	1 020 000	15 200	104 000	214 000	870 000
160	160	224	160	198	58	72	29	1	1	154 000	1 070 000	15 700	110 000	221 000	930 000

Note 1) AXB21 (Arrangement bearing) = AXK11 (Thrust needle roller bearing with cage) (2) + WS811 (Inner ring) (2) + ZS (Central washer) (1)
2) ARB21 (Arrangement bearing) = K811 (Thrust cylindlical roller bearing with cage) (2) + WS811 (Inner ring) (1) + ZS (Central washer) (1)

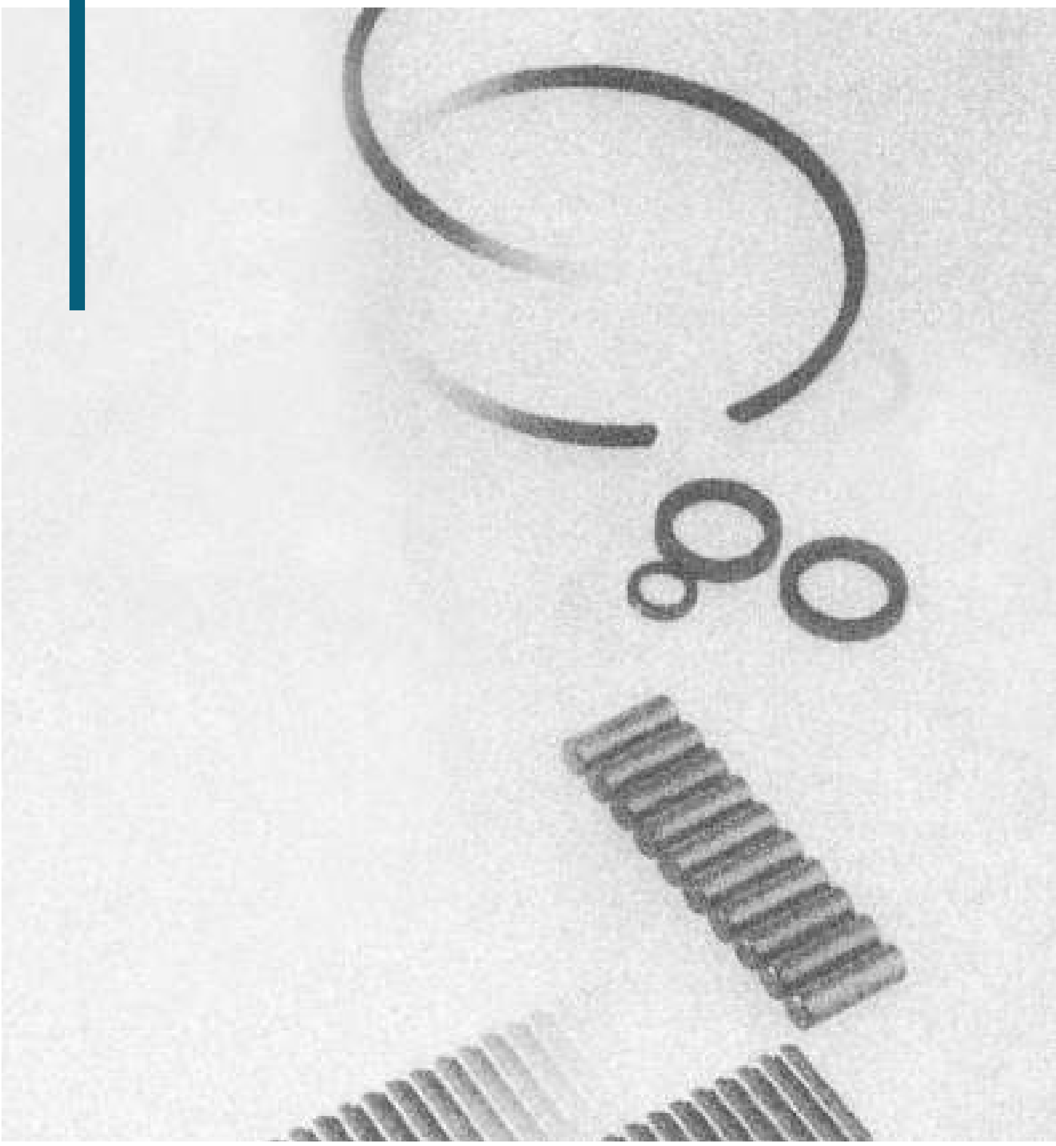


Type ZS

Basic load ratings Type ARB[3] dynamic kgf C_a	static kgf C_{oa}	Limiting speeds min^{-1} grease	oil	Bearing numbers Type AXB[4]	Type ARB[3]	Central washer Type ZS	Abutment dimensions Shaft dia. D min	Mass kg (approx.) Type AXB	Type ARB	Central washer Type ZS
1 250	2 730	2 800	11 000	AXB 2102	ARB 82102T2	ZS 1534	28.5	0.057	0.063	0.031
2 060	4 700	2 100	8 500	AXB 2104	ARB 82104T2	ZS 2041	35.5	0.084	0.098	0.046
2 790	6 900	1 800	7 000	AXB 2105	ARB 82105T2	ZS 2546	42.5	0.118	0.14	0.062
2 840	7 400	1 500	6 000	AXB 2106	ARB 82106T2	ZS 3051	47.5	0.145	0.171	0.081
3 150	8 900	1 400	5 500	AXB 2107	ARB 82107T2	ZS 3564	53	0.24	0.27	0.156
4 350	12 400	1 200	4 700	AXB 2108	ARB 82108T2	ZS 4069	61	0.314	0.373	0.191
4 650	13 800	1 100	4 300	AXB 2109	ARB 82109T2	ZS 4577	66	0.384	0.425	0.235
4 900	15 300	1 000	3 900	AXB 2110	ARB 82110T2	ZS 5084	71	0.481	0.526	0.316
6 350	21 900	900	3 500	AXB 2111	ARB 82111T2	ZS 5589	79	0.61	0.67	0.36
7 000	21 900	800	3 200	AXB 2112	ARB 82112T2	ZS 6099	86	0.75	0.838	0.47
7 450	24 100	750	3 000	AXB 2113	ARB 82113T2	ZS 65104	91	0.832	0.93	0.5
7 800	26 200	750	2 900	AXB 2114	ARB 82114T2	ZS 70109	96	1	1.07	0.612
7 950	27 300	700	2 700	AXB 2115	ARB 82115T2	ZS 75119	101	1.26	1.37	0.828
8 450	30 500	600	2 400	AXB 2117	ARB 82117T2	ZS 85134	111	1.66	1.78	1.18
16 100	57 000	500	2 000	AXB 2120	ARB 82120T2	ZS 100154	136	2.76	3.13	1.83
16 800	61 500	480	1 900	AXB 2122	ARB 82122T2	ZS 110169	146	3.22	3.63	2.21
17 500	66 500	430	1 700	AXB 2124	ARB 82124T2	ZS 120179	156	3.55	3.97	2.46
20 100	77 000	400	1 600	AXB 2126	ARB 82126	ZS 130189	171	4.48	4.9	2.74
21 000	83 000	380	1 500	AXB 2128	ARB 82128	ZS 140199	181	4.97	5.42	3.03
21 800	89 000	350	1 400	AXB 2130	ARB 82130	ZS 150214	191	5.88	6.37	3.83
22 600	95 000	330	1 300	AXB 2132	ARB 82132	ZS 160224	202	6.53	7.04	4.35

Note 3) Allowable minimum chamfer dimension r.
4) Allowable minimum chamfer dimension r_1.

COMPONENTS
Needle Rollers/Snap Rings/Seals



Needle Rollers

NTN needle rollers are all made of high carbon chrome bearing steel, fine-finished by grinding and polishing after heat-treated, and the hardness thereof ranges from HRC60 to 65. These needle rollers are supplied as not only rolling element but also pin and shaft individuals.

End face profile of needle roller

F-type needle roller bearing with flat end face is standard type, while A-type with round end face is semi-standard type. In addition to these two types, another needle roller type (nominal number with (suffix E) capable of damping edge load is also available. Feel free to contact **NTN** for the detail thereof.

Table 1 End face profile

Type	Name	Profile
F	Flat	
A	Round	

Composition of needle roller number

The needle roller number comprises type code (end face profile), dimension code [diameter (D_w)×length (L_w)] and a suffix.

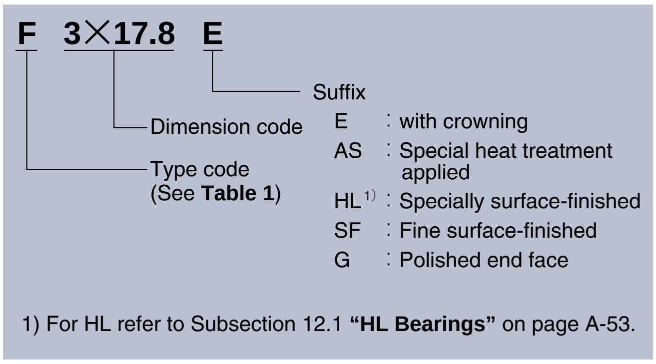


Fig. 1

Needle roller tolerances

The **NTN** needle rollers are manufactured per the dimensional accuracy and profile accuracy specified in JIS B 1506 "Rollers for roller bearings". (Refer to **Table 2** in this page.)

Table 2 Needle roller tolerances Unit: μm

Characteristics	Tolerance and allowable value
Tolerance for mean value of diameter D_w	0～−10
Mutual deviation of diameter D_w	2
Roundness of diameter D_w, Diameter variation in a single radial plane	1.0 (L_w/D_w≦6) 1.5 (L_w/D_w>6)
Tolerance for length L_w	h13
Accuracy class	Class-2

The needle rollers are delivered contained in same package after the mutual deviation of diameter D_w was assorted to 2μm and less. Before being delivered, the needle rollers are identified by label colors such as red, dark blue, blue, etc. according to the respective dimensional tolerances.

Further, mixed use of needle rollers contained in packages of different label colors is prohibited.

Table 3 Discrimination of needle rollers

Label color	Dimensional tolerance range μm	Discrimination
Red Dark blue Blue Black White	0～−2 −1～−3 −2～−4 −3～−5 −4～−6	Standard
Gray Green Brown Yellow	−5～−7 −6～−8 −7～−9 −8～−10	Semi-standard

Application of needle rollers

When configuring a full complement needle roller bearing using standard needle rollers, the shaft diameter (d), housing bore diameter (D), circumferential clearance (ΔC) and radial internal clearance (Δr) can be determined based on the needle roller diameter (D_w) and number of rollers (Z) by using the formula below (refer to **Fig. 2**).

Determine the minimum value of circumferential clearance (ΔC) using **formula (1)**. The radial internal clearance (Δr) of an intended needle roller bearing can be determined based on the shaft diameter and projected bearing operating conditions by referring to **Table 5.1** in Sec. **5.1 "Bearing radial internal clearance"** (page A-30). Generally, any full complement roller bearing needs a greater radial internal clearance compared with a needle roller and cage assembly.

$$\Delta C = (0.005 \sim 0.020) \times Z \text{ mm (minimum value)} \quad \textbf{(1)}$$

Then, determine the minimum value of housing bore diameter (D) and the maximum value of shaft diameter (d) using the **formulas (2)** and **(3)**.

$$D = \frac{1}{\sin\left(\frac{\pi}{Z}\right)} \cdot \left(D_w + \frac{\Delta C}{Z}\right) + D_w \text{ mm (minimum value)} \quad \cdots\cdots\cdots\cdots\textbf{(2)}$$

$$d = D - 2D_w - \Delta r \text{ mm (maximum value)} \cdots\cdots\cdots\textbf{(3)}$$

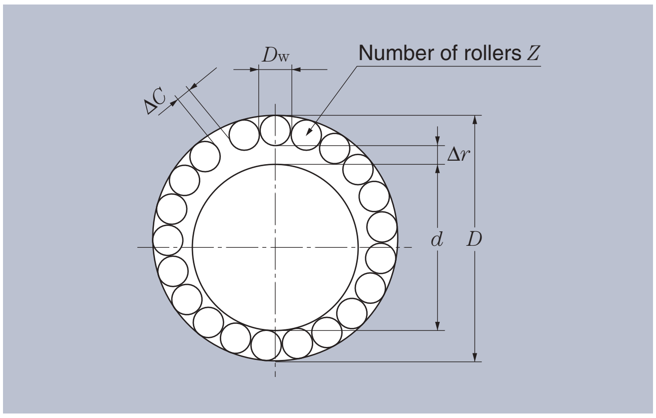


Fig. 2

The maximum value of housing bore diameter (D) required to retain needle rollers in a housing by a keystone can be determined from the minimum diameter value ($D_{w\,min}$) of the roller and the number of rollers using **formula (4)**. The coefficient K to be used in that time is as shown in **Table 4**.

$$D = K \cdot D_{w\,min} \text{ mm (max.)} \cdots\cdots\cdots\cdots\cdots\cdots\textbf{(4)}$$

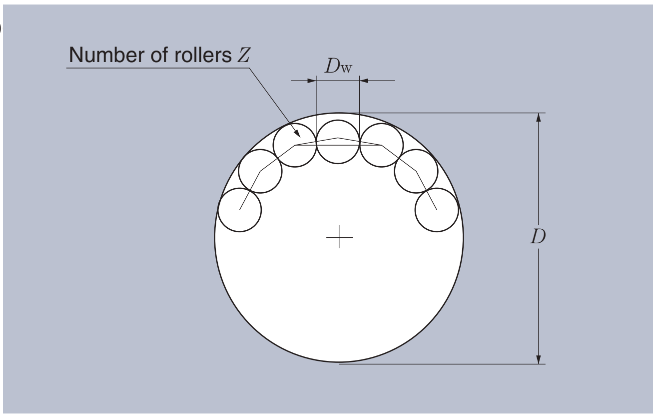
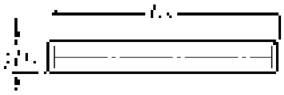


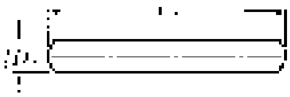
Fig. 3

Table 4 Coefficient K value

Z	K	Z	K
8	3.6763333	17	6.4536463
9	3.9709394	18	6.7689303
10	4.2727719	19	7.0846088
11	4.5789545	20	7.4006100
12	4.8879667	21	7.7168786
13	5.1989251	22	8.0333713
14	5.5112799	23	8.3500534
15	5.8246707	24	8.6668970
16	6.1388508	25	8.9838796

Type F
Type A


Type F


Type A

D_w 1.5〜4.5mm

Boundary dimensions mm D_w	L_w	Bearing numbers flat type	disk type	Mass kg per 1 000 pcs
1.5	5.8	**F1.5× 5.8**	A1.5× 5.8	0.080
	6.8	**F1.5× 6.8**	A1.5× 6.8	0.090
	7.8	**F1.5× 7.8**	A1.5× 7.8	0.104
	9.8	**F1.5× 9.8**	A1.5× 9.8	0.131
	11.8	**F1.5×11.8**	A1.5×11.8	0.159
	13.8	**F1.5×13.8**	A1.5×13.8	0.186
2	6.8	**F2 × 6.8**	A2 × 6.8	0.158
	7.8	**F2 × 7.8**	A2 × 7.8	0.183
	9.8	**F2 × 9.8**	A2 × 9.8	0.232
	11.8	**F2 ×11.8**	A2 ×11.8	0.281
	13.8	**F2 ×13.8**	A2 ×13.8	0.330
	15.8	**F2 ×15.8**	A2 ×15.8	0.379
	17.8	**F2 ×17.8**	A2 ×17.8	0.428
	19.8	**F2 ×19.8**	A2 ×19.8	0.477
2.5	7.8	**F2.5× 7.8**	A2.5× 7.8	0.284
	9.8	**F2.5× 9.8**	A2.5× 9.8	0.351
	11.8	**F2.5×11.8**	A2.5×11.8	0.438
	13.8	**F2.5×13.8**	A2.5×13.8	0.514
	15.8	**F2.5×15.8**	A2.5×15.8	0.591
	17.8	**F2.5×17.8**	A2.5×17.8	0.668
	19.8	**F2.5×19.8**	A2.5×19.8	0.745
	21.8	**F2.5×21.8**	A2.5×21.8	0.821
	23.8	**F2.5×23.8**	A2.5×23.8	0.898
3	9.8	**F3 × 9.8**	A3 × 9.8	0.556
	11.8	**F3 ×11.8**	A3 ×11.8	0.671
	13.8	**F3 ×13.8**	A3 ×13.8	0.784
	15.8	**F3 ×15.8**	A3 ×15.8	0.897
	17.8	**F3 ×17.8**	A3 ×17.8	1.01
	19.8	**F3 ×19.8**	A3 ×19.8	1.12
	21.8	**F3 ×21.8**	A3 ×21.8	1.23
3	23.8	**F3 ×23.8**	A3 ×23.8	1.34
	25.8	**F3 ×25.8**	A3 ×25.8	1.45
	27.8	**F3 ×27.8**	A3 ×27.8	1.56
3.5	11.8	**F3.5×11.8**	A3.5×11.8	0.849
	13.8	**F3.5×13.8**	A3.5×13.8	1.00
	15.8	**F3.5×15.8**	A3.5×15.8	1.15
	17.8	**F3.5×17.8**	A3.5×17.8	1.30
	19.8	**F3.5×19.8**	A3.5×19.8	1.45
	21.8	**F3.5×21.8**	A3.5×21.8	1.60
	23.8	**F3.5×23.8**	A3.5×23.8	1.75
	25.8	**F3.5×25.8**	A3.5×25.8	1.90
	29.8	**F3.5×29.8**	A3.5×29.8	2.20
	31.8	**F3.5×31.8**	A3.5×31.8	2.35
	34.8	**F3.5×34.8**	A3.5×34.8	2.58
4	13.8	**F4 ×13.8**	A4 ×13.8	1.27
	15.8	**F4 ×15.8**	A4 ×15.8	1.50
	17.8	**F4 ×17.8**	A4 ×17.8	1.70
	19.8	**F4 ×19.8**	A4 ×19.8	1.89
	21.8	**F4 ×21.8**	A4 ×21.8	2.09
	23.8	**F4 ×23.8**	A4 ×23.8	2.26
	25.8	**F4 ×25.8**	A4 ×25.8	2.48
	27.8	**F4 ×27.8**	A4 ×27.8	2.68
	29.8	**F4 ×29.8**	A4 ×29.8	2.87
	31.8	**F4 ×31.8**	A4 ×31.8	3.07
	34.8	**F4 ×34.8**	A4 ×34.8	3.31
	37.8	**F4 ×37.8**	A4 ×37.8	3.62
	39.8	**F4 ×39.8**	A4 ×39.8	3.82
4.5	17.8	**F4.5×17.8**	A4.5×17.8	2.11
	19.8	**F4.5×19.8**	A4.5×19.8	2.36
	21.8	**F4.5×21.8**	A4.5×21.8	2.61

D_w 4.5〜5mm

Boundary dimensions mm		Bearing numbers		Mass kg
D_w	L_w	flat type	disk type	per 1 000 pcs
4.5	23.8	**F4.5×23.8**	A4.5×23.8	2.86
	25.8	**F4.5×25.8**	A4.5×25.8	3.11
	29.8	**F4.5×29.8**	A4.5×29.8	3.62
	31.8	**F4.5×31.8**	A4.5×31.8	3.87
	34.8	**F4.5×34.8**	A4.5×34.8	4.25
	37.8	**F4.5×37.8**	A4.5×37.8	4.63
	39.8	**F4.5×39.8**	A4.5×39.8	4.88
	44.8	**F4.5×44.8**	A4.5×44.8	5.51
5	19.8	**F5 ×19.8**	A5 ×19.8	2.89
	21.8	**F5 ×21.8**	A5 ×21.8	3.20
	23.8	**F5 ×23.8**	A5 ×23.8	3.52
	25.8	**F5 ×25.8**	A5 ×25.8	3.82
	29.8	**F5 ×29.8**	A5 ×29.8	4.45
	31.8	**F5 ×31.8**	A5 ×31.8	4.74
	34.8	**F5 ×34.8**	A5 ×34.8	5.11
	37.8	**F5 ×37.8**	A5 ×37.8	5.55
	39.8	**F5 ×39.8**	A5 ×39.8	5.85
	49.8	**F5 ×49.8**	A5 ×49.8	7.33

Snap Rings

These snap rings are used exclusively for fixing or guiding a needle roller bearing ring or cage in axial direction. Furthermore, these snap rings have the profile identical to C-type concentric snap ring specified in JIS B 2806 and, in addition, snap rings with smaller section height (b) and also available in smaller dimension range are manufactured according to application of needle roller bearings. These snap rings are manufactured using hard steel wire rod and, after manufactured, chemical conversion treatment is applied to the surface thereof.

Types of snap ring

Two types of snap ring are available; one is **Type WR** designed for application to shaft and another is **Type BR** for application to bearing housing.

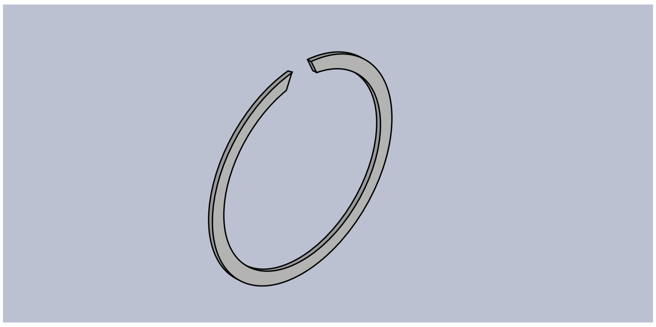


Fig. 1 WR snap ring

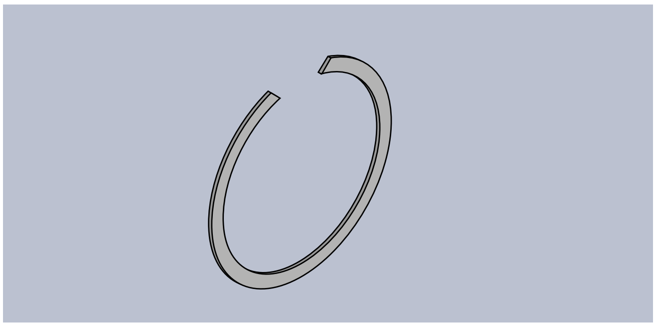


Fig. 2 BR snap ring

Table 1 Cut section angle of snap ring (α)

Type	Nominal number	Cut section angle(α)
Type WR	WR4, WR5	40°
	Type WR6 up to	60°
Type BR	All nominal numbers	90°

Composition of snap ring number

The snap ring number is composed of type code (**WR** or **BR**) and dimension code. The dimension code represents applicable shaft diameter in **Type WR** and applicable housing bore diameter in **Type BR**.

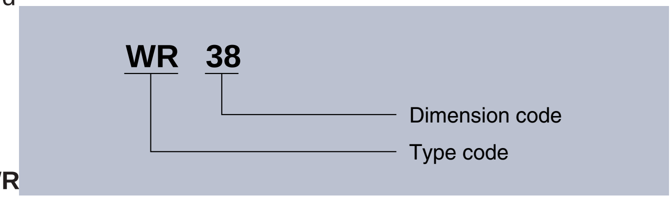


Fig. 3

Allowable running speed

The allowable running speed for **Type WR** for shaft application is as described in applicable Dimensions Table. This means the running speed when snap ring begins to get loose with opening of its cut ends.

Mounting relation

It is recommended to insert a spacer between snap rin and cage for guiding the cage in axial direction (Refer to **Fig. 4**.). On occasion, snap ring is difficult to remove, bu limited to a portion in which a pull-out tool can not be inserted easily. In such a case, consider the cross-sectional height of the needle roller bearing in question, and then judge whether or not an ordinary retaining ring (JIS B 2804 “Retaining rings-C type”) can be used.

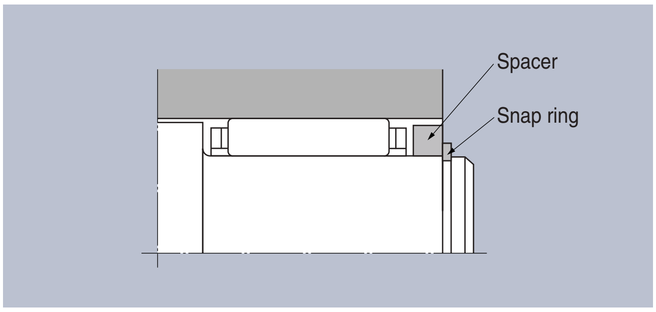
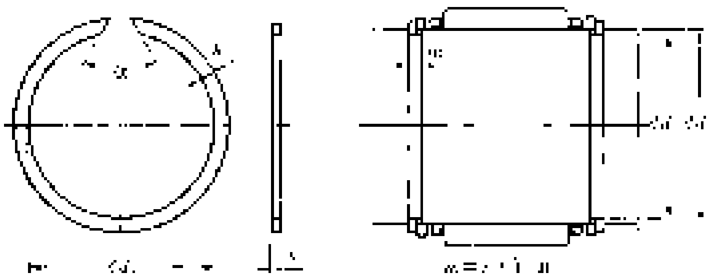


Fig. 4

For shaft

Type WR

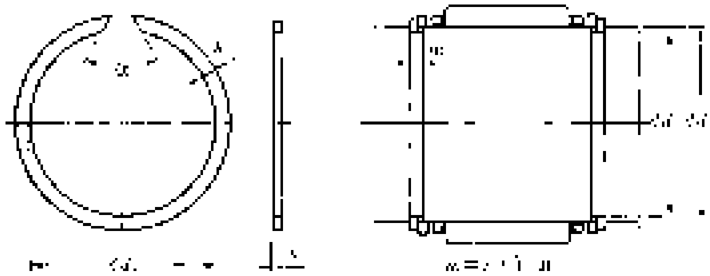


Bearing numbers	Boundary dimensions mm d_1	d_3 max	b	s ±0.06	d_2		Limiting speeds min^{-1}
WR 4	4	3.7	0.8	0.5	3.8		275 000
WR 5	5	4.7	1	0.5	4.8		192 000
WR 6	6	5.6	1.1	0.7	5.7		141 000
WR 7	7	6.5	1.2	0.7	6.7	0 −0.09	134 000
WR 8	8	7.4	1.3	1	7.6		108 000
WR 9	9	8.4	1.3	1	8.6		80 000
WR10	10	9.4	1.3	1	9.6		68 000
WR11	11	10.2	1.3	1	10.5		64 500
WR12	12	11.2	1.3	1	11.5		53 000
WR13	13	12.2	1.3	1	12.5		49 600
WR14	14	13.1	1.5	1.2	13.5	0 −0.11	45 900
WR15	15	14	1.75	1.2	14.4		44 500
WR16	16	15	1.75	1.2	15.4		38 000
WR17	17	16	1.75	1.2	16.4		34 500
WR18	18	17	1.75	1.2	17.4		30 000
WR19	19	17.9	1.75	1.2	18.4		28 900
WR20	20	18.7	1.75	1.2	19.2		26 200
WR21	21	19.7	1.75	1.2	20.2		23 400
WR22	22	20.7	1.75	1.2	21.2		20 800
WR23	23	21.7	1.75	1.2	22.2		19 500
WR24	24	22.5	1.75	1.2	23	0 −0.13	18 100
WR25	25	23.5	1.75	1.2	24		16 400
WR26	26	24.5	1.75	1.2	25		14 800
WR28	28	26.5	2.3	1.5	27		15 400
WR29	29	27.5	2.3	1.5	28		14 400
WR30	30	28.5	2.3	1.5	29		13 200
WR32	32	30.2	2.3	1.5	30.8		13 300
WR35	35	33.2	2.3	1.5	33.8	0 −0.16	10 700

Bearing numbers	Boundary dimensions mm d_1	d_3 max	b	s ±0.06	d_2		Limiting speeds min^{-1}
WR 37	37	35.2	2.3	1.5	35.8		9 200
WR 38	38	36.2	2.3	1.5	36.8		8 700
WR 40	40	37.8	2.3	1.5	38.5		8 100
WR 42	42	39.8	2.3	1.5	40.5		7 000
WR 43	43	40.8	2.3	1.5	41.5	0 −0.16	6 800
WR 45	45	42.8	2.3	1.5	43.5		5 800
WR 47	47	44.8	2.3	1.5	45.5		5 500
WR 48	48	45.8	2.3	1.5	46.5		5 300
WR 50	50	47.8	2.3	1.5	48.5		4 800
WR 52	52	49.8	2.3	1.5	50.5		4 300
WR 55	55	52.6	2.3	1.5	53.5		4 400
WR 58	58	55.6	2.3	1.5	56.5		3 900
WR 60	60	57.6	2.3	1.5	58.5		3 500
WR 61	61	58.6	2.3	1.5	59.5		3 300
WR 62	62	59.6	2.3	1.5	60.5		3 200
WR 63	63	60.6	2.3	1.5	61.5		3 100
WR 64	64	61.6	2.3	1.5	62.5	0 −0.19	2 900
WR 65	65	62.6	2.3	1.5	63.5		2 800
WR 68	68	65.4	2.8	2	66.2		2 900
WR 70	70	67.4	2.8	2	68.2		2 700
WR 72	72	69.4	2.8	2	70.2		2 600
WR 73	73	70.4	2.8	2	71.2		2 500
WR 75	75	72.4	2.8	2	73.2		2 300
WR 80	80	77.4	2.8	2	78.2		1 950
WR 85	85	82	3.4	2.5	83		2 300
WR 90	90	87	3.4	2.5	88	0 −0.22	2 000
WR 95	95	92	3.4	2.5	93		1 750
WR100	100	97	3.4	2.5	98		1 560

For shaft

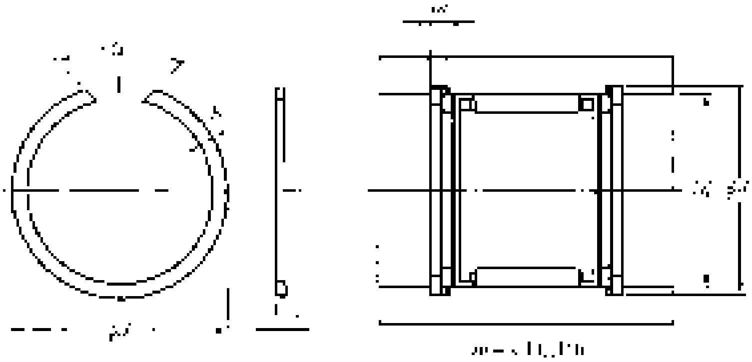
Type WR



Bearing numbers	Boundary dimensions mm d_1	d_3 max	b	s ±0.06	d_2		Limiting speeds r/min
WR105	105	101.7	3.4	2.5	102.7		1 390
WR110	110	106.7	3.4	2.5	107.7	0 / −0.22	1 240
WR115	115	111.7	3.4	2.5	112.7		1 100
WR120	120	116.7	3.4	2.5	117.7		1 000
WR125	125	121.7	3.4	2.5	122.7		920
WR130	130	126.7	3.4	2.5	127.7		830
WR135	135	131.6	4	2.5	132.4		830
WR140	140	136.6	4	2.5	137.4		760
WR145	145	141.6	4	2.5	142.4		690
WR150	150	146.6	4	2.5	147.4	0 / −0.25	640
WR155	155	151.6	4	2.5	152.4		590
WR160	160	156.6	4	2.5	157.4		550
WR165	165	161.6	4	2.5	162.4		500
WR170	170	166.6	4	2.5	167.4		470
WR175	175	171.6	4	2.5	172.4		440
WR180	180	175.6	5	3	177		430
WR185	185	180.6	5	3	182		590
WR190	190	185.6	5	3	187		540
WR195	195	190.6	5	3	192		510
WR200	200	195.6	5	3	197		480
WR210	210	205.6	5	3	207	0 / −0.29	420
WR220	220	215.6	5	3	217		380
WR225	225	220.6	5	3	222		360
WR230	230	225.6	5	3	227		350
WR240	240	235.6	5	3	237		310
WR250	250	245.6	5	3	247		270
WR260	260	253	7.5	4	255	0 / −0.32	430
WR265	265	258	7.5	4	260		410
WR270	270	263	7.5	4	265		380
WR280	280	273	7.5	4	275		360
WR285	285	278	7.5	4	280		350
WR290	290	283	7.5	4	285	0 / −0.32	340
WR300	300	293	7.5	4	295		300
WR305	305	298	7.5	4	300		290
WR310	310	303	7.5	4	305		280
WR320	320	313	7.5	4	315		260
WR330	330	323	7.5	4	325		240
WR340	340	333	7.5	4	335		220
WR350	350	343	7.5	4	345		210
WR360	360	353	7.5	4	355	0 / −0.36	190
WR370	370	363	7.5	4	365		180
WR380	380	373	7.5	4	375		170
WR390	390	383	7.5	4	385		160
WR400	400	393	7.5	4	395		150

For housing

Type BR

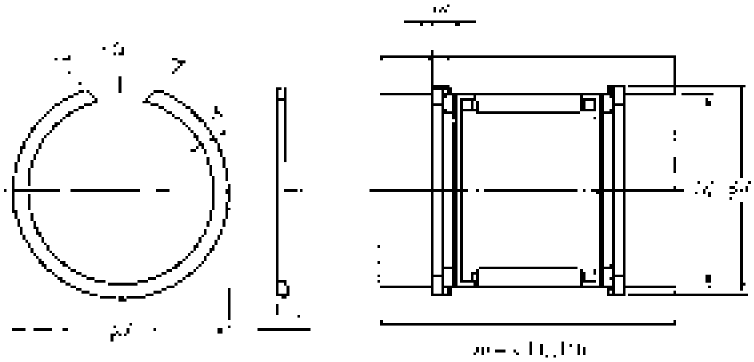


Bearing numbers	Boundary dimensions mm d_1	d_3 min	b	s ±0.06	d_2	
BR 7	7	7.5	1	0.8	7.3	
BR 8	8	8.5	1	0.8	8.3	+0.09 / 0
BR 9	9	9.5	1.1	0.8	9.3	
BR10	10	10.6	1.2	0.8	10.4	
BR11	11	11.6	1.3	1	11.4	
BR12	12	12.7	1.3	1	12.4	
BR13	13	13.8	1.3	1	13.5	+0.11 / 0
BR14	14	14.8	1.3	1	14.5	
BR15	15	15.8	1.3	1	15.5	
BR16	16	16.8	1.6	1.2	16.5	
BR17	17	17.8	1.6	1.2	17.5	
BR18	18	18.9	1.75	1.2	18.5	
BR19	19	19.9	1.75	1.2	19.6	
BR20	20	21	1.75	1.2	20.6	
BR21	21	22	1.75	1.2	21.6	
BR22	22	23	1.75	1.2	22.6	
BR23	23	24	1.75	1.2	23.6	+0.13 / 0
BR24	24	25.2	1.75	1.2	24.8	
BR25	25	26.2	1.75	1.2	25.8	
BR26	26	27.2	1.75	1.2	26.8	
BR27	27	28.2	1.75	1.2	27.8	
BR28	28	29.2	1.75	1.2	28.8	
BR29	29	30.2	1.75	1.2	29.8	
BR30	30	31.4	2.3	1.5	31	
BR31	31	32.4	2.3	1.5	32	
BR32	32	33.4	2.3	1.5	33	+0.16 / 0
BR33	33	34.4	2.3	1.5	34	
BR34	34	35.4	2.3	1.5	35	

Bearing numbers	Boundary dimensions mm d_1	d_3 min	b	s ±0.06	d_2	
BR35	35	36.4	2.3	1.5	36	
BR36	36	37.8	2.3	1.5	37.2	
BR37	37	38.8	2.3	1.5	38.2	
BR38	38	39.8	2.3	1.5	39.2	
BR39	39	40.8	2.3	1.5	40.2	
BR40	40	41.8	2.3	1.5	41.2	
BR41	41	42.8	2.3	1.5	42.2	+0.16 / 0
BR42	42	43.8	2.3	1.5	43.2	
BR43	43	44.8	2.3	1.5	44.2	
BR44	44	45.8	2.3	1.5	45.2	
BR45	45	46.8	2.3	1.5	46.2	
BR46	46	47.8	2.3	1.5	47.2	
BR47	47	48.8	2.3	1.5	48.2	
BR48	48	49.8	2.3	1.5	49.2	
BR49	49	50.8	2.3	1.5	50.2	
BR50	50	51.8	2.3	1.5	51.2	
BR52	52	54.3	2.3	1.5	53.5	
BR53	53	55.3	2.3	1.5	54.5	
BR54	54	56.3	2.3	1.5	55.5	
BR55	55	57.3	2.3	1.5	56.5	
BR57	57	59.3	2.3	1.5	58.5	+0.19 / 0
BR58	58	60.3	2.3	1.5	59.5	
BR60	60	62.3	2.3	1.5	61.5	
BR61	61	63.3	2.3	1.5	62.5	
BR62	62	64.3	2.3	1.5	63.5	
BR63	63	65.3	2.3	1.5	64.5	
BR64	64	66.3	2.3	1.5	65.5	
BR65	65	67.3	2.3	1.5	66.5	

For housing

Type BR



Bearing numbers	Boundary dimensions mm					
	d_1	d_3 min	b	s ±0.06	d_2	
BR 66	66	68.3	2.3	1.5	67.5	
BR 68	68	70.3	2.3	1.5	69.5	
BR 70	70	72.3	2.3	1.5	71.5	
BR 72	72	74.6	2.8	2	73.8	
BR 73	73	75.6	2.8	2	74.8	+0.19 0
BR 74	74	76.6	2.8	2	75.8	
BR 75	75	77.6	2.8	2	76.8	
BR 76	76	78.6	2.8	2	77.8	
BR 77	77	79.6	2.8	2	78.8	
BR 78	78	80.6	2.8	2	79.8	
BR 79	79	81.6	2.8	2	80.8	
BR 81	81	83.6	2.8	2	82.8	
BR 82	82	84.6	2.8	2	83.8	
BR 83	83	85.6	2.8	2	84.8	
BR 85	85	87.6	2.8	2	86.8	
BR 86	86	88.6	2.8	2	87.8	
BR 88	88	91	3.4	2.5	90	
BR 90	90	93	3.4	2.5	92	
BR 92	92	95	3.4	2.5	94	+0.22 0
BR 93	93	96	3.4	2.5	95	
BR 95	95	98	3.4	2.5	97	
BR 97	97	100	3.4	2.5	99	
BR 98	98	101	3.4	2.5	100	
BR100	100	103	3.4	2.5	102	
BR102	102	105.3	3.4	2.5	104.3	
BR103	103	106.3	3.4	2.5	105.3	
BR105	105	108.3	3.4	2.5	107.3	
BR107	107	110.3	3.4	2.5	109.3	

Bearing numbers	Boundary dimensions mm					
	d_1	d_3 min	b	s ±0.06	d_2	
BR108	108	111.3	3.4	2.5	110.3	
BR110	110	113.3	3.4	2.5	112.3	
BR112	112	115.3	3.4	2.5	114.3	+0.22 0
BR113	113	116.3	3.4	2.5	115.3	
BR115	115	118.3	3.4	2.5	117.3	
BR117	117	120.3	3.4	2.5	119.3	
BR118	118	121.3	3.4	2.5	120.3	
BR120	120	123.3	3.4	2.5	122.3	
BR123	123	126.3	3.4	2.5	125.3	
BR125	125	128.3	3.4	2.5	127.3	
BR127	127	130.3	3.4	2.5	129.3	
BR130	130	133.3	3.4	2.5	132.3	
BR133	133	136.3	3.4	2.5	135.3	
BR135	135	138.3	3.4	2.5	137.3	
BR137	137	140.3	3.4	2.5	139.3	
BR140	140	143.6	4	2.5	142.6	+0.25 0
BR143	143	146.6	4	2.5	145.6	
BR150	150	153.6	4	2.5	152.6	
BR153	153	156.6	4	2.5	155.6	
BR160	160	163.6	4	2.5	162.6	
BR163	163	166.6	4	2.5	165.6	
BR165	165	168.6	4	2.5	167.6	
BR170	170	173.6	4	2.5	172.6	
BR173	173	176.6	4	2.5	175.6	
BR175	175	178.6	4	2.5	177.6	
BR180	180	183.6	4	2.5	182.6	
BR183	183	186.6	4	2.5	185.6	
BR190	190	194.5	5	3	193	+0.29 0

Bearing numbers	Boundary dimensions mm					
	d_1	d_3 min	b	s ±0.06	d_2	
BR195	195	199.5	5	3	198	
BR200	200	204.5	5	3	203	
BR205	205	209.5	5	3	208	
BR210	210	214.5	5	3	213	$^{+0.29}_{0}$
BR215	215	219.5	5	3	218	
BR220	220	224.5	5	3	223	
BR225	225	229.5	5	3	228	
BR230	230	234.5	5	3	233	
BR240	240	244.5	5	3	243	
BR250	250	254.5	5	3	253	
BR260	260	267	7.5	4	265	$^{+0.32}_{0}$
BR270	270	277	7.5	4	275	
BR280	280	287	7.5	4	285	
BR300	300	307	7.5	4	305	
BR320	320	327	7.5	4	325	
BR325	325	332	7.5	4	330	
BR350	350	357	7.5	4	355	
BR355	355	362	7.5	4	360	
BR360	360	367	7.5	4	365	$^{+0.36}_{0}$
BR375	375	382	7.5	4	380	
BR380	380	387	7.5	4	385	
BR385	385	392	7.5	4	390	
BR395	395	402	7.5	4	400	
BR400	400	407	7.5	4	405	
BR415	415	422	7.5	4	420	
BR420	420	427	7.5	4	425	$^{+0.40}_{0}$
BR440	440	447	7.5	4	445	

Seals

Seals

These are the special-purposed seals for needle roller bearings whose cross sectional height is designed so small as to match applicable needle roller bearings. These contact seals are made of synthetic rubber reinforced with steel plate, being then used in operating temperature range of -25 to +120˚C and, under continuous running, at 100˚C and less. Further, feel free to contact **NTN** for the use of these seals under special operating condition, e.g. operating temperature of over 120˚C.

Types of seal

Two different seal types are available; one is **Type G** with one lip and another is **Type GD** with two lips. In addition to these two, sliding rubber seals (**LEG**, **LEGD**), wherein lubrication property was assigned to a rubber material fulfilling low torque under an non-lubrication environment, are also manufactured. Feel free to contact **NTN** for the detail of these seal types.

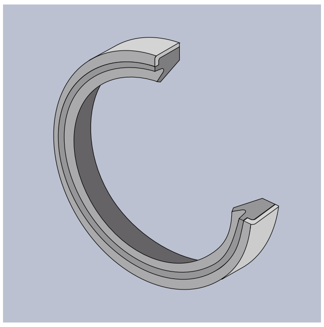


Fig. 1 Type G (LEG)

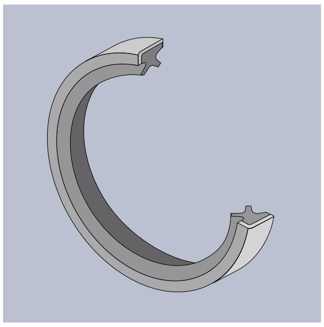


Fig. 2 Type GD (LEGD)

Where seal contact surface and lubricating condition are good, **Type G** with one lip can be used up to 10m/s maximum at peripheral speed and **Type GD** with two lips used up to 6m/s maximum.

This seal is intended to hold grease and to prevent dust invasion from outside. It has no function to hold lubrication oil, etc. unlike oil seal.

Composition of seal number

The seal number is composed of type code (G, GD) and dimension code (bore dia.×outer dia.×width).

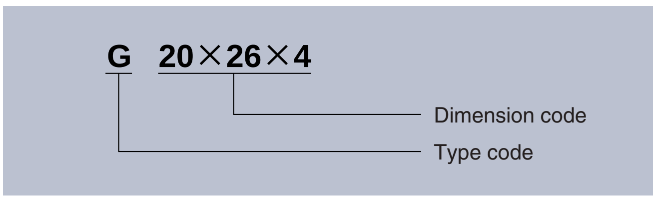


Fig. 3

Fitting relations

The seal contact surface must be finished by grinding, after hardened, to get its good sealing performance. In addition, harmful flaw and indent are not allowed to exist on the seal contact surface. Where the inner ring raceway surface is used as seal contact surface, a wide inner ring must be used.

When fitting a seal in a bearing, it is desirable to taper the shaft end face or the housing end face so as to protect the seal lip and outer surface from damaging, as illustrated in **Fig. 4**. Where shaft end is not tapered or chamfered (rounded), it is recommended to a fitting jig as illustrated in **Fig.5**. Regarding the seal to housing interference, a adequate interference can be got in the usual housing tolerance range of G7 toR7.

Furthermore, it is recommended to apply pre-coat of a lubricant to the seal lip before fitting seals G and GD, for better lubrication. Further, when fitting a seal and inserting it through a shaft, take good care to protect its lip from deforming.

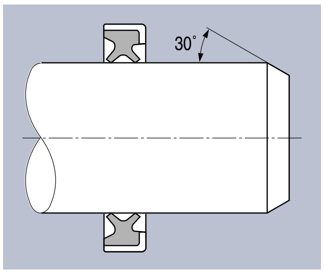


Fig. 4

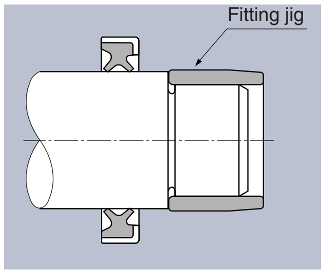


Fig. 5

Seal application examples

Figs.6 to **8** illustrate design examples using these seals.

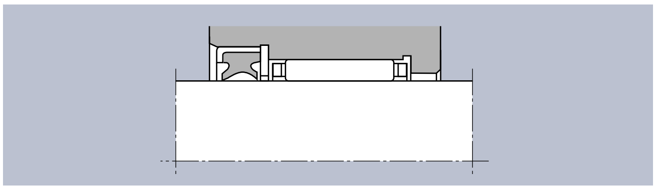


Fig. 6

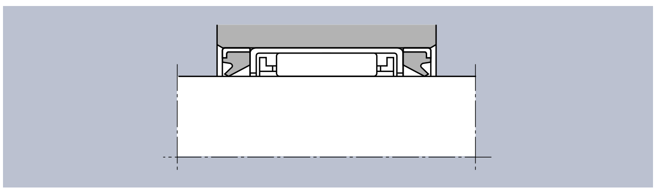


Fig. 7

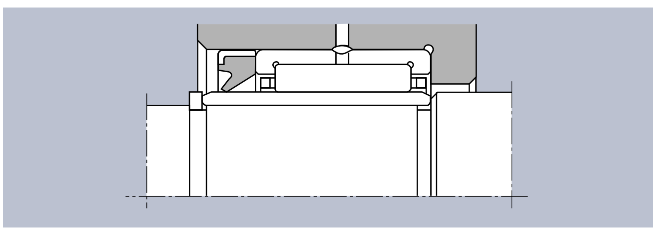
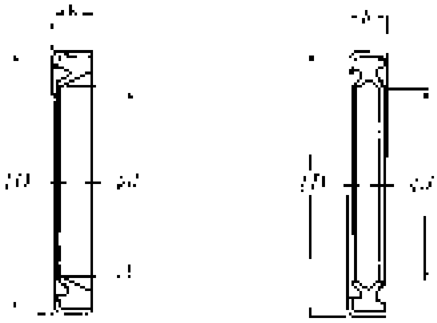


Fig. 8

Type G
Type GD



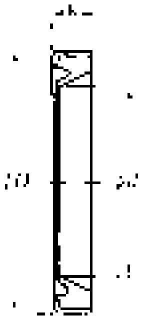
Type G   Type GD

Bearing numbers Type G	Bearing numbers Type GD	Boundary dimensions mm d	D 1)	D tolerance	b (+0.2/0)	Mass ×10⁻³ kg G	Mass ×10⁻³ kg GD
G 4×8×2	—	4	8		2	0.18	—
G 5×9×2	—	5	9	+0.081 / +0.023	2	0.19	—
G 5×10×2	—	5	10		2	0.22	—
G 6×10×2	—	6	10		2	0.21	—
G 6×12×2	—	6	12		2	0.38	—
G 7×11×2	—	7	11		2	0.25	—
G 7×14×2	—	7	14		2	0.52	—
G 8×12×3	—	8	12		3	0.41	—
G 8×15×3	—	8	15		3	0.74	—
G 9×13×3	—	9	13	+0.098 / +0.028	3	0.44	—
G 9×16×3	—	9	16		3	0.69	—
G10×14×3	—	10	14		3	0.50	—
G10×17×3	—	10	17		3	0.87	—
G12×16×3	—	12	16		3	0.56	—
G12×18×3	—	12	18		3	0.86	—
G12×19×3	—	12	19		3	0.94	—
G13×19×3	—	13	19		3	0.87	—
G14×20×3	GD14×20×3	14	20		3	0.96	0.99
G14×21×3	GD14×21×3	14	21		3	1.1	1.1
G14×22×3	GD14×22×3	14	22		3	1.3	1.2
G15×21×3	GD15×21×3	15	21		3	1.0	1.0
G15×23×3	GD15×23×3	15	23	+0.119 / +0.035	3	1.3	1.3
G16×22×3	GD16×22×3	16	22		3	1.3	1.1
G16×24×3	GD16×24×3	16	24		3	1.3	1.3
G16×25×3	GD16×25×3	16	25		3	1.6	1.6
G17×23×3	GD17×23×3	17	23		3	1.3	1.1
G17×25×3	GD17×25×3	17	25		3	1.5	1.4
G18×24×3	GD18×24×3	18	24		3	1.2	1.2

Bearing numbers Type G	Bearing numbers Type GD	Boundary dimensions mm d	D 1)	D tolerance	b (+0.2/0)	Mass ×10⁻³ kg G	Mass ×10⁻³ kg GD
G18×26×4	GD18×26×4	18	26		4	1.8	1.8
G19×27×4	GD19×27×4	19	27		4	2.0	1.9
G20×26×4	GD20×26×4	20	26		4	1.8	1.8
G20×28×4	GD20×28×4	20	28	+0.119 / +0.035	4	2.1	2.1
G21×29×4	GD21×29×4	21	29		4	2.2	2.1
G22×28×4	GD22×28×4	22	28		4	1.8	1.9
G22×30×4	GD22×30×4	22	30		4	2.2	2.3
G24×32×4	GD24×32×4	24	32		4	2.5	2.4
G25×32×4	GD25×32×4	25	32		4	2.3	2.2
G25×33×4	GD25×33×4	25	33		4	2.5	2.5
G25×35×4	GD25×35×4	25	35		4	2.6	2.6
G26×34×4	GD26×34×4	26	34		4	2.6	2.6
G28×35×4	GD28×35×4	28	35		4	2.4	2.5
G28×37×4	GD28×37×4	28	37		4	3.1	2.8
G29×37×4	GD29×37×4	29	37		4	2.7	2.7
G29×38×4	GD29×38×4	29	38		4	3.2	2.9
G30×37×4	GD30×37×4	30	37	+0.143 / +0.043	4	2.7	2.6
G30×40×4	GD30×40×4	30	40		4	3.6	3.3
G32×42×4	GD32×42×4	32	42		4	3.7	3.9
G32×45×4	GD32×45×4	32	45		4	5.1	5.2
G35×42×4	GD35×42×4	35	42		4	3.0	2.9
G35×45×4	GD35×45×4	35	45		4	4.1	3.6
G37×47×4	GD37×47×4	37	47		4	4.0	3.8
G38×48×4	GD38×48×4	38	48		4	4.4	4.0
G40×47×4	GD40×47×4	40	47		4	3.3	3.5
G40×50×4	GD40×50×4	40	50		4	4.6	4.0
G40×52×5	GD40×52×5	40	52	+0.173 / +0.053	5	4.8	4.7
G42×52×4	GD42×52×4	42	52		4	4.7	4.2

Note 1) The outer diameter tolerance is the mean value of the measured values at two measuring points.

Type G
Type GD



Type G

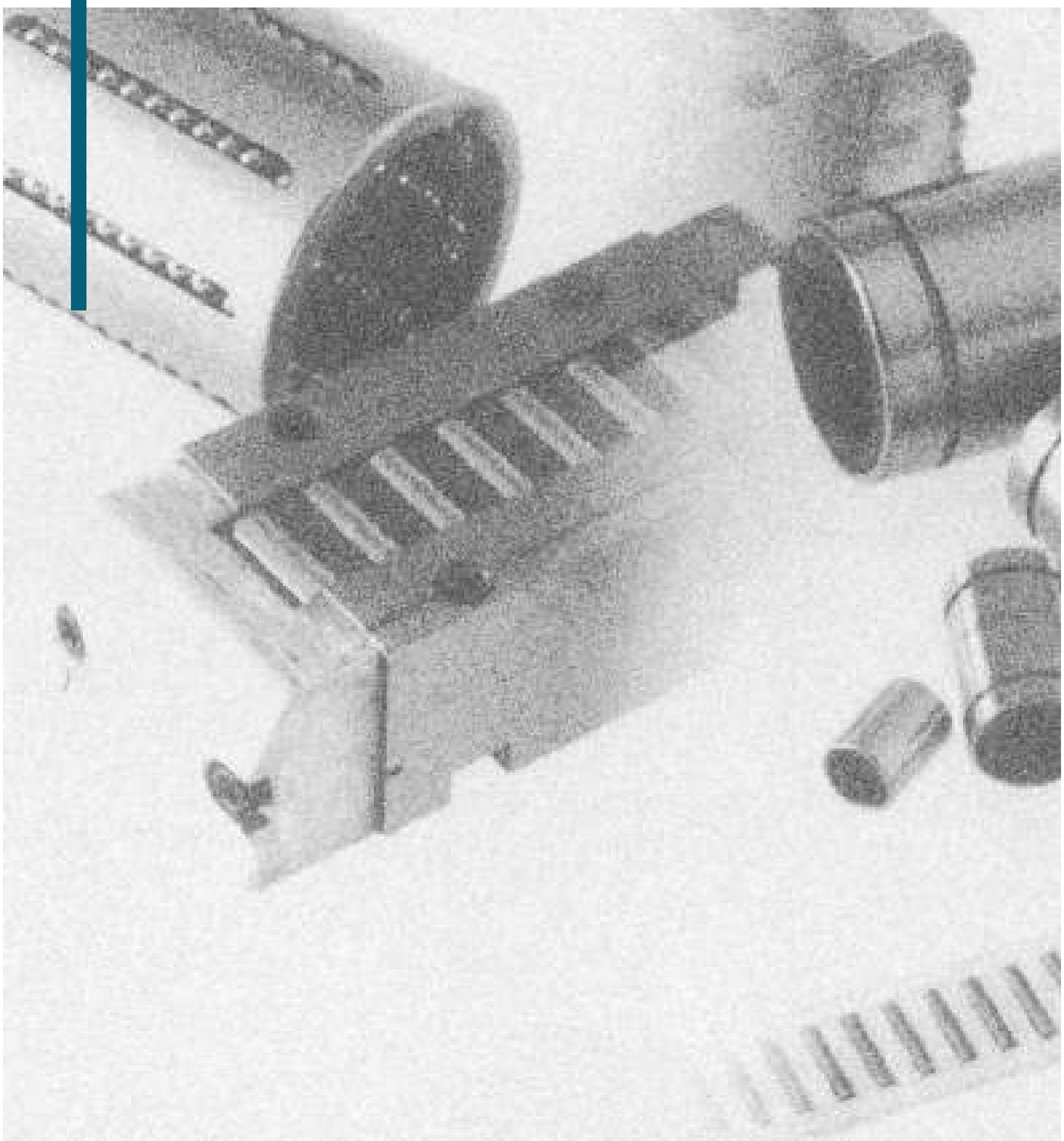
Type GD

Bearing numbers		Boundary dimensions mm			Mass ×10⁻³ kg	
Type G	Type GD	*d*	*D*[1)]	*b* $^{+0.2}_{0}$	G	GD
G43×53×4	GD43×53×4	43	53	4	4.8	4.3
G45×52×4	GD45×52×4	45	52	4	3.8	3.8
G45×55×4	GD45×55×4	45	55 $^{+0.173}_{+0.053}$	4	5.2	5.5
G50×58×4	GD50×58×4	50	58	4	4.5	5.2
G50×62×5	GD50×62×5	50	62	5	10.4	10

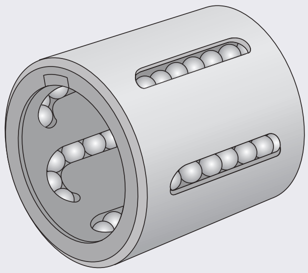
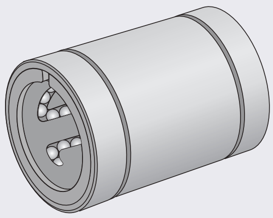
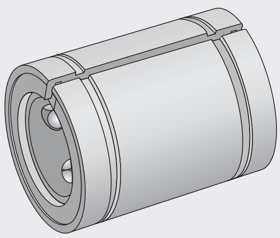
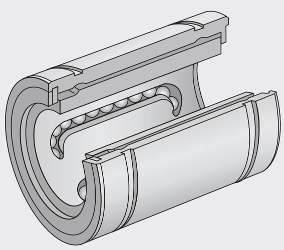
Note 1) The outer diameter tolerance is the mean value of the measured values at two measuring points.

LINEAR BEARINGS

LINEAR BALL BEARINGS:
Drawn Cup, Solid, Stroke, Linear Flat Roller, and Linear Roller Bearing Types



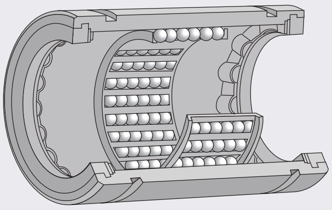
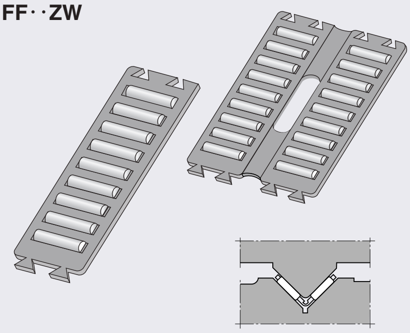
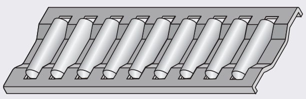
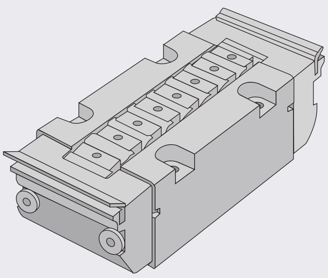
Linear Ball Bearings

Type		Applicable shaft diameter (mm)	Composition of bearing number
KH 	This type is composed of an outer ring, steel balls and a cage and the outer ring is cylindrical similarly to that of Type KLM and drawn from a steel plate by precision deep drawing, then enabling to design a compact bearing construction of low section and lightweight. This type also ensures precise and smooth infinite linear motion similarly to other types.	φ6—φ50 With seal φ10—φ50	**KH 20 30 LL/3AS** Suffix LL: Seal 3AS: Grease code Width Roller set bore diameter Type code
KLM 	This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity.	φ3—φ40	**KLM 06 LL/3AS** Suffix LL: Seal 3AS: Grease code Roller set bore diameter Type code
KLM··S 	his type is composed of an outer ring, steel balls and a cage. And both of the outer ring and the cage have an axial slit, as illustrated, so as to enable to shrink the inscribed circle diameter of the cage by pressing the outer ring in radial direction from the housing and to thereby adjust radial clearance from shaft. Thus, this type also ensures precise and smooth infinite linear motion.	φ16—φ40	**KLM 30 S** Suffix S: Clearance-adjustable Roller set bore diameter Type code
KLM··P 	This type is composed of an outer ring, steel balls and a cage. And the outer ring and the cage are of arc sectional shape, from which one row of balls (equivalent to 50˚ to 60˚ degree spacing) is removed. Thus, the arc cross-sectional ring and cage with 50˚ to 60˚ degree opening allows the bearing assy to pass through a shaft support truss or a shaft support stand on midway of the shaft stroke. This type also ensures precise and smooth infinite linear motion, similarly to other types. The bearing radial clearance can be also adjusted.	φ16—φ40	**KLM 30 P LL/3AS** Suffix P: Open configuration LL: Seal 3AS: Grease code Roller set bore diameter Type code

<table>
<tr><th>Components</th><th>Infinite motion</th><th>Finite motion</th><th>Rotating motion</th><th>Remarks</th></tr>
<tr><td>Roller set bore diameter: φ20
Width: 30
Seal: Double-side seal
Grease: Prefilled</td><td>○</td><td>○</td><td>×</td><td rowspan="4">The cages of the bearing types KLM, KLM, S, KLM,P and KH are all molded from polyamide resin and, therefore, these bearing types shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less.

To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C.

These bearing types can't rotate.</td></tr>
<tr><td>Roller set bore diameter: φ6
Seal: Double-side seal
Grease: Prefilled</td><td>○</td><td>○</td><td>×</td></tr>
<tr><td>Roller set bore diameter: φ30
Type: Clearance-adjustable type</td><td>○</td><td>○</td><td>×</td></tr>
<tr><td>Roller set bore diameter: φ30
Type: Open type
Seal: Double-side seal
Grease: Prefilled</td><td>○</td><td>○</td><td>×</td></tr>
</table>

Type		Applicable shaft diameter (mm)	Composition of bearing number
KD 	This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity.	Shaft diameter φ10—φ80	**KD 20 32 45 LL/3AS** Suffix LL: Seal 3AS: Grease Width Outer diameter Roller set bore diameter Type code
FF **FF··ZW** 	This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction actor by being inserted between two planes in relative position. The cage made of polyamide resin is provided with grooved joint at its both ends so several cages can be jointed together into one unit.	Roller diameter φ2—φ3.5	**FF 25 18 ZW** Suffix ZW: Double row Width Roller diameter ×10 Type code
BF（RF） 	This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction factor by being inserted between two planes in relative position. Press-formed steel plate cage (BF) and polyamde resin cage (RF) are selectively available. However, in the case of this bearing type several bearings can't not be jointed together into one unit.	Roller diameter φ3—φ7	**BF 30 20 / 1000** Cage overall length Width Roller diameter ×10 Type code
RLM 	This type is composed of a track frame, a separator and rollers. This type has the function enabling cylindrical rollers to circulate within the track frame and ensures infinite linear motion on a plane.	Section height 16—38	**RLM 26 × 86** Bearing overall length Section height Type code

Components	Infinite motion	Finite motion	Rotating motion	Remarks
Roller set bore diameter: φ20 Outer diameter: f32 Width: 45 Seal: Double-side seal Grease: Prefilled	×	○	○	To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120 C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C.
Roller diameter: φ2.5 Width: 18 ZW: Double-row type Number of rows: Two	○	○	×	Due to its resin cage, this bearing shall be used at allowable temperature 90˚C and, under continuous running, at 80˚C and less. The double-row type has an elastic joint on the cage center so double rows of flat rollers can be bent to any optional angle along the elastic joint by heating them in oil of 70 to 90˚C. By cooling down the double-row rollers with the bent angle held unchanged for several seconds after having bent them to any optional angle, the bent shape of the double rows can be held unchanged so that the double-row rollers can be mounted on a V-shaped surface as illustrated.
Roller diameter: φ3 Width: 20 Cage length: 1000	○	○	×	Where the resin cage RF is used, the bearing shall be used at allowable temperature 90˚C and, under continuous running, at 80˚C and less. The standard length of the bearing unit with BF cage is 1000 mm. The standard length of the bearing unit with RF cage is 705 mm. Two or more bearings of this type can't be jointed with each other, but it can be supplied at any desired length on request.
Section height: 26 Bearing overall length: 86	○	○	×	

Linear Ball Bearings, Drawn Cup and Solid Types

Four to nine rows of balls are configured equally in the outer ring (outer cylinder). The ball rows circulate in axial direction while being guided by the cage. Thus, these bearing types move infinitely on a shaft in axial direction. However, these bearing types can't rotate.

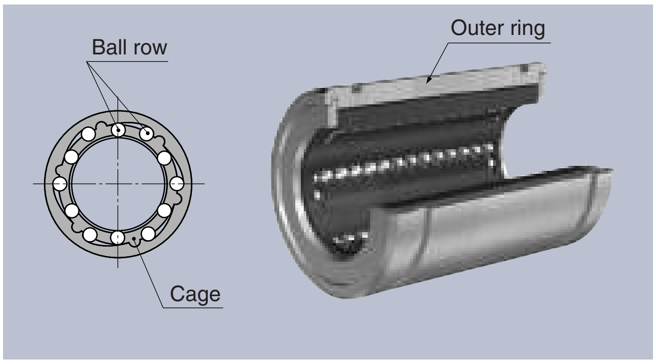


Fig. 1

Dimensional accuracy

Because of its thin-walled outer ring, the **Type KH** (drawn cup type) unavoidably develops certain degree of deformation in various manufacturing steps, in particular in the heat treatment process. Nevertheless, this bearing type has been designed so that when press-fitted into a housing of accurate dimensions, its deformation is corrected and it can restore its original accuracy to fully develop its design functions. For a method for determining dimensional accuracy of this bearing, contact **NTN** Engineering for technical assistance.

The dimensional accuracies in boundary dimensions, ball set bore diameter (F_w), outside diameter (D) and width (C) of the **Type KH** (**KLM** solid type) are listed in the relevant dimension table. Upon request, **NTN** will supply linear ball bearing products for higher accuracy. For details, contact **NTN** Engineering.

Bearing fit

By employing a shaft or housing featuring dimensional tolerance in **Table 1** in this page, an appropriate radial internal clearance can be provided in the installed bearing. When a further smaller radial internal clearance is needed, achieve selective fit to obtain an intended radial internal clearance by selecting a relevant bearing-shaft or bearing-housing combination.

Table 1 Bearing fit

Type	Shaft	Housing
series HK Drawn-cup type	h6 (j5)	H7 (H6) - steel series - K7 (K6) - light metal alloy series -
series KLM Solid type	g6 (g5)	H7 (H6)

Note) The parenthesized data is applied to shaft/housing subjected to higher accuracy or of vertical construction.

Shaft and housing requirements

Any shaft /housing on/in which these bearing types are fitted must meet the requirements specified in **Table 2**.

Table 2 Shaft and housing requirements (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT3	IT4
Cylindricity (max)	IT2	IT4
Surface roughness (max.)	0.4a	1.6a
Surface hardness	HRC58~64	—
Case depth (min)	0.4mm	—

How to mount

The Type KH (drawn cup) bearing is press-fitted into the housing in interference fit mode: therefore this type bearing does not need axial positioning with a means such as a snap ring. For press-fitting, force the marking side on the outer ring with a mandrel illustrated in **Fig.**

The **Type KLM** (solid type) cannot be locked to the housing by interference alone. This type of bearing need to be axially located with a snap ring.

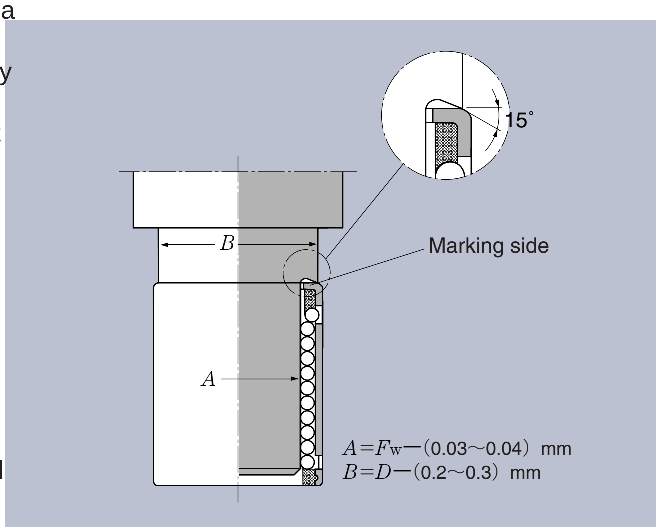
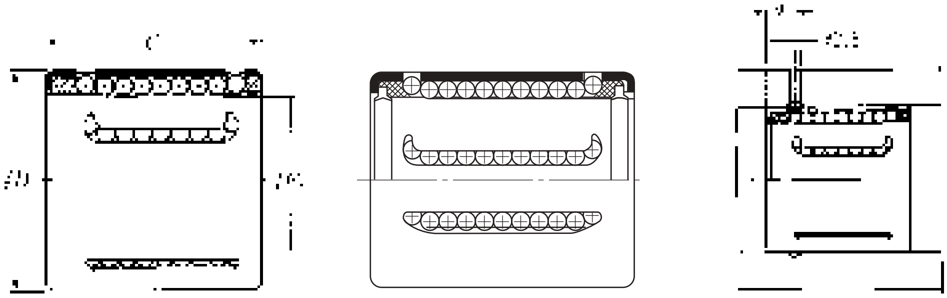


Fig. 2 Series KH

Accessories

Shafts, shaft support stands and housings exclusive for **NTN** linear ball bearings are also offerable. Feel free to contact **NTN** for the detailed information.

Type KH
Type KH··LL



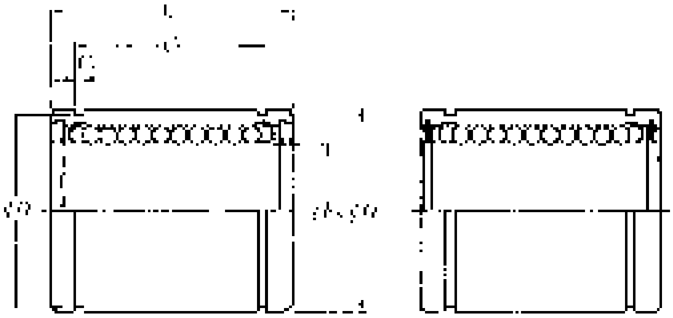
With seal

F_w 6～50mm

Boundary dimensions (mm)				Bearing numbers	Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Number of ball rows	Mass kg (approx.)
F_w	D	C	a[1)]		C_r	C_{or}	C_r	C_{or}		
6	12	22	4	**KH0622**[2)]	380	225	39	23	4	0.007
8	15	24	5	**KH0824**[2)]	420	255	43	26	4	0.012
10	17	26	5	**KH1026**[2)]	480	325	49	33	4	0.015
12	19	28	6	**KH1228**	605	495	62	51	5	0.018
	19	28	6	**KH1228LL/3AS**	605	495	62	51	5	0.018
14	21	28	6	**KH1428**	600	505	61	51	5	0.021
16	24	30	7	**KH1630**	775	600	79	61	5	0.027
	24	30	7	**KH1630LL/3AS**	775	600	79	61	5	0.027
20	28	30	7	**KH2030**	1 050	880	107	90	6	0.033
	28	30	7	**KH2030LL/3AS**	1 050	880	107	90	6	0.033
25	35	40	8	**KH2540**	1 930	1 560	196	159	6	0.066
	35	40	8	**KH2540LL/3AS**	1 930	1 560	196	159	6	0.066
30	40	50	8	**KH3050**	2 700	2 450	275	250	7	0.095
	40	50	8	**KH3050LL/3AS**	2 700	2 450	275	250	7	0.095
40	52	60	9	**KH4060**	4 250	4 000	435	410	8	0.18
50	62	70	9	**KH5070**	5 300	5 700	540	580	9	0.24

Note 1) Showing a-value from the side face with stamped mark thereon.
2) Imported product from INA, Germany.

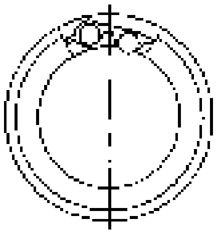
Type KLM **Type KLM··LL**
Type KLM··S **Type KLM··SLL**
Type KLM··P **Type KLM··PLL**



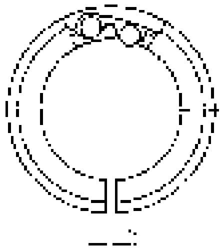
With seal

F_W 3〜35mm

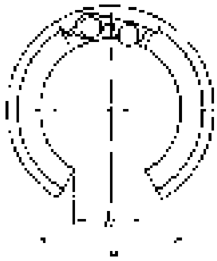
Boundary dimensions mm									Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Bearing numbers	Number of ball rows	Mass kg
F_W	D	C	C_1 ±0.240	C_2	D_1	g	h	θ	C_r	C_{or}	C_r	C_{or}			(approx.)
3 $^{0}_{-0.008}$	7 $^{0}_{-0.010}$	10 $^{0}_{-0.120}$	—	—	—	—	—	—	51	40	5	4	**KLM03**	4	0.002
4 $^{0}_{-0.008}$	8 $^{0}_{-0.010}$	12 $^{0}_{-0.120}$	—	—	—	—	—	—	71	52	7	5	**KLM04**	4	0.003
5 $^{0}_{-0.009}$	10 $^{0}_{-0.010}$	15 $^{0}_{-0.120}$	—	—	—	—	—	—	118	90	12	9	**KLM05**	4	0.005
6 $^{0}_{-0.009}$	12 $^{0}_{-0.010}$	19 $^{0}_{-0.120}$	13.3	1.1	11.5	—	—	—	130	107	13	11	**KLM06**	4	0.009
8 $^{0}_{-0.009}$	15 $^{0}_{-0.010}$	17 $^{0}_{-0.120}$	11.3	1.1	14.3	—	—	—	115	94	12	9	**KLM08**	4	0.012
	15 $^{0}_{-0.010}$	24 $^{0}_{-0.120}$	17.3	1.1	14.3	—	—	—	234	188	24	19	**KLM08-1**	4	0.017
10 $^{0}_{-0.009}$	19 $^{0}_{-0.012}$	29 $^{0}_{-0.120}$	21.7	1.3	18	—	—	—	440	297	45	30	**KLM10**	4	0.028
12 $^{0}_{-0.009}$	22 $^{0}_{-0.012}$	32 $^{-0}_{-0.120}$	22.7	1.3	21	—	—	—	545	455	55	46	**KLM12**	5	0.042
13 $^{0}_{-0.009}$	23 $^{0}_{-0.012}$	32 $^{0}_{-0.120}$	22.7	1.3	22	—	—	—	540	455	55	46	**KLM13**	5	0.045
	28	37	26.5	1.6	27	—	—	—	995	805	102	82	**KLM16**	5	0.075
16 $^{0}_{-0.009}$	28 $^{0}_{-0.012}$	37 $^{0}_{-0.120}$	26.5	1.6	27	0.6	—	—	995	805	102	82	**KLM16S**	5	0.075
	28	37	26.5	1.6	27	—	8.2	60°	995	805	102	82	**KLM16P**	4	0.062
	32	42	30.3	1.6	30.5	—	—	—	1 320	1 150	135	117	**KLM20**	6	0.10
20 $^{0}_{-0.010}$	32 $^{0}_{-0.014}$	42 $^{0}_{-0.120}$	30.3	1.6	30.5	0.6	—	—	1 320	1 150	135	117	**KLM20S**	6	0.10
	32	42	30.3	1.6	30.5	—	8.6	50°	1 320	1 150	135	117	**KLM20P**	5	0.085
	40	59	40.7	1.85	38	—	—	—	2 560	2 340	261	238	**KLM25**	6	0.22
25 $^{0}_{-0.010}$	40 $^{0}_{-0.014}$	59 $^{0}_{-0.120}$	40.7	1.85	38	0.6	—	—	2 560	2 340	261	238	**KLM25S**	6	0.22
	40	59	40.7	1.85	38	—	10.8	50°	2 560	2 340	261	238	**KLM25P**	5	0.19
	45	64	44.2	1.85	43	—	—	—	2 540	2 370	259	241	**KLM30**	6	0.26
30 $^{0}_{-0.010}$	45 $^{0}_{-0.014}$	64 $^{0}_{-0.120}$	44.2	1.85	43	0.6	—	—	2 540	2 370	259	241	**KLM30S**	6	0.26
	45	64	44.2	1.85	43	—	13.0	50°	2 540	2 370	259	241	**KLM30P**	5	0.22
	52	70	49.2	2.2	49	—	—	—	3 650	3 350	375	340	**KLM35**	6	0.40
35 $^{0}_{-0.012}$	52 $^{0}_{-0.017}$	70 $^{0}_{-0.120}$	49.2	2.2	49	1.2	—	—	3 650	3 350	375	340	**KLM35S**	6	0.40
	52	70	49.2	2.2	49	—	15.1	50°	3 650	3 350	375	340	**KLM35P**	5	0.34



Type KLM
(Standard type)



Type KLM··S
(Clearance-adjustable type)



Type KLM··P
(Open type)

F_W 40mm

Boundary dimensions (mm)									Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Bearing numbers	Number of ball rows	Mass (kg)
F_W	D	C	C_1 ±0.300	C_2	D_1	g	h	θ	C_r	C_{or}	C_r	C_{or}			(approx.)
40 $^{0}_{-0.012}$	60 $^{0}_{-0.017}$	80 $^{0}_{-0.120}$	60.3	2.1	57	—	—	—	3 950	3 750	400	380	**KLM40**	6	0.62
	60 $^{0}_{-0.017}$	80 $^{0}_{-0.120}$	60.3	2.1	57	1.2	—	—	3 950	3 750	400	380	**KLM40S**	6	0.62
	60 $^{0}_{-0.017}$	80 $^{0}_{-0.120}$	60.3	2.1	57	—	17.2	50°	3 950	3 750	400	380	**KLM40P**	5	0.53

Linear Ball Bearings, Stroke Type

The bearing cage with multiple ball rows (several balls per row) configured circumferentially therein can move within the outer ring in both circumferential and axial directions. Thus, this bearing type can rotate and reciprocate (but at a limited stroke) on a shaft.

Bearing construction

Maximum available length of the reciprocal stroke is two times as long as the stroke at which the cage ca reciprocate within the outer ring. The outer ring is provided at its both ends with a snap ring acting as a stopper and a wave spring is provided between the sna ring and the cage to damp a shock acting on the cag well as to prevent wear of the cage.

In addition to the standard type, a special type with synthetic rubber seal (Tail code: **LL**) on the both ends of its outer ring is also available.

Dimensional accuracy of Bearing

Table 1 the bearing tolerance.

Table 1 Dimensional accuracy

Characteristics	Dimensional tolerance
Ball inscribed circle diameter (F_w) Outer ring outer diameter (D)	F6 h5

Bearing fit and radial internal clearance

Linear ball bearings need to be used with minimum possible radial internal clearance. In particular, when a linear bearing is used on a vertical shaft or higher accuracy is needed, it is desirable to combine a bearin with a selected shaft and use the bearing-shaft combination with a radial internal clearance in a range 0 to -5 mm (guideline).

Table 2 shows the bearing fits on shaft and in housin

Table 2 Bearing fits (recommended)

Operating conditions	Shaft	Housing
Usual operating conditions	k5 (m5)	H6 (H7)
Vertical shaft and high accuracy applications	n5 (p5)❶	J6 (J7)

❶ Selective fit

Shaft and housing requirements

Table 3 specifies the requirements for shaft and housing which of the outer surfaces are used as the d raceway.

Table 3 Shaft and housing requirements (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT2	IT4
Cylindricality (max)	IT2	IT4
Surface roughness (max)	0.2a	1.6a
Surface hardness	HRC58～64	–
Hardened layer depth (min)	0.4mm	–

How to mount

This bearing type can't be fixed perfectly to a housin with interference only and, therefore, it is fixed in axial direction using a snap ring. (Refer to **Fig. 1**)

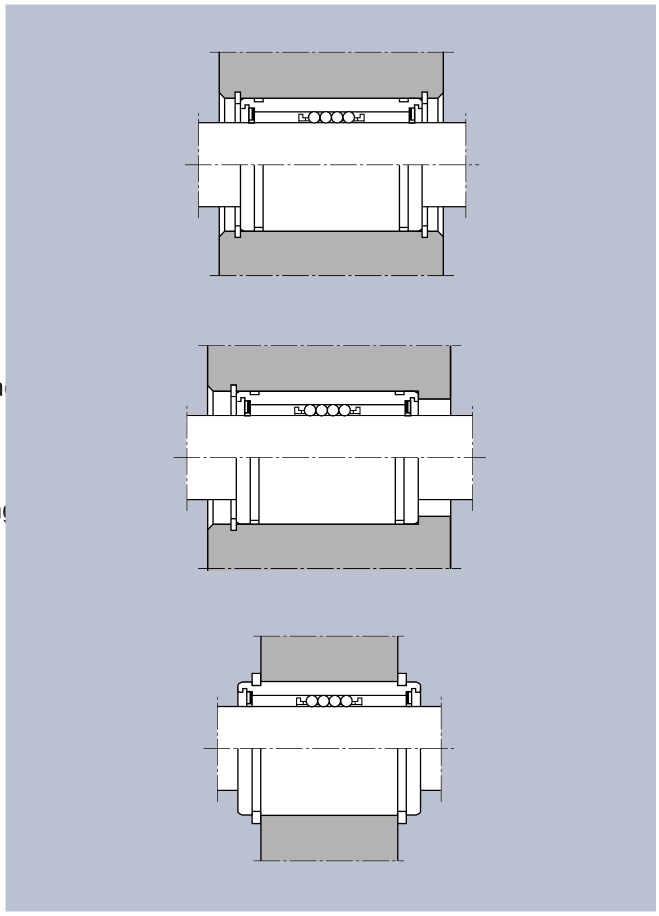


Fig. 1 Axial fixing of bearing

For adjusting the cage so it locates at the outer ring center after a shaft was mounted, push the cage in the arrow direction in **Fig. 2** by inserting the shaft into the outer ring that was press-fitted in the housing. (**Fig. 2**)
In this condition, insert slowly the shaft up to the center point of the reciprocating stroke and, thereafter, further push-in the shaft by 1/2 of the stroke. (**Fig. 3**) Then, return the shaft by 1/2 of the stroke to thereby locate the cage at the outer ring center and the shaft at the center point of the reciprocating stroke. (**Fig. 4**)

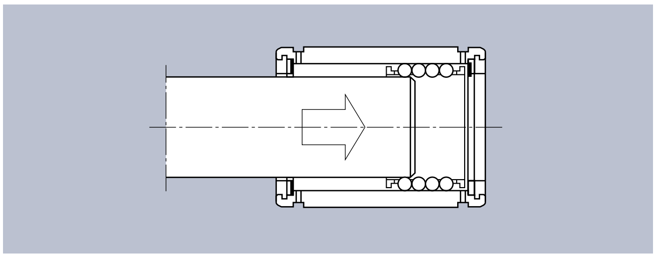


Fig. 2

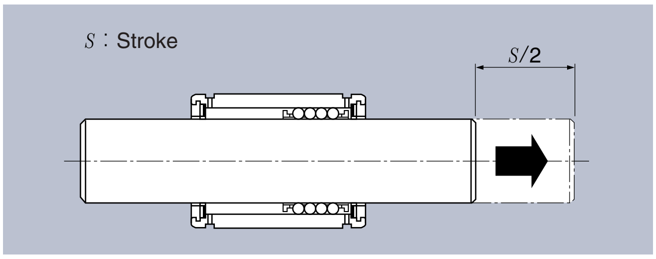


Fig. 3

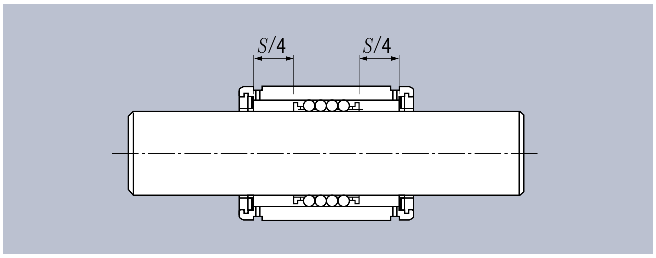
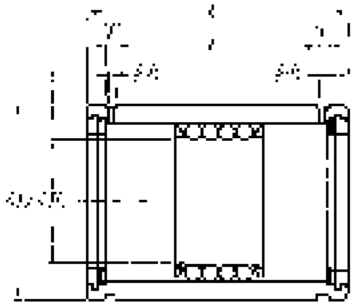


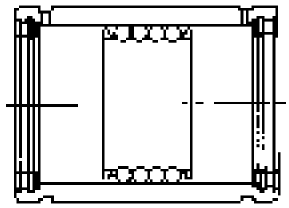
Fig. 4

The outer ring must be press-fitted so its grease feed hole locates at load non-acting side.
Where moment load acts on a bearing due to use of a vertical shaft, the load could act on the grease feed hole. Caution it.

Type KD
Type KD··LL



Type KD
(Open type)



Type KD··LL
(With seal)

F_w 10～80mm

Boundary dimensions mm										Bearing numbers		Basic load ratings				Mass (approx.) kg	
						Type KD		Type KD··LL				dynamic N	static N	dynamic kgf	static kgf		
F_w F6	D h5	C[1)]	T	t	d_1	C_1	Max. stroke	C_1	Max. stroke	Type KD	Type KD··LL	C_r	C_{or}	C_r	C_{or}	Type KD	Type KD··LL
10	19	30	1.7	0.4	1.5	22.7	27	15.5	19	**KD101930**	**KD101930LL/3AS**	720	535	74	55	0.028	0.030
12	23	32	1.7	0.4	1.5	24.5	30	17.1	22	**KD122332**	**KD122332LL/3AS**	920	725	94	74	0.052	0.055
16	28	37	1.7	0.5	1.5	29.1	33	21.1	26	**KD162837**	**KD162837LL/3AS**	1 480	1 070	151	109	0.073	0.078
20	32	45	2.2	0.5	2	35.8	55	26.8	46	**KD203245**	**KD203245LL/3AS**	1 670	1 230	171	125	0.100	0.105
25	37	45	2.2	0.6	2	35.8	55	26.8	46	**KD253745**	**KD253745LL/3AS**	1 890	1 410	192	144	0.115	0.120
30	45	65	2.7	0.7	2.5	53.5	81	45.1	73	**KD304565**	**KD304565LL/3AS**	3 800	3 100	390	315	0.265	0.265
35	52	70	2.7	0.7	2.5	58.5	90	50.1	79	**KD355270**	**KD355270LL/3AS**	4 200	3 500	430	355	0.405	0.405
40	60	80	2.7	0.7	2.5	68.3	103	59.9	93	**KD406080**	**KD406080LL/3AS**	5 900	4 750	600	485	0.635	0.635
45	65	80	2.7	0.7	2.5	68.3	103	59.9	93	**KD456580**	**KD456580LL/3AS**	6 400	5 300	655	540	0.675	0.680
50	72	100	3.2	1	3	86.4	136	77.4	125	**KD5072100**	**KD5072100LL/3AS**	8 500	6 850	870	695	1.00	1.02
55	80	100	3.2	1	3	86.4	136	77.4	125	**KD5580100**	**KD5580100LL/3AS**	9 200	7 550	940	770	1.34	1.36
60	85	100	3.2	1	3	86.4	136	77.4	122	**KD6085100**	**KD6085100LL/3AS**	9 900	8 250	1 010	840	1.41	1.43
70	95	100	3.2	1	3	86.4	136	77.4	122	**KD7095100**	**KD7095100LL/3AS**	10 600	9 000	1 080	920	1.61	1.63
80	110	100	3.2	1.2	3	86	129	77	116	**KD80110100**	**KD80110100LL/3AS**	13 300	10 900	1 350	1 110	2.37	2.40

Note 1) The tolerance for dimension C is -0, -0.120 mm against $F_w \leq 50$ mm and 0, -0.150 mm against $F_w > 50$ mm.

Linear Flat Rollers

Linear Flat Rollers

This bearing type composed of a needle roller and flat cage assembly (needle rollers are configured in the flat cage) ensures smooth reciprocating motion with less friction coefficient.

Types

For **Type FF**, the polyamide resin cage has a dovetail joint groove on its both ends so that several cages can be jointed together into one unit.

For **Type FF-ZW**, two rows of needle rollers are configured in the cage and the cage has an elastic joint on its center so as to enable to bend two rows of flat rollers to any optional angle at the elastic joint by heating them in oil of 70 to 90˚C. The two roller rows bent to optional angle can hold the bent shape unchanged, even under normal operating temperature, by being cooled down for several seconds, with the bending angle held unchanged.

For **Type BF**, the cage is press-formed from steel plate and the standard length of the bearing unit is 1000 mm.

For **Type RF**, the cage is of polyamide resin and the standard length of the bearing unit is 705 mm. The both are unavailable for cage to cage inter-jointing, but a bearing unit of any desired length is offerable upon request. Feel free to contact **NTN** for the detailed information.

Needle roller tolerance

The needle rollers contained in the flat roller cage are manufactured within the dimensional tolerance range of 0 to -2 μm against the nominal diameter (D_w).

Raceway surface requirements

Table 1 shows the requirements for raceway surface applied to the linear flat roller bearings.

Table 1 Raceway surface requirements (recommended)

Characteristics	Tolerance
Surface roughness (max)	0.2a
Surface hardness ❶	HRC58～64
Effective hardened layer depth (min)	0.4mm
Mounting accuracy (max)❷	0.1 mm per 1000 mm

❶ Where raceway surface hardening not allowed, a quenched spring plate may be used.
❷ Mounting accuracy is expressed with an inclination value in **Fig. 1.**

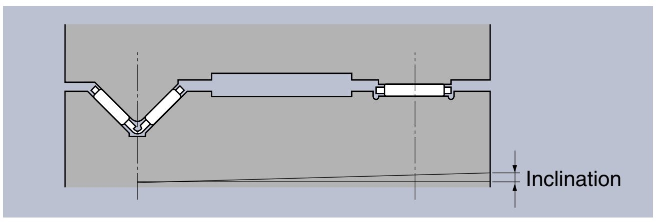


Fig. 1

How to mount

Theoretically the linear flat roller bearing moves by 1/2 of table moving stroke in same direction as the table moving direction. The relationship of bed length (L) - stroke (S) - cage length (L_1) can be expressed in **formula (1).** (**Fig. 2**)

$$L=S/2+L_1 \quad \cdots\cdots (1)$$

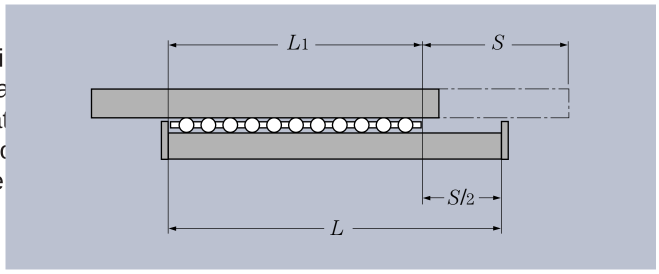


Fig. 2

The linear flat roller bearing results in moving deviation due to profile deviation of raceway surface, uneven load or vibration. Therefore, the table or the bed must be equipped with a stopper at its end portion to prevent over run of the flat roller bearing. (**Fig. 5**)

Figs. 3 and **4** illustrate application examples of the linear flat roller bearing unit.

If a separate raceway surface having undergone heat treatment and grinding is installed to a machine main body, be careful to avoid deformation of the bearing that can result from tightening.

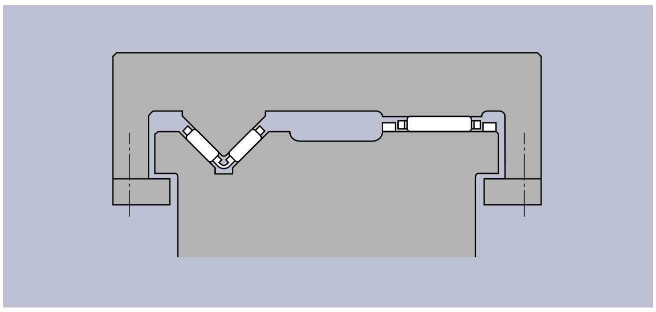


Fig. 3 General application

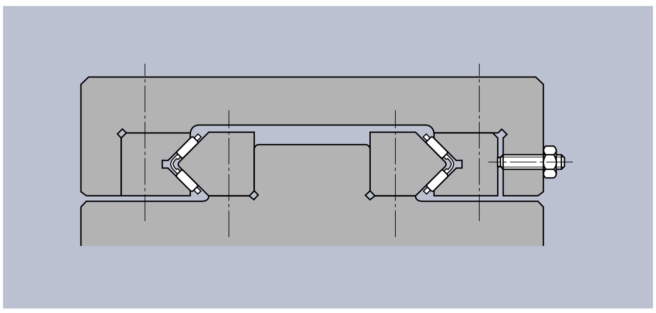


Fig. 4 When overhung load acts on

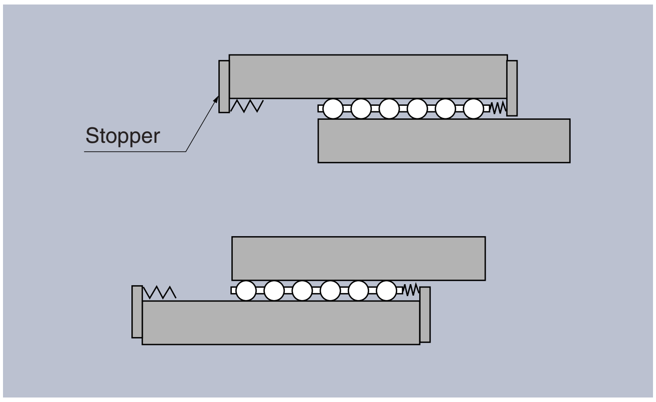
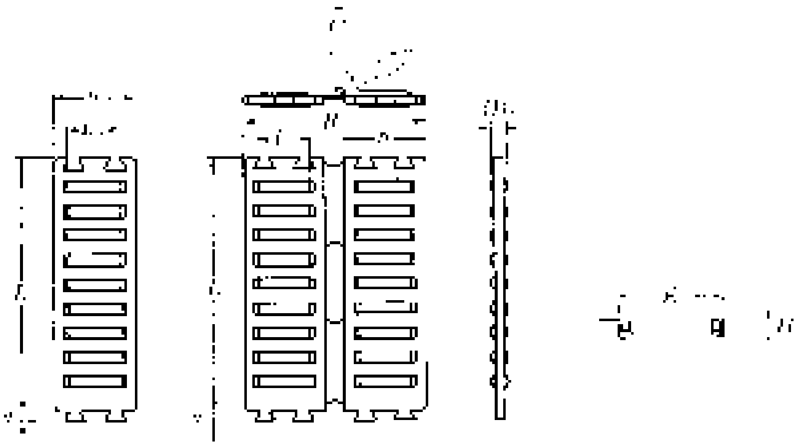


Fig. 5

Type FF
Type FF··ZW



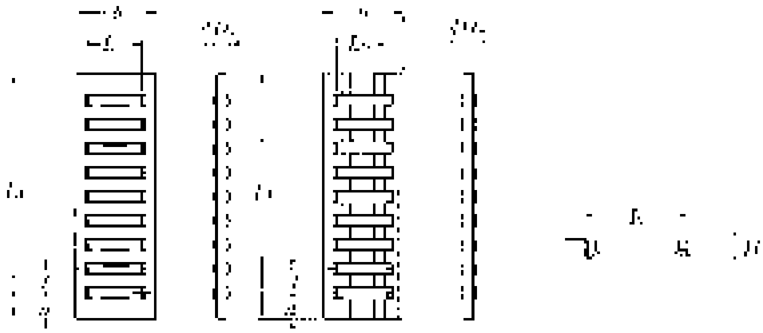
Type FF Type FF··ZW

D_w 2～3.5mm

Boundary dimensions mm						Basic load ratings dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Bearing numbers	Number of rolls	Abutment dimensions mm		Mass kg
D_w[1)]	b	B	L	L_w	a	C_r	C_{or}	C_r	C_{or}			E	H	(approx.)
2	10	—	32	6.8	2	8 500	19 700	865	2 010	**FF2010**	7	$10.3^{+0.1}_{0}$	$1.7^{0}_{-0.2}$	0.0020
2	10	25	32	6.8	2	15 500	39 500	1 580	4 000	**FF2025ZW**	14	$25.3^{+0.1}_{0}$	$1.7^{0}_{-0.2}$	0.0043
2.5	15	—	45	9.8	2.4	17 100	41 400	1 740	4 200	**FF2515**	8	$15.3^{+0.1}_{0}$	$2.2^{0}_{-0.2}$	0.0038
2.5	15	35	45	9.8	2.4	29 300	82 500	2 980	8 450	**FF2535ZW**	16	$35.3^{+0.1}_{0}$	$2.2^{0}_{-0.2}$	0.0082
3	20	—	60	13.8	3	31 000	79 500	3 150	8 100	**FF3020**	9	$20.4^{+0.1}_{0}$	$2.7^{0}_{-0.2}$	0.0089
3	20	45	60	13.8	3	53 500	159 000	5 450	16 200	**FF3045ZW**	18	$45.4^{+0.1}_{0}$	$2.7^{0}_{-0.2}$	0.019
3.5	25	—	75	17.8	3.2	50 000	132 000	5 100	13 500	**FF3525**	10	$25.4^{+0.1}_{0}$	$3.2^{0}_{-0.2}$	0.017
3.5	25	55	75	17.8	3.2	86 000	265 000	8 800	27 000	**FF3555ZW**	20	$55.4^{+0.1}_{0}$	$3.2^{0}_{-0.2}$	0.035

Note 1) The dimensional tolerance for needle roller diameter D_w is 0 to -2 μm.

Type BF
Type RF



Type RF Type BF

D_w 3～7mm

Boundary dimensions (mm)						Basic load ratings[3] dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Bearing numbers	Abutment dimensions (mm)		Mass[4] (kg)
D_w[1]	b	L_1[2]	L_w	l	a	C_r	C_{or}	C_r	C_{or}		E	H	(approx.)
3	20	705	13.8	6	4.5	34 000	88 500	3 450	9 000	**RF3020/705**	$20.4^{+0.1}_{0}$	$2.7^{0}_{-0.2}$	0.015
3	20	1 000	15.8	6	5	38 000	102 000	3 850	10 400	**BF3020/1000**	$20.4^{+0.1}_{0}$	$2.7^{0}_{-0.2}$	0.037
5	23	1 000	19.8	8	8	87 000	211 000	8 850	21 500	**BF5023/1000**	$23.4^{+0.1}_{0}$	$4.7^{0}_{-0.2}$	0.054
5	32	1 000	27.8	8	8	114 000	299 000	11 600	30 500	**BF5032/1000**	$32.4^{+0.1}_{0}$	$4.7^{0}_{-0.2}$	0.073
7	28	1 000	24	11	10.5	138 000	305 000	14 000	31 000	**BF7028/1000**	$28.5^{+0.1}_{0}$	$6.7^{0}_{-0.2}$	0.091
7	35	1 000	30	11	10.5	185 000	445 000	18 900	45 500	**BF7035/1000**	$35.5^{+0.1}_{0}$	$6.7^{0}_{-0.2}$	0.110

Note 1) The dimensional tolerance for needle roller diameter is 0 to -2 μm.
2) The standard length of L_1 the cage shall be 1000 mm for Type BF and 705 mm for Type RF.
Where special cage length is required, the nominal bearing number is followed by the numerical length value as exemplified below.
Ex. Where L_1= 500 mm is required for **BF3020**, **BF302/500**
3) The listed basic load ratings are subject to use of 10 flat rollers. Calculate the basic load ratings for any optional cage length L_1 by the following formula.
$C = f^{7/9} \cdot C_r$
$C_0 = f \cdot C_{0r}$
Herein, f=0.1 (L_1+l-2a) / l
4) The listed weights are subject to L_1=1000 mm.

Remarks: For **Type BF**
1. On occasion, the length of an ordered unit could be shorter by dimension l than shown in each Dimensions Table because the roller and cage assy is cut at the minimum unit of each pocket so as to match the required length.
2. Where this bearing unit is used frequently at various lengths, it is more economical to cut the standard bearing of 1000 mm each desired length at your side.

Linear Roller Bearings

This roller bearing with cylindrical rollers having the function capable of circulating within the raceway block ensures smooth infinite linear motion on a flat surface. The cylindrical rollers are retained and guided by the cage and the ribs of the raceway block.

The cage is of such a construction as not allow adjacent rollers to contact with one another. Hence, the friction coefficient is low.

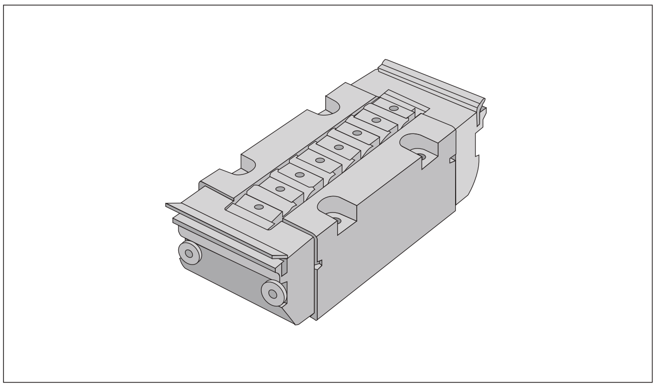


Fig. 1

Bearing accuracy

All the linear roller bearings are manufactured within the dimensional tolerance range of 0 to -2.5μm for bearing height (H). And these bearings are delivered classified into 5-stepped tolerance classes. (See **Table 1**)

Table 1 Classification of bearing height H accuracy class

Unit : μm

Class code	Tolerance for height (H)
1H	0～－ 5
2H	－ 5～－10
3H	－10～－15
4H	－15～－20
5H	－20～－25

Requirements and tolerances for raceway surface and mounting surface

Table 2 shows the requirements and tolerances for the raceway surface, on which linear roller bearing rolls, and the bearing mounting surface. Where adhesion of a hard foreign matter to the raceway surface is forecast, the raceway surface must be protected with a proper protective cover.

The reference surface for mounting is the back face and opposite face to **NTN** mark.

Table 2 Requirements for raceway surface and mounting surface (recommended)

Characteristics	Allowable value or tolerance range
Raceway surface roughness (max)	0.2a
Raceway surface hardness	HRC58～64
Effective hardened layer depth of raceway surface (min)	as described in applicable Dimensions Table
Parallelism of mounting surface	
Δx (See **Fig. 2**)	0.05 mm per 100 mm
Δy (See **Fig. 3**)	0.01 mm per 100 mm

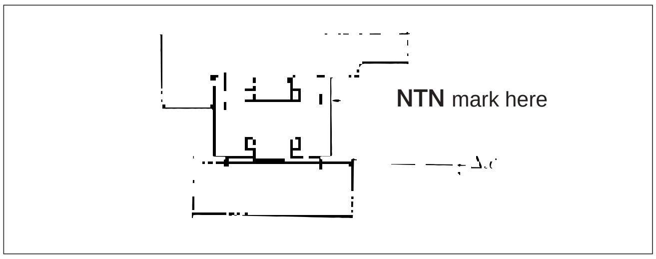


Fig. 2

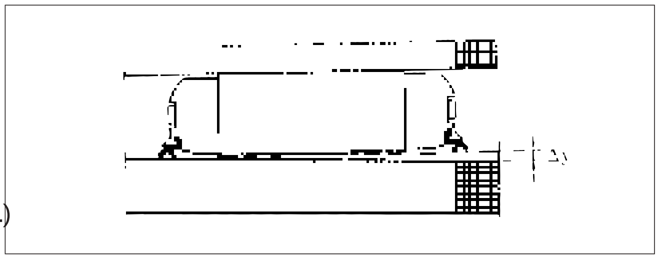


Fig. 3

How to mount

Fix linear roller bearing using the tapped holes which are provided on the mounting reference surface. (See **Fig. 4**)

If a plurality of bearing units are installed on a same plane, select the units that belong to a same bearing height H dimensional accuracy class (**Table 1**) so that t load is uniformly distributed onto them.

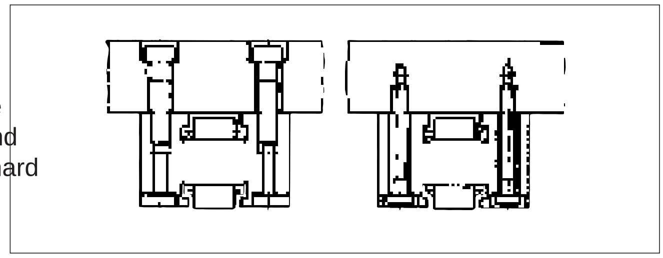
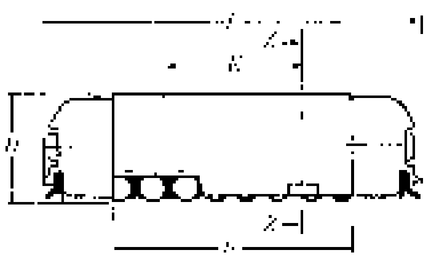
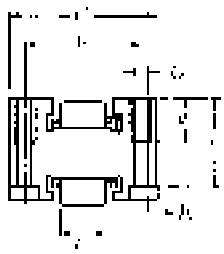


Fig. 4

Type RLM



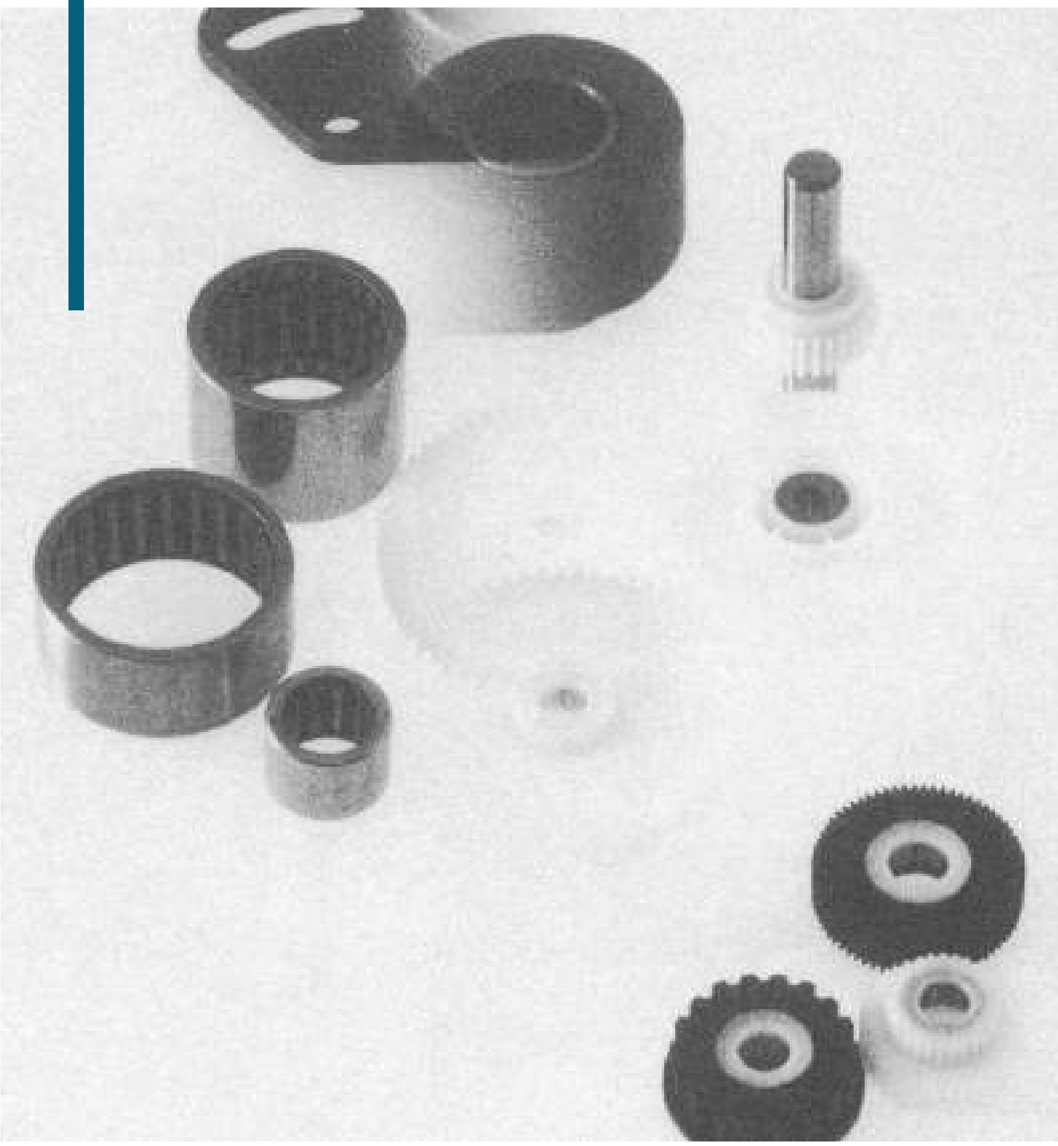


Section Z-Z

H 16～38mm

Boundary dimensions mm											Bearing numbers	Basic load ratings dynamic N	static N	dynamic kgf	static kgf	Required case depth on track (min.) mm	Mass kg (approx.)
H	C	L	L_w	E	F	G	L_t	e	g	K		C_r	C_{or}	C_r	C_{or}		
16	25	62	8	17	19	M4	35.5	12.5	6	ϕ3.2	**RLM16×62A**	15 400	34 000	1 570	3 450	0.3	0.11
19	27	69	10	25.5	20.6	M4	43.4	15.5	6	ϕ3.2	**RLM19×69B**	26 100	58 000	2 660	5 900	0.3	0.16
26	40	86	14	28	30	M6	52.4	21	10	ϕ4.5	**RLM26×86A**	50 000	106 000	5 100	10 800	0.4	0.41
26	40	102	14	44	30	M6	67.9	21	10	ϕ4.5	**RLM26×102A**	62 500	142 000	6 350	14 400	0.4	0.53
26	40	126	14	68	30	M6	91.8	21	10	ϕ4.5	**RLM26×126A**	80 000	195 000	8 150	19 900	0.4	0.70
38	52	134	20	51	41	M8	85.7	31	14	ϕ6.5	**RLM38×134B**	124 000	270 000	12 600	27 500	0.5	1.3

One-way Clutches
Tension Pulleys,
Bottom Roller Bearings



One-way Clutches

This is a compact and roller type one-way clutch whi formed a cam face on its outer ring. (Available shaft diameter range: 6 to 35 mm) When the outer ring be to turn in the counterclockwise direction (direction marke on the outer ring width surface) relative to the shaft, th force of spring causes the rollers to advance to the engagement positions on the outer ring cam face, therel the wedge action taking place between the outer ring c face and the shaft drives the shaft. (See **Fig. 1**) When the outer ring rotates clockwise against the shaft, the shaft rotates counterclockwise relatively to the outer ring and, as the result, the rollers get away from the outer ring cam face and simultaneously the outer ring idles against the shaft. (See **Fig. 2**)

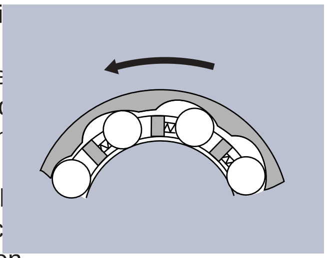


Fig. 1
One-way clutch in engagement

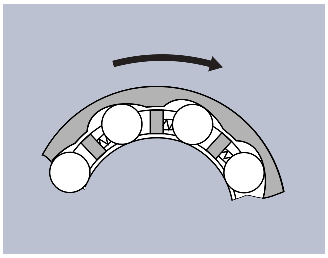
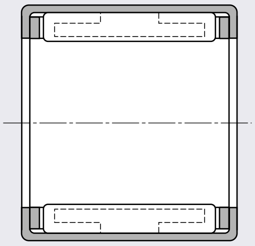
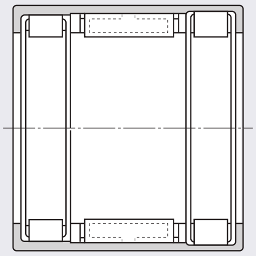


Fig. 2
One-way clutch in idling

Type	Applied shaft diameter (mm)	Composition of nominal clutch number	Remarks
Type HF 	φ6—φ35	HF 10 12 — Width; Bore diameter; Type code	One-way clutch HF composed of an outer ring drawn from a thin steel plate by precision drawing has the clutching function only. **In order for a oneway clutch to be able to carry a radial load and smoothly rotate, its both ends each need to be supported by a radial load carrying bearing.**
Type HFL 	φ8—φ35	HFL 10 22 — Width; Bore diameter; Type code	One-way clutch HFL has an outer ring drawn from thin steel plate by precision drawing, a clutching function, and an integral needle roller and cage assembly capable of supporting radial load at its both ends respectively. Thus, this HFL can function as clutch and, in addition, support radial load.

Both of Type HF and HFL use a polyamide resin cage and press the needle rollers to a wedge, which is formed between the outer ring cam face and the shaft, by action of a plate spring supported with the cage.

Clutch fit

Table 1 shows the one-way clutch fits on shaft and in housing. Both of Type HF and HFL are only press-fitted in a housing, needing no axial fixing by use of a snap ring, etc.

However, due to the outer ring drawn from thin steel by precision drawing, the performance of the both is directly affected by the dimensional and profile deviations of the shaft/housing. To avoid such an inverse affect, shaft and housing accuracy must be controlled with good care. Any housing is required to have the wall thickness of a specified value or more. **Table 2** shows the recommended value.

Table 1 Clutch fits (recommended)

Type	Shaft	Housing	
		Iron series	Light metal alloy
HF HFL	h5 (h6)	N6 (N7)	R6 (R7)

Table 2 Recommended housing wall thickness (recommended)

Housing material	Housing wall thickness
Iron-based	0.75 $(D-F_w)$ and over
Light metal alloy	1.5 $(D-F_w)$ and over

For values of D and F_w, refer to the relevant dimension table.

Shaft and housing requirements

Table 3 shows the shaft and housing requirements.

Table 3 Shaft and housing requirements (recommended)

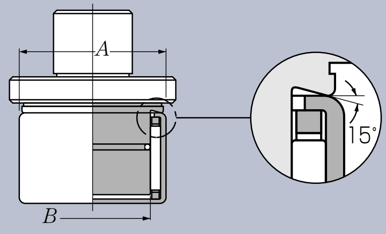
Characteristics	Shaft		Housing	
	Type HF	Type HFL	Type HF	Type HFL
Roundness (max)	IT3 (IT4)		IT4 (IT5)	
Cylindricality (max)	IT3 (IT4)		IT4 (IT5)	
Surface roughness	0.2a		1.6a	
Surface hardness	HRC58—64		—	
Effective hardened layer depth (min)	0.4mm		—	

Lubrication

Oil lubrication is optimum for these one-way clutches, but generally grease lubrication is mostly applied to this type of one-way clutch. **NTN** one-way clutches are filled up with a suitable grease. These clutches need no further grease replenishment, but subject to general applications.

In replenishing, good care must be exercised of too much grease filling. Too much filling could cause interference with smooth clutching.

For selection of an appropriate lubricant, contact **NTN** Engineering for technical assistance.



$A = D - (0.2\sim0.3)$ mm
$B = F_w - (0\sim0.025)$ mm
D = Outer diameter of one-way clutch mm
F_w = Roller inscribed circle diameter mm
(Refer to applicable Dimensions Table.)

Fig. 3

Allowable operating temperature

For **Type HF** and **HFL**···Oil lubrication : -10 to 120˚C
Grease lubrication : -10 to 70˚C

When intending to use the oneway clutch at the upper or lower limit for its allowable operating temperature range, contact **NTN** Engineering for technical assistance.

How to mount

It is convenient to use a press-fitting mandrel as illustrated in **Fig. 3** for assembling and mounting these one-way clutches. In that case, press-fit the outer ring, with its stamped mark side kept in contact with the mandrel shoulder.

In assembling, be careful to prevent the outer ring from twisting. Avoid to hammer directly the outer ring and, in press-fitting, bring a proper jig in contact with the outer ring side face without fail. Furthermore, when press-fitting in an housing with shoulder, good care must be exercised to prevent the bearing side face from coming into contact with the housing shoulder and to thereby avoid deformation of the bearing.

Also, shaft can be easily assembled by turning it in clutch idling direction. Where impossible to do so, provide the shaft end with a tapered (chamfered) guide to facilitate assembling-in.

Precautions in selecting

NTN is verifying the functions of its oneway clutch products under various test conditions. However, if an **NTN** oneway clutch is used under a higher load torque, in high oscillation cycles and fine oscillation mode, or when a greater radial load acts on the oneway clutch, or if the hardness of the mating shaft is low, the life of oneway clutch can become shorter.

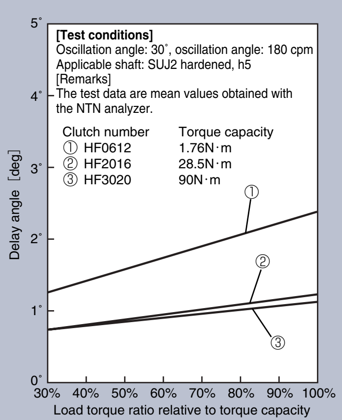
Furthermore, lock failure could occur in the cases of fast idling speed, frequent use in idling, and application incurring vibration.

When using these one-way clutches under the special conditions stated above, feel free to contact **NTN** for further instructions.

If loss of the clutching function of oneway clutch (slipping occurs during engagement motion) can impose severe damage to personnel or equipment, a positive safety device needs to be separately provided for the machine.

■Delay angle

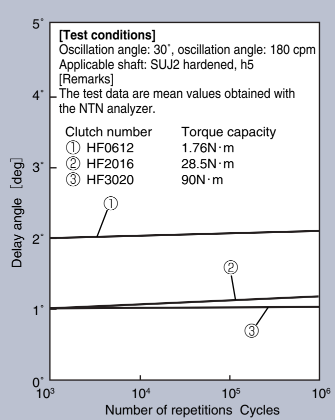
"Delay angle" means the difference ($\theta_i - \theta_o$) between the angle of rotation of the input shaft (θ_i) and the angle of rotation of the output shaft (θ_o). The delay angle of **NTN** oneway clutch can vary depending on the oneway clutch designation and the magnitude of torque the oneway clutch carries. The chart in the right graphically illustrates the trend in relation between load torque and delay angle (data measured with an **NTN** analyzer).



Type HF
Relation between load torque and delay angle

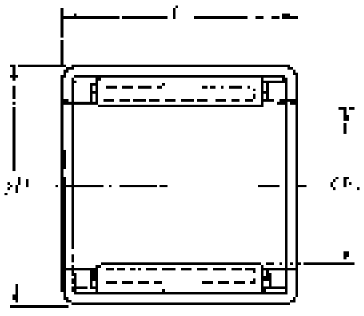
■Life

NTN has verified that even if a torque as high as the torque capacity of **NTN** oneway clutch products is exerted, and when the number of engagement cycles exceeds 10^6, change in the delay angle on **NTN** oneway clutches is small (data obtained from the **NTN** analyzer).



Type HF
Change in delay angle owing to increase in number of repeated cycles

Type HF



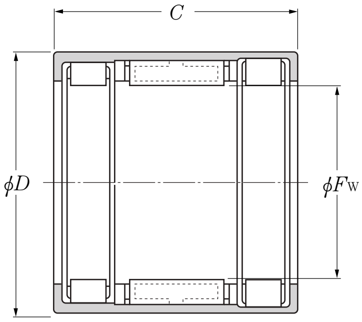
Type HF

F_W 6〜35mm

Boundary dimensions mm			Torque capacity M_d		Bearing numbers	Mass kg (approx.)	Part number by radial load (approx.)	
F_W	D	C $^{0}_{-0.25}$	N·m	kgf·m			needle roller bearing	oil retaining bearing
6	10	12	1.76	0.18	**HF0612**	0.003	HK0609T2	B-S6-22
8	12	12	3.15	0.32	**HF0812**	0.0035	HK0810	B-S8-25
10	14	12	5.30	0.54	**HF1012**	0.004	HK1010	B-S10-21
12	18	16	12.2	1.24	**HF1216**	0.0116	HK1212	B-S12-32
14	20	16	17.3	1.76	**HF1416**	0.013	HK1412	B-S14-13
16	22	16	20.5	2.09	**HF1616**	0.014	HK1612	B-S16-13
18	24	16	24.1	2.46	**HF1816**	0.0155	HK1812	B-S18-8
20	26	16	28.5	2.91	**HF2016**	0.017	HK2012	B-S20-19
25	32	20	66	6.73	**HF2520**	0.0309	HK2512	B-S25-11
30	37	20	90	9.18	**HF3020**	0.036	HK3012	B-S30-19
35	42	20	121	12.3	**HF3520**	0.040	HK3512	B-S35-7

Remarks: Type HF is subject to delivery of INA product instead.
Type HFL is the imported product from INA, Germany.

Type HFL



Type HFL

d 8～35mm

Shaft dia. mm *d*	Boundary dimensions mm *Fw*	*D*	*C* 0 −0.25	Basic load ratings dynamic N *Cr*	static N *Cor*	dynamic kgf *Cr*	static kgf *Cor*	Bearing numbers	Torque capacity N·mm	kgf·m	Mass kg (approx.)
8	8	12	22	4 050	413	4 150	423	**HFL0822**	3.15	0.32	0.0063
10	10	14	22	4 300	438	4 650	474	**HFL1022**	5.30	0.54	0.0074
12	12	18	26	6 300	642	6 500	663	**HFL1226**	12.2	1.24	0.018
14	14	20	26	7 100	724	7 700	785	**HFL1426**	17.3	1.76	0.020
16	16	22	26	7 300	744	8 400	857	**HFL1626**	20.5	2.09	0.022
18	18	24	26	8 300	846	10 300	1 050	**HFL1826**	24.1	2.46	0.024
20	20	26	26	8 200	836	10 400	1 060	**HFL2026**	28.5	2.91	0.027
25	25	32	30	10 900	1 110	14 100	1 440	**HFL2530**	66.0	6.73	0.044
30	30	37	30	12 600	1 280	17 600	1 790	**HFL3030**	90.0	9.18	0.051
35	35	42	30	13 000	1 330	19 300	1 970	**HFL3530**	121	12.3	0.058

Bottom Roller Bearings for Textile Machinery

These are needle roller bearings that support the bottom rollers (fluted rollers) on fine spinning machines, roving frames or drawing frames. **Type FRIS** is applied to a fine spinning machine and a roving frame, and **Type FR** is applied to a drawing frame.

Types and construction

Bottom roller bearing **FRIS** is used to support the bottom rollers of a fine spinning machine and a roving frame. The outer ring outer profile of this bearing type is spherical, which can allow, to some extent, mounting error in the bottom rollers. On the other hand, the inne ring is provided with a rib at its both ends and a clea between the outer ring and each inner ring rib is minimized. Furthermore, the rib outer surface is knurled to prevent invasion of cotton pieces into the bearing.

These bottom roller bearings are classified into internationally interchangeable **A-series** bearings with bearing fixing saddle (to fix a bearing to a support sta and **B-series** bearings adaptable to the dimensions of JIS Fluted Rollers.

A-series bearings are further classified into one bearing type (suffix **SA**) wherein inner ring and outer ri are separable from one another according to saddle type and another bearing type (suffix **SB**) wherein inner ring and outer ring are non-separable. Of course, these bearings can also be supplied without saddle.

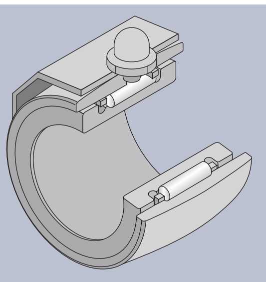


Fig. 1 Type FRIS··SA

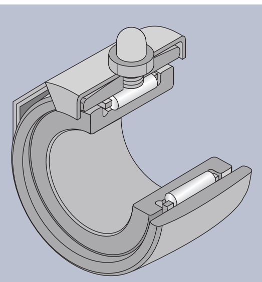


Fig. 2 Type FRIS··SB

On the other hand, **B-series** bearings are further classified into bearing type with grease nipple (suffix **N**), bearing type with knock pin on its outer ring (suffix **P**) and bearing type with knock hole on its outer ring (suffix **W**) (latter two types-classified by the fixing method applied).

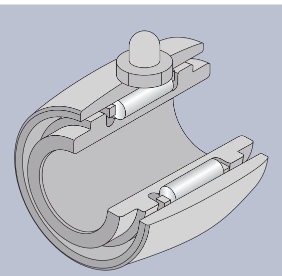


Fig.3 Type FRIS

These bearings can be supplied with saddle thereon o request, similarly to **A-series**.

Type **FR** is used to support the rollers of a drawing frame. This bearing type is composed of two drawn cup type needle roller bearings which are configured in a housing. These have no inner ring and use a shaft as direct raceway surface. Synthetic rubber seal is fitted in the both ends of the housing. This bearing type is fixe a support stand with knock pins press-fitted in the housing. The knock pin is provided with an grease ho to enable grease replenishing.

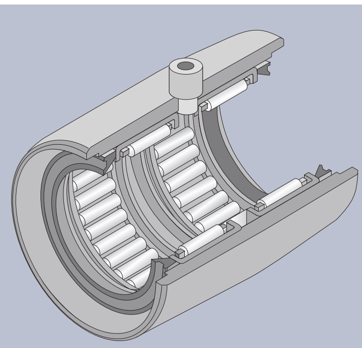


Fig. 4 Type FR

Composition of bearing number

The bearing number comprises type code, dimension code [diameter (d or F_w)] and a suffix.

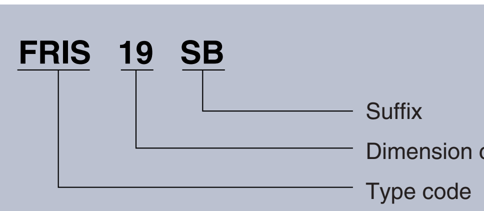


Fig.5

Bearing fits

Table 1 shows bearing fits on/in shaft and housing.

Table 1 Bearing fits

Bearing type	Shaft		Housing (stand)
	Screwed joint	Spline joint	
FRIS	g5 (g6)	j5 (j6)	H10
FR	h5 (h6)		H10

Precautions for mounting

(1) For the shaft shoulder dimensions of the Type FRIS, refer to the dimensions d and G in the relevant dimension table. To be able to prevent entanglement with fly and avoid adverse effect onto spinning quality, it is necessary to promptly remove entangling fly without stopping the machine. In this context, the conditions that must be satisfied to allow the bearing to fully develop its functions and maintain spinning quality by provide sufficiently deep and wide shaft shoulder.

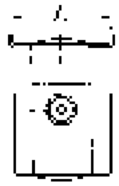
(2) To axially position the bottom roller connected to the machine, use a thrust bearing on the gear end side so that axial movement of the bottom roller is positively prevented.

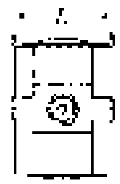
(3) When rinsing the bottom roller with cleaning liquid such as light oil, be careful not to allow the cleaning liquid to enter the bearing.

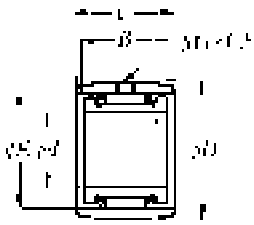
(4) When installing the bearing to a stand, position the outer ring to the middle of the inner ring width.

(5) Carefully install the bottom roller so that its runout is not greater than 0.05 mm.

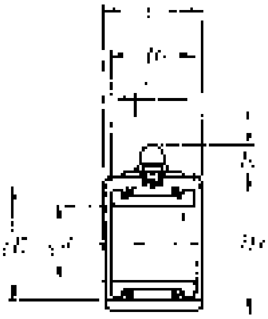
Type FRIS Series A
(For fine spinning machine/ roving frame)



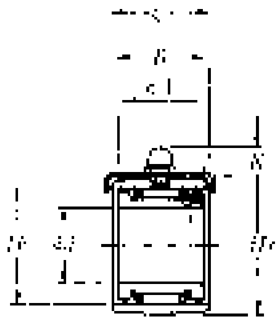




Type FRIS



Type FRIS··SA
(Separable)

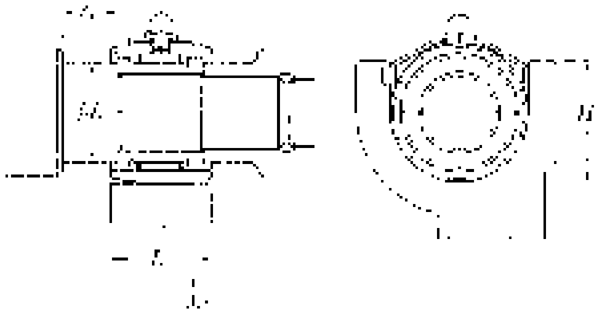


Type FRIS··SB
(Non-separable)

d 16.5～25mm

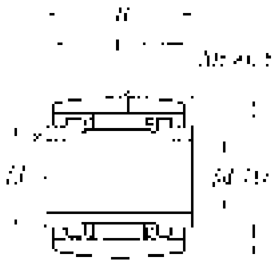
Boundary dimensions (mm)									Basic load ratings: dynamic (N)	static (N)	dynamic (kgf)	static (kgf)
d 0 −0.010	D		B 0 −0.050	C 0 −0.120	E	$r_{s\,min}$ 1)	L	K	C_r	C_{or}	C_r	C_{or}
16.5	28	0 −0.020	19	22	23.5	0.3	22.2	7.7	10 200	14 600	1 040	1 480
19	32	0 −0.025	20	23	27	0.3	22.2	7.7	11 800	18 500	1 200	1 880
	36		22	25	29	0.3	22.2	9.8	12 700	17 600	1 300	1 800
22	42	0 −0.025	25	29	35	0.3	26.4	10.2	19 500	25 300	1 980	2 580
25	45	0 −0.025	25	29	37	0.3	26.4	10.2	21 300	29 100	2 170	2 970

Note 1) Allowable minimum chamfer dimension



Bearing numbers			Abutment dimensions mm				Mass kg
bearing	bearing with saddle						bearing with saddle
	Type SA	Type SB	L_1	d_1	G	H	(approx.)
FRIS16.5	FRIS16.5SA	FRIS16.5SB	22	21	13	24～26	0.059
FRIS19	FRIS19SA	FRIS19SB	22	24	15	27～29	0.081
FRIS19-5	FRIS19-5SA	FRIS19-5SB	22	26	15	30～32	0.120
FRIS22-2	FRIS22-2SA	—	26	30	15	35～37	0.208
FRIS25	FRIS25SA	—	26	33	15	37～39	0.226

Type FRIS Series B
(For fine spinning machine/ roving frame)



Type FRIS

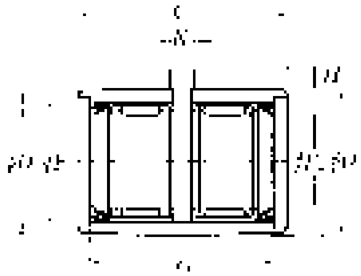
Type FRIS··NP
(With grease nipple/knock pin) 2)

d 15～25mm

Boundary dimensions (mm)								Basic load ratings, dynamic (N)	static (N)	dynamic (kgf)	static (kgf)	Bearing numbers		Mass (approx.) kg
d 0/−0.010	D		B 0/−0.050	C 0/−0.120	J	$r_{s\,min}$ 1)	K	C_r	C_{or}	C_r	C_{or}	Type FRIS	Type FRIS··NP	Type FRIS··NP
15	28	0/−0.020	24	22	22	0.3	7.7	10 200	14 600	1 040	1 480	**FRIS15**	—	0.070
15.875	30	0/−0.020	25.4	22	22	0.3	7.1	10 200	14 600	1 040	1 480	**FRIS15.87**	**FRIS15.87NP**	0.082
16	28	0/−0.020	26	22	22	0.3	7.7	10 200	14 600	1 040	1 480	**FRIS16**	**FRIS16NP**	0.083
	30		26	22	22	0.3	7.1	10 200	14 600	1 040	1 480	**FRIS16-2**	**FRIS16-2NP**	0.098
18	31.750	0/−0.025	24	23	24	0.3	7.7	11 800	18 500	1 200	1 880	**FRIS18**	**FRIS18NP**	0.083
	32		26	23	24	0.3	7.7	11 800	18 500	1 200	1 880	**FRIS18-2**	**FRIS18-2NP**	0.088
19.050	31.750	0/−0.025	23.81	23	24	0.3	7.7	11 800	18 500	1 200	1 880	**FRIS19.05**	—	0.078
	34		25.4	23	26	0.3	7.7	12 700	17 600	1 300	1 800	**FRIS19.05-1**	**FRIS19.05-1NP**	0.098
20	34	0/−0.025	24	23	26	0.3	7.7	12 700	17 600	1 300	1 800	**FRIS20-2**	**FRIS20-2NP**	0.089
	34		26	23	26	0.3	7.7	12 700	17 600	1 300	1 800	—	**FRIS20-4NP**	0.097
	36		26	23	26	0.3	7.1	12 700	17 600	1 300	1 800	—	**FRIS20-7NP**	0.125
22	40	0/−0.025	26	24	30	0.6	7.1	16 200	22 300	1 650	2 280	**FRIS22-1**	**FRIS22-1NP**	0.154
22.225	40	0/−0.025	25.4	24	30	0.6	7.1	16 200	22 300	1 650	2 280	**FRIS22.22**	**FRIS22.22NP**	0.145
25	42	0/−0.025	26	24	32	0.6	7.1	16 000	22 500	1 640	2 290	**FRIS25-1**	**FRIS25-1NP**	0.154
	44		26	24	34	0.6	7.1	17 200	25 100	1 750	2 560	**FRIS25-2**	**FRIS25-2NP**	0.174

Note 1) Allowable minimum chamfer dimension
2) Example of bearing with grease nipple: Ex. FRIS 18N
Bearing with knock pin only: Ex. FRIS 15.87P

Type FR
(Drawing frame)



Type FR

F_w 17.462～22mm

Boundary dimensions (mm)									Basic load ratings				Bearing numbers	Mass
									dynamic (N)	static (N)	dynamic (kgf)	static (kgf)		kg
F_w		D (0 / −0.050)	C (0 / −0.20)	E	G	H	K	D_1	C_r	C_{or}	C_r	C_{or}		(approx.)
17.462	+0.053 / +0.010	26.5	46	24	31	5	5	26	10 200	16 600	1 040	1 690	FR17.46P	0.066
		26.5	47.6	24.6	42.86	4.76	4.76	26	14 400	25 900	1 470	2 640	FR17.46-1P	0.075
		26.5	52.38	24.6	42.86	4.76	4.76	26	14 400	25 900	1 470	2 640	FR17.46-2P	0.082
		26.988	41.28	24	31	5	5	26.5	10 200	16 600	1 040	1 690	FR17.46-3P	0.068
19.050	+0.053 / +0.020	31.750	52.38	28	42.86	4.76	4.76	31.2	16 700	25 800	1 700	2 630	FR19.05P	0.134
22	+0.053 / +0.020	34	46	28	43	4.76	4.76	33.5	23 400	44 000	2 380	4 500	FR22P	0.150

Tensioner Pulleys for Textile Machinery

These pulleys are used to guide and tension the tapes and belts driving the spindles of a fine spinning machine, a roving frame, a false twister, etc.

A pulley drawn precisely from steel plate by precision deep drawing is press-fitted in the outer ring of shaft bearing in in place of inner ring.

Types and construction

Single-row or double-row ball bearing is built in this pulley, which is internally prefilled with lithium soap base grease. Grease is replenished through a grease hole which is internally provided in the stud. Two different mounting methods are available as follows for these pulleys; one method is to bolt a pulley to the roller ca of machine with holder bolt using a special-purposed holder (Type code **JF··S**) and another method is to bolt directly a pulley to machine frame using the bolting hol drilled in the stud and a corresponding hexagon head bolt. A knock pin press-fitted in the stud end face is to lock the bolt after tightened.

When a pulley is directly bolted to machine frame, provide the hexagon head bolt center with a grease through-hole for grease replenishing and screw a grease nipple in its end face.

In mounting a double-row ball bearing type tension pulley, insert the stud directly into machine frame and tighten it with nut, without using the special-purposed holder. Replenish grease using the box nut.

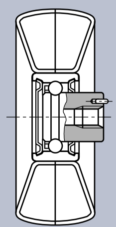


Fig. 1
Single-row bearing type ension pulley

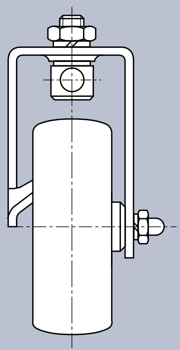


Fig. 2
Tension pulley with holder

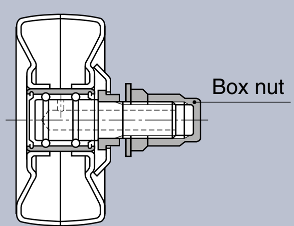


Fig. 3
Double-row bearing type tension pulley

Composition of pulley number

The pulley number of a given **NTN** tension pulley consists of a type code (**JPU**), dimension code [pulley outside diameter (D)] and a suffix. A pulley having a special holder is marked with the holder number of that holder added to the suffix.

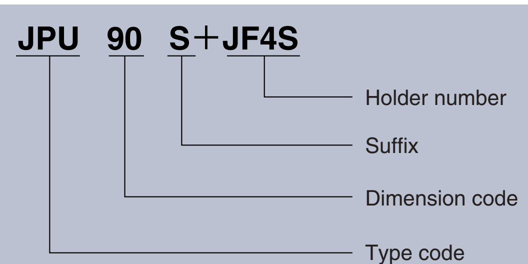
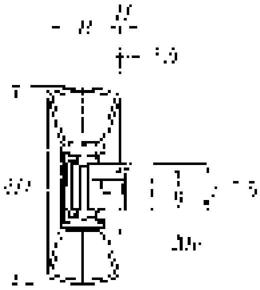
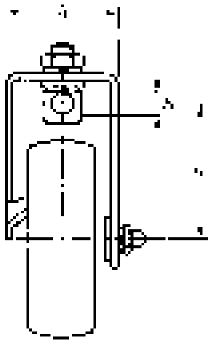


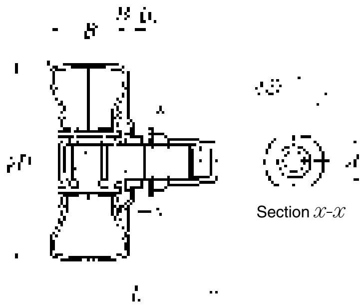
Fig. 4



Example 1



Example 2



Example 3

D 60～100mm

Boundary dimensions mm										Bearing numbers	Sample number	Mass kg (approx.)
D	*B*	B_1	*H*	d_1 $^{0}_{-0.3}$	*a*	*b*	*S*	*L*	B_2			
60	25	—	3.5	—	—	—	—	—	—	**JPU60S**	1	0.140
70	25	—	3.5	—	—	—	—	—	—	**JPU70S**	1	0.160
	25	—	3.5	—	48	39	10.2	—	—	**JPU70S＋JF1S**	2	0.235
	30	2	—	21	—	—	—	67 ～71	5～9	**JPU70-2S**	3	0.245
	32	—	—	—	—	—	—	—	—	**JPU70-1S**	1	0.175
	32	—	—	—	48	46	10.2	—	—	**JPU70-1S＋JF2S**	2	0.250
90	25	—	3.5	—	—	—	—	—	—	**JPU90S**	1	0.215
	25	—	3.5	—	58	39	10.2	—	—	**JPU90S＋JF3S**	2	0.300
	32	—	—	—	—	—	—	—	—	**JPU90-1S**	1	0.230
	32	—	—	—	58	46	10.2	—	—	**JPU90-1S＋JF4S**	2	0.320
	32	3.5	—	21	—	—	—	70.5～74.5	5～9	**JPU90-9S**	3	0.325
	45	3.5	—	21	—	—	—	83.5～87.5	5～9	**JPU90-10S**	3	0.380
100	32	3.5	—	21	—	—	—	70.5～74.5	5～9	**JPU100-14S**	3	0.290
	40	3.5	—	21	—	—	—	78.5～82.5	5～9	**JPU100-12S**	3	0.390

Contents of Appendix

Approximate conversion values against Rockwell C hardness of steel materials[1)]

Rockwell C scale hardness[2)]	Pickers hardness (DPH)	Brinnel hardness 100 mm ball, load 3000 kgf			Rockwell hardness[2)]			Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm² Approx. value	Rockwell C scale hardness[2)]
		Standard ball	Hultgren ball	Tungsten carbite ball	A scale Load 60kgf brale identer	B scale Load 100 kgf dia. 1/16in. ball	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgfkgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
68	940	—	—	—	85.6	—	76.9	93.2	84.4	75.4	97	—	68
67	900	—	—	—	85.0	—	76.1	92.9	83.6	74.2	95	—	67
66	865	—	—	—	84.5	—	75.4	92.5	82.8	73.3	92	—	66
65	832	—	—	739	83.9	—	74.5	92.2	81.9	72.0	91	—	65
64	800	—	—	722	83.4	—	73.8	91.8	81.1	71.0	88	—	64
63	772	—	—	705	82.8	—	73.0	91.4	80.1	69.9	87	—	63
62	746	—	—	688	82.3	—	72.2	91.1	79.3	68.8	85	—	62
61	720	—	—	670	81.8	—	71.5	90.7	78.4	67.7	83	—	61
60	697	—	613	654	81.2	—	70.7	90.2	77.5	66.6	81	—	60
59	674	—	599	634	80.7	—	69.9	89.8	76.6	65.5	80	—	59
58	653	—	587	615	80.1	—	69.2	89.3	75.7	64.3	78	—	58
57	633	—	575	595	79.6	—	68.5	88.9	74.8	63.2	76	—	57
56	613	—	561	577	79.0	—	67.7	88.3	73.9	62.0	75	—	56
55	595	—	546	560	78.5	—	66.9	87.9	73.0	60.9	74	212	55
54	577	—	534	543	78.0	—	66.1	87.4	72.0	59.8	72	205	54
53	560	—	519	525	77.4	—	65.4	86.9	71.2	58.6	71	199	53
52	544	500	508	512	76.8	—	64.6	86.4	70.2	57.4	69	192	52
51	528	487	494	496	76.3	—	63.8	85.9	69.4	56.1	68	186	51
50	513	475	481	481	75.9	—	63.1	85.5	68.5	55.0	67	179	50
49	498	464	469	469	75.2	—	62.1	85.0	67.6	53.8	66	172	49
48	484	451	455	455	74.7	—	61.4	84.5	66.7	52.5	64	167	48
47	471	442	443	443	74.1	—	60.8	83.9	65.8	51.4	63	161	47
46	458	432	432	432	73.6	—	60.0	83.5	64.8	50.3	62	156	46
45	446	421	421	421	73.1	—	59.2	83.0	64.0	49.0	60	151	45
44	434	409	409	409	72.5	—	58.5	82.5	63.1	47.8	58	146	44
43	423	400	400	400	72.0	—	57.7	82.0	62.2	46.7	57	141	43
42	412	390	390	390	71.5	—	56.9	81.5	61.3	45.5	56	136	42
41	402	381	381	381	70.9	—	56.2	80.9	60.4	44.3	55	132	41
40	392	371	371	371	70.4	—	55.4	80.4	59.5	43.1	54	127	40
39	382	362	362	362	69.9	—	54.6	79.9	58.6	41.9	52	124	39
38	372	353	353	353	69.4	—	53.8	79.4	57.7	40.8	51	120	38
37	363	344	344	344	68.9	—	53.1	78.8	56.8	39.6	50	118	37
36	354	336	336	336	68.4	(109.0)	52.3	78.3	55.9	38.4	49	114	36
35	345	327	327	327	67.9	(108.5)	51.5	77.7	55.0	37.2	48	110	35
34	336	319	319	319	67.4	(108.0)	50.8	77.2	54.2	36.1	47	108	34
33	327	311	311	311	66.8	(107.5)	50.0	76.6	53.3	34.9	46	105	33
32	318	301	301	301	66.3	(107.0)	49.2	76.1	52.1	33.7	44	102	32
31	310	294	294	294	65.8	(106.0)	48.4	75.6	51.3	32.5	43	100	31
30	302	286	286	286	65.3	(105.5)	47.7	75.0	50.4	31.3	42	97	30
29	294	279	279	279	64.7	(104.5)	47.0	74.5	49.5	30.1	41	95	29
28	286	271	271	271	64.3	(104.0)	46.1	73.9	48.6	28.9	41	93	28
27	279	264	264	264	63.8	(103.0)	45.2	73.3	47.7	27.8	40	90	27
26	272	258	258	258	63.3	(102.5)	44.6	72.8	46.8	26.7	38	88	26
25	266	253	253	253	62.8	(101.5)	43.8	72.2	45.9	25.5	38	86	25
24	260	247	247	247	62.4	(101.0)	43.1	71.6	45.0	24.3	37	84	24
23	254	243	243	243	62.0	100.0	42.1	71.0	44.0	23.1	36	82	23
22	248	237	237	237	61.5	99.0	41.6	70.5	43.2	22.0	35	80	22
21	243	231	231	231	61.0	98.5	40.9	69.9	42.3	20.7	35	79	21
20	238	226	226	226	60.5	97.8	40.1	69.4	41.5	19.6	34	77	20
(18)	230	219	219	219	—	96.7	—	—	—	—	33	75	(18)
(16)	222	212	212	212	—	95.5	—	—	—	—	32	72	(16)
(14)	213	203	203	203	—	93.9	—	—	—	—	31	69	(14)
(12)	204	194	194	194	—	92.3	—	—	—	—	29	66	(12)
(10)	196	187	187	187	—	90.7	—	—	—	—	28	63	(10)
(8)	188	179	179	179	—	89.5	—	—	—	—	27	61	(8)
(6)	180	171	171	171	—	87.1	—	—	—	—	26	59	(6)
(4)	173	165	165	165	—	85.5	—	—	—	—	25	56	(4)
(2)	166	158	158	158	—	83.5	—	—	—	—	24	54	(2)
(0)	160	152	152	152	—	81.7	—	—	—	—	24	53	(0)

Note 1) Approximate values were determined from **SAE J 417**.
2) Some of the parenthesized values in the above table are not used so frequently.

˚C-˚F temperature conversion table

˚C		F	˚C		F	˚C		F	˚C		F
−73	−100	−148	−1.6	29	84.2	17.7	64	147.2	37.1	99	210.2
−62	− 80	−112	−1.1	30	86.0	18.2	65	149.0	37.7	100	212
−51	− 60	− 76	−0.6	31	87.8	18.8	66	150.8	40.6	105	221
−40	− 40	− 40	0	32	89.6	19.3	67	152.6	43	110	230
−29	− 20	− 4	0.5	33	91.4	19.9	68	154.4	49	120	248
−23.3	− 10	14	1.1	34	93.2	20.4	69	156.2	54	130	266
−17.7	0	32	1.6	35	95.0	21.0	70	158.0	60	140	284
−17.2	1	33.8	2.2	36	96.8	21.5	71	159.8	65	150	302
−16.6	2	35.6	2.7	37	98.6	22.2	72	161.6	71	160	320
−16.1	3	37.4	3.3	38	100.4	22.7	73	163.4	76	170	338
−15.5	4	39.2	3.8	39	102.2	23.3	74	165.2	83	180	356
−15.0	5	41.0	4.4	40	104.0	23.8	75	167.0	88	190	374
−14.4	6	42.8	4.9	41	105.8	24.4	76	168.8	93	200	392
−13.9	7	44.6	5.4	42	107.6	25.0	77	170.6	121	250	482
−13.3	8	46.4	6.0	43	109.4	25.5	78	172.4	149	300	572
−12.7	9	48.2	6.6	44	111.2	26.2	79	174.2	177	350	662
−12.2	10	50.0	7.1	45	113.0	26.8	80	176.0	204	400	752
−11.6	11	51.8	7.7	46	114.8	27.3	81	177.8	232	450	842
−11.1	12	53.6	8.2	47	116.6	27.7	82	179.6	260	500	932
−10.5	13	55.4	8.8	48	118.4	28.2	83	181.4	288	550	1 022
−10.0	14	57.2	9.3	49	120.2	28.8	84	183.2	315	600	1 112
− 9.4	15	59.0	9.9	50	122.0	29.3	85	185.0	343	650	1 202
− 8.8	16	61.8	10.4	51	123.8	29.9	86	186.8	371	700	1 292
− 8.3	17	63.6	11.1	52	125.6	30.4	87	188.6	399	750	1 382
− 7.7	18	65.4	11.5	53	127.4	31.0	88	190.4	426	800	1 472
− 7.2	19	67.2	12.1	54	129.2	31.5	89	192.2	454	850	1 562
− 6.6	20	68.0	12.6	55	131.0	32.1	90	194.0	482	900	1 652
− 6.1	21	69.8	13.2	56	132.8	32.6	91	195.8	510	950	1 742
− 5.5	22	71.6	13.7	57	134.6	33.3	92	197.6	538	1 000	1 832
− 5.0	23	73.4	14.3	58	136.4	33.8	93	199.4	593	1 100	2 012
− 4.4	24	75.2	14.8	59	138.2	34.4	94	201.2	648	1 200	2 192
− 3.9	25	77.0	15.6	60	140.0	34.9	95	203.0	704	1 300	2 372
− 3.3	26	78.8	16.1	61	141.8	35.5	96	204.8	760	1 400	2 552
− 2.8	27	80.6	16.6	62	143.6	36.1	97	206.6	815	1 500	2 732
− 2.2	28	82.4	17.1	63	145.4	36.6	98	208.4	871	1 600	2 937

(How to read this table)
For example, for conversion from 38˚C to ˚F read 38 in 4th row box (10th line from the top) and then read the right-side ˚F box.
38˚C is equivalent to 100.4˚F upon reading. Furthermore, for conversion from 38˚F to ˚C read the left-side ˚C box.
˚F38 is equivalent to 3.3˚C upon reading.

$C = 5/9(F-32)$
$F = 9/5C+32$

Approximate conversion values against Vickers hardness of steel materials[1)]

Vickers hardness (DPH)	Brinnel hardness 10 mm ball, load 3000 kgf			Rockwell hardness[2)]				Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm² Approx. value	Vickers hardness Load 50kgf
	Standard ball	Hultgren ball	Tungsten carbite ball	A scale Load 60 kgf brale identer	B scale Load 100 kgf dia. 1/16in. ball	C-scale Load 150 kgf brale indenter	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
940	—	—	—	85.6	—	68.0	76.9	93.2	84.4	75.4	97	—	940
920	—	—	—	85.3	—	67.5	76.5	93.0	84.0	74.8	96	—	920
900	—	—	—	85.0	—	67.0	76.1	92.9	83.6	74.2	95	—	900
880	—	—	767	84.7	—	66.4	75.7	92.7	83.1	73.6	93	—	880
860	—	—	757	84.4	—	65.9	75.3	92.5	82.7	73.1	92	—	860
840	—	—	745	84.1	—	65.3	74.8	92.3	82.2	72.2	91	—	840
820	—	—	733	83.8	—	64.7	74.3	92.1	81.7	71.8	90	—	820
800	—	—	722	83.4	—	64.0	73.8	91.8	81.1	71.0	88	—	800
780	—	—	710	83.0	—	63.3	73.3	91.5	80.4	70.2	87	—	780
760	—	—	698	82.6	—	62.5	72.6	91.2	79.7	69.4	86	—	760
740	—	—	684	82.2	—	61.8	72.1	91.0	79.1	68.6	84	—	740
720	—	—	670	81.8	—	61.0	71.5	90.7	78.4	67.7	83	—	720
700	—	615	656	81.3	—	60.1	70.8	90.3	77.6	66.7	81	—	700
690	—	610	647	81.1	—	59.7	70.5	90.1	77.2	66.2	—	—	690
680	—	603	638	80.8	—	59.2	70.1	89.8	76.8	65.7	80	—	680
670	—	597	630	80.5	—	58.8	69.8	89.7	76.4	65.3	—	—	670
660	—	590	620	80.3	—	58.3	69.4	89.5	75.9	64.7	79	—	660
650	—	585	611	80.0	—	57.8	69.0	89.2	75.5	64.1	—	—	650
640	—	578	601	79.8	—	57.3	68.7	89.0	75.1	63.5	77	—	640
630	—	571	591	79.5	—	56.8	68.3	88.8	74.6	63.0	—	—	630
620	—	564	582	79.2	—	56.3	67.9	88.5	74.2	62.4	75	—	620
610	—	557	573	78.9	—	55.7	67.5	88.2	73.6	61.7	—	—	610
600	—	550	564	78.6	—	55.2	67.0	88.0	73.2	61.2	74	—	600
590	—	542	554	78.4	—	54.7	66.7	87.8	72.7	60.5	—	210	590
580	—	535	545	78.0	—	54.1	66.2	87.5	72.1	59.9	72	206	580
570	—	527	535	77.8	—	53.6	65.8	87.2	71.7	59.3	—	202	570
560	—	519	525	77.4	—	53.0	65.4	86.9	71.2	58.6	71	199	560
550	505	512	517	77.0	—	52.3	64.8	86.6	70.5	57.8	—	195	550
540	496	503	507	76.7	—	51.7	64.4	86.3	70.0	57.0	69	190	540
530	488	495	497	76.4	—	51.1	63.9	86.0	69.5	56.2	—	186	530
520	480	487	488	76.1	—	50.5	63.5	85.7	69.0	55.6	67	183	520
510	473	479	479	75.7	—	49.8	62.9	85.4	68.3	54.7	—	179	510
500	465	471	471	75.3	—	49.1	62.2	85.0	67.7	53.9	66	174	500
490	456	460	460	74.9	—	48.4	61.6	84.7	67.1	53.1	—	169	490
480	448	452	452	74.5	—	47.7	61.3	84.3	66.4	52.2	64	165	480
470	441	442	442	74.1	—	46.9	60.7	83.9	65.7	51.3	—	160	470
460	433	433	433	73.6	—	46.1	60.1	83.6	64.9	50.4	62	156	460
450	425	425	425	73.3	—	45.3	59.4	83.2	64.3	49.4	—	153	450
440	415	415	415	72.8	—	44.5	58.8	82.8	63.5	48.4	59	149	440
430	405	405	405	72.3	—	43.6	58.2	82.3	62.7	47.4	—	144	430
420	397	397	397	71.8	—	42.7	57.5	81.8	61.9	46.4	57	140	420
410	388	388	388	71.4	—	41.8	56.8	81.4	61.1	45.3	—	136	410
400	379	379	379	70.8	—	40.8	56.0	81.0	60.2	44.1	55	131	400
390	369	369	369	70.3	—	39.8	55.2	80.3	59.3	42.9	—	127	390
380	360	360	360	69.8	(110.0)	38.8	54.4	79.8	58.4	41.7	52	123	380

continued

Vickers hardness (DPH)	Brinnel hardness 10 mm ball, load 3000 kgf			Rockwell hardness[2]				Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm² Approx. value	Vickers hardness Load 50kgf
	Standard ball	Hultgren ball	Tungsten carbite ball	A scale Load 60 kgf brale identer	B scale Load 100 kgf dia. 1/16in. ball	C-scale Load 150 kgf brale indenter	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
370	350	350	350	69.2	–	37.7	53.6	79.2	57.4	40.4	–	120	370
360	341	341	341	68.7	(109.0)	36.6	52.8	78.6	56.4	39.1	50	115	360
350	331	331	331	68.1	–	35.5	51.9	78.0	55.4	37.8	–	112	350
340	322	322	322	67.6	(108.0)	34.4	51.1	77.4	54.4	36.5	47	109	340
330	313	313	313	67.0	–	33.3	50.2	76.8	53.6	35.2	–	105	330
320	303	303	303	66.4	(107.0)	32.2	49.4	76.2	52.3	33.9	45	103	320
310	294	294	294	65.8	–	31.0	48.4	75.6	51.3	32.5	–	100	310
300	284	284	284	65.2	(105.5)	29.8	47.5	74.9	50.2	31.1	42	97	300
295	280	280	280	64.8	–	29.2	47.1	74.6	49.7	30.4	–	96	295
290	275	275	275	64.5	(104.5)	28.5	46.5	74.2	49.0	29.5	41	94	290
285	270	270	270	64.2	–	27.8	46.0	73.8	48.4	28.7	–	92	285
280	265	265	265	63.8	(103.5)	27.1	45.3	73.4	47.8	27.9	40	91	280
275	261	261	261	63.5	–	26.4	44.9	73.0	47.2	27.1	–	89	275
270	256	256	256	63.1	(102.0)	25.6	44.3	72.6	46.4	26.2	38	87	270
265	252	252	252	62.7	–	24.8	43.7	72.1	45.7	25.2	–	86	265
260	247	247	247	62.4	(101.0)	24.0	43.1	71.6	45.0	24.3	37	84	260
255	243	243	243	62.0	–	23.1	42.2	71.1	44.2	23.2	–	82	255
250	238	238	238	61.6	99.5	22.2	41.7	70.6	43.4	22.2	36	81	250
245	233	233	233	61.2	–	21.3	41.1	70.1	42.5	21.1	–	79	245
240	228	228	228	60.7	98.1	20.3	40.3	69.6	41.7	19.9	34	78	240
230	219	219	219	–	96.7	(18.0)	–	–	–	–	33	75	230
220	209	209	209	–	95.0	(15.7)	–	–	–	–	32	71	220
210	200	200	200	–	93.4	(13.4)	–	–	–	–	30	68	210
200	190	190	190	–	91.5	(11.0)	–	–	–	–	29	65	200
190	181	181	181	–	89.5	(8.5)	–	–	–	–	28	62	190
180	171	171	171	–	87.1	(6.0)	–	–	–	–	26	59	180
170	162	162	162	–	85.0	(3.0)	–	–	–	–	25	56	170
160	152	152	152	–	81.7	(0.0)	–	–	–	–	24	53	160
150	143	143	143	–	78.7	–	–	–	–	–	22	50	150
140	133	133	133	–	75.0	–	–	–	–	–	21	46	140
130	124	124	124	–	71.2	–	–	–	–	–	20	44	130
120	114	114	114	–	66.7	–	–	–	–	–	–	40	120
110	105	105	105	–	62.3	–	–	–	–	–	–	–	110
100	95	95	95	–	56.2	–	–	–	–	–	–	–	100
95	90	90	90	–	52.0	–	–	–	–	–	–	–	95
90	86	86	86	–	48.0	–	–	–	–	–	–	–	90
85	81	81	81	–	41.0	–	–	–	–	–	–	–	85

Note 1) Approximate values were determined from **SAE J 417**.
2) Some of the parenthesized values in the above table are not used so frequently.

Contrast table of SI and CGS system units, gravitation system units

Unit system \ Quantity	Length L	Mass M	Time T	Acceleration	Force	Stress	Pressure	Energy
SI	m	kg	s	m/s^2	N	Pa	Pa	J
CGS system	cm	g	s	Gal	dyn	dyn/cm^2	dyn/cm^2	erg
Gravitation system	m	$kgf \cdot s^2/m$	s	m/s^2	kgf	kgf/m^2	kgf/m^2	$kgf \cdot m$

Conversion to SI unit

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Angle	Degree	°	$\pi/180$	Radian	rad
	Minute	′	$\pi/10\ 800$		
	Second	″ (sec)	$\pi/648\ 000$		
Length	Meter	m	1	Meter	m
	Micron	μ	10^{-6}		
	Angstrom	Å	10^{-10}		
Area	Square meter	m^2	1	Square meter	m^2
	Are	a	10^2		
	Hector	ha	10^4		
Volume	Cubic meter	m^3	1	Cubic meter	m^3
	Liter	R.L	10^{-3}		
Mass	kilogram	kg	1	Kilogram	kg
	Ton	t	10^3		
	Weight kilogram.square second per meter	$kgf \cdot s^2/m$	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meter per second	m/s	1	Meter per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s^{-1} (pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute per second	rpm (r/min)	1/60	Per second	s^{-1}
Angular speed	Radian per second	rad/s	1	Radian per second	rad/s
Acceleration	Meter per second per second	m/s^2	1	Meter per second per second	m/s^2
	G	G	9.806 65		
Force	Weight kilogram	kgf	9.806 65	Newton	N
	Weight ton	tf	9 806.65		
	Dyne	dyn	10^{-5}		
Force moment	Weight kilogram meter	$kgf \cdot m$	9.806 65	Newton meter	$N \cdot m$
Inertia moment	Weight kilogram per square meter	$kgf \cdot m \cdot s^2$	9.806 65	kilogram square meter	$kg \cdot m^2$
Stress	Weight kilogram per square meter	kgf/m^2	9.806 65	Pascal or Newton per square meter	Pa or N/m^2
Pressure	Weight kilogram per square meter	kgf/m^2	9.806 65	Pascal	Pa
	Water column meter	mH_2O	9 806.65		
	Mercury column meter	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmospheric pressure	atm	101 325		
	Bar	bar	10^5		
Energy	Erg	erg	10^{-7}	Joule	J
	IT calorie	cal_{IT}	4.186 8		
	Weight kilogram meter	$kgf \cdot m$	9.806 65		
	Kilowatt per hour	$kW \cdot h$	3.600×10^6		
	Horse power per hour	$PS \cdot h$	$2.647\ 79 \times 10^6$		
Power rate and power	Watt	W	1	Watt	W
	Horse power	PS	735.5		
	Weight kilogram meter per second	$kgf \cdot m/s$	9.806 65		

Unit system \ Quantity	Power rate	Temperature	Viscosity	Dynamic viscosity	Magnetic flux	Flux density	Magnetic field strength
SI	W	K	Pa · s	m^2/s	Wb	T	A/m
CGS system	erg/s	˚C	P	St	Mx	Gs	Oe
Gravitation system	kgf · m/s	˚C	kgf · s/m^2	m^2/s	—	—	—

Conversion to SI unit

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Viscosity	Poise	P	10^{-1}	Pascal second	Pa · s
	Centi poise	cP	10^{-3}		
	Weight kilogram second per square meter	kgf · s/m^2	9.806 65		
Dynamic viscosity	Stokes	St	10^{-4}	Square meter per second	m^2/s
	Centistokes	cSt	10^{-6}		
Temperature	Degree	˚C	+273.15	Kelvin	K
Radioactive	Curie	Ci	3.7×10^{10}	Becquere	Bq
Dosage	Roentgen	R	2.58×10^{-4}	Coulomb per kilogram	C/kg
Absorption dosage	Rad	rad	10^{-2}	Gray	Gy
Dosage equivalent	Rem	rem	10^{-2}	Sivert	Sv
Magnetic flux	Maxwell	Mx	10^{-8}	Weber	Wb
Flux density	Gamma	γ	10^{-9}	Tesler	T
	Gauss	Gs	10^{-4}		
Magnetic field strength	Oersted	Oe	$10^3/4\pi$	Ampere per meter	A/m
Quantity of electricity	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Current	Ampere	A	1	Ampere	A

Integer multiplication of SI unit 10

Unit × multiple	Initial letter	
	Name	Symbol
10^{18}	Exa	E
10^{15}	Peta	P
10^{12}	Tera	T
10^{9}	Guiga	G
10^{6}	Mega	M
10^{3}	Kilo	k
10^{2}	Hect	h
10	Daca	da
10^{-1}	Deci	d
10^{-2}	Centi	c
10^{-3}	Mili	m
10^{-6}	Micro	μ
10^{-9}	Nano	n
10^{-12}	Pico	p
10^{-15}	Femt	f
10^{-18}	Atto	a

kgf-N conversion table

kgf		N	kgf		N	kgf		N
0.1020	1	9.8066	3.4670	34	333.43	6.8321	67	657.04
0.2039	2	19.613	3.5690	35	343.23	6.9341	68	666.85
0.3059	3	29.420	3.6710	36	353.04	7.0361	69	676.66
0.4079	4	39.227	3.7730	37	362.85	7.1380	70	686.46
0.5099	5	49.033	3.8749	38	372.65	7.2400	71	696.27
0.6118	6	58.840	3.9769	39	382.46	7.3420	72	706.08
0.7138	7	68.646	4.0789	40	392.27	7.4440	73	715.88
0.8158	8	78.453	4.1808	41	402.07	7.5459	74	725.69
0.9177	9	88.260	4.2828	42	411.88	7.6479	75	735.50
1.0197	10	98.066	4.3848	43	421.68	7.7499	76	745.30
1.1217	11	107.87	4.4868	44	431.49	7.8518	77	755.11
1.2237	12	117.68	4.5887	45	441.30	7.9538	78	764.92
1.3256	13	127.49	4.6907	46	451.10	8.0558	79	774.72
1.4276	14	137.29	4.7927	47	460.91	8.1578	80	784.53
1.5296	15	147.10	4.8946	48	470.72	8.2597	81	794.34
1.6316	16	156.91	4.9966	49	480.52	8.3617	82	804.14
1.7335	17	166.71	5.0986	50	490.33	8.4637	83	813.95
1.8355	18	176.52	5.2006	51	500.14	8.5656	84	823.76
1.9375	19	186.33	5.3025	52	509.94	8.6676	85	833.56
2.0394	20	196.13	5.4045	53	519.75	8.7696	86	843.37
2.1414	21	205.94	5.5065	54	529.56	8.8716	87	853.18
2.2434	22	215.75	5.6085	55	539.36	8.9735	88	862.98
2.3454	23	225.55	5.7104	56	549.17	9.0755	89	872.79
2.4473	24	235.36	5.8124	57	558.98	9.1775	90	882.60
2.5493	25	245.17	5.9144	58	568.78	9.2794	91	892.40
2.6513	26	254.97	6.0163	59	578.59	9.3814	92	902.21
2.7532	27	264.78	6.1183	60	588.40	9.4834	93	912.02
2.8552	28	274.59	6.2203	61	598.20	9.5854	94	921.82
2.9572	29	284.39	6.3223	62	608.01	9.6873	95	931.63
3.0592	30	294.20	6.4242	63	617.82	9.7893	96	941.44
3.1611	31	304.01	6.5262	64	627.62	9.8913	97	951.24
3.2631	32	313.81	6.6282	65	637.43	9.9932	98	961.05
3.3651	33	323.62	6.7302	66	647.24	10.0952	99	970.86

[How to read the table]
For example, for conversion from 10kgf to N read 10 on center stage of 1st row box and then read the right-side N. 10kgf is equivalent to 98.066 upon reading. Furthermore, for conversion from 10N to kfg read the right side kgf box. 10N is equivalent to 1.0197kg upon reading.

1kgf＝9.80665N
1N＝0.101972kgf

Viscosity conversion table

Dynamic viscosity mm²/s	Saybolt SUS (sec)	Redwood R" (sec)	Engler E (deg.)
2.7	35	32.2	1.18
4.3	40	36.2	1.32
5.9	45	40.6	1.46
7.4	50	44.9	1.60
8.9	55	49.1	1.75
10.4	60	53.5	1.88
11.8	65	57.9	2.02
13.1	70	62.3	2.15
14.5	75	67.6	2.31
15.8	80	71.0	2.42
17.0	85	75.1	2.55
18.2	90	79.6	2.68
19.4	95	84.2	2.81
20.6	100	88.4	2.95
23.0	110	97.1	3.21
25.0	120	105.9	3.49
27.5	130	114.8	3.77
29.8	140	123.6	4.04
32.1	150	132.4	4.32
34.3	160	141.1	4.59
36.5	170	150.0	4.88
38.8	180	158.8	5.15
41.0	190	167.5	5.44
43.2	200	176.4	5.72
47.5	220	194.0	6.28
51.9	240	212	6.85
56.5	260	229	7.38
60.5	280	247	7.95
64.9	300	265	8.51
70.3	325	287	9.24
75.8	350	309	9.95
81.2	375	331	10.7
86.8	400	353	11.4
92.0	425	375	12.1
97.4	450	397	12.8

Dynamic viscosity mm²/s	Saybolt SUS (sec)	Redwood R" (sec)	Engler E (deg.)
103	475	419	13.5
108	500	441	14.2
119	550	485	15.6
130	600	529	17.0
141	650	573	18.5
152	700	617	19.9
163	750	661	21.3
173	800	705	22.7
184	850	749	24.2
195	900	793	25.6
206	950	837	27.0
217	1 000	882	28.4
260	1 200	1 058	34.1
302	1 400	1 234	39.8
347	1 600	1 411	45.5
390	1 800	1 587	51
433	2 000	1 763	57
542	2 500	2 204	71
650	3 000	2 646	85
758	3 500	3 087	99
867	4 000	3 526	114
974	4 500	3 967	128
1 082	5 000	4 408	142
1 150	5 500	4 849	156
1 300	6 000	5 290	170
1 400	6 500	5 730	185
1 510	7 000	6 171	199
1 630	7 500	6 612	213
1 740	8 000	7 053	227
1 850	8 500	7 494	242
1 960	9 000	7 934	256
2 070	9 500	8 375	270
2 200	10 000	8 816	284

Ordinary tolerance for cutting dimensions

JIS B 0405

Ordinary tolerance is applied to cutting dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerances shall be indicated by either one of the following methods (1) and (2).

(1) Numerical value table for each dimensional division
(2) Applicable Standard No. and tolerance class
Ex. Ordinary tolerance shall conform to the "Medium Class" specified in JIS B 0405.

Unit : mm

Dimensional division \ Class	Fine class	Medium class	Coarse class
0.5 and over 3 incl.	±0.05	±0.1	–
Over 3 6 incl.	±0.05	±0.1	±0.2
Over 6 30 incl.	±0.1	±0.2	±0.5
Over 30 120 incl.	±0.15	±0.3	±0.8
Over 120 315 incl.	±0.2	±0.5	±1.2
Over 315 1000 incl.	±0.3	±0.8	±2
Over 1000 2000 incl.	±0.5	±1.2	±3

Reference: The numerical values given above every each of "Fine Class", "Medium class" and "Coarse Class" match "Fine series, Medium series", and Coarse series" specified in ISO 2768 (Permissible Machining Variations in Dimensions without Tolerance Indication).

Ordinary tolerances for castings

JIS B 0403

This Standard specifies the ordinary tolerances for the as-casted length and wall thickness dimensions (hereinafter referred to as" ordinary tolerance") of gray castings and spherical graphite castings molded using sand molds (excluding precision mold and other equivalent).

The ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

(1) Numerical value table for each dimensional division
(2) Applicable Standard No. and tolerance class
Ex. JIS B 0403, Coarse class

Ordinary tolerance for length

Unit : mm

Dimensional division \ Material / Class	Gray castings Fine class	Gray castings Coarse class	Spherical graphite castings Fine class	Spherical graphite castings Coarse class
120 incl.	±1	± 1.5	±1.5	± 2
Over 120 250 incl.	±1.5	± 2	±2	± 2.5
Over 250 400 incl.	±2	± 3	±2.5	± 3.5
Over 400 800 incl.	±3	± 4	±4	± 5
Over 800 1600 incl.	±4	± 6	±5	± 7
Over 1600 3150 incl.	–	±10	–	±10

Ordinary tolerance for wall thickness

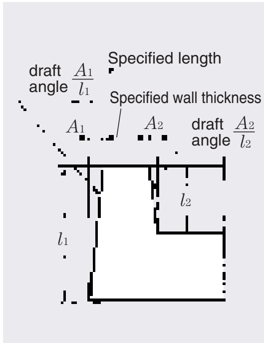
Unit : mm

Dimensional division \ Material / Class	Gray castings Fine class	Gray castings Coarse class	Spherical graphite castings Fine class	Spherical graphite castings Coarse class
10 incl.	±1	±1.5	±1.2	±2
Over 10 18 incl.	±1.5	±2	±1.5	±2.5
Over 18 30 incl.	±2	±3	±2	±3
Over 30 50 incl.	±2	±3.5	±2.5	±4

Dimension-A for draft angle

Unit : mm

Dimensional division l	Dimension A (max)
18 incl.	1
Over 18 30 incl.	1.5
Over 30 50 incl.	2
Over 50 120 incl.	2.5
Over 120 315 incl.	3.5
Over 315 630 incl.	6
Over 630 1000 incl.	9



Remarks : l means l_1 and l_2 in the above sketch.
A means A_1, A_2 in the above sketch.

Ordinary tolerances for press-formed metal parts

JIS B 0408

This Standard specifies the ordinary tolerances for the punching, bending and drawing dimensions, bending angle of press-formed metal parts (hereinafter referred to as "ordinary tolerance").

Ordinary tolerance is applied to the dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

(1) Numerical value table for each dimensional division
(2) Applicable Standard No. and tolerance class
Ex. JIS B0408, Class-A

Ordinary tolerance for punching

Unit : mm

Dimensional division	Class		
	Class-A	Class-B	Class-C
6 incl.	±0.05	±0.1	±0.3
Over 6 30 incl.	±0.1	±0.2	±0.5
Over 30 120 incl.	±0.15	±0.3	±0.8
Over 120 400 incl.	±0.2	±0.5	±1.2
Over 400 1000 incl.	±0.3	±0.8	±2
Over 1000 2000 incl.	±0.5	±1.2	±3

Ordinary tolerance for bending angle

Unit : mm

Dimensional division	Class		
	Class-A	Class-B	Class-C
6 incl.	±0.1	±0.3	±0.5
Over 6 30 incl.	±0.2	±0.5	±1
Over 30 120 incl.	±0.3	±0.8	±1.5
Over 120 400 incl.	±0.5	±1.2	±2.5
Over 400 1000 incl.	±0.8	±2	±4
Over 1000 2000 incl.	±1.2	±3	±6

Ordinary tolerances for sheared metal plates

JIS B 0410

This Standard specifies the ordinary tolerances for the shearing width and ordinary tolerances for the straightness and perpendicularity (hereinafter generically referred to as "ordinary tolerance") of metal plates of 12mm and less in thickness which were sheared by direct shearing machines such as gear pusher, square shear, etc.

The ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

(1) Numerical value table for each dimensional division
(2) Applicable standard No. and tolerance class

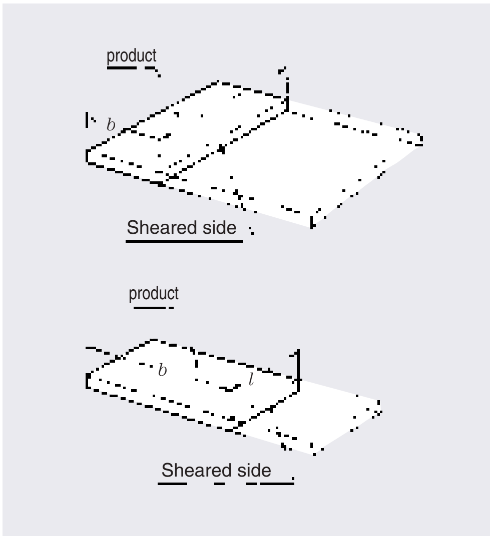
Ex. 1. JIS B 0410, Class-B
2. Cutting width, straightness: JIS B 0410, Class-B
Perpendicularity: JIS B 0410, Class-A

Definition of the terms: The terms used in this Standa are as defined in JIS B 0111 (Terminology relating to press machines) and, in addition, defined as follows.

(1) Cutting width: Distance from one side sheared by shear cutter to opposite side, as illustrated in Fig. l
(2) Cutting length: length of one side sheared by shea cutter, as illustrated in Fig. l.

Ordinary tolerance for shearing width — Unit : mm

Cutting width division b	Classification by plate thickness (t)							
	t≦1.6		1.6<t≦3		3<t≦6		6<t≦12	
	Class							
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	±0.1	±0.3	—	—	—	—	—	—
Over 30 120 incl.	±0.2	±0.5	±0.3	±0.5	±0.8	±1.2	—	±1.5
Over 120 400 incl.	±0.3	±0.8	±0.4	±0.8	±1	±1.5	—	±2
Over 400 1000 incl.	±0.5	±1	±0.5	±1.2	±1.5	±2	—	±2.5
Over 1000 2000 incl.	±0.8	±1.5	±0.8	±2	±2	±3	—	±3
Over 2000 4000 incl.	±1.2	±2	±1.2	±2.5	±3	±4	—	±4



Ordinary tolerance for straightness — Unit : mm

Cutting length division	Classification by plate thickness (t)							
	t≦1.6		1.6<t≦3		3<t≦6		6<t≦12	
	Class							
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	0.1	0.2	—	—	—	—	—	—
Over 30 120 incl.	0.2	0.3	0.2	0.3	0.5	0.8	—	1.5
Over 120 400 incl.	0.3	0.5	0.3	0.5	0.8	1.5	—	2
Over 400 1000 incl.	0.5	0.8	0.5	1	1.5	2	—	3
Over 1000 2000 incl.	0.8	1.2	0.8	1.5	2	3	—	4
Over 2000 4000 incl.	1.2	2	1.2	2.5	3	5	—	6

Ordinary tolerance for squareness — Unit : mm

Narrow side length division	Classification by plate thickness (t)					
	t≦3		3<t≦6		6<t≦12	
	Class					
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	—	—	—	—	—	—
Over 30 120 incl.	0.3	0.5	0.5	0.8	—	1.5
Over 120 400 incl.	0.8	1.2	1	1.5	—	2
Over 400 1000 incl.	1.5	3	2	3	—	3
Over 1000 2000 incl.	3	6	4	6	—	6
Over 2000 4000 incl.	6	10	6	10	—	10

Ordinary tolerance for sintered metal parts

JIS B 0411

This Standard specifies the ordinary tolerance which is applied to the machining dimensions of sintered mechanical parts and sintered oil-contained bearing, of sintered metal parts, but excluding machining methods other (e.g. cutting, etc.) than the machining method specific for sintered metal parts.

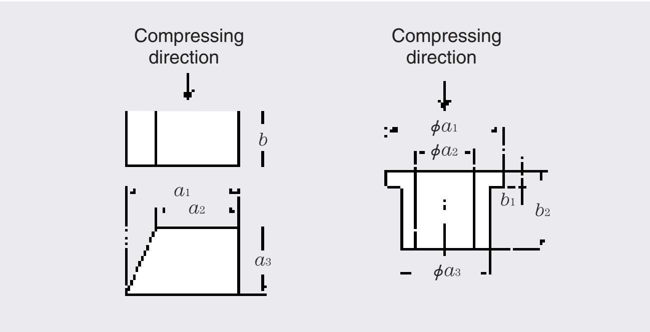
Ordinary tolerance is applied to the dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

(1) Numerical value table for each dimensional division
(2) Applicable Standard No. and tolerance class
Ex. JIS B0411, Fine Class

Definition of terms: The terms used in this Standard are as defined below.

(1) Width: Perpendicular dimension against compressing direction in compressive molding of powders, as illustrated in Fig. a.
(2) Height: Dimension parallel to compressing direction in molding of powders, as illustrated in Fig. b.



Class: The ordinary tolerance class shall be three classes of “Fine Class”, “Medium Class” and “Coarse class”.
Reference: The numerical values every each class of “Fine Class”, “Medium Class” and “Coarse class” match “Fine Series, Medium Series and Coarse Series specified in ISO 2768 (Permissible machining variations in dimensions without tolerance indication)

Ordinary tolerance for width

Unit : mm

Dimensional division \ class	Fine class	Medium class	Coarse class
6 and less	±0.05	±0.1	±0.2
Over 6 - 30 incl.	±0.1	±0.2	±0.5
Over 30 - 120 incl.	±0.15	±0.3	±0.8
Over 120 - 315 incl.	±0.2	±0.5	±1.2

Ordinary tolerance for height

Unit : mm

Dimensional division \ class	Fine class	Medium class	Coarse class
6 and less	±0.1	±0.2	±0.6
Over 6 - 30 incl.	±0.2	±0.5	±1
Over 30 - 120 incl.	±0.3	±0.8	±1.8

Dimensional tolerance for shaft (JIS B 0401-2)

Diameter division mm		a13		c12		d6		e6		e13		f5		f6		g5		g6	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	−270	−450	−70	−190	−30	−38	−20	−28	−20	−200	−10	−15	−10	−18	−4	−9	−4	−12
6	10	−280	−500	−80	−230	−40	−49	−25	−34	−25	−245	−13	−19	−13	−22	−5	−11	−5	−14
10	18	−290	−560	−95	−275	−50	−61	−32	−43	−32	−302	−16	−24	−16	−27	−6	−14	−6	−17
18	30	−300	−630	−110	−320	−65	−78	−40	−53	−40	−370	−20	−29	−20	−33	−7	−16	−7	−20
30	40	−310	−700	−120	−370	−80	−96	−50	−66	−50	−440	−25	−36	−25	−41	−9	−20	−9	−25
40	50	−320	−710	−130	−380														
50	65	−340	−800	−140	−440	−100	−119	−60	−79	−60	−520	−30	−43	−30	−49	−10	−23	−10	−29
65	80	−360	−820	−150	−450														
80	100	−380	−920	−170	−520	−120	−142	−72	−94	−72	−612	−36	−51	−36	−58	−12	−27	−12	−34
100	120	−410	−950	−180	−530														
120	140	−460	−1 090	−200	−600	−145	−170	−85	−110	−85	−715	−43	−61	−43	−68	−14	−32	−14	−39
140	160	−520	−1 150	−210	−610														
160	180	−580	−1 210	−230	−630														
180	200	−660	−1 380	−240	−700	−170	−199	−100	−129	−100	−820	−50	−70	−50	−79	−15	−35	−15	−44
200	225	−740	−1 460	−260	−720														
225	250	−820	−1 540	−280	−740														
250	280	−920	−1 730	−300	−820	−190	−222	−110	−142	−110	−920	−56	−79	−56	−88	−17	−40	−17	−49
280	315	−1 050	−1 860	−330	−850														
315	355	−1 200	−2 090	−360	−930	−210	−246	−125	−161	−125	−1 015	−62	−87	−62	−98	−18	−43	−18	−54
355	400	−1 350	−2 240	−400	−970														
400	450	−1 500	−2 470	−440	−1 070	−230	−270	−135	−175	−135	−1 105	−68	−95	−68	−108	−20	−47	−20	−60
450	500	−1 650	−2 620	−480	−1 110														
500	560	–	–	–	–	−260	−304	−145	−189	–	–	–	–	−76	−120	–	–	−22	−66
560	630																		
630	710	–	–	–	–	−290	−340	−160	−210	–	–	–	–	−80	−130	–	–	−24	−74
710	800																		
800	900	–	–	–	–	−320	−376	−170	−226	–	–	–	–	−86	−142	–	–	−26	−82
900	1 000																		
1 000	1 120	–	–	–	–	−350	−416	−195	−261	–	–	–	–	−98	−164	–	–	−28	−94
1 120	1 250																		
1 250	1 400	–	–	–	–	−390	−468	−220	−298	–	–	–	–	−110	−188	–	–	−30	−108
1 400	1 600																		

Diameter division mm		j5		js5		j6		js6		j7		k4		k5		k6		m5	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+3	−2	+2.5	−2.5	+6	−2	+4	−4	+8	−4	+5	+1	+6	+1	+9	+1	+9	+4
6	10	+4	−2	+3	−3	+7	−2	+4.5	−4.5	+10	−5	+5	+1	+7	+1	+10	+1	+12	+6
10	18	+5	−3	+4	−4	+8	−3	+5.5	−5.5	+12	−6	+6	+1	+9	+1	+12	+1	+15	+7
18	30	+5	−4	+4.5	−4.5	+9	−4	+6.5	−6.5	+13	−8	+8	+2	+11	+2	+15	+2	+17	+8
30	40	+6	−5	+5.5	−5.5	+11	−5	+8	−8	+15	−10	+9	+2	+13	+2	+18	+2	+20	+9
40	50																		
50	65	+6	−7	+6.5	−6.5	+12	−7	+9.5	−9.5	+18	−12	+10	+2	+15	+2	+21	+2	+24	+11
65	80																		
80	100	+6	−9	+7.5	−7.5	+13	−9	+11	−11	+20	−15	+13	+3	+18	+3	+25	+3	+28	+13
100	120																		
120	140	+7	−11	+9	−9	+14	−11	+12.5	−12.5	+22	−18	+15	+3	+21	+3	+28	+3	+33	+15
140	160																		
160	180																		
180	200	+7	−13	+10	−10	+16	−13	+14.5	−14.5	+25	−21	+18	+4	+24	+4	+33	+4	+37	+17
200	225																		
225	250																		
250	280	+7	−16	+11.5	−11.5	+16	−16	+16	−16	+26	−26	+20	+4	+27	+4	+36	+4	+43	+20
280	315																		
315	355	+7	−18	+12.5	−12.5	+18	−18	+18	−18	+29	−28	+22	+4	+29	+4	+40	+4	+46	+21
355	400																		
400	450	+7	−20	+13.5	−13.5	+20	−20	+20	−20	+31	−32	+25	+5	+32	+5	+45	+5	+50	+23
450	500																		
500	560	–	–	–	–	–	–	+22	−22	–	–	–	–	–	–	+44	0	–	–
560	630																		
630	710	–	–	–	–	–	–	+25	−25	–	–	–	–	–	–	+50	0	–	–
710	800																		
800	900	–	–	–	–	–	–	+28	−28	–	–	–	–	–	–	+56	0	–	–
900	1 000																		
1 000	1 120	–	–	–	–	–	–	+33	−33	–	–	–	–	–	–	+66	0	–	–
1 120	1 250																		
1 250	1 400	–	–	–	–	–	–	+39	−39	–	–	–	–	–	–	+78	0	–	–
1 400	1 600																		

Unit : μm

h4		h5		h6		h7		h8		h9		h10		h11		h13		js4		Diameter division mm	
High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	Over	incl.
0	− 4	0	− 5	0	− 8	0	− 12	0	− 18	0	− 30	0	− 48	0	− 75	0	−180	+ 2	− 2	3	6
0	− 4	0	− 6	0	− 9	0	− 15	0	− 22	0	− 36	0	− 58	0	− 90	0	−220	+ 2	− 2	6	10
0	− 5	0	− 8	0	−11	0	− 18	0	− 27	0	− 43	0	− 70	0	−110	0	−270	+ 2.5	− 2.5	10	18
0	− 6	0	− 9	0	−13	0	− 21	0	− 33	0	− 52	0	− 84	0	−130	0	−330	+ 3	− 3	18	30
0	− 7	0	− 11	0	−16	0	− 25	0	− 39	0	− 62	0	−100	0	−160	0	−390	+ 3.5	− 3.5	30 40	40 50
0	− 8	0	−13	0	−19	0	− 30	0	− 46	0	− 74	0	−120	0	−190	0	−460	+ 4	− 4	50 65	65 80
0	−10	0	−15	0	−22	0	− 35	0	− 54	0	− 87	0	−140	0	−220	0	−540	+ 5	− 5	80 100	100 120
0	−12	0	−18	0	−25	0	− 40	0	− 63	0	−100	0	−160	0	−250	0	−630	+ 6	− 6	120 140 160	140 160 180
0	−14	0	−20	0	−29	0	− 46	0	− 72	0	−115	0	−185	0	−290	0	−720	+ 7	− 7	180 200 225	200 225 250
0	−16	0	−23	0	−32	0	− 52	0	− 81	0	−130	0	−210	0	−320	0	−810	+ 8	− 8	250 280	280 315
0	−18	0	−25	0	−36	0	− 57	0	− 89	0	−140	0	−230	0	−360	0	−890	+ 9	− 9	315 355	355 400
0	−20	0	−27	0	−40	0	− 63	0	− 97	0	−155	0	−250	0	−400	0	−970	+10	−10	400 450	450 500
−	−	−	−	0	−44	0	− 70	0	−110	0	−175	0	−280	0	−440	0	−	−	−	500 560	560 630
−	−	−	−	0	−50	0	− 80	0	−125	0	−200	0	−320	0	−500	0	−	−	−	630 710	710 800
−	−	−	−	0	−56	0	− 90	0	−140	0	−230	0	−360	0	−560	0	−	−	−	800 900	900 1 000
−	−	−	−	0	−66	0	−105	0	−165	0	−260	0	−420	0	−660	0	−	−	−	1 000 1 120	1 120 1 250
−	−	−	−	0	−78	0	−125	0	−195	0	−310	0	−500	0	−780	0	−	−	−	1 250 1 400	1 400 1 600

Unit : μm

m6		n5		n6		p5		p6		r6		r7		Basic tolerance				Diameter division mm	
High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	IT2	IT3	IT5	IT7	Over	incl.
+ 12	+ 4	+13	+ 8	+ 16	+ 8	+17	+12	+ 20	+ 12	+ 23	+ 15	+ 27	+ 15	1.5	2.5	5	12	3	6
+ 15	+ 6	+16	+10	+ 19	+10	+21	+15	+ 24	+ 15	+ 28	+ 19	+ 34	+ 19	1.5	2.5	6	15	6	10
+ 18	+ 7	+20	+12	+ 23	+12	+26	+18	+ 29	+ 18	+ 34	+ 23	+ 41	+ 23	2	3	8	18	10	18
+ 21	+ 8	+24	+15	+ 28	+15	+31	+22	+ 35	+ 22	+ 41	+ 28	+ 49	+ 28	2.5	4	9	21	18	30
+ 25	+ 9	+28	+17	+ 33	+17	+37	+26	+ 42	+ 26	+ 50	+ 34	+ 59	+ 34	2.5	4	11	25	30 40	40 50
+ 30	+11	+33	+20	+ 39	+20	+45	+32	+ 51	+ 32	+ 60 + 62	+ 41 + 43	+ 71 + 73	+ 41 + 43	3	5	13	30	50 65	65 80
+ 35	+13	+38	+23	+ 45	+23	+52	+37	+ 59	+ 37	+ 73 + 76	+ 51 + 54	+ 86 + 89	+ 51 + 54	4	6	15	35	80 100	100 120
+ 40	+15	+45	+27	+ 52	+27	+61	+43	+ 68	+ 43	+ 88 + 90 + 93	+ 63 + 65 + 68	+103 +105 +108	+ 63 + 65 + 68	5	8	18	40	120 140 160	140 160 180
+ 46	+17	+51	+31	+ 60	+31	+70	+50	+ 79	+ 50	+106 +109 +113	+ 77 + 80 + 84	+123 +126 +130	+ 77 + 80 + 84	7	10	20	46	180 200 225	200 225 250
+ 52	+20	+57	+34	+ 66	+34	+79	+56	+ 88	+ 56	+126 +130	+ 94 + 98	+146 +150	+ 94 + 98	8	12	23	52	250 280	280 315
+ 57	+21	+62	+37	+ 73	+37	+87	+62	+ 98	+ 62	+144 +150	+108 +114	+165 +171	+108 +114	9	13	25	57	315 355	355 400
+ 63	+23	+67	+40	+ 80	+40	+95	+68	+108	+ 68	+166 +172	+126 +132	+189 +195	+126 +132	10	15	27	63	400 450	450 500
+ 70	+26	−	−	+ 88	+44	−	−	+122	+ 78	+194 +199	+150 +155	+220 +225	+150 +155	−	−	−	70	500 560	560 630
+ 80	+30	−	−	+100	+50	−	−	+138	+ 88	+225 +235	+175 +185	+255 +265	+175 +185	−	−	−	80	630 710	710 800
+ 90	+34	−	−	+112	+56	−	−	+156	+100	+266 +276	+210 +220	+300 +310	+210 +220	−	−	−	90	800 900	900 1 000
+106	+40	−	−	+132	+66	−	−	+186	+120	+316 +326	+250 +260	+355 +365	+250 +260	−	−	−	105	1 000 1 120	1 120 1 250
+126	+48	−	−	+156	+78	−	−	+218	+140	+378 +408	+300 +330	+425 +455	+300 +330	−	−	−	125	1 250 1 400	1 400 1 600

Dimensional tolerance for housing bore (JIS B 0401-2)

Diameter division mm		E7		E10		E11		E12		F6		F7		F8		G6		G7		H6	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+32	+20	+68	+20	+95	+20	+140	+20	+18	+10	+22	+10	+28	+10	+12	+4	+16	+4	+8	0
6	10	+40	+25	+83	+25	+115	+25	+175	+25	+22	+13	+28	+13	+35	+13	+14	+5	+20	+5	+9	0
10	18	+50	+32	+102	+32	+142	+32	+212	+32	+27	+16	+34	+16	+43	+16	+17	+6	+24	+6	+11	0
18	30	+61	+40	+124	+40	+170	+40	+250	+40	+33	+20	+41	+20	+53	+20	+20	+7	+28	+7	+13	0
30 40	40 50	+75	+50	+150	+50	+210	+50	+300	+50	+41	+25	+50	+25	+64	+25	+25	+9	+34	+9	+16	0
50 65	65 80	+90	+60	+180	+60	+250	+60	+360	+60	+49	+30	+60	+30	+76	+30	+29	+10	+40	+10	+19	0
80 100	100 120	+107	+72	+212	+72	+292	+72	+422	+72	+58	+36	+71	+36	+90	+36	+34	+12	+47	+12	+22	0
120 140 160	140 160 180	+125	+85	+245	+85	+335	+85	+485	+85	+68	+43	+83	+43	+106	+43	+39	+14	+54	+14	+25	0
180 200 225	200 225 250	+146	+100	+285	+100	+390	+100	+560	+100	+79	+50	+96	+50	+122	+50	+44	+15	+61	+15	+29	0
250 280	280 315	+162	+110	+320	+110	+430	+110	+630	+110	+88	+56	+108	+56	+137	+56	+49	+17	+69	+17	+32	0
315 355	355 400	+182	+125	+355	+125	+485	+125	+695	+125	+98	+62	+119	+62	+151	+62	+54	+18	+75	+18	+36	0
400 450	450 500	+198	+135	+385	+135	+535	+135	+765	+135	+108	+68	+131	+68	+165	+68	+60	+20	+83	+20	+40	0
500 560	560 630	+215	+145	–	–	–	–	–	–	+120	+76	+146	+76	+186	+76	+66	+22	+92	+22	+44	0
630 710	710 800	+240	+160	–	–	–	–	–	–	+130	+80	+160	+80	+205	+80	+74	+24	+104	+24	+50	0
800 900	900 1 000	+260	+170	–	–	–	–	–	–	+142	+86	+176	+86	+226	+86	+82	+26	+116	+26	+56	0
1 000 1 120	1 120 1 250	+300	+195	–	–	–	–	–	–	+164	+98	+203	+98	+263	+98	+94	+28	+133	+28	+66	0
1 250 1 400	1 400 1 600	+345	+220	–	–	–	–	–	–	+188	+110	+235	+110	+305	+110	+108	+30	+155	+30	+78	0
1 600 1 800	1 800 2 000	+390	+240	–	–	–	–	–	–	+212	+120	+270	+120	+350	+120	+124	+32	+182	+32	+92	0

Unit : μm

Diameter division mm		K6		K7		M6		M7		N6		N7		P6		P7		R6		R7	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+2	−6	+3	−9	−1	−9	0	−12	−5	−13	−4	−16	−9	−17	−8	−20	−12	−20	−11	−23
6	10	+2	−7	+5	−10	−3	−12	0	−15	−7	−16	−4	−19	−12	−21	−9	−24	−16	−25	−13	−28
10	18	+2	−9	+6	−12	−4	−15	0	−18	−9	−20	−5	−23	−15	−26	−11	−29	−20	−31	−16	−34
18	30	+2	−11	+6	−15	−4	−17	0	−21	−11	−24	−7	−28	−18	−31	−14	−35	−24	−37	−20	−41
30 40	40 50	+3	−13	+7	−18	−4	−20	0	−25	−12	−28	−8	−33	−21	−37	−17	−42	−29	−42	−25	−50
50 65	65 80	+4	−15	+9	−21	−5	−24	0	−30	−14	−33	−9	−39	−26	−45	−21	−51	−35 −37	−54 −56	−30 −32	−60 −62
80 100	100 120	+4	−18	+10	−25	−6	−28	0	−35	−16	−38	−10	−45	−30	−52	−24	−59	−44 −47	−66 −69	−38 −41	−73 −76
120 140 160	140 160 180	+4	−21	+12	−28	−8	−33	0	−40	−20	−45	−12	−52	−36	−61	−28	−68	−56 −58 −61	−81 −83 −86	−48 −50 −53	−88 −90 −93
180 200 225	200 225 250	+5	−24	+13	−33	−8	−37	0	−46	−22	−51	−14	−60	−41	−70	−33	−79	−68 −71 −75	−97 −100 −104	−60 −63 −67	−106 −109 −113
250 280	280 315	+5	−27	+16	−36	−9	−41	0	−52	−25	−57	−14	−66	−47	−79	−36	−88	−85 −89	−117 −121	−74 −78	−126 −130
315 355	355 400	+7	−29	+17	−40	−10	−46	0	−57	−26	−62	−16	−73	−51	−87	−41	−98	−97 −103	−133 −139	−87 −93	−144 −150
400 450	450 500	+8	−32	+18	−45	−10	−50	0	−63	−27	−67	−17	−80	−55	−95	−45	−108	−113 −119	−153 −159	−103 −109	−166 −172
500 560	560 630	0	−44	0	−70	−26	−70	−26	−96	−44	−88	−44	−114	−78	−122	−78	−148	−150 −155	−194 −199	−150 −155	−220 −225
630 710	710 800	0	−50	0	−80	−30	−80	−30	−100	−50	−100	−50	−130	−88	−138	−88	−168	−175 −185	−225 −235	−175 −185	−225 −265
800 900	900 1 000	0	−56	0	−90	−34	−90	−34	−124	−56	−112	−56	−146	−100	−156	−100	−190	−210 −220	−266 −276	−210 −220	−300 −310
1 000 1 120	1 120 1 250	0	−66	0	−105	−40	−106	−40	−145	−66	−132	−66	−171	−120	−186	−120	−225	−250 −260	−316 −326	−250 −260	−355 −365
1 250 1 400	1 400 1 600	0	−78	0	−125	−48	−126	−48	−173	−78	−156	−78	−203	−140	−218	−140	−265	−300 −330	−378 −408	−300 −330	−425 −455
1 600 1 800	1 800 2 000	0	−92	0	−150	−58	−150	−58	−208	−92	−184	−92	−242	−170	−262	−170	−320	−370 −400	−462 −492	−370 −400	−520 −550

Unit : μm

H7		H8		H9		H10		H11		H13		J6		Js6		J7		Js7		K5		Diameter division mm	
High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	Over	incl.
+12	0	+18	0	+30	0	+48	0	+75	0	+180	0	+5	−3	+4	−4	+6	−6	+6	−6	0	−5	3	6
+15	0	+22	0	+36	0	+58	0	+90	0	+220	0	+5	−4	+4.5	−4.5	+8	−7	+7.5	−7.5	+1	−5	6	10
+18	0	+27	0	+43	0	+70	0	+110	0	+270	0	+6	−5	+5.5	−5.5	+10	−8	+9	−9	+2	−6	10	18
+21	0	+33	0	+52	0	+84	0	+130	0	+330	0	+8	−5	+6.5	−6.5	+12	−9	+10.5	−10.5	+1	−8	18	30
+25	0	+39	0	+62	0	+100	0	+160	0	+390	0	+10	−6	+8	−8	+14	−11	+12.5	−12.5	+2	−9	30 40	40 50
+30	0	+46	0	+74	0	+120	0	+190	0	+460	0	+13	−6	+9.5	−9.5	+18	−12	+15	−15	+3	−10	50 65	65 80
+35	0	+54	0	+87	0	+140	0	+220	0	+540	0	+16	−6	+11	−11	+22	−13	+17.5	−17.5	+2	−13	80 100	100 120
+40	0	+63	0	+100	0	+160	0	+250	0	+630	0	+18	−7	+12.5	−12.5	+26	−14	+20	−20	+3	−15	120 140 160	140 160 180
+46	0	+72	0	+115	0	+185	0	+290	0	+720	0	+22	−7	+14.5	−14.5	+30	−16	+23	−23	+2	−18	180 200 225	200 225 250
+52	0	+81	0	+130	0	+210	0	+320	0	+810	0	+25	−7	+16	−16	+36	−16	+26	−26	+3	−20	250 280	280 315
+57	0	+89	0	+140	0	+230	0	+360	0	+890	0	+29	−7	+18	−18	+39	−18	+28.5	−28.5	+3	−22	315 355	355 400
+63	0	+97	0	+155	0	+250	0	+400	0	+970	0	+33	−7	+20	−20	+43	−20	+31.5	−31.5	+2	−25	400 450	450 500
+70	0	+110	0	+175	0	+280	0	+440	0	−	0	−	−	+22	−22	−	−	+35	−35	−	−	500 560	560 630
+80	0	+125	0	+200	0	+320	0	+500	0	−	0	−	−	+25	−25	−	−	+40	−40	−	−	630 710	710 800
+90	0	+140	0	+230	0	+360	0	+560	0	−	0	−	−	+28	−28	−	−	+45	−45	−	−	800 900	900 1 000
+105	0	+165	0	+260	0	+420	0	+660	0	−	0	−	−	+33	−33	−	−	+52.5	−52.5	−	−	1 000 1 120	1 120 1 250
+125	0	+195	0	+310	0	+500	0	+780	0	−	0	−	−	+39	−39	−	−	+62.5	−62.5	−	−	1 250 1 400	1 400 1 600
+150	0	+230	0	+370	0	+600	0	+920	0	−	0	−	−	+46	−46	−	−	+75	−75	−	−	1 600 1 800	1 800 2 000

Inch - Millimeter conversion table

1in.=25.4mm

Inch		0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
Fraction	Decimals										
			25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791
1/16	0.062500	1.588	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584
3/32	0.093750	2.381	27.781	53.181	48.581	103.981	129.381	154.781	180.181	205.581	230.981
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378
1/ 8	0.125000	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966
3/16	0.187500	4.762	30.162	55.562	80.962	106.362	131.762	157.162	182.562	207.962	233.362
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553
1/ 4	0.250000	6.350	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141
5/16	0.312500	7.938	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728
3/ 8	0.375000	9.525	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125
25/64	0.390625	9.922	35.322	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316
7/16	0.437500	11.112	36.512	61.912	87.312	112.721	138.112	163.512	188.912	214.312	239.712
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903
1/ 2	0.500000	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491
9/16	0.562500	14.288	39.688	65.088	90.488	115.888	141.283	166.688	192.088	217.488	242.888
37/64	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284
19/32	0.593750	15.081	40.481	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078
5/ 8	0.625000	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666
11/16	0.687500	17.462	42.862	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.056	246.459
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253
3/ 4	0.750000	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841
13/16	0.812500	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428
7/ 8	0.875000	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222
39/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016
15/16	0.937500	23.812	49.212	74.612	100.012	125.412	150.812	176.212	201.612	227.012	252.412
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809
31/32	0.968750	24.606	50.006	75406	100.806	126.206	151.606	177.006	202.406	227.806	253.206
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603

For New Technology Network

NTN®

NTN corporation

Insulated Bearings MEGAOHM™ Series

CAT. No. 3030/E

Insulated Bearings MEGAOHM™ Series : Offering Enhanced Safety and Reliability

Bearings used in electrical equipment such as motors and power generators tend to exhibit electrical pitting as a result of current leakage. **NTN**'s **MEGAOHM**™ **Series** of insulated bearings has been specifically designed to counteract electrical pitting. These bearings are available in both ceramic and resin types suited to a variety of applications. The **MEGAOHM**™ **Series** of insulated bearings offers the following unique advantages:

MΩ series

- **Exhibits insulation resistance of at least 100 MΩ at 500 VDC.**
- **Available in a wide range of variants with various insulating layer materials, high voltage resistance and shock immunity that accommodate diverse user requirements.**
- **Compatible with ISO 492, DIN 620 and JIS 1514 standards.**
- **Available in bore diameters ranging from 50 to 160 mm.**

1 The Mechanism of Electrical Pitting

An electrical current present near a bearing can flow to the inside of the bearing, causing sparks that damage the rolling contact surface. This phenomenon is known as "electrical pitting." When such sparks first occur, circular spots can appear on the rolling contact surface (**Photo 1**). The thermal effects of the sparks can cause the metallurgical composition and hardness in this problematic area to differ from those of the surrounding normal areas, resulting in a white layer, hardened layer and tempered layer. As a result, the problematic area can eventually develop flaking. Furthermore, if the electrical pitting phenomenon progresses, a corrugation pattern (**Photo 2**) can develop that increases running noise and vibration. Consequently, the bearing can no longer adequately function.

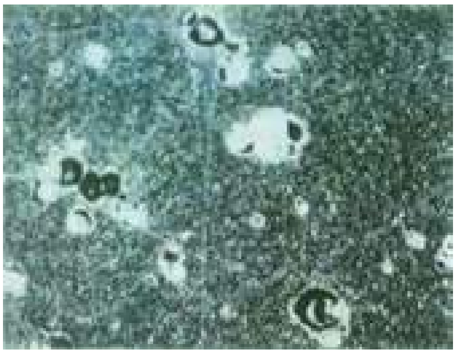


Photo 1

Photo 3

Photo 2

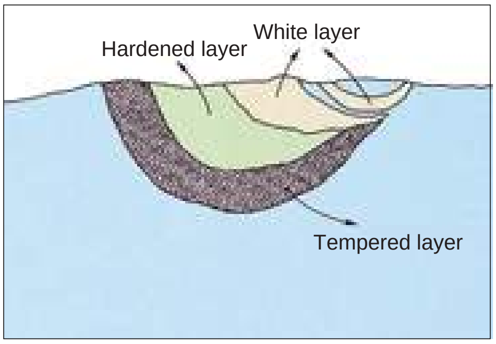


Fig. 1

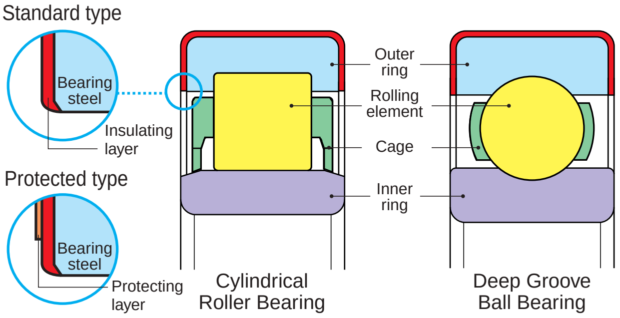
2 Specifications

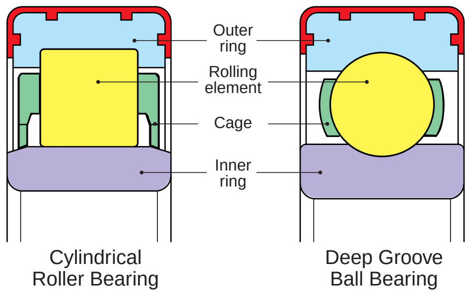
Ceramic Insulated Bearings

Resin Insulated Bearings

Standard type

Protected type





Bearing Numbers

Ceramic insulated bearings

7MC3 - 6 3 30 M C3

- C3: Clearance
- M: Cage
- 30: Bore diameter
- 3: Dimension series
- 6: Bearing type
- 7MC: Protected ceramic layer type with high voltage resistance
- 7MC2: Protected ceramic layer type
- 7MC3: Standard type

Resin insulated bearings

7MP - NU 2 14 L1 BC4 P6

- P6: Tolerance
- C4: Clearance
- L1B: Cage
- 14: Bore diameter
- 2: Dimension series
- NU: Bearing type
- 7MP: Standard resin type
- 7MP2: Heat-dissipating and creep-resistant resin type

High voltage resistance

7MC	: 5kV
7MC2	: 3kV
7MC3	: 3kV
7MP	: 5kV
7MP2	: 5kV

Note: The insulated bearings MEGAOHM™ Series includes a range of high-temperature models. For technical assistance, contact **NTN** Engineering.

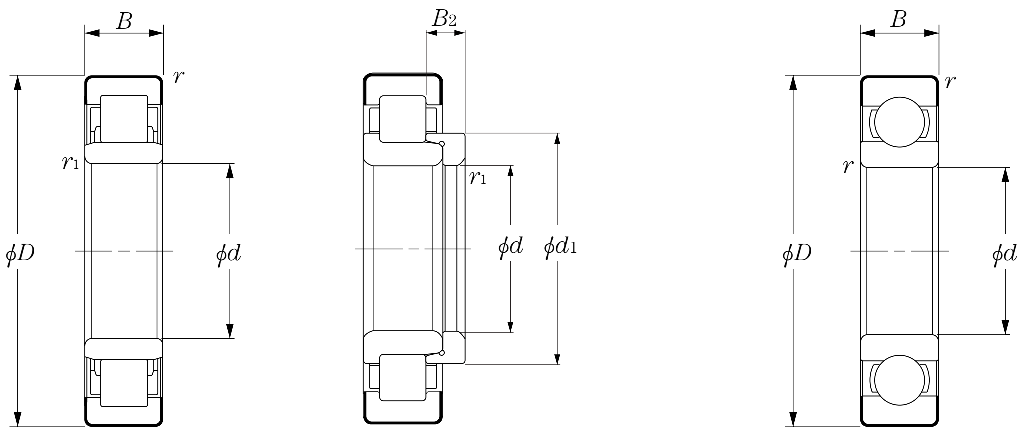
3 Performance

The various features of the insulated bearings MEGAOHM™ Series are summarized below. Choose the configuration that best suits your application.

	Ceramic	Resin	Ceramic Rolling Element (reference)
Insulation performance	◎	◎	◎
Creep resistance	◎	○	◎
Heat dissipation	◎	○	◎
Shock immunity	○	○	◎
Price	○	◎	△

◎ : Excellent
○ : Normal
△ : Poor

4 Dimension Tables for Ceramic Insulated Bearings



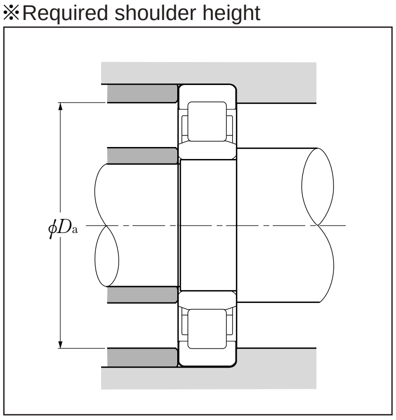
Cylindrical roller bearing **Deep groove ball bearing**

Bearing types	Bearing numbers	Boundary dimensions mm				Basic load ratings		Collar ring numbers	Boundary dimensions mm					Required shoulder height mm D_a	
						Dynamic N	Static N								
		d	D	B	r_s min	C_r	C_{or}		d	d_1	B_1	B_2	r_{1s} min	max	min
Cylindrical roller bearing	**7MC (n) -NU214**	70	125	24	1.5	83 500	95 000	—	—	—	—	—	—	117	109
	7MC (n) -NU314	70	150	35	2.1	158 000	168 000	—	—	—	—	—	—	139	126.5
	7MC (n) -NU316	80	170	39	2.1	201 000	223 000	—	—	—	—	—	—	159	143.2
	7MC (n) -NH318	90	190	43	3	240 000	265 000	HJ318	90	125	12	21	3	177	163.8
	7MC (n) -NH320	100	215	47	3	299 000	335 000	HJ320	100	140.5	13	22.5	3	202	180.3
	7MC (n) -NH322	110	240	50	3	360 000	400 000	HJ322	110	155.5	14	23	3	227	200.9
	7MC (n) -NU326	130	280	58	4	560 000	665 000	—	—	—	—	—	—	264	235.9
	7MC (n)-NU330	150	320	65	4	665 000	805 000	—	—	—	—	—	—	304	268.9
Deep groove ball bearing	**7MC (n) -6311**	55	120	29	2	71 500	45 000	—	—	—	—	—	—	111	104.5
	7MC (n) -6312	60	130	31	2.1	82 000	52 000	—	—	—	—	—	—	119	112.6
	7MC (n) -6316	80	170	39	2.1	123 000	86 500	—	—	—	—	—	—	159	150.7
	7MC (n) -6324	120	260	55	3	207 000	185 000	—	—	—	—	—	—	247	225.6
	7MC (n) -6230	150	270	45	3	176 000	168 000	—	—	—	—	—	—	257	240.2
	7MC (n) -6330	150	320	65	4	274 000	284 000	—	—	—	—	—	—	304	275.9

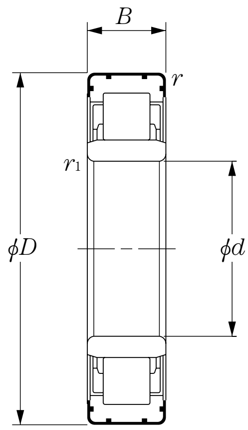
Notes : For bearing clearances and cage types, contact **NTN** Engineering.
The bearing numbers listed here refer to current products. For bearings with other numbers, contact **NTN** Engineering.

7MC(n)
- 7MC: Protected ceramic layer type with high voltage resistance
- 7MC2: Protected ceramic layer type
- 7MC3: Standard type

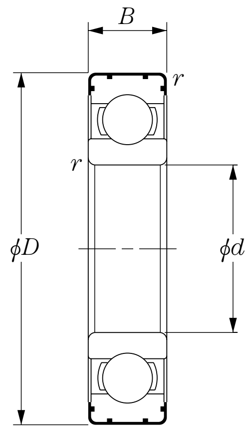
※Required shoulder height



5 Dimension Tables for Resin Insulated Bearings



Cylindrical roller bearing



Deep groove ball bearing

Bearing types	Bearing numbers	Boundary dimensions mm				Basic load ratings Dynamic N	Static N	Required shoulder height mm
		d	D	B	r_s min	C_r	C_{or}	D_a max
Cylindrical roller bearing	7MP-NUP208	40	80	18	1.1	43 500	43 000	73.5
	7MP-NUP210	50	90	20	1.1	48 000	51 000	83.5
	7MP2-NU214	70	125	24	1.5	83 500	95 000	117
	7MP2-NU314	70	150	35	2.1	158 000	168 000	139
	7MP2-NU215	75	130	25	1.5	166 000	195 000	122
	7MP-NU315 ※	75	160	37	2.1	190 000	205 000	149
	7MP-NU316 ※	80	170	39	2.1	201 000	223 000	159
	7MP2-NU217	85	150	28	2	126 000	149 000	141
	7MP-NU1017 ※	85	130	22	1.1	74 500	95 500	123.5
	7MP-NU219 ※	95	170	32	2.1	166 000	195 000	159
	7MP-NU220 ※	100	180	34	2.1	183 000	217 000	169
Deep groove ball bearing	7MP2-6310	50	110	27	2	62 000	38 500	101
	7MP2-6311	55	120	29	2	71 500	45 000	111
	7MP2-6312	60	130	31	2.1	82 000	52 000	119
	7MP2-6314	70	150	35	2.1	104 000	68 000	139
	7MP-6215	75	130	25	1.5	66 000	49 500	122
	7MP-6316 ※	80	170	39	2.1	123 000	86 500	159
	7MP2-6217	85	150	28	2	83 500	64 000	141
	7MP-6318 ※	90	190	43	3	143 000	107 000	177
	7MP-6219 ※	95	170	32	2.1	109 000	82 000	159
	7MP-6319 ※	95	200	45	3	153 000	119 000	187
	7MP-6320 ※	100	215	47	3	173 000	141 000	202
	7MP-6322 ※	110	240	50	3	205 000	179 000	227
	7MP-6030 ※	150	225	35	2.1	126 000	126 000	214

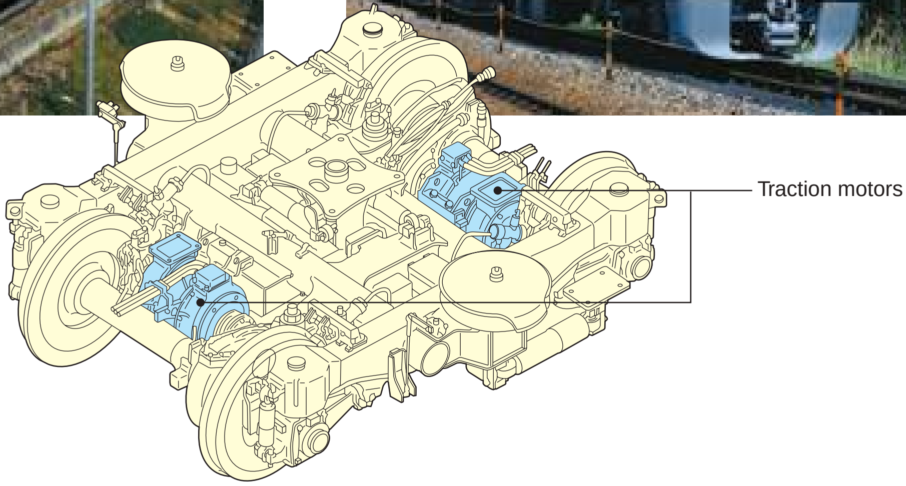
Notes : For bearing clearances and cage types, contact **NTN** Engineering.
The bearing numbers listed here refer to current products. For bearings with other numbers, contact **NTN** Engineering.

※Available only with a 7MP prefix.

6 Typical Applications

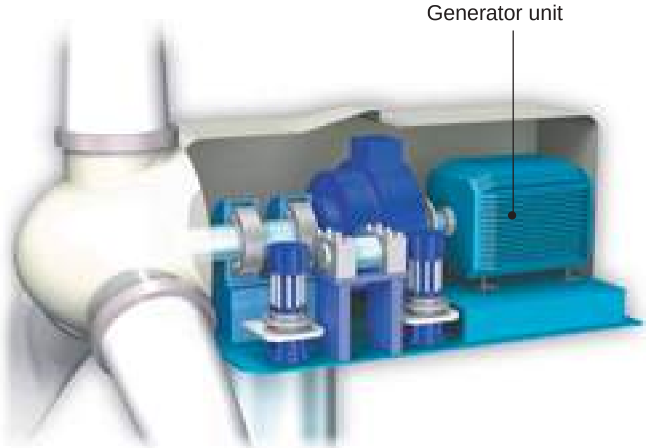
Electric Motors

The insulated bearings MEGAOHM™ Series is widely used in the traction motors of railway cars.
The unique knowledge and experience **NTN** has gained from motor applications in railways- where safety is the No. 1 priority- have contributed to the greatly improved reliability of general-purpose motors.



Power Generators

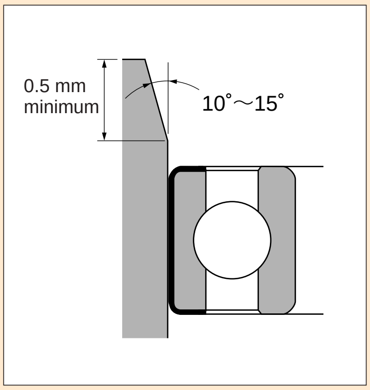
The insulated bearings MEGAOHM™ Series is also used in wind power generation systems, which are one solution to energy issues such as the prevention of global warming. These bearings contribute to the improved reliability of eco-friendly wind power generation systems.



Operating Precautions

To avoid an accident or failure resulting from damage to insulated bearings, carefully observe the following.

- Never drop an insulated bearing or strike it directly with a hammer during installation (**Illustrations 1 and 2**).
- Do not use an insulated bearing if a defect is visible on the surface (**Illustration 3**) or it has an unusual appearance.
- Attaching an electrical conductor to an insulated bearing can lower the bearing's insulation resistance.
- To prevent current flow from the side faces of a bearing, strictly observe the mounting dimensions given in the dimension tables for required shoulder height.
- Providing approximately 15° of relief (illustrated at right) at the entrance to the housing will facilitate assembly.
- For DC motors such as those used in railway cars, earth-ground the shaft during a voltage resistance test.



Relief at entrance of housing bore

Excessive shock can damage the insulating layer, possibly resulting in electrical pitting. Electrical pitting can in turn damage the bearing, leading to abnormal bearing performance and possible faulty operation or failure.

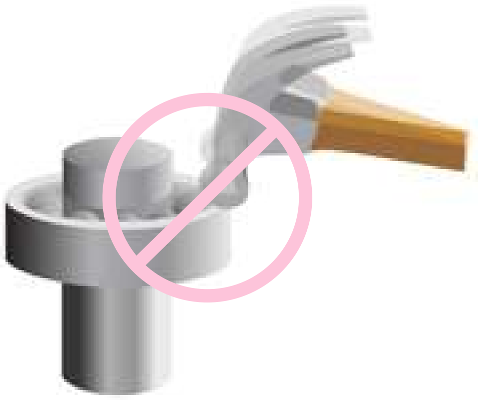


Illustration 1

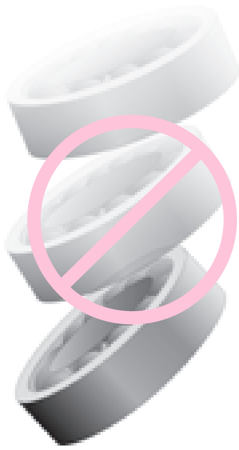


Illustration 2


Illustration 3

NTN®

IC Tag Integrated Bearing

ULTAGE

ULTAGE®

CAT. No. 3019/E

ULTAGE®

IC Tag Integrated Bearing

Improved Maintainability

Direct writing of electronic data

First in the Industry

Features

First in the industry

Record electronic data within the bearing itself.

112 English one byte characters can be read and written into Φ4.5mm IC Tag.

Compact

The data can be read and written with dedicated Reader/Writer.

Compact and light weight Reader/Writer (PDA) will not choose the place for recording the data.
(When applied out of Japan, the warranty of legality to Local Radio Law has to be confirmed.)
Personal Computers can be used with specialized software.

Format

Exclusive format is prepared.

Exclusive format for information is prepared, but it can be adjustable to customers' request.

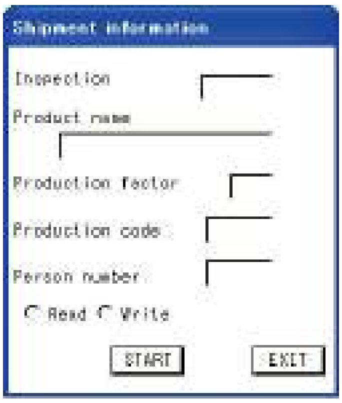
Applications

1. It can be possible to compare the information at maintenance to the original information.
2. It is possible to confirm previous maintenance date, operating hours and others by writing the latest information at the maintenance.
3. The historical data can be saved into PC and it enables to control bearing information of whole machines.(Pen type Reader/Writer is required for PC.)

Dedicated format

Standard format

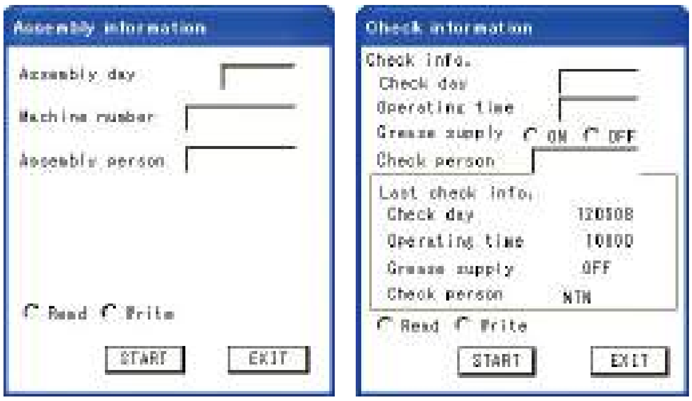
Ex.：Input screen of bearing information



1. Bearing information

Recorded by NTN at shipment time

Ex.：Input screen of bearing management information



2. Bearing management information

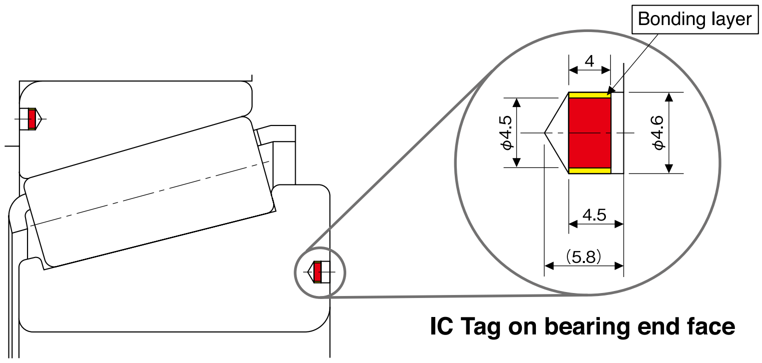
Recorded by the user for maintenance record

"ULTAGE"(a name created from the combination of "ultimate", signifying refinement, and "stage", signifying NTN's intention that this series of products be employed in diverse applications) is the general name for NTN's New generation of bearings that are noted for their industry-leading performance.

ULTAGE Series "IC Tag Integrated Bearing" allows electronic data such as maintenance record, information for replacement, quality records of the bearing saved directly within the bearing itself which can be used for every application.

Applicable bearing

1. Applicable to bearings which have enough space to attach IC Tag. (Φ4.5×4)
   A small hole will be formed on the end face of the bearing.
   In case of small size bearings and thin section bearings, IC Tag could not be attached.
2. IC Tag is good for oil and heat, but if the bearings would be used under special environment,please contact NTN Engineering.



IC Tag on bearing end face

Specifications of IC Tag

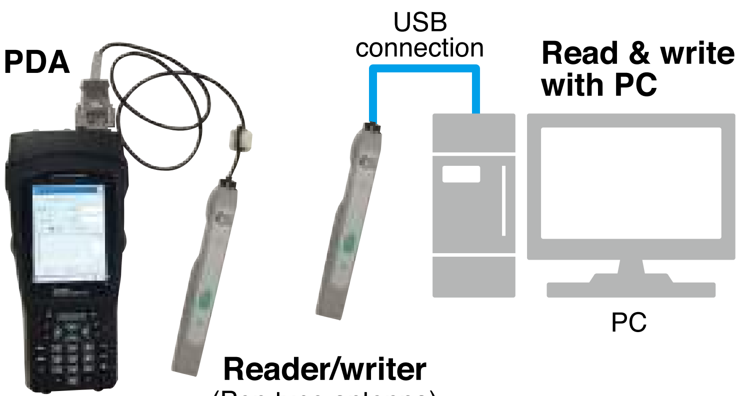
IC Tag
(mounted on end face)

■ **Specification of IC Tag**

Item	Specification
Memory Capacity Including Quality information	112byte
Data retention period	10 years
Data rewritable time	over 100,000 times
Carrier frequency	13.56MHz
Compliance standards	ISO 15693
Communication distance	～2mm
Ambient operating temperature	～120°C
Dimension	Φ4.5mm×4mm

Data retention period, data rewritable time and communication distance are reference values.

Specifications of reader/writer



Reader/writer
(Pen type antenna)

■ **Specification of reader/writer (PDA)**

Item	Specificaion
Carrier frequency	13.56 MHz
Compliance standards	ISO 15693
Ambient operating temperature	-10°C～50°C
Dimension	79mm×164mm×25mm (3.5 inch)
Weight	320g
Charging power	AC100V～250V(50～60Hz)

In case of inability of communication, apply dedicated Antenna Adapter on tip of pen type antenna.

Status of compliance of reader/writer to Local Radio Law

Certified in Japan, Europe, USA, Canada, Mexico, Thailand, Vietnam, Singapore, Malaysia, Indonesia, Philippines, China, Hong Kong,Taiwan, and Korea. Under adjustment in Australia.

IC Tag: Small electronic memory with RFID(Radio Frequency Identification) technologies.

NTN®

Large Size Tapered Roller Bearings

ULTAGE Metric Series

ULTAGE®

CAT. No. 3035/E

ULTAGE®

Large Size Tapered Roller Bearings

ULTAGE Metric Series

Large size tapered roller bearings (ULTAGE metric series, OD≧ϕ270mm) deliver longer life, higher load ratings, and higher speed capabilities. Developed as the new standard of NTN bearings, the ULTAGE series will contribute to improvements in industrial machinery today and into the future.

Higher Reliability

- Greater high load capacity by optimizing internal design
- Longer maintenance intervals

Higher Load Capability

- Allowable misalignment 0.0017 (6')

※Under conditions of $Fr \leqq 0.35Cr$

Higher Limiting Speed

- Up to 10% increase of allowable speed by optimizing the inner ring, large-end rib, and the roller end

"ULTAGE®" (a name created from the combination of **"Ultimate,"** signifying refinement,and **"Stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

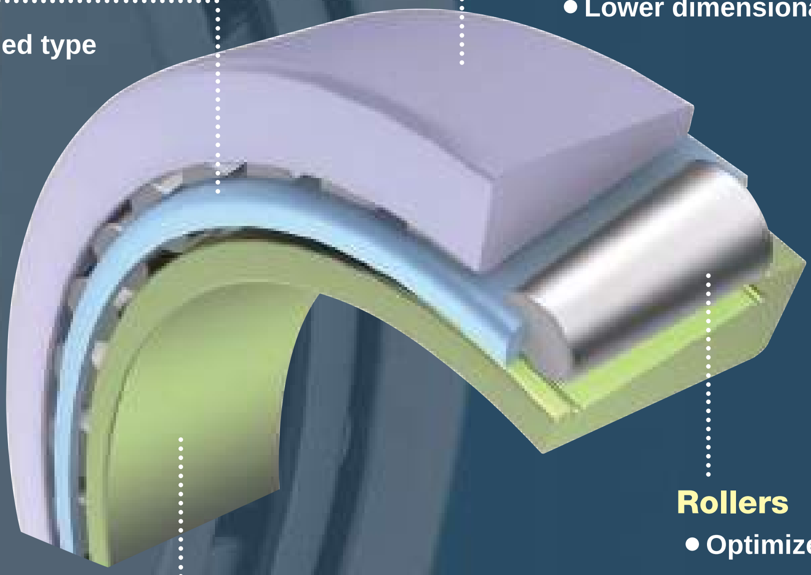
ULTAGE

Life
x3

Basic dynamic load rating
+30%

Up to
+10%
higher allowable speed

Dimensional change
1/10



INDEX

1. Features

1.1 The highest level of reliability

The optimized roller crowning delivers a dramatically increased load rating by better distributing load across the roller length, greatly reducing edge stress concentrations as shown in **Fig.1**.

① **Tested life:**
3.0 times larger than conventional bearings

② **Basic dynamic load rating:**
30% larger than conventional bearings

1.2 Allowable misalignment

Misalignment : 0.0017rad (6')

- Optimizations made to the crowning shape allow combinations of 0.35 C_r and misalignment up to 0.0017rad (6') to be used.
- Minimum required load : 0.04C_{0r}

Fig.1 shows the stress distribution when the radial load is below 0.35 C_r. Edge stress is significantly decreased and contact stresses are better distributed along the length of the roller, as compared the stresses resulting from a conventional design.

【Studied conditions】

Bearing size：30316U（φ80×φ170×42.5）

Load：102kN

Misalignment：0.0017rad.

※Since allowable misalignment varies depend on combination of load and misalignment, please consult **NTN** engineering.

1.3 Allowable speed

The optimized design between the roller and inner ring rib end makes it possible to minimize rotational torque and temperature rise, allowing for up to 10% higher allowable speed when compared to a conventional design as shown in **Fig. 2, 3** and **4**.

1.4 Improved demensional stability over time

The special heat treatment to the bearing steel allows for better dimensional stability over time, and reduces dimensional change during operation.

●**Less dimensional change**

1/10 compared with through hardened steel

1/4 compared with carburized steel

1.5 Easily adaptable

Boundary dimensions and tolerance of bearings comply with **ISO 355** (**JIS B 1512**), **ISO 492** (**JIS B 1514**).

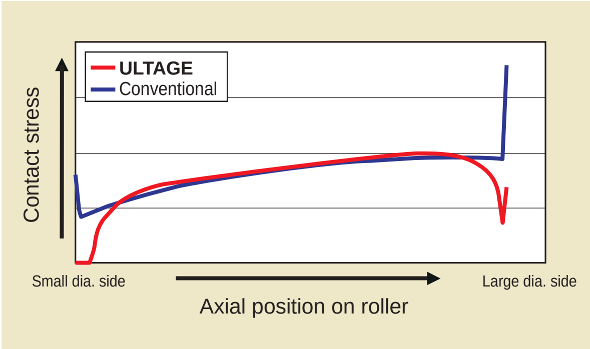


Fig. 1 Stress distribution on roller

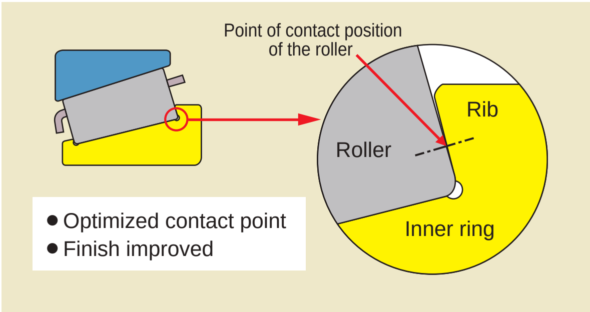


Fig. 2 Optimized design between a roller and an inner ring rib

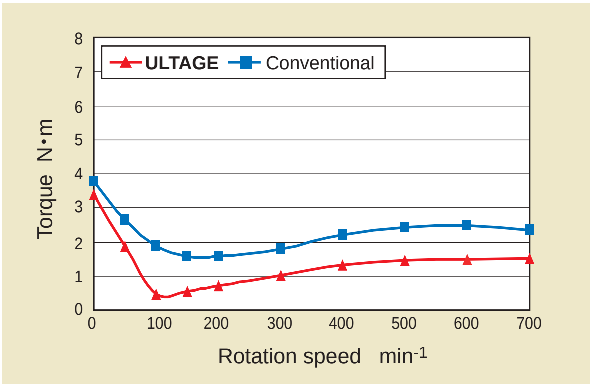


Fig. 3 Torque comparison

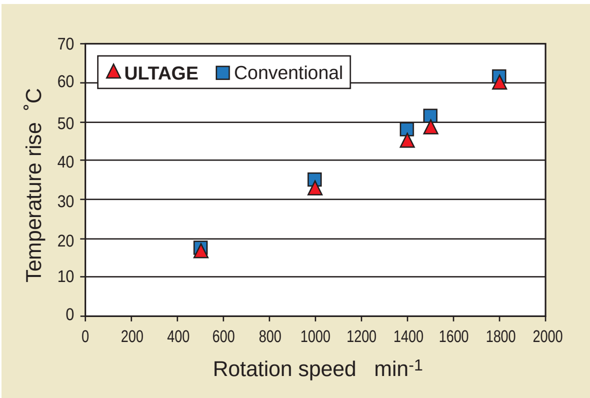


Fig. 4 Temperature rise test

2. Bearing Number

2.1 Single row tapered roller bearings

Bearing number : 3 03 28 U UTG

- UTG — Type code : ULTAGE
- U — Internationally interchangeable tapered roller bearings
- 28 — Nominal bore diameter 140mm
- 03 — Dimension series 03
- 3 — Bearing type (Single row tapered roller bearings)

2.2 Double row tapered roller bearings (Outside direction)

Bearing number : 43 03 28X UTG

- UTG — Type code : ULTAGE
- 28X — Nominal bore diameter 140mm
- 03 — Dimension series 03
- 43 — Bearing type (Double row tapered roller bearings (Outside direction))

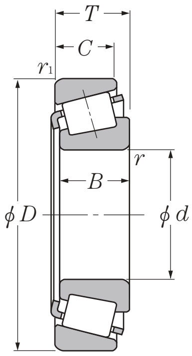
2.3 Double row tapered roller bearings (Inside direction)

Bearing number : 32 31 32 UTG

- UTG — Type code : ULTAGE
- 32 — Nominal bore diameter 160mm
- 31 — Dimension series 31
- 32 — Bearing type (Double row tapered roller bearings (Inside direction))

3. Dimension Table

3.1 Single row tapered roller bearings



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

$P_{0r} = 0.5F_r + Y_0F_a$

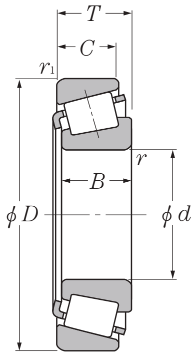
When $P_{0r} < F_r$ use $P_{0r} = F_r$

For values of e, Y_2, and Y_0 refer to that of conventional bearings.

d 130～220mm

Boundary dimensions mm							Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	T	B	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)		C_r	C_{0r}	C_r	C_{0r}
130	280	63.75	58	49	5	4	**30326UUTG**	830	830	84 500	84 500
	280	98.75	93	78	4	4	**32326UTG**	1 140	1 240	117 000	126 000
140	300	67.75	62	53	5	4	**30328UUTG**	945	950	96 000	97 000
	300	107.75	102	85	4	4	**32328UTG**	1 260	1 370	129 000	140 000
150	320	72	65	55	5	4	**30330UUTG**	1 060	1 070	108 000	109 000
	320	114	108	90	4	4	**32330UTG**	1 490	1 750	152 000	179 000
160	290	52	48	40	4	3	**30232UUTG**	670	720	68 500	73 500
	290	84	80	67	4	3	**32232UUTG**	1 140	1 420	116 000	145 000
	340	75	68	58	5	4	**30332UUTG**	1 170	1 200	119 000	122 000
	340	121	114	95	4	4	**32332UTG**	1 580	1 840	161 000	188 000
170	310	57	52	43	5	4	**30234UUTG**	780	845	79 500	86 500
	310	91	86	71	5	4	**32234UUTG**	1 280	1 600	130 000	163 000
	360	80	72	62	5	4	**30334UUTG**	1 290	1 320	131 000	135 000
	360	127	120	100	4	4	**32334UTG**	1680	1 940	171 000	198 000
180	280	64	64	48	3	2.5	**32036XUUTG**	825	1 170	84 500	119 000
	320	57	52	43	5	4	**30236UUTG**	805	890	82 000	91 000
	320	91	86	71	5	4	**32236UUTG**	1 320	1 690	134 000	172 000
	380	83	75	64	4	4	**30336UTG**	1 170	1 190	119 000	121 000
	380	134	126	106	4	4	**32336UTG**	1 850	2 150	188 000	219 000
190	290	64	64	48	3	2.5	**32038XUUTG**	840	1 210	85 500	124 000
	340	60	55	46	5	4	**30238UUTG**	915	1 000	93 500	102 000
	340	97	92	75	5	4	**32238UUTG**	1 470	1 850	150 000	189 000
	400	86	78	65	5	5	**30338UTG**	1 190	1 200	122 000	123 000
	400	140	132	109	5	5	**32338UTG**	2 040	2 390	208 000	244 000
200	280	51	51	39	3	2.5	**32940XUUTG**	620	895	63 000	91 000
	310	70	70	53	3	2.5	**32040XUUTG**	1 020	1 470	104 000	149 000
	360	64	58	48	5	4	**30240UUTG**	1 010	1 110	103 000	113 000
	360	104	98	82	5	4	**32240UUTG**	1 690	2 130	172 000	217 000
	420	89	80	67	5	5	**30340UTG**	1 340	1 370	136 000	140 000
	420	146	138	115	5	5	**32340UTG**	2 230	2 650	228 000	270 000
220	300	51	51	39	3	2.5	**32944XUUTG**	610	950	62 500	97 000
	340	76	76	57	4	3	**32044XUUTG**	1 180	1 690	120 000	173 000
	400	72	65	54	4	4	**30244UTG**	1 040	1 220	107 000	124 000
	400	114	108	90	4	4	**32244UTG**	1 780	2 410	181 000	246 000
	460	97	88	73	5	5	**30344UTG**	1 620	1 690	165 000	172 000
	460	154	145	122	5	5	**32344UTG**	2 580	3 050	263 000	315 000

1) Minimal allowable dimension for chamfer dimension r or r_1.



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

$P_{0r} = 0.5F_r + Y_0F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$

For values of e, Y_2, and Y_0 refer to that of conventional bearings.

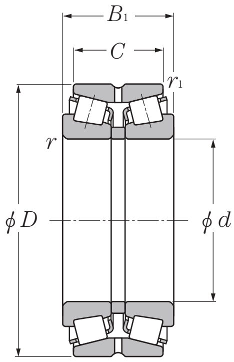
d 240～440mm

Boundary dimensions mm							Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	T	B	C	r_s min 1)	r_{1s} min 1)		C_r	C_{0r}	C_r	C_{0r}
240	320	51	51	39	3	2.5	**32948XUUTG**	625	1 000	64 000	102 000
	360	76	76	57	4	3	**32048XUUTG**	1 190	1 760	122 000	179 000
	440	79	72	60	4	4	**30248UTG**	1 250	1 480	128 000	151 000
	440	127	120	100	4	4	**32248UTG**	2 180	2 750	222 000	280 000
	500	105	95	80	5	5	**30348UTG**	1 900	2 000	194 000	204 000
	500	165	155	132	5	5	**32348UTG**	2 990	3 600	305 000	365 000
260	360	63.5	63.5	48	3	2.5	**32952XUUTG**	905	1 430	92 500	146 000
	400	87	87	65	5	4	**32052XUUTG**	1 540	2 270	157 000	231 000
	480	89	80	67	5	5	**30252UTG**	1 500	1 810	153 000	185 000
	480	137	130	106	5	5	**32252UTG**	2 410	3 350	246 000	340 000
280	380	63.5	63.5	48	3	2.5	**32956XUUTG**	930	1 520	95 000	155 000
	420	87	87	65	5	4	**32056XUUTG**	1 560	2 350	159 000	240 000
	500	89	80	67	5	5	**30256UTG**	1 590	1 910	162 000	195 000
	500	137	130	106	5	5	**32256UTG**	2 530	3 500	258 000	355 000
	580	187	175	145	6	6	**32356UTG**	4 200	5 250	425 000	535 000
300	420	76	76	57	4	3	**32960XUUTG**	1 290	2 090	131 000	213 000
	460	100	100	74	5	4	**32060XUUTG**	1 910	2 830	195 000	289 000
	540	96	85	71	5	5	**30260UTG**	1 820	2 220	186 000	226 000
	540	149	140	115	5	5	**32260UTG**	2 950	4 100	300 000	420 000
320	440	76	76	57	4	3	**32964XUUTG**	1 300	2 150	132 000	219 000
	480	100	100	74	5	4	**32064XUUTG**	1 940	2 940	198 000	300 000
	580	104	92	75	5	5	**30264UTG**	2 130	2 580	217 000	263 000
	580	159	150	125	5	5	**32264UTG**	3 350	4 650	340 000	470 000
340	460	76	76	57	4	3	**32968XUUTG**	1 340	2 270	136 000	232 000
	520	112	106	90	5	5	**32068UTG**	2 120	3 150	216 000	320 000
360	480	76	76	57	4	3	**32972XUUTG**	1 340	2 330	137 000	238 000
	540	112	106	90	5	5	**32072UTG**	2 230	3 300	227 000	340 000
380	520	87	82	72	4	4	**32976UTG**	1 460	2 500	148 000	255 000
	560	112	106	90	5	5	**32076UTG**	2 460	3 800	250 000	390 000
400	540	87	82	71	4	4	**32980UTG**	1 530	2 710	156 000	276 000
	600	125	118	100	5	5	**32080UTG**	2 790	4 250	284 000	435 000
420	560	87	82	71	4	4	**32984UTG**	1 570	2 840	160 000	290 000
	620	125	118	100	6	5	**32084UTG**	2 920	4 550	298 000	465 000
440	600	100	95	82	4	4	**32988UTG**	2 050	3 450	209 000	355 000
	650	130	122	104	6	6	**32088UTG**	3 250	5 000	330 000	510 000

1) Minimal allowable dimension for chamfer dimension r or r_1.

3. Dimension Table

3.2 Double row tapered roller bearings (Outside direction)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

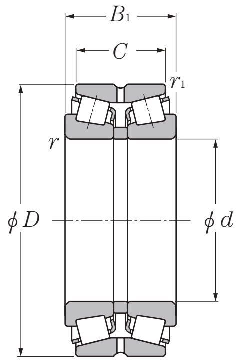
$P_{or} = F_r + Y_o F_a$

For values of e, Y_2, and Y_o refer to that of conventional bearings.

d 130～200mm

Boundary dimensions mm						Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)		C_r	C_{0r}	C_r	C_{0r}
130	280	137	107.5	5	1.5	**430326XUUTG**	1 420	1 660	145 000	169 000
	280	205	163.5	4	1.5	**432326UTG**	1 960	2 470	200 000	252 000
140	300	145	115.5	5	1.5	**430328XUUTG**	1 620	1 900	165 000	194 000
	300	223	177.5	4	1.5	**432328UTG**	2 170	2 740	221 000	279 000
150	320	154	120	5	1.5	**430330UUTG**	1 810	2 140	184 000	218 000
160	270	86	76	3	1	**413132UTG**	760	965	77 500	98 000
	270	108	86	3	1	**423132UTG**	865	1 180	88 500	120 000
	290	115	91	4	1	**430232UUTG**	1 150	1 440	118 000	147 000
	290	178	144	4	1	**432232UUTG**	1 950	2 840	199 000	290 000
	340	160	126	5	1.5	**430332XUUTG**	2 010	2 390	205 000	244 000
170	280	88	78	3	1	**413134UTG**	705	900	72 000	92 000
	280	110	88	3	1	**423134UTG**	930	1 270	94 500	130 000
	310	125	97	5	1.5	**430234UUTG**	1 340	1 690	136 000	173 000
	310	192	152	5	1.5	**432234XUUTG**	2 190	3 200	223 000	325 000
180	280	74	66	3	1	**413036UTG**	540	735	55 500	75 000
	280	93	74	3	1	**423036UTG**	745	1 050	76 000	107 000
	300	96	85	4	1.5	**413136UTG**	905	1 190	92 000	121 000
	300	120	96	4	1.5	**423136UTG**	1 130	1 530	116 000	156 000
	320	127	99	5	1.5	**430236UUTG**	1 380	1 780	141 000	182 000
	320	192	152	5	1.5	**432236UUTG**	2 260	3 350	230 000	345 000
190	290	75	67	3	1	**413038UTG**	550	740	56 500	75 500
	290	94	75	3	1	**423038UTG**	790	1 110	80 500	113 000
	320	104	92	4	1.5	**413138UTG**	1 000	1 280	102 000	131 000
	320	130	104	4	1.5	**423138UTG**	1 260	1 710	128 000	174 000
	340	133	105	5	1.5	**430238UUTG**	1 570	2 010	160 000	205 000
	340	204	160	5	1.5	**432238UUTG**	2 530	3 700	258 000	380 000
200	310	82	73	3	1	**413040UTG**	680	940	69 000	96 000
	310	103	82	3	1	**423040UTG**	920	1 320	94 000	135 000
	340	112	100	4	1.5	**413140UTG**	1 240	1 660	126 000	169 000
	340	140	112	4	1.5	**423140UTG**	1 400	1 910	143 000	195 000
	360	142	110	5	1.5	**430240UUTG**	1 730	2 210	176 000	226 000
	360	218	174	5	1.5	**432240UUTG**	2 890	4 250	295 000	435 000

1) Minimal allowable dimension for chamfer dimension r or r_1.



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_2, and Y_0 refer to that of conventional bearings.

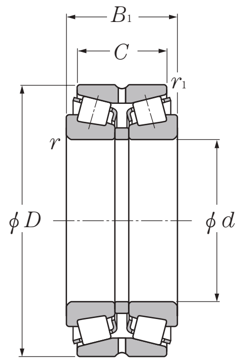
d 220～360mm

Boundary dimensions mm						Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)		C_r	C_{0r}	C_r	C_{0r}
220	340	90	80	4	1.5	**413044UTG**	765	1 060	78 000	108 000
	340	113	90	4	1.5	**423044UTG**	1 130	1 650	115 000	168 000
	370	120	107	5	1.5	**413144UTG**	1 420	1 920	145 000	196 000
	370	150	120	5	1.5	**423144UTG**	1 560	2 260	159 000	230 000
	400	158	122	4	1.5	**430244UTG**	1 790	2 440	183 000	249 000
240	360	92	82	4	1.5	**413048UTG**	835	1 160	85 500	118 000
	360	115	92	4	1.5	**423048UTG**	1 160	1 770	119 000	181 000
	400	128	114	5	1.5	**413148UTG**	1 580	2 130	161 000	217 000
	400	160	128	5	1.5	**423148UTG**	1 790	2 600	182 000	265 000
	440	165	127	4	1.5	**430248UTG**	2 140	2 960	219 000	300 000
	440	266	212	4	1.5	**432248UTG**	3 750	5 500	380 000	560 000
260	400	104	92	5	1.5	**413052UTG**	1 070	1 540	109 000	157 000
	400	130	104	5	1.5	**423052UTG**	1 470	2 190	150 000	223 000
	440	144	128	5	1.5	**413152UTG**	1 910	2 630	195 000	268 000
	440	180	144	5	1.5	**423152UTG**	2 510	3 750	256 000	380 000
280	420	106	94	5	1.5	**413056UTG**	1 140	1 630	116 000	166 000
	420	133	106	5	1.5	**423056UTG**	1 540	2 340	157 000	238 000
	460	146	130	6	2	**413156UTG**	2 100	2 900	214 000	296 000
	460	183	146	6	2	**423156UTG**	2 480	3 650	253 000	375 000
300	460	118	105	5	1.5	**413060UTG**	1 370	1 990	139 000	203 000
	460	148	118	5	1.5	**423060UTG**	2 070	3 150	211 000	320 000
	500	160	142	6	2	**413160UTG**	2 580	3 600	263 000	370 000
	500	200	160	6	2	**423160UTG**	2 690	4 050	274 000	415 000
320	480	121	108	5	1.5	**413064UTG**	1 520	2 250	155 000	229 000
	480	151	121	5	1.5	**423064UTG**	2 030	3 100	207 000	315 000
	540	176	157	6	2	**413164UTG**	2 870	4 100	292 000	415 000
	540	220	176	6	2	**423164UTG**	3 200	4 900	325 000	500 000
340	520	133	118	6	2	**413068UTG**	1 890	2 870	193 000	293 000
	520	165	133	6	2	**423068UTG**	2 420	3 750	246 000	380 000
	580	190	169	6	2	**413168UTG**	3 450	4 900	350 000	500 000
	580	238	190	6	2	**423168UTG**	4 300	6 500	440 000	660 000
360	540	134	120	6	2	**413072UTG**	1 880	2 810	191 000	287 000
	540	169	134	6	2	**423072UTG**	2 620	4 200	268 000	430 000
	600	192	171	6	2	**413172UTG**	3 500	5 050	355 000	515 000
	600	240	192	6	2	**423172UTG**	4 100	6 500	420 000	660 000

1) Minimal allowable dimension for chamfer dimension r or r_1.

3. Dimension Table

3.2 Double row tapered roller bearings (Outside direction)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{0r} = F_r + Y_0 F_a$

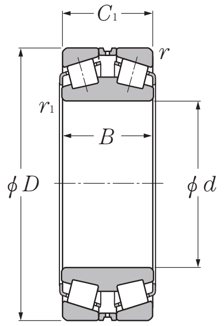
For values of e, Y_2, and Y_0 refer to that of conventional bearings.

d 380～710mm

Boundary dimensions mm						Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)		C_r	C_{0r}	C_r	C_{0r}
380	560	135	122	6	2	**413076UTG**	2 160	3 350	221 000	340 000
	560	171	135	6	2	**423076UTG**	2 670	4 350	272 000	445 000
	620	194	173	6	2	**413176UTG**	3 650	5 250	370 000	535 000
	620	243	194	6	2	**423176UTG**	4 250	6 700	435 000	685 000
400	600	148	132	6	2	**413080UTG**	2 390	3 700	243 000	375 000
	600	185	148	6	2	**423080UTG**	3 250	5 450	330 000	555 000
	650	200	178	6	3	**413180UTG**	3 850	5 800	395 000	590 000
	650	250	200	6	3	**423180UTG**	4 800	7 850	490 000	800 000
420	620	150	134	6	2	**413084UTG**	2 700	4 250	276 000	435 000
	620	188	150	6	2	**423084UTG**	3 400	5 900	345 000	600 000
	700	224	200	6	3	**413184UTG**	4 700	7 200	480 000	735 000
	700	280	224	6	3	**423184UTG**	6 150	9 700	625 000	990 000
440	650	157	140	6	3	**413088UTG**	3 150	5 150	320 000	525 000
	650	196	157	6	3	**423088UTG**	3 350	5 450	340 000	560 000
	720	226	201	6	3	**413188UTG**	5 150	7 800	525 000	795 000
	720	283	226	6	3	**423188UTG**	6 400	10 300	650 000	1 050 000
460	680	163	145	6	3	**413092UTG**	3 350	5 350	340 000	550 000
	680	204	163	6	3	**423092UTG**	3 950	6 750	405 000	685 000
	760	240	214	7.5	4	**413192UTG**	5 850	9 150	595 000	930 000
	760	300	240	7.5	4	**423192UTG**	6 300	10 300	640 000	1 050 000
480	700	165	147	6	3	**413096UTG**	3 200	5 000	325 000	510 000
	700	206	165	6	3	**423096UTG**	3 900	6 700	400 000	685 000
	790	248	221	7.5	4	**413196UTG**	6 150	9 600	625 000	975 000
	790	310	248	7.5	4	**423196UTG**	6 750	11 100	690 000	1 130 000
500	720	167	149	6	3	**4130/500UTG**	3 350	5 400	340 000	550 000
	720	209	167	6	3	**4230/500UTG**	3 950	6 900	400 000	700 000
	830	264	235	7.5	4	**4131/500UTG**	6 700	10 500	680 000	1 070 000
	830	330	264	7.5	4	☆**4231/500UTGG2**	8 200	14 000	835 000	1 420 000
530	780	185	163	6	3	**4130/530UTG**	3 750	5 900	380 000	600 000
	870	340	272	7.5	4	☆**4231/530AUTGG2**	9 900	16 700	1 010 000	1 710 000
560	920	350	280	7.5	4	☆**4231/560UTGG2**	9 700	17 400	990 000	1 780 000
600	870	200	176	6	3	**4130/600UTG**	5 000	8 550	510 000	870 000
	980	388	300	7.5	4	☆**4231/600UTGG2**	10 950	18 400	1 120 000	1 870 000
670	1 090	392	336	7.5	4	☆**4231/670UTGG2**	13 450	24 800	1 370 000	2 530 000
710	1 030	236	208	7.5	4	☆**4130/710UTGG2**	7 550	13 900	770 000	1 420 000

1) Minimal allowable dimension for chamfer dimension r or r_1.
Remarks: Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

3.3 Double row tapered roller bearings (Inside direction)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_2, and Y_0 refer to that of conventional bearings.

d 160～710mm

Boundary dimensions mm						Bearing numbers	Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)		C_r	C_{0r}	C_r	C_{0r}
160	270	86	86	2.5	3	**323132UTG**	865	1 180	88 500	120 000
170	280	88	88	2.5	3	**323134UTG**	930	1 270	94 500	130 000
180	280	74	74	2.5	3	**323036UTG**	745	1 050	76 000	107 000
	300	96	96	3	4	**323136UTG**	1 130	1 530	116 000	156 000
190	290	75	75	2.5	3	**323038UTG**	790	1 110	80 500	113 000
	320	104	104	3	4	**323138UTG**	1 260	1 710	128 000	174 000
200	310	82	82	2.5	3	**323040UTG**	920	1 320	94 000	135 000
	340	112	112	3	4	**323140UTG**	1 400	1 910	143 000	195 000
220	340	90	90	3	4	**323044UTG**	1 130	1 650	115 000	168 000
	370	120	120	4	5	**323144UTG**	1 560	2 260	159 000	230 000
240	360	92	92	3	4	**323048UTG**	1 160	1 770	119 000	181 000
	400	128	128	4	5	**323148UTG**	1 790	2 600	182 000	265 000
260	400	104	104	4	5	**323052UTG**	1 470	2 190	150 000	223 000
	440	144	144	4	5	**323152UTG**	2 510	3 750	256 000	380 000
280	420	106	106	4	5	**323056UTG**	1 540	2 340	157 000	238 000
	460	146	146	5	6	**323156UTG**	2 480	3 650	253 000	375 000
300	460	118	118	4	5	**323060UTG**	2 070	3 150	211 000	320 000
	500	160	160	5	6	**323160UTG**	2 690	4 050	274 000	415 000
320	480	121	121	4	5	**323064UTG**	2 030	3 100	207 000	315 000
	540	176	176	5	6	**323164UTG**	3 200	4 900	325 000	500 000
340	520	133	133	5	6	**323068UTG**	2 420	3 750	246 000	380 000
	580	190	190	5	6	**323168UTG**	4 300	6 500	440 000	660 000
360	540	134	134	5	6	**323072UTG**	2 620	4 200	268 000	430 000
	600	192	192	5	6	**323172UTG**	4 100	6 500	420 000	660 000
400	600	148	148	5	6	**323080UTG**	3 250	5 450	330 000	555 000
	650	200	200	6	6	**323180UTG**	4 800	7 850	490 000	800 000
420	620	150	150	5	6	**323084UTG**	3 400	5 900	345 000	600 000
	700	224	224	6	6	**323184UTG**	6 150	9 700	625 000	990 000
440	650	157	157	6	6	**323088UTG**	3 350	5 450	266 000	560 000
	720	226	226	6	6	**323188UTG**	6 400	10 300	510 000	1 050 000
460	680	163	163	6	6	**323092UTG**	3 950	6 600	310 000	670 000
	760	240	240	7.5	7.5	**323192UTG**	6 300	10 300	500 000	1 050 000
480	700	165	165	6	6	**323096UTG**	3 900	6 700	400 000	685 000
	790	248	248	7.5	7.5	**323196UTG**	6 750	11 100	540 000	1 130 000
500	720	167	167	6	6	**3230/500UTG**	3 950	6 900	400 000	700 000
	830	264	264	7.5	7.5	**☆3231/500UTGG2**	8 200	14 000	650 000	1 420 000
630	920	212	212	7.5	7.5	**☆3230/630UTGG2**	6 850	12 800	545 000	1 310 000
710	1 150	345	345	12	12	**☆3231/710BUTGG2**	14 000	25 300	1 430 000	2 580 000

1) Minimal allowable dimension for chamfer dimension r or r_1.
Remarks: Bearing numbers marked "☆" designate bearing with hollow rollers and pin type cages.

For New Technology Network

NTN®

NTN corporation

Cam Followers & Roller Followers

カムフォロア ローラフォロア

CAT. No. 3604-Ⅵ／JE

Cam Followers & Roller Followers カムフォロア·ローラフォロア

CONTENTS

Cam Followers
カムフォロア

CONTENTS

Construction and Characteristics

NTN cam followers are stud-type track roller assemblies each comprising a thick-walled outer ring encompassing integral rollers. The cam follower is designed to operate with its outer ring rolling on the track.

Because it is run in direct contact with the track, the outer ring is designed with a thick wall capable of withstanding an impact load.

The outside surface of the outer ring is either spherical or cylindrical in shape. A spherical outer ring can effectively withstand edge loads that result from mounting error.

Because the cylindrical outer ring is in contact with a larger contact area of the associated track surface, the contact surface pressure is lower. Thus, this type of outer ring can bear a larger load compared with spherical outer rings and can be used even if the hardness of the associated track surface is low.

NTN cam followers can be categorized into a caged type and full-complement roller type. With the caged type, the rollers are guided by the cage, making this type suitable for high-speed applications.

The full-complement roller type, by contrast, has an increased load rating, making it suitable for high-load applications (low-speed operation). The double-row cylindrical roller type (NUKR type), however, can bear an even higher load.

In addition to unsealed configurations, **NTN** cam followers are available in configurations incorporating either a rubber seal or a labyrinth seal (shield plate). Cam followers with a seal and full-complement roller-type cam followers are prelubricated with standard grease (lithium soap grease).

Both types have an oil hole at the end of the stud that allows for relubrication with grease. This arrangement enables the user to replenish the grease using the grease nipple provided as standard accessories.

The stud rib of an **NTN** cam follower is provided with a hexagonal socket, a tapped hole or a slot for a flat-blade screwdriver.

To secure a cam follower to its associated housing, tighten the hexagonal nut threaded onto the stud while preventing rotation of the stud with a screwdriver or Allen key.

NTN also offers a unique type of cam follower whose stud features an eccentric axis on its threaded portion. This arrangement can be used to compensate for any variation - within the range of the eccentricity - in the stud mounting hole position.

構造と特徴

NTNカムフォロアは，肉厚の外輪にころを組み込んだスタッド付きのトラックローラで，軌道（トラック）上を外輪が転がり運動する。

外輪は直接トラックに接触させて使用するため，肉厚の外輪として衝撃荷重にも耐えられるよう設計している。

外輪外径は球面と円筒面があり，球面外輪は，取付誤差によるエッジロード緩和に有効である。

また，円筒外輪は相手トラック面との接触面積が大きいので，接触面圧が軽減され球面外輪に比べ大きな荷重や相手トラック面の硬度が低い場合でも使用できる。

NTNカムフォロアは保持器付き形と総ころ形とがあり，保持器付き形は保持器によってころが案内されるため，高速回転での使用に適している。

また，総ころ形は保持器付き形に比べ定格荷重が大きく高荷重（低速運転）での用途に適しており，複列円筒ころ形（NUKR形）はさらに高荷重を負荷することができる。

NTNカムフォロアはシールなしの他に，シール有り，ラビリンスシール（シールド板）付きの形式が用意されており，シール付き及び総ころ形は標準グリース（リチウム石けん基グリース）が封入されている。

なお，いずれの形式でもスタッド端部にグリースを補給するための給脂孔が設けられており，付属のグリースニップルを用いて給脂することができる。

NTNカムフォロアはスタッドつば部にドライバ溝が付いた形式と，六角穴やタップ穴が付いた形式が用意されている。

カムフォロアを相手ハウジングへ取付ける際は，ドライバまたは六角レンチを用いてスタッドの回り止めをし，スタッドねじ部に取付けた六角ナットを締め込むことにより固定できる。

また，スタッドねじ側の軸心を偏心させた形式も用意しており，スタッド取付穴位置のばらつきを偏心量の範囲内で調整することができる。

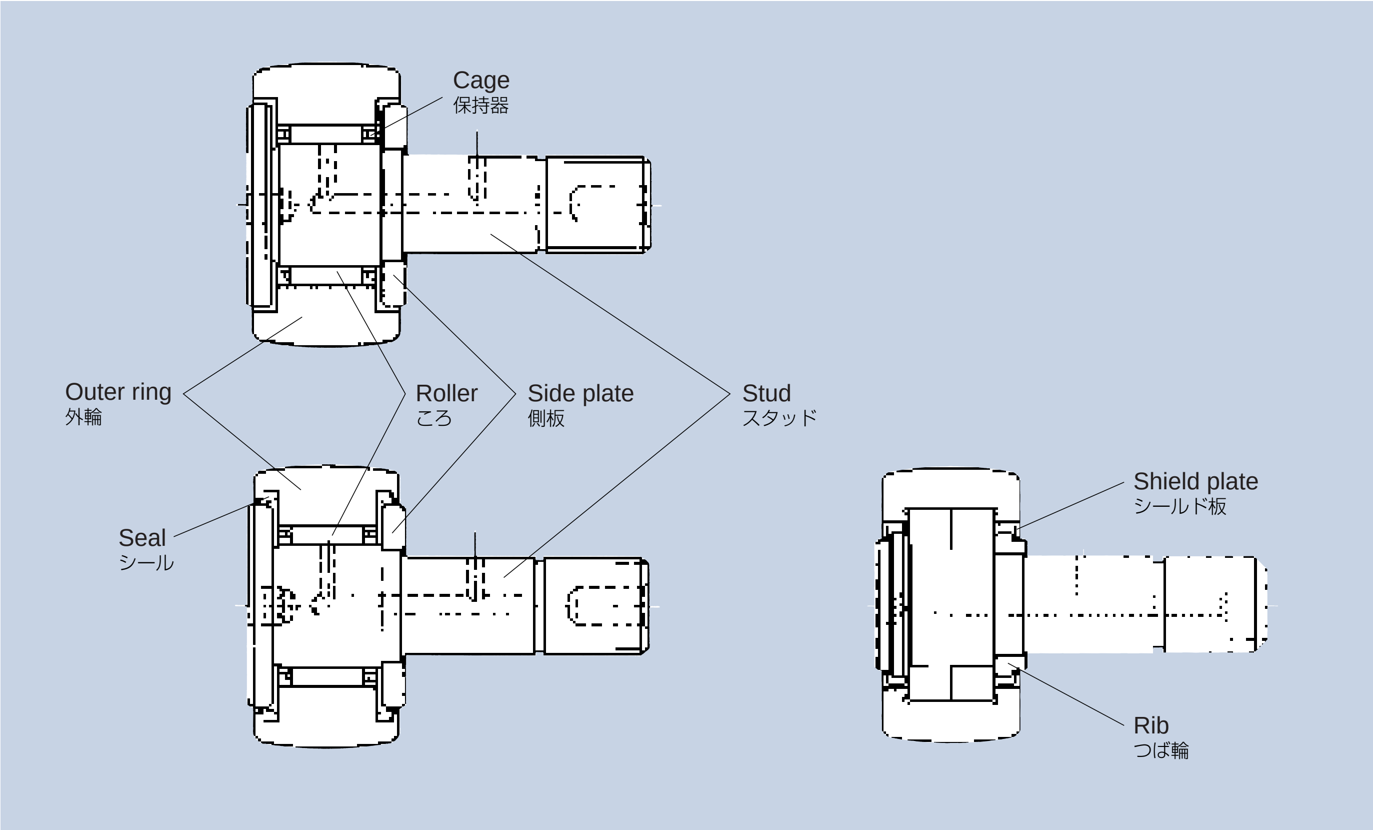
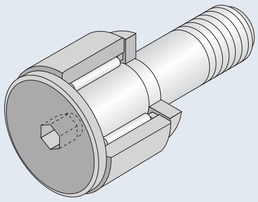
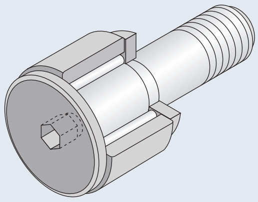
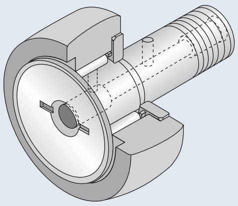
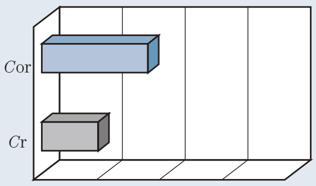
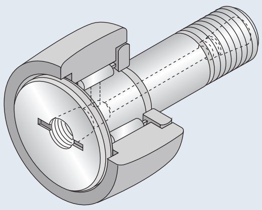
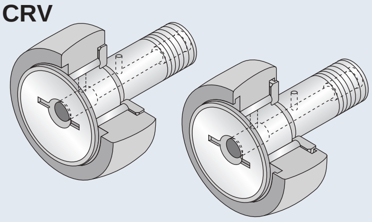
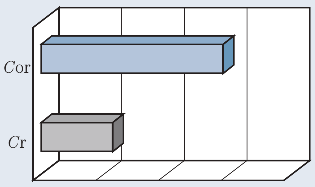
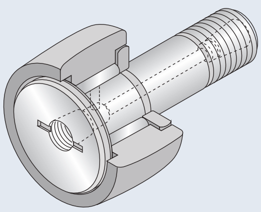


Fig.1 Cam follower components
部品名称

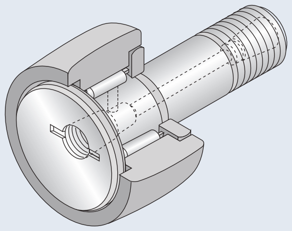
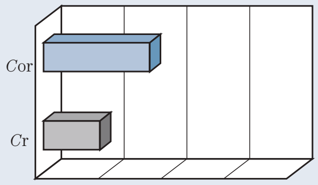
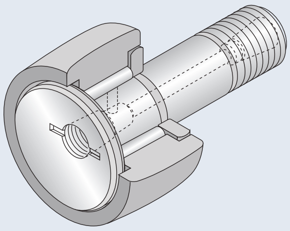
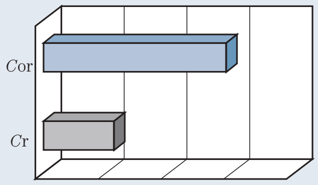
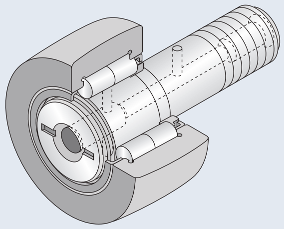
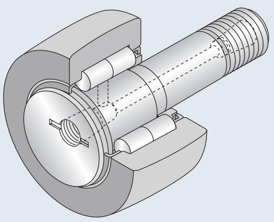
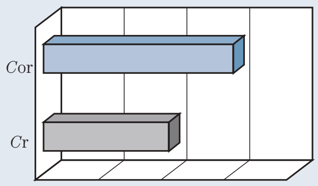
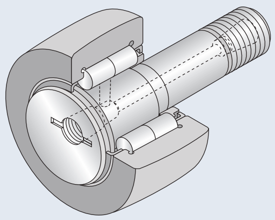
Construction and characteristics
構造と特徴

Follower type 形　式	Shaft diameter (mm) 適用軸径(mm)	Load capacity 負荷容量	Bearing nomenclature 呼び番号の構成
KRM・・XH 	ϕ1.5～ϕ6	—	**KRM 4 XT2H / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 T2 ：Resin cage 樹脂保持器 H ：With hexagonal hole 六角穴付き 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
KRMV・・XH 	ϕ1.5～ϕ6		**KRMV 4 XH / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 H ：With hexagonal hole 六角穴付き 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
KR **CR** 	KR： ϕ3～ϕ30 CR： ϕ4.826～ϕ22.225	 **KR90**	**KR 12 T2 H / 3AS** Suffix 接尾記号 T2 ：Resin cage 樹脂保持器 H ：With hexagonal hole 六角穴付き 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
KRT 	ϕ6～ϕ30		**KRT 32 X** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 Dimension code 寸法記号 Type code 形式記号
KRV **CRV** 	KRV： ϕ3～ϕ30 CRV： ϕ4.826～ϕ63.5	 **KRV90**	**CRV 30 X LL / 3AS** Suffix 接尾記号 LL ：Seal シール 3AS：grease グリース Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 Dimension code 寸法記号 Type code 形式記号
KRVT 	ϕ6～ϕ30		**KRVT 52 X LL / 3AS** Suffix 接尾記号 LL ：Seal シール 3AS：grease グリース Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 Dimension code 寸法記号 Type code 形式記号

※Each listed load capacity refers to a bearing diameter of ϕ30.
負荷容量の基準軸受軸径はϕ30の時の値である。

<table>
<tr><th>Follower components
構成内容</th><th>Features
特　徴</th></tr>
<tr><td>Outer ring outer diameter : φ4　外輪外径　：φ4
Metric series with cage　メートル系保持器付き形
Outer profile : spherical　外径形状 ： 円筒形状
Stud head : with hexagonal hole　スタッド頭部形状：六角穴付き
Cage : resin cage　保持器 ：樹脂保持器
Grease : prelubricated　グリース ： 封入済</td><td>● Polyamide resin cage (T2 suffix) can operate at temperatures up to 120˚C (100˚C for continuous operation).
● Prelubricated (no relubrication hole)
● ポリアミド樹脂保持器（接尾記号：T2）の場合，許容温度：120℃，連続使用温度：100℃以下で使用すること。
● 給脂穴はないが，グリースは封入済みである。</td></tr>
<tr><td>Outer ring outer diameter : φ4　外輪外径　：φ4
Metric series full-complement type　メートル系総ころ形
Outer profile : spherical　外径形状 ： 円筒形状
Stud head : with hexagonal hole　スタッド頭部形状：六角穴付き
Grease : prelubricated　グリース ： 封入済</td><td>● Better for heavy loads than KRM‥XH type.
● Prelubricated (no relubrication hole)
● KRM‥XH形よりも高荷重に適する。
● 給脂穴はないが，グリースは封入済みである</td></tr>
<tr><td>Outer ring outer diameter : φ12　外輪外径　：φ12
Metric series with cage　メートル系保持器付き形
Seal : none　シールなし
Outer profile : spherical　外径形状 ：球面形状
Stud head : with hexagonal hole　スタッド頭部形状：六角穴付き
Cage : resin cage　保持器：樹脂保持器
Grease : prelubricated　グリース：封入済</td><td rowspan="2">● Standard cage is pressed steel.
● Polyamide resin cage (T2 suffix) is also available.
Allowable temperature: 120˚C max.
Continuous operating temperature: 100˚C max
● Suited to high speed.
● Due to a high initial grease fill, this type can be used for a long period of time without additional greasing.
● The standard Type KRT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.
● If there is no grease code, the follower is not prelubricated.
● 保持器は鋼板打ち抜き保持器が標準である。
● ポリアミド樹脂保持器（接尾記号：T2記号）も用いられる。
許容温度　：120℃
連続使用温度：100℃以下
● 高速に適している。
● グリース封入量が多く使用条件によっては長時間無給脂で使用できる。
● KRT形標準品に六角穴付き(接尾記号H)はないが，六角穴付きねじプラグを標準添付している。
● 接尾記号にグリース記号がないものはグリース未封入品である。</td></tr>
<tr><td>Outer ring outer diameter : φ32　外輪外径：φ32
Metric series with cage　メートル系保持器付き形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝付き及びタップ穴付き
Outer surface profile : cylindrical　外径形状：円筒形状
Grease : unlubricated　グリース：未封入</td></tr>
<tr><td>Outer ring outer diameter : φ47.825　外輪外径：φ47.825
Inch series full-complement type　インチ系総ころ形
Stud head : with recessed slot for screwdriver　スタッド頭部形状：ドライバ溝付き
Outer surface profile : cylindrical　外径形状：円筒形状
Seal : included　シール：シール付き
Grease : prelubricated　グリース：封入済</td><td rowspan="2">● Suited to high load.
● Lower allowable running speed than caged types.
● Grease replenishing interval must be shortened due to the small internal volume available for grease.
● The standard Type KRVT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.
● 高荷重に適する。
● 保持器付き形より許容回転速度は低い。
● 空間容積が小さいため，グリース補給間隔を短くする必要がある。
● KRVT形標準品に六角穴付き(接尾記号H)はないが，六角穴付きねじプラグを標準添付している。</td></tr>
<tr><td>Outer ring outer diameter : φ52　外輪外径：φ52
Metric series full-complement type　メートル系総ころ形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝及びタップ穴付き
Outer surface profile : cylindrical　外径形状：円筒形状
Seal : included　シール ：シール付き
Grease : prelubricated　グリース：封入済</td></tr>
</table>

Construction and characteristics
構造と特徴

Follower type 形　　式	Shaft diameter (mm) 適用軸径(mm)	Load capacity 負荷容量	Bearing nomenclature 呼び番号の構成
KRU 	ϕ 6～ϕ 30	 **KRU90**	**KRU 32** Dimension code 寸法記号 Type code 形式記号
KRVU 	ϕ 6～ϕ 30	 **KRVU90**	**KRVU 62 X LL / 3AS** Suffix 接尾記号 LL ：Seal シール 3AS：grease グリース Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 Dimension code 寸法記号 Type code 形式記号
NUKR 	ϕ 12～ϕ 64		**NUKR 80 H / 3AS** Suffix 接尾記号 H ：With hexagonal hole 六角穴付き 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
NUKRT 	ϕ 12～ϕ 64	 **NUKR90**	**NUKRT 90 / 3AS** Suffix 接尾記号 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
NUKRU 	ϕ 12～ϕ 64		**NUKRU 140 X / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号

※Each listed load capacity refers to a bearing diameter of ϕ 30.
負荷容量の基準軸受軸径はϕ 30の時の値である。

<table>
<tr><th>Follower components
構成内容</th><th>Features
特　徴</th></tr>
<tr><td>Outer ring outer diameter: φ32　外輪外径 ： φ32
Metric series with cage　メートル系保持器付き
Eccentric stud type　スタッド偏心形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝及びタップ穴付き
Outer profile : spherical　外径形状：球面形状
Grease : unlubricated　グリース：未封入</td><td rowspan="2">● Unlike Type KRT and KRVT, Type KRU and KRVU have an eccentric stud (eccentricity : 0.25 to 1.0mm) to compensate for positional variation of the stud mounting hole.
● The standard follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug .
● If there is no grease code, the follower is not prelubricated.

●KRU形及びKRVU形は、それぞれKRT形及びKRVT形のスタッドが偏心（偏心量0.25～1.0mm）した形式で，スタッド取付け穴の位置のばらつきを調整することができる。
●標準品に六角穴付き（接尾記号H）はないが，六角穴付きねじプラグを標準添付している。
●接尾記号にグリース記号がないものはグリース未封入品である。</td></tr>
<tr><td>Outer ring outer diameter: φ62　外輪外径 ： φ62
Metric series full-complement roller type　メートル系総ころ形
Eccentric stud type　スタッド偏心形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝及びタップ穴付き
Outer profile : cylindrical　外径形状：円筒形状
Seal : included　シール ：シール付き
Grease : prelubricated　グリース：封入済</td></tr>
<tr><td>Outer ring outer diameter: φ80　外輪外径 ： φ80
Metric series full-complement double-row cylindrical roller type　メートル系複列円筒ころ形
Shield : included　シールド付き総ころ形
Stud head : with hexagonal hole　スタッド頭部形状：六角穴付き
Outer profile : spherical　外径形状：球面形状
Grease : prelubricated　グリース：封入済</td><td rowspan="3">● Highest load rating, best-suited to applications subject to heavy nominal and/or shock loads.
● The outer ring is guided in the axial direction by the outer ring ribs and the end faces of the cylindrical rollers.
● Grease replenishing interval must be shortened due to the small internal volume available for grease.
● Type NUKRU has an eccentric stud (eccentricity: 0.4 to 2.5mm) to compensate for positional variation of the stud mounting hole.
● The standard Type NUKRT and NUKRU followers have no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.

●最も定格荷重が大きく高荷重，衝撃荷重が作用する用途に適している。
●外輪は外輪つばと円筒ころ端面でアキシアル方向に案内されている。
●空間容積が小さいため，グリース補給間隔を短くする必要がある。
●NUKRU形は，スタッドが偏心（0.4～2.5mm）しており，スタッド取付け穴の位置のばらつきを調整することができる。
●NUKRT形及びNUKRU形標準品に六角穴付き（接尾記号H）はないが，六角穴付きねじプラグを標準添付している。</td></tr>
<tr><td>Outer ring outer diameter: φ90　外輪外径 ： φ90
Metric series full-complement double-row cylindrical roller type　メートル系複列円筒ころ形
Shield : included　シールド付き総ころ形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝及びタップ穴付き
Outer profile : spherical　外径形状：球面形状
Grease : prelubricated　グリース：封入済</td></tr>
<tr><td>Outer ring outer diameter: φ140　外輪外径 ： φ140
Metric series full-complement double-row cylindrical roller type　メートル系複列円筒ころ形
Eccentric stud type　スタッド偏心形
Shield : included　シールド付き総ころ形
Stud head : with tapped hole and recessed slot for screwdriver　スタッド頭部形状：ドライバ溝及びタップ穴付き
Outer profile : cylindrical　外径形状：円筒形状
Grease : prelubricated　グリース：封入済</td></tr>
</table>

Bearing accuracy

The dimensional accuracy and profile accuracy of the cylindrical roller outer diameter (D) ,the outer ring width (C), and the running accuracy of the bearing assembly are as shown in **Tables 12** (page 93) The accuracy class conforms to JIS Class-0.

The dimensional accuracy of spherical outer diameter (D) and stud diameter (d_1) are as shown in applicable Dimension Tables.

軸受の精度

円筒面外径（D），外輪幅（C）の寸法精度，形状精度及び軸受組立の回転精度は93ページの**表12**に示し，精度等級はJIS 0級である。

球面外径（D），及びスタッド径（d_1）の寸法精度は寸法表に示している。

Bearing fit and radial internal clearance

Table 1 shows the recommended fitting tolerance for the stud mounting hole.

Table 2 shows the radial internal clearance.

はめあい及びラジアルすきま

スタッドを取付ける穴の推奨はめあいを**表1**に示す。

また，ラジアルすきまは**表2**に示す。

Table 1 Recommended tolerance for stud mounting hole
推奨はめあい

Classification 区　分	Tolerance class for mounting hole 穴の公差域クラス
Metric series メートル系	H7
Inch series インチ系	F7

Note) When a shock load is applied, make the clearance between the stud and hole as small as possible.

注）衝撃荷重が作用する場合には，スタッドと穴とのすきまをできるだけ小さくして組み立ててください。

Table 2 Radial internal clearance
ラジアルすきま

Unit : μm

Nominal roller inscribed circle diameter ころ内接円径の呼び F_W (mm)		Clearance すきま C2		CN (ordinary) CN（普通）		C3		C4	
over を超え	incl. 以下	min 最小	max 最大	min 最小	max 最大	min 最小	max 最大	min 最小	max 最大
3	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

Lubrication and Method for Grease Replenishment

Lubrication

Cam followers with synthetic rubber seals (LL suffix) and full-complement roller types are pre-filled with lithium soap base grease. They can be used in the operating temperature range of -20 to +100˚C.

Please contact **NTN** if a grease with better low-temperature characteristics is desired.

Unsealed cage-type cam followers are not prelubricated. If a prelubricated type is needed, feel free to contact **NTN**.

Additionally, **NTN** Bearings with Solid Grease, which have solid lubricant with less leakage than conventional grease, are also available on request. Feel free to contact **NTN** for detailed information.

The outer ring outer surface of bearing and the track surface must both be lubricated. Failure to lubricate could result in premature bearing failure.

Method for Grease Replenishment

Replenishment of grease can be performed by attaching a grease-gun to a grease nipple on the flange end face or threaded-side end face of the stud. Be sure to first plug the grease-feed hole or the tapped hole on the opposite side with a special-purpose plug or a threaded plug with hexagonal socket.

A grease nipple and plug are enclosed in each cam follower package. Attach them to the cam follower before mounting unit.

Both special grease nipples and those specified in the JIS Standard are available. The dimensions thereof and the applicable bearing types are specified in **Tables 3** and **4** respectively.

Furthermore, special press-fit type plugs and threaded plugs with hexagonal sockets are available. The dimensions thereof and the applicable bearing types are specified in **Tables 5-1**, **5-2** and **Table 6**.

When using special-purpose press-fit plugs, press-fit into the grease feed hole using a mandrel as shown in **Table 7**.

潤滑と内部への供給・補給方法

潤滑

合成ゴムシールを装着した形式（接尾記号LL）及び総ころ形式には，リチウム石けん基のグリースが前もって封入され，−20～+100℃の温度範囲で使用できる。

なお，常時0℃以下の場合には，低温特性に優れたグリース封入品仕様を推奨しますので**NTN**へ御照会ください。

保持器付き形でシールなし品には，グリースは封入されていません。封入品が必要な場合は**NTN**へ御照会ください。

なお，潤滑剤の漏れが少ない固形グリースを封入した**NTN**ポリルーブベアリングもありますので，**NTN**へ御照会ください。

また，大気中での低発塵性が必要な場合には低発塵用グリースを封入することもできますので**NTN**へ御照会ください。

軸受の外輪外径面と軌道（トラック）間にも潤滑が必要です。潤滑されていないと，軸受の損傷が早期に発生する場合があります。

供給・補給方法

グリースガン等を用いてスタッドのフランジ端面，またはねじ側端面に取付けられたグリースニップルにより行う。給脂しない側の給脂穴またはタップ穴はプラグ（専用プラグまたは六角穴付きねじプラグ）により塞ぐ。

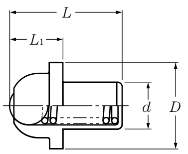
グリースニップル及びプラグはパッケージに同封されているので，カムフォロアを組付ける前に取付ける。

グリースニップルには専用のものとJISで定められたものがあり，その寸法を**表3**に，適用軸受形式を**表4**に示す。

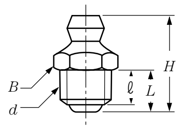
また，プラグにも専用の圧入タイプと六角穴付きねじプラグがあり，その寸法を**表5-1,2**に，適用軸受形式を**表6**に示す。

専用の圧入タイププラグの場合は，**表7**に示す寸法のマンドレルを用いて給脂穴に圧入する。

Table 3 Grease nipple dimensions
グリースニップル寸法



Nominal nipple number ニップル呼び番号	Dimensions 寸 法 mm			
	d	D	L	L_1
NIP-B3	3	7.5	9	5.5
NIP-B4	4	7.5	10	5.5
NIP-B6	6	8	13	6
NIP-B8	8	10	16	7



Nominal nipple number ニップル呼び番号	Dimensions 寸 法 mm				
	d	H	ℓ	L	B
NIP-X30	M4×0.7	13.9	4	5	7
JIS A-M6F	M6×0.75	13.5	4	5.4	7
JIS A-PT1/8	PT1/8	20	8	9.5	10

B: Hexagon with across flats
B: 六角二面幅

Table 4 Grease nipple availability for various cam followers series
グリースニップル適用軸受形式と寸法記号

Nominal nipple number ニップル呼び番号	Cam follower series 適用軸受形式									
	KR··H, KRV··H	KR, KRV	CRV··H	CRV	NUKR··H	NUKR	KRT, KRVT	NUKRT	KRU, KRVU	NUKRU
NIP-B3	—	—	—	8.8-1	—	—	—	—	—	—
NIP-B4	22～26	16～26	12～18	10～18	—	—	—	—	—	—
NIP-B6	30～40	30～40	20～44	20～44	30～40	30～40	—	—	—	—
NIP-B8	47～90	47～90	48～96	48～96	47～90	47～90	—	—	—	—
NIP-X30	—	—	—	—	—	—	16～26	—	16～26	—
JIS A-M6F	—	—	—	—	—	—	30～32	30	30～35	30～35
JIS A-PT1/8	—	—	—	—	100～180	100～180 (Threaded side) (ねじ側)	35～90	35～180	40～90	40～180

Special-purpose plug
専用プラグ

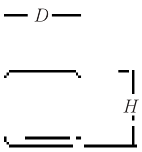


Table 5-1 Plug dimensions
プラグ寸法

unit : mm

Nominal number 呼び番号	D	H
SEN 3	3	3
SEN 4	4	4
SEN 6	6	6
SEN 8	8	8

Threaded plug with hexagonal socket
六角穴付きねじプラグ

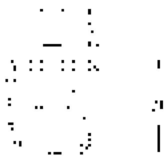


Table 5-2 Plug dimensions
プラグ寸法

unit : mm

Nominal number 呼び番号	d	H	Width across flats h 二面幅
M4X0.7X4 ℓ	M4X0.7	4	2
M6X0.75X6 ℓ	M6X0.75	6	3
PT1/8X7 ℓ	PT1/8	7	5

Table 6 Plug availability for various cam follower series
プラグ適用軸受形式と寸法記号

Plug プラグ	Cam follower series 適用軸受形式									
	KR, KRV	KR··H, KRV··H	CRV	CRV··H	NUKR	NUKR··H	KRT, KRVT	NUKRT	KRU, KRVU	NUKRU
SEN3	—	—	8.8-1	—	—	—	—	—	—	—
SEN4	16～26	22～26	10～18	12～18	—	—	—	—	—	—
SEN6	30～40	30～40	20～44	20～44	30～40	30～40	—	—	—	—
SEN8	47～90	47～90	48～96	48～96	47～180	47～90	—	—	—	—
M4X0.7X4 ℓ	—	—	—	—	—	—	16～26	—	16～26	—
M6X0.75X6 ℓ	—	—	—	—	—	—	30～32	30	30～35	30～35
PT1/8X7 ℓ	—	—	—	—	—	100～180	35～90	35～180	40～90	40～180

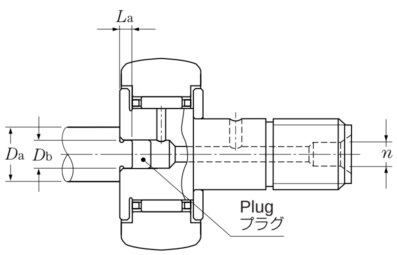


Table 7 Mandrels used for press-fitting of plug
プラグ圧入用マンドレル

unit : mm

Grease feed hole dia. 給脂穴径 n	Mandrel dimension マンドレル寸法		
	D_a	D_b $^{0}_{-0.1}$	L_a $^{0}_{-0.1}$
3	8	2.8	1.5
4	10	3.8	1.5
6	12	5.8	1.5
8	15	7.8	2.5

Installation

(1) Make the face height at the cam follower mount greater than "e" dimension given in the applicable Dimension Table. (**Fig.2)**
Furthermore, make the chamfer of the stud mounting hole as small as possible (around 0.5×45˚) to bring the side face and housing into precise contact.

取付け関係

（1）カムフォロアの取付け部における側面高さは，寸法表に記載の"*e*"寸法より大きくとる（**図2**）。スタッド取付け穴の面取りは，なるべく小さくし（0.5X45˚ 程度），側板の側面を正確に当てるようにする。

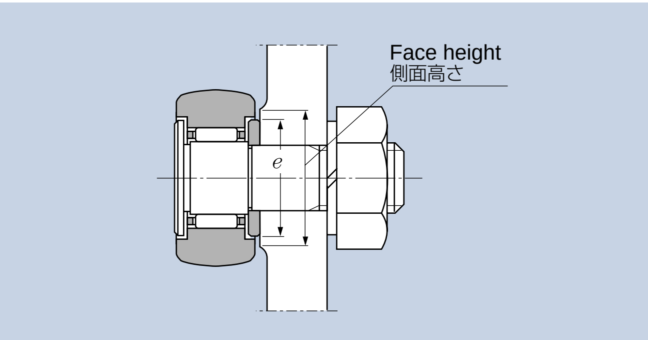


Fig.2

(2) Don't hammer directly the cam follower rib. Doing so may cause damage to the rib and eventual bearing failure.

（2）**カムフォロアのつば部を直接ハンマなどで叩かないこと。つば部が割れたり，回転不良の原因となる。**

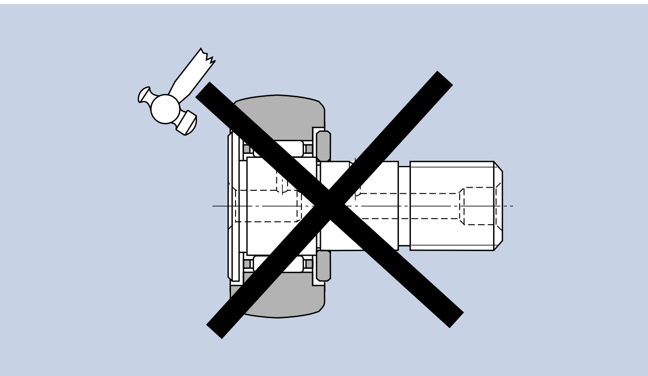


Fig.3

(3) The oil hole position on the stud raceway surface is designated by the **NTN** mark stamped on the stud rib surface. Mount the stud so the oil hole is located opposite the load zone. (**Fig. 4**) If the oil hole is located within the load area, it may result in shorter life of the follower.

（3）スタッドの軌道面にある油穴位置は，スタッドのつば面の**NTN**マークで示しており，非負荷域（荷重を受けない側）に取付ける。（**図4**）
油穴が負荷域にあると，短寿命の原因となる。

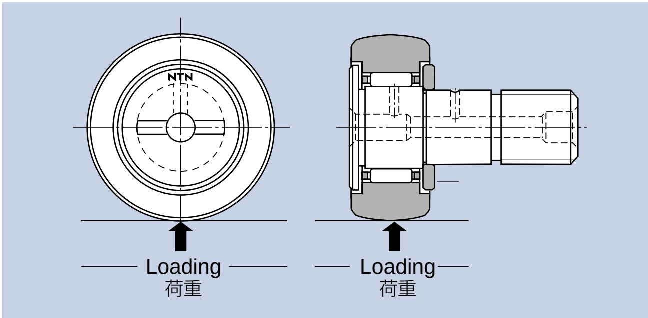


Fig.4

(4) In applications where the stud and nut may loosen due to a wide amplitude of vibration during operation, **NTN** recommends the mounting methods illustrated in **Fig. 5**.

（4）特に振動の激しい使用条件で取付け用のねじの緩む恐れのある場合は，**図5**のような方法がある。

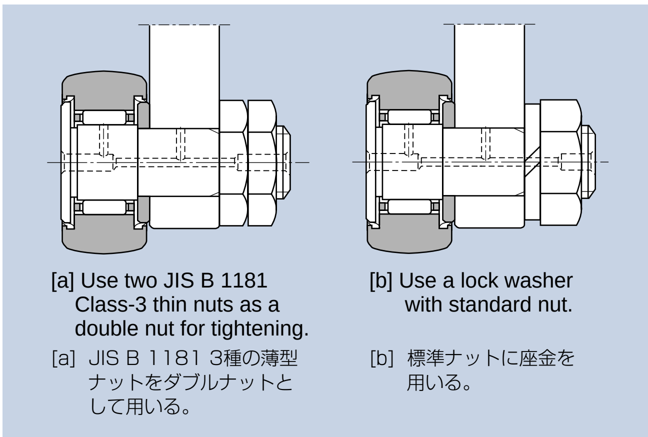


Fig.5

(5) The stud is subjected to bending stress and tensile force arising from bearing load. Tighten the stud screws with tightening torque which does not exceed the torque value specified in applicable Dimension Table. **Overtightening could result in damage to the threaded portion.**

(6) A hole is provided in the center of the stud as illustrated in **Fig. 6**. Use this hole for locking the follower in place or grease replenishment.

(5) スタッドは軸受荷重による曲げ応力及び引張力を受けるので，ねじの締付トルクは寸法表の値を超えないように締付ける。

締付トルクが大きすぎると，ねじ部が破断することがある。

(6) スタッド中央の軸心に直角に設けた穴は，**図6**のような回り止め，またはグリースの補給用として用いる。

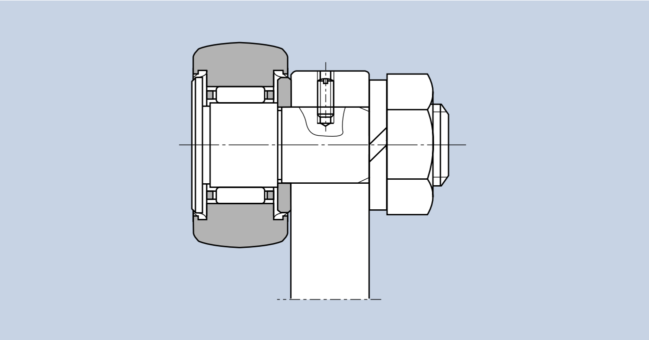


Fig.6

(7) For mounting and adjustment of eccentric stud type cam followers, follow the instructions below.

1. Insert the stud in the mounting hole so that the **NTN** mark (showing oil hole position) is located opposite of the loaded area of the bearings as illustrated in **Fig. 4**.
2. Turn the stud using the recessed slot on the stud head or the threaded plug with hexagonal socket to adjust the clearance with the mating contact surface.
3. After adjustment, tighten the stud nut to the tightening torque described in the applicable Dimensions Table.

(7) スタッド偏心形カムフォロアの取付け調整は，次のように行う。

1　荷重が，作用する方向に対し，スタッドを**NTN**マーク（油穴位置）が**図4**の位置になるように取付け穴を挿入し，ナットを軽く締込む。この時スタッドは，回るようにしておく。

2　スタッド頭部のドライバー溝又は，付属の六角穴付きねじプラグをスタッドに取付けスタッドを回転させて，相手接触面とのすきまを調整する。

3　調整が終わったら，スタッドが，回らないように，ナットを寸法表記載のトルクで締付ける。

NTN cam follower are generally mounted by a stud supported on only one side. This cantilevered load arrangement can lead to an increase in bearing clearance over time due to wear from uneven load distribution within the bearing.

To ensure stability of equipment , check that the clearance between the stud and mounting hole is sufficiently small to prevent uneven loading.

NTNカムフォロアは，一般的に片持ちで取付けるため，継続使用によるはめあいのゆるみの影響で不均一な荷重（片当り）が軸受に作用する場合があります。設備安定稼動のため，はめあいのゆるみには十分な注意が必要です。

Track Load Capacity of Cam Followers and Roller Followers

The track load capacity is calculated by determining the standard hardness (standard tensile stress) from the relation between the hardness and pure tensile force on the material, and by the relation between the standard tensile stress and Hertz stress.

The method of determining the standard hardness (standard tensile stress) varies from manufacturer to manufacturer. **NTN** has chosen to use the hardness-tensile stress relation table at the end of the JIS Handbook for Steel (approximate values in the revised conversion table in JIS Z 8413).

For the standard hardness (tensile stress) of HRC40, we selected the following:

σ = 1245 MPa (127 kgf/mm^2).

Correction factors for track load capacity

The greater the hardness of the track material, the greater the tensile stress of the track material, which results in a greater track load capacity. The true track load capacity is determined under this assumption by multiplying the track load capacity correction factor in **Table 8** by the corresponding track load capacity in the same table.

Note: The track load capacity determined by this method is based on a pure tensile stress and is not an allowable Hertz stress. Generally, a stress (relative stress) that causes creep on a material is greater than a tensile stress. In the case of a static load in particular, the track load capacity determined by the above-mentioned method can be considered to include a margin of safety.

Example: Determine a track load capacity T_c', at a given hardness by using a track load capacity correction factor.

The track load capacity T_c' can be determined by finding a track load capacity T_c in the dimension table and a track load capacity correction factor G in **Table 8**. The procedure is as follows:

$T_c' = G \times T_c$

For the NATR15X type roller follower with hardness HRC50:

T_c＝ 11,900N（1,220kgf），　G＝1.987

∴ T_c'＝1.987×11,900N（1,220kgf）

＝23,645N（2,424kgf）

カムフォロア・ローラフォロアのトラック負荷容量

トラック負荷容量は，硬度と材料の純引張応力における関係で基準硬度（基準引張応力）を設定し，その応力とヘルツ応力の関係から求めた。

基準硬度（引張応力）のとり方は各社で若干異なるが，ここでは，硬度ー引張応力の関係として鉄鋼JISハンドブック巻末表を用いた（JIS Z8413改訂案換算表による近似数値)。

基準硬度（引張応力）として

HRC40ではσ＝1 245MPa（127kgf／mm^2）を採用した。

〈トラック負荷容量補正係数〉

材料は，硬度の増加とともに引張応力が増大するが，それに伴ってトラック負荷容量も増大する。この場合は**表8**に示すトラック負荷容量補正係数をトラック負荷容量に乗じて求めることができる。

注) ここで求めたトラック負荷容量は，純引張応力を基準としており，許容ヘルツ応力ではない。一般に材料にクリープを起こす応力（比応力）は引張応力より大きく，特に静的荷重の場合，今回のトラック負荷容量は安全側の値となる。

例) トラック負荷容量補正係数を用いてある硬さのトラック負荷容量T_c'を求める場合

寸法表記載値のトラック負荷容量をT_c，当該硬さにおけるトラック負荷容量補正係数をGとすると，そのときのトラック負荷容量T_c'は

T_c'＝G・T_c

となる。

NATR15Xで硬度HRC50の場合

T_c＝ 11 900N（1 220kgf），　G＝1.987

∴ T_c'＝1.987×11 900N（1 220kgf）

＝23 645N（2 424kgf）

Track Load Capacity of Cam Followers and Roller Followers
カムフォロア・ローラフォロアのトラック負荷容量

Track Load Capacity Calculation Process

- With a cylindrical outer ring

$$\sigma_{max}=60.9\sqrt{\frac{T_c \Sigma \rho}{B_{eff}}}$$

- With a spherical outer ring

$$\sigma_{max}=\frac{187}{\mu \nu}\sqrt[3]{(\Sigma \rho)^2 T_c}$$

σ_{max}=1,245MPa（127kgf／mm²）

T_c　：Track load capacity（N {kgf} ）
$\Sigma \rho$　：Sum of curvatures
B_{eff}　：Effective contact length（mm）
that is, (outer ring width－chamfer×2)
$\mu \nu$　：Factor governed by curvature

参考（トラック負荷容量 算出プロセス）

- 外輪形状円筒の場合

$$\sigma_{max}=60.9\sqrt{\frac{T_c \Sigma \rho}{B_{eff}}}$$

- 外輪形状球面の場合

$$\sigma_{max}=\frac{187}{\mu \nu}\sqrt[3]{(\Sigma \rho)^2 T_c}$$

σ_{max}=1 245MPa（127kgf／mm²）

T_c　：トラック負荷容量（N {kgf} ）
$\Sigma \rho$　：曲率の和
B_{eff}　：有効接触長さ（mm）
ここでは（外輪幅－2×チャンファ）
$\mu \nu$：曲率で決まる係数

Table 8. Track Load Capacity Correction Factor
トラック負荷容量補正係数

Hardness HRC 硬度	Tensile stress MPa {kgf／mm²} 引張応力	Correction factor G 補正係数 Cylindrical outer surface 外径円筒	Spherical outer surface 外径球面
20	755 {77}	0.368	0.223
21	774 {79}	0.387	0.241
22	784 {80}	0.397	0.250
23	804 {82}	0.417	0.269
24	823 {84}	0.437	0.289
25	843 {86}	0.459	0.311
26	862 {88}	0.480	0.333
27	882 {90}	0.502	0.356
28	911 {93}	0.536	0.393
29	931 {95}	0.560	0.419
30	951 {97}	0.583	0.446
31	980 {100}	0.620	0.488
32	1 000 {102}	0.645	0.518
33	1 029 {105}	0.684	0.565
34	1 058 {108}	0.723	0.615
35	1 078 {110}	0.750	0.650
36	1 117 {114}	0.806	0.723
37	1 156 {118}	0.863	0.802
38	1 176 {120}	0.893	0.844
39	1 215 {124}	0.953	0.931
40	1 245 {127}	1.0	1.0
41	1 294 {132}	1.080	1.123
42	1 333 {136}	1.147	1.228
43	1 382 {141}	1.233	1.369
44	1 431 {146}	1.322	1.519
45	1 480 {151}	1.414	1.681
46	1 529 {156}	1.509	1.853
47	1 578 {161}	1.607	2.037
48	1 637 {167}	1.729	2.274
49	1 686 {172}	1.834	2.484
50	1 754 {179}	1.987	2.800
51	1 823 {186}	2.145	3.141
52	1 882 {192}	2.286	3.455
53	1 950 {199}	2.455	3.847
54	2 009 {205}	2.606	4.206
55	2 078 {212}	2.787	4.652

Outer Ring Strength

The outer ring should not break under normal operating loads. When considering outer ring strength when the cam follower is used under an impact load or heavy load, use the following method for calculating the outer ring strength.

The forms of the outer ring are illustrated in **Fig. 7**. The outer ring strength is calculated with the expressions given below. The outer ring breaking strength is the breaking strength when the rollers are supported in a bridge configuration.

Generally, the breaking stress of bearing steel can be assumed to be 1760 MPa (180 kgf/mm^2). However, in our experience we have found it preferable to assume a breaking stress value with a safety margin [1170 MPa (120 kgf/mm^2)] in order to reflect stress concentration. The outer ring should not break under normal operating loads. However, if an impact load or heavy load is expected on the outer ring, it is necessary to check the breaking strength of the outer ring.

It is recommended to use 196MPa {20kgf/mm^2} or less for continuous use.

$$P=\frac{4\pi}{1+f(\alpha)}\times\frac{D-2h}{h(D-2h_2)^2}\times I\times\sigma$$

where

$$f(\alpha)=\frac{(\pi-\alpha)\sin\alpha-(1+\cos\alpha)}{2\cos\alpha}$$

$$\alpha=\frac{\pi}{Z}\ (\text{rad.})$$

P : Breaking load (N)
I : Outer ring cross-section secondary moment (mm^4)
Z : Number of rollers
σ =Breaking stress (MPa)
D, h, h_2 : See **Fig. 7** (mm).

外輪強度

一般的には通常使用荷重であれば外輪が破壊することはないが，衝撃荷重，重荷重使用時の検討を実施する場合の計算方法を以下に示す。

それぞれの外輪形状を**図7**とし，下記の式により求める。この場合の外輪破壊強度は，ころのブリッジ状態の破壊強度をいう。

破壊応力のとり方として，一般には，軸受鋼の場合，1760MPa {180kgf/mm^2} をとれるが，応力集中を考慮した場合,及び経験から更に安全側の値(1170MPa {120kgf/mm^2})をとるのが望ましい。一般的には，通常使用荷重であれば外輪が破壊することはないが，衝撃荷重及び重荷重が加わる場合には外輪破壊強度をチェックする必要がある。

なお，通常使用の応力としては196MPA {20kgf/mm^2}以下であることが望ましい。

$$P=\frac{4\pi}{1+f(\alpha)}\times\frac{D-2h}{h(D-2h_2)^2}\times I\times\sigma$$

ここで

$$f(\alpha)=\frac{(\pi-\alpha)\sin\alpha-(1+\cos\alpha)}{2\cos\alpha}$$

$$\alpha=\frac{\pi}{Z}\ (\text{rad.})$$

P：破壊荷重（N）
I：外輪断面二次モーメント（mm^4）
Z：ころ数
σ＝破壊応力（MPa）
D，h，h_2：**図7**参照（mm）とする。

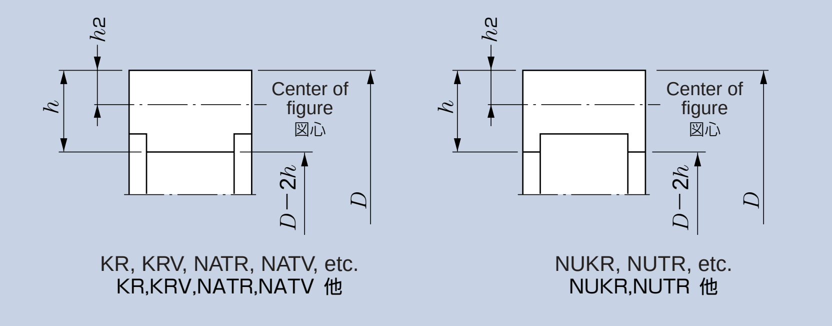


Fig. 7

Cam Follower Stud Strength

If a load Fr is exerted on the midpoint of the outer ring as illustrated in **Fig. 8**, a bending moment $F_r \times \ell$ occurs, and a bending stress σ_1 (considered to be a tensile stress) occurs on the stud surface. Furthermore, since the stud itself is mounted to the machine side with a nut, a tensile stress σ_2 resulting from a thread tightening force also occurs. The stud strength can be evaluated by comparing the sum of the tensile stresses ($\sigma_1 + \sigma_2$) with the allowable stress s of the stud material.

$$\sigma_1 + \sigma_2 < \sigma$$

$$\sigma_1 = \frac{F_r \cdot \ell}{Z}$$

F_r : Max. radial load

Z : Shaft cross-section intersecting point A factor

$\sigma_2 ≒ 98$MPa {10kgf/mm²}

Tensile stress resulting from max. tightening torque specified in dimension table

σ : Allowable stress of the material

The following value is determined from the results of the flex test:

Allowable stress for application of static bending stress:

$\sigma = 1372$MPa {140kgf/mm²}

Allowable stress for application of repeated bending stress (in one direction):

$\sigma = 784$MPa {80kgf/mm²}

Allowable stress for application of repeated bending stress (in both directions):

$\sigma = 392$MPa {40kgf/mm²}

therefore

$$F_r < \frac{Z}{\ell}(\sigma - \sigma_2)$$

カムフォロアのスタッド強度

図8のように外輪中央に荷重F_rが作用する場合，曲げモーメント$F_r \cdot \ell$が生じ，スタッド表面には曲げ応力σ_1（引張応力と考える）が発生する。さらにスタッド自体は，機械本体にナットで締付けられて設置されるため，ねじ締付けによる引張応力σ_2も生じる。この引張応力の和（$\sigma_1 + \sigma_2$）と，材料の許容応力σとの比較からスタッド強度の検討ができる。

$$\sigma_1 + \sigma_2 < \sigma$$

$$\sigma_1 = \frac{F_r \cdot \ell}{Z}$$

F_r：最大ラジアル荷重

Z ：点Aを通る軸断面係数

$\sigma_2 ≒ 98$MPa {10kgf/mm²}

寸法表に記している締付け最大トルクによる引張応力

σ：材料の許容応力

材料の繰り返し曲げ試験の結果から次の値をとる。

静的曲げ応力を受ける場合

$\sigma = 1372$MPa {140kgf/mm²}

繰り返し曲げ応力を受ける場合（片振り）

$\sigma = 784$MPa {80kgf/mm²}

繰り返し曲げ応力を受ける場合（両振り）

$\sigma = 392$MPa {40kgf/mm²}

したがって

$$F_r < \frac{Z}{\ell}(\sigma - \sigma_2)$$

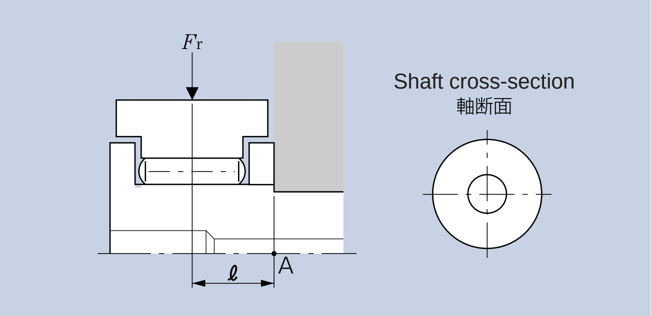


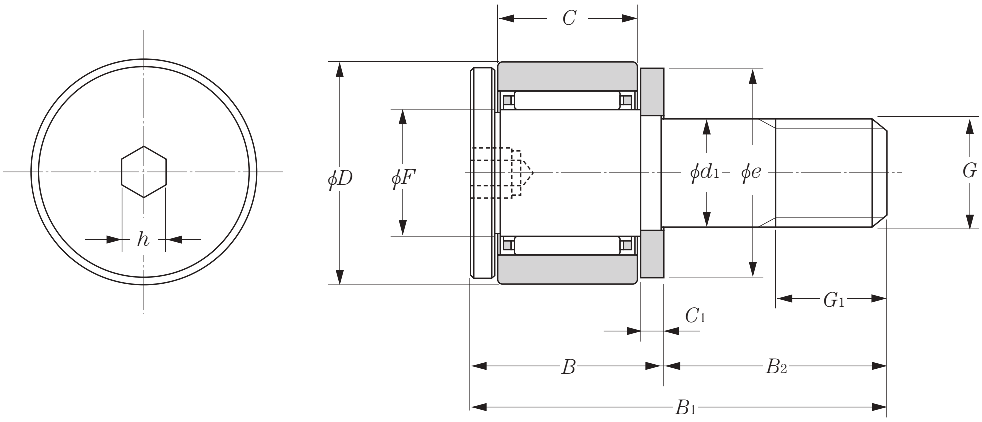
Fig. 8

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴 / ドライバ溝	
シールなし	シール付

Miniature Cam Followers
ミニアチュアカムフォロア

KRM‥XH type (with cage)
KRMV‥XH type (Full-complement roller type)

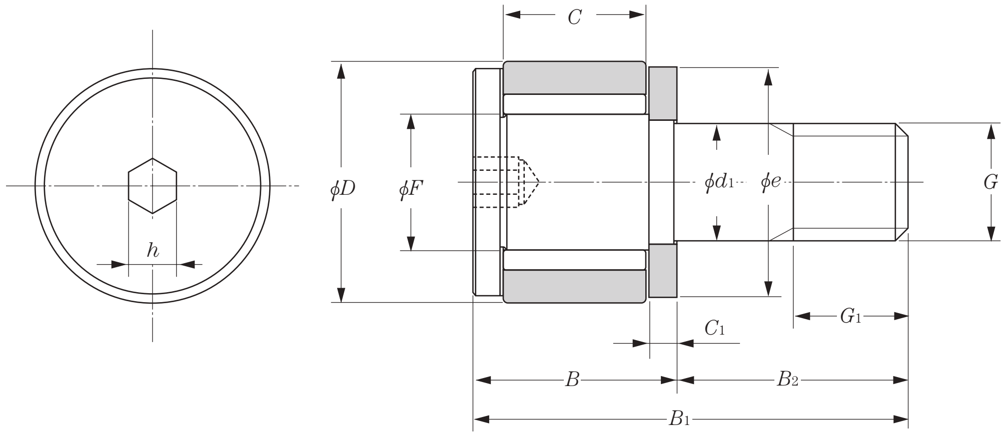
KRM‥XH形（保持器付）
KRMV‥XH形（総ころ形）



KRM‥XH type (with cage)
KRM‥XH形（保持器付）

OD[1) 外径 mm D	Cam Follower number 呼び番号		Dimensions 寸法 mm											
	With cage 保持器付き	Full-complement roller 総ころ	d_1	C	F	B	B_1	B_2	G	G_1	C_1	e	h
4	KRM4XT2H/3AS	—	1.5 $^{0}_{-0.006}$	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9
	—	KRMV4XH/3AS	1.5 $^{0}_{-0.006}$	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9
4.5	KRM4.5XT2H/3AS	—	2 $^{0}_{-0.006}$	2.5	2.25	4	8	4	M2 ×0.4	2	0.7	4.3	0.9
	—	KRMV4.5XH/3AS	2 $^{0}_{-0.006}$	2.5	2.25	4	8	4	M2 ×0.4	2	0.7	4.3	0.9
5	KRM5XT2H/3AS	—	2.5 $^{0}_{-0.006}$	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9
	—	KRMV5XH/3AS	2.5 $^{0}_{-0.006}$	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9
6	KRM6XT2H/3AS	—	3 $^{0}_{-0.006}$	4	3.4	5.5	11.5	6	M3 ×0.5	3	0.7	5.8	1.3
	—	KRMV6XH/3AS	3 $^{0}_{-0.006}$	4	3.4	5.5	11.5	6	M3 ×0.5	3	0.7	5.8	1.3
8	KRM8XT2H/3AS	—	4 $^{0}_{-0.008}$	5	4.5	7	15	8	M4 ×0.7	4	1	7.7	1.5
	—	KRMV8XH/3AS	4 $^{0}_{-0.008}$	5	4.5	7	15	8	M4 ×0.7	4	1	7.7	1.5
10	KRM10XT2H/3AS	—	5 $^{0}_{-0.008}$	6	5.9	8	18	10	M5 ×0.8	5	1	9.6	2
	—	KRMV10XH/3AS	5 $^{0}_{-0.008}$	6	5.9	8	18	10	M5 ×0.8	5	1	9.6	2
12	KRM12XT2H/3AS	—	6 $^{0}_{-0.008}$	7	6.7	9.5	21.5	12	M6 ×1	6	1.2	11.6	2.5
	—	KRMV12XH/3AS	6 $^{0}_{-0.008}$	7	6.7	9.5	21.5	12	M6 ×1	6	1.2	11.6	2.5

Note: 1. JIS Class 0 is the dimensional tolerance.
注1）許容差はJIS 0級である。



KRMV··XH type (Full-complement roller type)

KRMV··XH形（総ころ形）

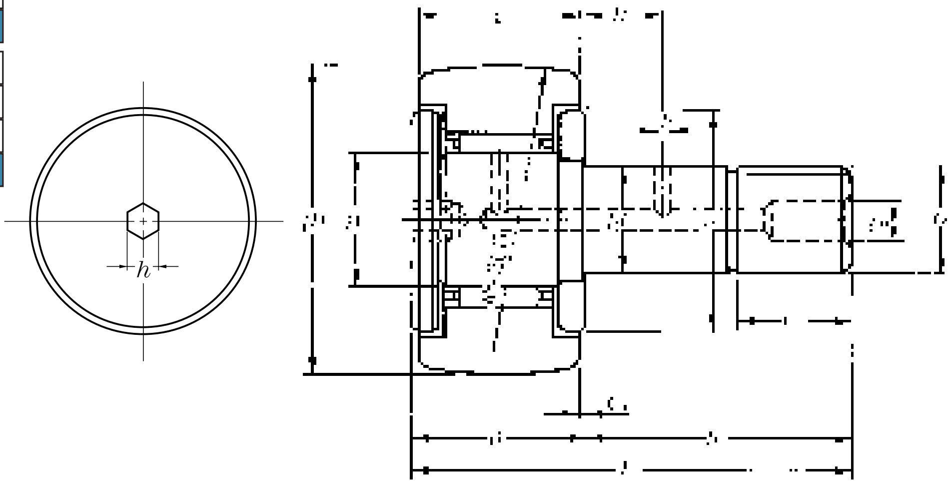
Basic load ratings dynamic 基本動定格荷重 N kgf C_r	Basic load ratings static 基本静定格荷重 N kgf C_{or}	Track load capacity トラック負荷容量 N kgf	Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
222 23	138 14	147 15	0.1 0.01	0.0003	**1.5**
505 51	480 49			0.0004	
305 31	216 22	216 22	0.1 0.01	0.0005	**2**
695 71	765 78			0.0006	
445 45	370 37	294 30	0.3 0.03	0.0007	**2.5**
905 92	1 110 114			0.0009	
645 66	630 63	480 49	0.5 0.05	0.0013	**3**
1 280 130	1 840 187			0.0014	
1 120 114	1 120 114	785 80	1 0.1	0.0029	**4**
2 120 216	3 050 310			0.0030	
1 570 160	1 860 189	1 190 121	2 0.2	0.0055	**5**
2 820 288	4 800 490			0.0059	
2 160 220	2 300 237	1 640 167	3 0.3	0.0093	**6**
4 150 425	6 450 655			0.0080	

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴 / ドライバ溝	
シールなし	シール付

Cam Followers with Cage
保持器付カムフォロア

KR··H type
KR··XH type
KR··LLH type
KR··XLLH type

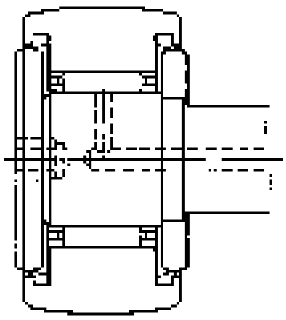
KR··H形
KR··XH形
KR··LLH形
KR··XLLH形



KR··H type (with cage)
KR··H形（保持器付）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number [2)] 呼び番号				Dimensions 寸法 mm						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G
10	KR10T2H/3AS	KR10XT2H/3AS	KR10T2LLH/3AS	KR10XT2LLH/3AS	3 $^{0}_{-0.010}$	7	4	8	17	9	M3×0.5
12	KR12T2H/3AS	KR12XT2H/3AS	KR12T2LLH/3AS	KR12XT2LLH/3AS	4 $^{0}_{-0.012}$	8	4.8	9	20	11	M4×0.7
13	KR13T2H/3AS	KR13XT2H/3AS	KR13T2LLH/3AS	KR13XT2LLH/3AS	5 $^{0}_{-0.012}$	9	5.75	10	23	13	M5×0.8
16	KR16H/3AS	KR16XH/3AS	KR16LLH/3AS	KR16XLLH/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KR19H/3AS	KR19XH/3AS	KR19LLH/3AS	KR19XLLH/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KR22H	KR22XH	KR22LLH/3AS	KR22XLLH/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KR26H	KR26XH	KR26LLH/3AS	KR26XLLH/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KR30H	KR30XH	KR30LLH/3AS	KR30XLLH/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KR32H	KR32XH	KR32LLH/3AS	KR32XLLH/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KR35H	KR35XH	KR35LLH/3AS	KR35XLLH/3AS	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KR40H	KR40XH	KR40LLH/3AS	KR40XLLH/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KR47H	KR47XH	KR47LLH/3AS	KR47XLLH/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KR52H	KR52XH	KR52LLH/3AS	KR52XLLH/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KR62H	KR62XH	KR62LLH/3AS	KR62XLLH/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KR72H	KR72XH	KR72LLH/3AS	KR72XLLH/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KR80H	KR80XH	KR80LLH/3AS	KR80XLLH/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
85	KR85H	KR85XH	KR85LLH/3AS	KR85XLLH/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KR90H	KR90XH	KR90LLH/3AS	KR90XLLH/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

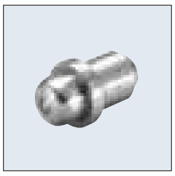
Notes: 1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KR··XH and KR··XLLH types whose outside surface form is cylindrical.
2. A bearing number with a T2 suffix indicates a bearing with a resin cage. Its maximum allowable temperature is 120˚C and continuous operation temperature is 100˚C.
注1）外径面が円筒であるKR··XH形，KR··XLLH形の外輪外径 D の許容差はJIS 0級である。
2）呼び番号の後にT2の付く軸受は，樹脂保持器付きであり，許容温度は120℃，連続使用では100℃以下とする。



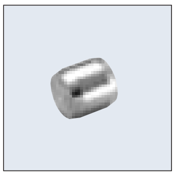
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
10〜19	—	—	1M3×0.5〜1M8×1.25
22〜26	NIP-B4	SEN4	1M10×1.25
30〜40	NIP-B6	SEN6	1M12×1.5〜1M18×1.5
47〜90	NIP-B8	SEN8	1M20×1.5〜1M30×1.5

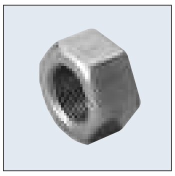
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6



1M12

KR··LLH type (with cage, sealed)

KR··LLH形（保持器付シール形）

Dimensions 寸法 mm							Basic load ratings dynamic / static 基本動定格荷重 / 基本静定格荷重 N / kgf		Track load capacity トラック負荷容量 N / kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m / kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	B_3	C_1	n	a	e	h	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
5	—	0.5	—	—	7	2.5	1 640 168	1 270 130	560 57	1 360 139	※27 000	※40 000	0.5 0.05	0.005	**3**
6	—	0.5	—	—	8.5	2.5	2 170 221	1 690 172	725 74	1 790 183	※25 000	※36 000	1 0.1	0.008	**4**
7.5	—	0.5	—	—	9.5	3	2 650 270	2 260 231	805 82	2 220 226	※23 000	※33 000	2 0.2	0.010	**5**
8	—	0.6	—	—	12	3	4 050 415	4 200 430	1 080 110	3 400 350	※19 000	※25 000	3 0.3	0.019	**6**
10	—	0.6	—	—	14	4	4 750 480	5 400 555	1 380 141	4 050 415	※15 000	※20 000	8 0.8	0.031	**8**
12	—	0.6	4	—	17	4	5 300 540	6 650 680	1 690 172	5 150 525	※12 000	※16 000	14 1.4	0.046	**10**
12	—	0.6	4	—	17	4	5 300 540	6 650 680	2 120 216	6 100 620	※12 000	※16 000	14 1.4	0.059	**10**
13	6	0.6	6	3	23	6	7 850 800	9 650 985	2 620 267	7 700 785	10 000	※13 000	20 2	0.087	**12**
13	6	0.6	6	3	23	6	7 850 800	9 650 985	2 860 291	8 200 835	10 000	※13 000	20 2	0.097	**12**
17	8	0.8	6	3	27	6	12 200 1 240	17 900 1 830	3 200 325	11 900 1 220	8 000	※11 000	52 5.3	0.169	**16**
19	8	0.8	6	3	32	6	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	9 000	76 7.8	0.248	**18**
21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	8 000	98 10	0.386	**20**
21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	6 000	8 000	98 10	0.461	**20**
25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600	6 950 710	34 500 3 500	5 000	6 500	178 18	0.790	**24**
25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600	8 050 820	38 500 3 900	5 000	6 500	178 18	1.04	**24**
32	15	1	8	4	53	8	45 000 4 600	88 500 9 050	9 800 1 000	53 000 5 400	4 000	5 500	360 37	1.55	**30**
32	15	1	8	4	53	8	45 000 4 600	88 500 9 050	10 400 1 060	56 000 5 750	4 000	5 500	360 37	1.74	**30**
32	15	1	8	4	53	8	45 000 4 600	88 500 9 050	11 400 1 160	59 000 6 100	4 000	5 500	360 37	1.95	**30**

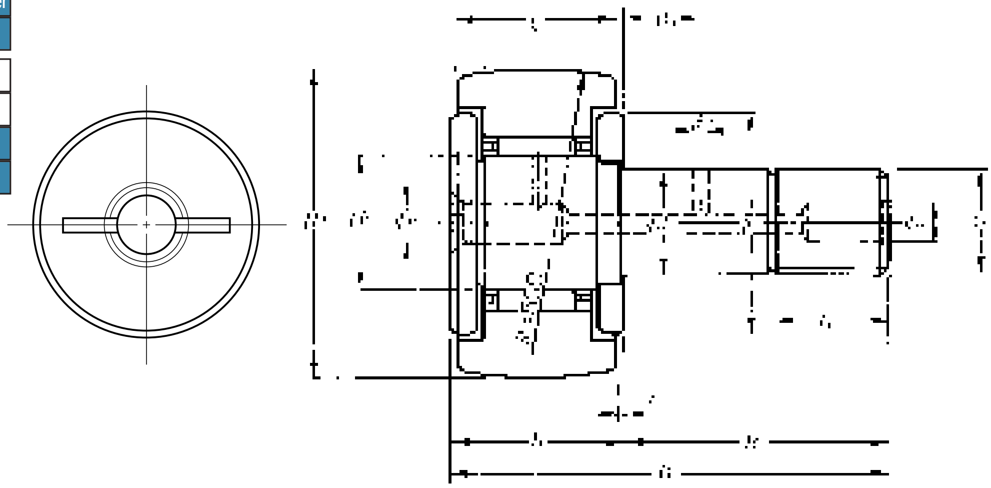
Note: The limiting speed of KR··LLH and KR··XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール有りKR··LLH形，KR··XLLH形の許容回転速度はおおよそ10 000 r/minである。

Cam Followers with Cage

保持器付カムフォロア

KR type
KR‥X type
KR‥LL type
KR‥XLL type

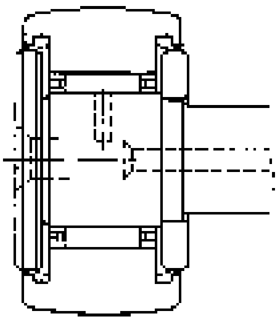
KR形
KR‥X形
KR‥LL形
KR‥XLL形



KR type (with cage)
KR形（保持器付）

OD[1)] 外径 mm D $^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G
16	KR16	KR16X	KR16LL/3AS	KR16XLL/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KR19	KR19X	KR19LL/3AS	KR19XLL/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KR22	KR22X	KR22LL/3AS	KR22XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KR26	KR26X	KR26LL/3AS	KR26XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KR30	KR30X	KR30LL/3AS	KR30XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KR32	KR32X	KR32LL/3AS	KR32XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KR35	KR35X	KR35LL/3AS	KR35XLL/3AS	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KR40	KR40X	KR40LL/3AS	KR40XLL/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KR47	KR47X	KR47LL/3AS	KR47XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KR52	KR52X	KR52LL/3AS	KR52XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KR62	KR62X	KR62LL/3AS	KR62XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KR72	KR72X	KR72LL/3AS	KR72XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KR80	KR80X	KR80LL/3AS	KR80XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
85	KR85	KR85X	KR85LL/3AS	KR85XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KR90	KR90X	KR90LL/3AS	KR90XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KR‥X and KR‥XLL types whose outside surface form is cylindrical.
2. The grease replenishment port is situated only in the front (in the left side face in the diagram above).
注1）外径面が円筒であるKR‥X形，KR‥XLL形の外輪外径Dの許容差はJIS 0級である。
2）グリースの補給穴は正面（上図左側面）にだけ設けている。



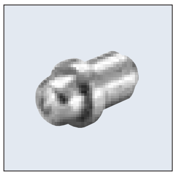
KR··LL type (with cage, sealed)

KR··LL形（保持器付シール形）

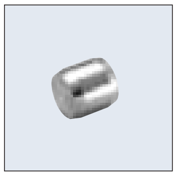
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
16〜26	NIP-B4	SEN4	1M 6×1 〜1M10×1.25
30〜40	NIP-B6	SEN6	1M12×1.5〜1M18×1.5
47〜90	NIP-B8	SEN8	1M20×1.5〜1M30×1.5

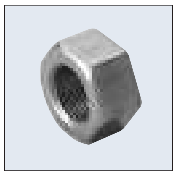
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6



1M12

Dimensions 寸法 mm						Basic load ratings N (kgf) dynamic 基本動定格荷重	static 基本静定格荷重	Track load capacity トラック負荷容量 N (kgf) Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Oil lubrication 油潤滑	Maximum tightening torque 締付最大トルク N·m (kgf·m)	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	B_3	C_1	n	a	e	C_r	C_{or}							
8	—	0.6	$4^{2)}$	—	12	4 050 415	4 200 430	1 080 110	3 400 350	※19 000	※25 000	3 0.3	0.019	**6**
10	—	0.6	$4^{2)}$	—	14	4 750 480	5 400 555	1 380 141	4 050 415	※15 000	※20 000	8 0.8	0.031	**8**
12	—	0.6	4	—	17	5 300 540	6 650 680	1 690 172	5 150 525	※12 000	※16 000	14 1.4	0.046	**10**
12	—	0.6	4	—	17	5 300 540	6 650 680	2 120 216	6 100 620	※12 000	※16 000	14 1.4	0.059	**10**
13	6	0.6	6	3	23	7 850 800	9 650 985	2 620 267	7 700 785	10 000	※13 000	20 2	0.087	**12**
13	6	0.6	6	3	23	7 850 800	9 650 985	2 860 291	8 200 835	10 000	※13 000	20 2	0.097	**12**
17	8	0.8	6	3	27	12 200 1 240	17 900 1 830	3 200 325	11 900 1 220	8 000	※11 000	52 5.3	0.169	**16**
19	8	0.8	6	3	32	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	9 000	76 7.8	0.248	**18**
21	9	0.8	8	4	37	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	8 000	98 10	0.386	**20**
21	9	0.8	8	4	37	20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	6 000	8 000	98 10	0.461	**20**
25	11	0.8	8	4	44	28 900 2 950	55 000 5 600	6 950 710	34 500 3 500	5 000	6 500	178 18	0.790	**24**
25	11	0.8	8	4	44	28 900 2 950	55 000 5 600	8 050 820	38 500 3 900	5 000	6 500	178 18	1.04	**24**
32	15	1	8	4	53	45 000 4 600	88 500 9 050	9 800 1 000	53 000 5 400	4 000	5 500	360 37	1.55	**30**
32	15	1	8	4	53	45 000 4 600	88 500 9 050	10 400 1 060	56 000 5 750	4 000	5 500	360 37	1.74	**30**
32	15	1	8	4	53	45 000 4 600	88 500 9 050	11 400 1 160	59 000 6 100	4 000	5 500	360 37	1.95	**30**

Note: The limiting speed of KR··LL and KR··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール有りKR··LL形，KR··XLL形の許容回転速度はおおよそ10 000r/minである。

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal

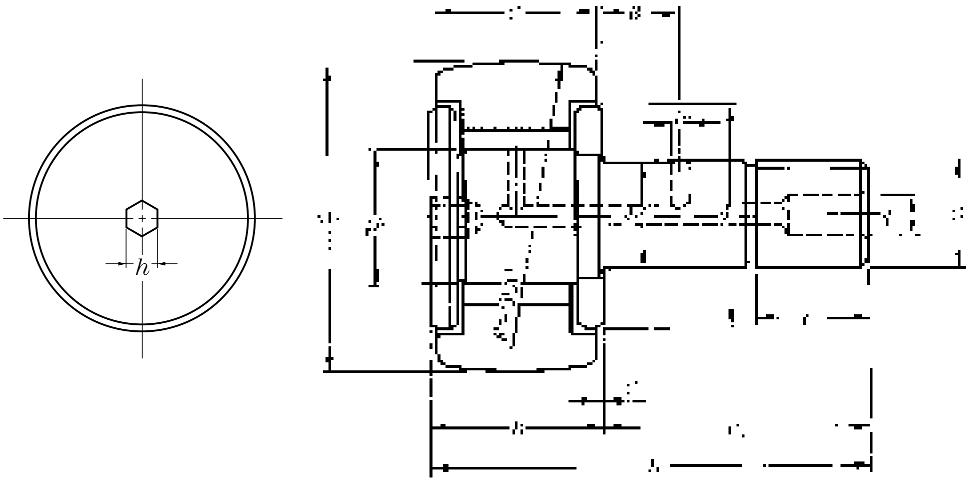
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴 / ドライバ溝	
シールなし	シール付

Full-Complement Roller-Type Cam Followers

総ころ形カムフォロア

KRV‥H type
KRV‥XH type
KRV‥LLH type
KRV‥XLLH type

KRV‥H形
KRV‥XH形
KRV‥LLH形
KRV‥XLLH形



KRV‥H type (Full-complement roller type)
KRV‥H形（総ころ形）

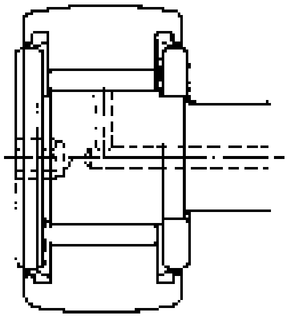
OD[1)] 外径 mm D $^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G
10	KRV10H/3AS	KRV10XH/3AS	KRV10LLH/3AS	KRV10XLLH/3AS	3 $^{0}_{-0.010}$	7	4	8	17	9	M3×0.5
12	KRV12H/3AS	KRV12XH/3AS	KRV12LLH/3AS	KRV12XLLH/3AS	4 $^{0}_{-0.012}$	8	4.8	9	20	11	M4×0.7
13	KRV13H/3AS	KRV13XH/3AS	KRV13LLH/3AS	KRV13XLLH/3AS	5 $^{0}_{-0.012}$	9	5.75	10	23	13	M5×0.8
16	KRV16H/3AS	KRV16XH/3AS	KRV16LLH/3AS	KRV16XLLH/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KRV19H/3AS	KRV19XH/3AS	KRV19LLH/3AS	KRV19XLLH/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KRV22H/3AS	KRV22XH/3AS	KRV22LLH/3AS	KRV22XLLH/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KRV26H/3AS	KRV26XH/3AS	KRV26LLH/3AS	KRV26XLLH/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KRV30H/3AS	KRV30XH/3AS	KRV30LLH/3AS	KRV30XLLH/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KRV32H/3AS	KRV32XH/3AS	KRV32LLH/3AS	KRV32XLLH/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KRV35H/3AS	KRV35XH/3AS	KRV35LLH/3AS	KRV35XLLH/3AS	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KRV40H/3AS	KRV40XH/3AS	KRV40LLH/3AS	KRV40XLLH/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KRV47H/3AS	KRV47XH/3AS	KRV47LLH/3AS	KRV47XLLH/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KRV52H/3AS	KRV52XH/3AS	KRV52LLH/3AS	KRV52XLLH/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KRV62H/3AS	KRV62XH/3AS	KRV62LLH/3AS	KRV62XLLH/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KRV72H/3AS	KRV72XH/3AS	KRV72LLH/3AS	KRV72XLLH/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KRV80H/3AS	KRV80XH/3AS	KRV80LLH/3AS	KRV80XLLH/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KRV90H/3AS	KRV90XH/3AS	KRV90LLH/3AS	KRV90XLLH/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

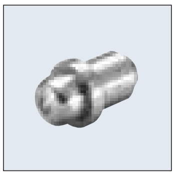
Note: 1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRV‥XH and KRV‥XLLH types whose outside surface form is cylindrical.
注1）外径面が円筒であるKRV‥XH形，KRV‥XLLH形の外輪外径 D の許容差はJIS 0級である。

Accessories / 付属部品

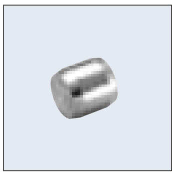
Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
10～19	—	—	1M3×0.5～1M8×1.25
22～26	NIP-B4	SEN4	1M10×1.25
30～40	NIP-B6	SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN8	1M20×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。

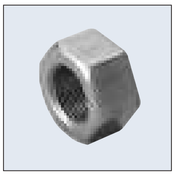




NIP-B6



SEN6



1M12

KRV··LLH type
(Full-complement roller type, with seal)

KRV··LLH形（総ころシール形）

Dimensions 寸法 mm G_1	B_3	C_1	n	a	e	h	Basic load ratings dynamic 基本動定格荷重 N kgf C_r	static 基本静定格荷重 C_{or}	Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Oil lubrication 油潤滑	Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
5	—	0.5	—	—	7	2.5	2 500 255	2 610 267	560 57	1 360 139	※25 000	※32 000	0.5 0.05	0.005	**3**
6	—	0.5	—	—	8.5	2.5	3 500 360	3 800 385	725 74	1 790 183	※20 000	※27 000	1 0.1	0.008	**4**
7.5	—	0.5	—	—	9.5	3	4 500 455	5 350 545	805 82	2 220 226	※17 000	※22 000	2 0.2	0.011	**5**
8	—	0.6	—	—	12	3	6 500 665	9 350 955	1 080 110	3 400 350	※13 000	※16 000	3 0.3	0.020	**6**
10	—	0.6	—	—	14	4	7 450 760	11 700 1 190	1 380 141	4 050 415	10 000	※13 000	8 0.8	0.032	**8**
12	—	0.6	4	—	17	4	8 200 840	14 000 1 420	1 690 172	5 150 525	8 500	※11 000	14 1.4	0.047	**10**
12	—	0.6	4	—	17	4	8 200 840	14 000 1 420	2 120 216	6 100 620	8 500	※11 000	14 1.4	0.061	**10**
13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070	2 620 267	7 700 785	6 500	8 500	20 2	0.089	**12**
13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070	2 860 291	8 200 835	6 500	8 500	20 2	0.100	**12**
17	8	0.8	6	3	27	6	17 600 1 790	34 000 3 500	3 200 325	11 900 1 220	5 500	7 000	52 5.3	0.172	**16**
19	8	0.8	6	3	32	6	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	4 500	6 000	76 7.8	0.252	**18**
21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	4 000	5 000	98 10	0.392	**20**
21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250	5 550 565	23 300 2 370	4 000	5 000	98 10	0.465	**20**
25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000	6 950 710	34 500 3 500	3 300	4 500	178 18	0.800	**24**
25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000	8 050 820	38 500 3 900	3 300	4 500	178 18	1.05	**24**
32	15	1	8	4	53	8	58 000 5 900	147 000 15 000	9 800 1 000	53 000 5 400	2 600	3 500	360 37	1.56	**30**
32	15	1	8	4	53	8	58 000 5 900	147 000 15 000	11 400 1 160	59 000 6 100	2 600	3 500	360 37	1.97	**30**

Note: The limiting speed of the KRV··LLH and KR··XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール有りKRV··LLH形，KRV··XLLH形の許容回転速度はおおよそ10 000r/minである。

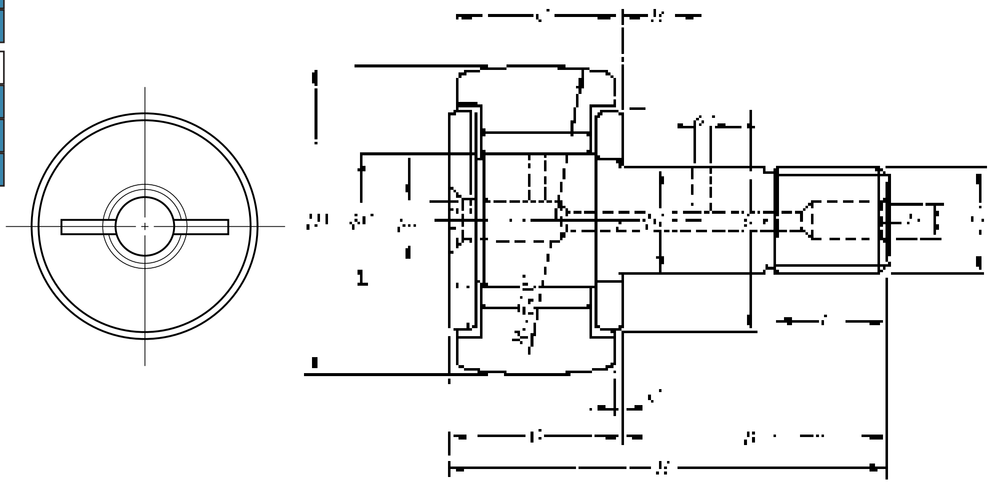
Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without seal	With seal
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴	ドライバ溝
シールなし	シール付

Full-Complement Roller-Type Cam Followers

総ころ形カムフォロア

KRV type
KRV··X type
KRV··LL type
KRV··XLL type

KRV形
KRV··X形
KRV··LL形
KRV··XLL形

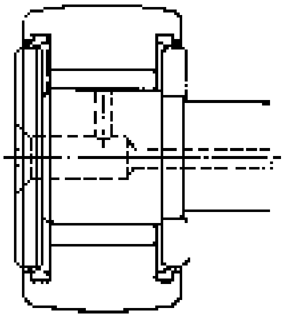


KRV type (Full-complement roller type)
KRV形（総ころ形）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number 呼び番号				Dimensions 寸法 mm						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G
16	KRV16/3AS	KRV16X/3AS	KRV16LL/3AS	KRV16XLL/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KRV19/3AS	KRV19X/3AS	KRV19LL/3AS	KRV19XLL/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KRV22/3AS	KRV22X/3AS	KRV22LL/3AS	KRV22XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KRV26/3AS	KRV26X/3AS	KRV26LL/3AS	KRV26XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KRV30/3AS	KRV30X/3AS	KRV30LL/3AS	KRV30XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KRV32/3AS	KRV32X/3AS	KRV32LL/3AS	KRV32XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KRV35/3AS	KRV35X/3AS	KRV35LL/3AS	KRV35XLL/3AS	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KRV40/3AS	KRV40X/3AS	KRV40LL/3AS	KRV40XLL/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KRV47/3AS	KRV47X/3AS	KRV47LL/3AS	KRV47XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KRV52/3AS	KRV52X/3AS	KRV52LL/3AS	KRV52XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KRV62/3AS	KRV62X/3AS	KRV62LL/3AS	KRV62XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KRV72/3AS	KRV72X/3AS	KRV72LL/3AS	KRV72XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KRV80/3AS	KRV80X/3AS	KRV80LL/3AS	KRV80XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KRV90/3AS	KRV90X/3AS	KRV90LL/3AS	KRV90XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

Notes: 1. JIS class 0 is the dimensional tolerance of outside diameter D of the outer rings of the KRV··X and KRV··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるKRV··X形，KRV··XLL形の外輪外径 D の許容差はJIS 0級である。
2）グリースの補給穴は正面（上図左側面）にだけ設けている。

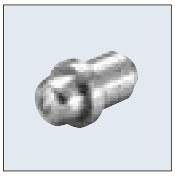


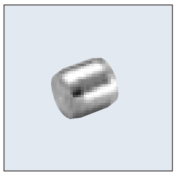
KRV··LL type
(Full-complement roller type, with seal)
KRV··LL形（総ころシール形）

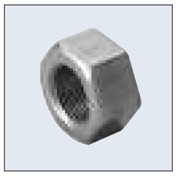
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
16～26	NIP-B4	SEN4	1M 6×1 ～1M10×1.25
30～40	NIP-B6	SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN8	1M20×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


NIP-B6


SEN6


1M12

Dimensions 寸法 mm						Basic load ratings 基本定格荷重 N / kgf		Track load capacity トラック負荷容量 N / kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m / kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	B_3	C_1	n	a	e	dynamic 基本動定格荷重 C_r	static 基本静定格荷重 C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
8	—	0.6	4[2)]	—	12	6 500 665	9 350 955	1 080 110	3 400 350	※13 000	※16 000	3 0.3	0.020	**6**
10	—	0.6	4[2)]	—	14	7 450 760	11 700 1 190	1 380 141	4 050 415	10 000	※13 000	8 0.8	0.032	**8**
12	—	0.6	4	—	17	8 200 840	14 000 1 420	1 690 172	5 150 525	8 500	※11 000	14 1.4	0.047	**10**
12	—	0.6	4	—	17	8 200 840	14 000 1 420	2 120 216	6 100 620	8 500	※11 000	14 1.4	0.061	**10**
13	6	0.6	6	3	23	12 000 1 230	20 300 2 070	2 620 267	7 700 785	6 500	8 500	20 2	0.089	**12**
13	6	0.6	6	3	23	12 000 1 230	20 300 2 070	2 860 291	8 200 835	6 500	8 500	20 2	0.100	**12**
17	8	0.8	6	3	27	17 600 1 790	34 000 3 500	3 200 325	11 900 1 220	5 500	7 000	52 5.3	0.172	**16**
19	8	0.8	6	3	32	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	4 500	6 000	76 7.8	0.252	**18**
21	9	0.8	8	4	37	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	4 000	5 000	98 10	0.390	**20**
21	9	0.8	8	4	37	28 800 2 940	61 000 6 250	5 550 565	23 300 2 370	4 000	5 000	98 10	0.465	**20**
25	11	0.8	8	4	44	39 500 4 000	98 500 10 000	6 950 710	34 500 3 500	3 300	4 500	178 18	0.800	**24**
25	11	0.8	8	4	44	39 500 4 000	98 500 10 000	8 050 820	38 500 3 900	3 300	4 500	178 18	1.05	**24**
32	15	1	8	4	53	58 000 5 900	147 000 15 000	9 800 1 000	53 000 5 400	2 600	3 500	360 37	1.56	**30**
32	15	1	8	4	53	58 000 5 900	147 000 15 000	11 400 1 160	59 000 6 100	2 600	3 500	360 37	1.97	**30**

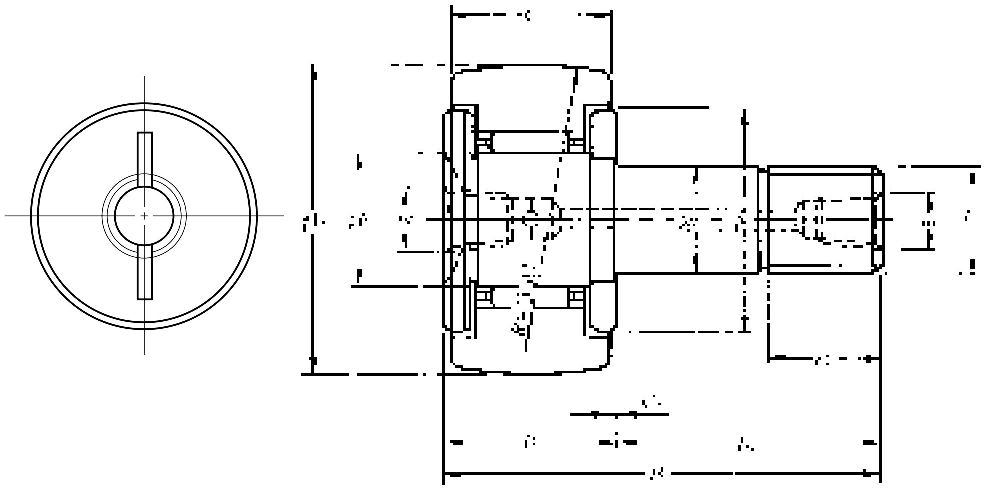
Note: The limiting speed of the KRV··LL and KR··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール有りKRV··LL形，KRV··XLL形の許容回転速度はおおよそ10 000r/minである。

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	
ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールなし	シール付	

Cam Followers with Cage
保持器付カムフォロア

KRT type
KRT‥X type
KRT‥LL type
KRT‥XLL type

KRT形
KRT‥X形
KRT‥LL形
KRT‥XLL形

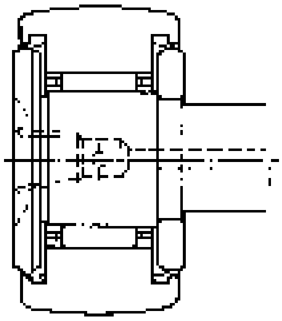


KRT type (with cage)
KRT形（保持器付）

OD[1] 外径 mm D 0 −0.05	Cam Follower number 呼び番号 Without seal シールなし Spherical outer rings 球面外輪	Without seal シールなし Cylindrical outer rings 円筒外輪	With seal シール有り Spherical outer rings 球面外輪	With seal シール有り Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm d_1	C	F	B	B_1	B_2	G
16	KRT16	KRT16X	KRT16LL/3AS	KRT16XLL/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KRT19	KRT19X	KRT19LL/3AS	KRT19XLL/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KRT22	KRT22X	KRT22LL/3AS	KRT22XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KRT26	KRT26X	KRT26LL/3AS	KRT26XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KRT30	KRT30X	KRT30LL/3AS	KRT30XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KRT32	KRT32X	KRT32LL/3AS	KRT32XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KRT35	KRT35X	KRT35LL/3AS	KRT35XLL/3AS	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KRT40	KRT40X	KRT40LL/3AS	KRT40XLL/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KRT47	KRT47X	KRT47LL/3AS	KRT47XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KRT52	KRT52X	KRT52LL/3AS	KRT52XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KRT62	KRT62X	KRT62LL/3AS	KRT62XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KRT72	KRT72X	KRT72LL/3AS	KRT72XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KRT80	KRT80X	KRT80LL/3AS	KRT80XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
85	KRT85	KRT85X	KRT85LL/3AS	KRT85XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KRT90	KRT90X	KRT90LL/3AS	KRT90XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

Notes:1. JIS class 0 is the dimensional tolerance of outside diameter D of the outer rings of the KRT‥X and KRT‥XLL types whose outside surface form is cylindrical.
2. The tapped hole is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるKRT‥X形，KRT‥XLL形の外輪外径 D の許容差はJIS 0級である。
2）タップ穴は正面（上図左側面）にだけ設けている。



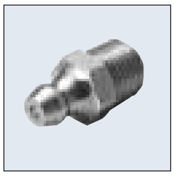
KRT‥LL type (with cage, sealed)

KRT‥LL形（保持器付シール形）

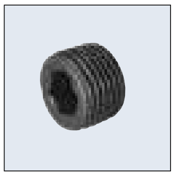
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable Hexagonal Nut Number 適用六角ナット 呼び番号
16～26	NIP-X30	M4×0.7 ×4ℓ	1M 6×1 ～1M10×1.25
30～32	JIS-A-M6F	M6×0.75×6ℓ	1M12×1.5
35～90	JIS-A PT⅛	PT⅛×7ℓ	1M16×1.5～1M30×1.5

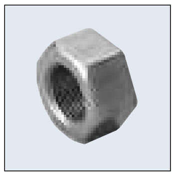
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



JIS A PT⅛



PT⅛



1M12

Dimensions 寸法 mm				Basic load ratings 基本動定格荷重 dynamic N kgf	Basic load ratings 基本静定格荷重 static N kgf	Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	C_1	m	e	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
8	0.6	M4×0.7[2)]	12	4 050 415	4 200 430	1 080 110	3 400 350	※19 000	※25 000	3 0.3	0.019	6
10	0.6	M4×0.7[2)]	14	4 750 480	5 400 555	1 380 141	4 050 415	※15 000	※20 000	8 0.8	0.031	8
12	0.6	M4×0.7	17	5 300 540	6 650 680	1 690 172	5 150 525	※12 000	※16 000	14 1.4	0.046	10
12	0.6	M4×0.7	17	5 300 540	6 650 680	2 120 216	6 100 620	※12 000	※16 000	14 1.4	0.059	10
13	0.6	M6×0.75	23	7 850 800	9 650 985	2 620 267	7 700 785	10 000	※13 000	20 2	0.087	12
13	0.6	M6×0.75	23	7 850 800	9 650 985	2 860 291	8 200 835	10 000	※13 000	20 2	0.097	12
17	0.8	PT⅛	27	12 200 1 240	17 900 1 830	3 200 325	11 900 1 220	8 000	※11 000	52 5.3	0.169	16
19	0.8	PT⅛	32	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	9 000	76 7.8	0.248	18
21	0.8	PT⅛	37	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	8 000	98 10	0.386	20
21	0.8	PT⅛	37	20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	6 000	8 000	98 10	0.461	20
25	0.8	PT⅛	44	28 900 2 950	55 000 5 600	6 950 710	34 500 3 500	5 000	6 500	178 18	0.790	24
25	0.8	PT⅛	44	28 900 2 950	55 000 5 600	8 050 820	38 500 3 900	5 000	6 500	178 18	1.04	24
32	1	PT⅛	53	45 000 4 600	88 500 9 050	9 800 1 000	53 000 5 400	4 000	5 500	360 37	1.55	30
32	1	PT⅛	53	45 000 4 600	88 500 9 050	10 400 1 060	56 000 5 750	4 000	5 500	360 37	1.74	30
32	1	PT⅛	53	45 000 4 600	88 500 9 050	11 400 1 160	59 000 6 100	4 000	5 500	360 37	1.95	30

Note: The limiting speed of the KRT‥LL and KRT‥XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考 ※印シール有りKRT‥LL形，KRT‥XLL形の許容回転速度はおおよそ10 000 r/minである。

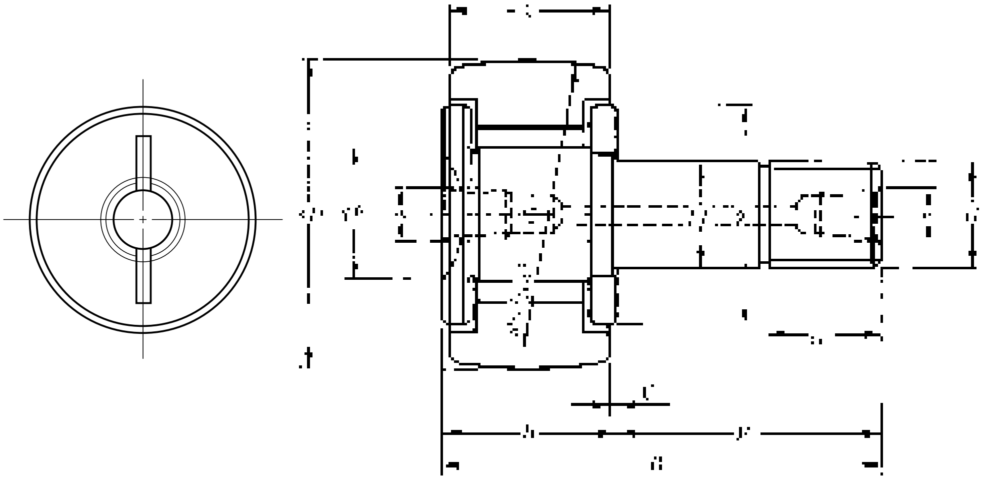
Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールなし	シール付	

Full-Complement Roller-Type Cam Followers
総ころ形カムフォロア

KRVT type
KRVT··X type
KRVT··LL type
KRVT··XLL type

KRVT形
KRVT··X形
KRVT··LL形
KRVT··XLL形

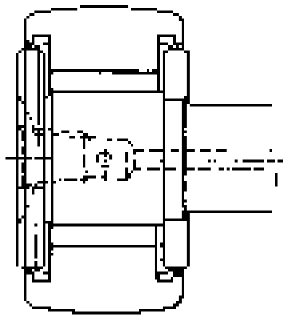


KRVT type (Full-complement roller type)
KRVT形（総ころ形）

OD[1)] 外径 mm D $^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G
16	KRVT16/3AS	KRVT16X/3AS	KRVT16LL/3AS	KRVT16XLL/3AS	$6^{\ 0}_{-0.012}$	11	8	12	28	16	M6×1
19	KRVT19/3AS	KRVT19X/3AS	KRVT19LL/3AS	KRVT19XLL/3AS	$8^{\ 0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KRVT22/3AS	KRVT22X/3AS	KRVT22LL/3AS	KRVT22XLL/3AS	$10^{\ 0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KRVT26/3AS	KRVT26X/3AS	KRVT26LL/3AS	KRVT26XLL/3AS	$10^{\ 0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KRVT30/3AS	KRVT30X/3AS	KRVT30LL/3AS	KRVT30XLL/3AS	$12^{\ 0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KRVT32/3AS	KRVT32X/3AS	KRVT32LL/3AS	KRVT32XLL/3AS	$12^{\ 0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KRVT35/3AS	KRVT35X/3AS	KRVT35LL/3AS	KRVT35XLL/3AS	$16^{\ 0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5
40	KRVT40/3AS	KRVT40X/3AS	KRVT40LL/3AS	KRVT40XLL/3AS	$18^{\ 0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KRVT47/3AS	KRVT47X/3AS	KRVT47LL/3AS	KRVT47XLL/3AS	$20^{\ 0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KRVT52/3AS	KRVT52X/3AS	KRVT52LL/3AS	KRVT52XLL/3AS	$20^{\ 0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KRVT62/3AS	KRVT62X/3AS	KRVT62LL/3AS	KRVT62XLL/3AS	$24^{\ 0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KRVT72/3AS	KRVT72X/3AS	KRVT72LL/3AS	KRVT72XLL/3AS	$24^{\ 0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KRVT80/3AS	KRVT80X/3AS	KRVT80LL/3AS	KRVT80XLL/3AS	$30^{\ 0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KRVT90/3AS	KRVT90X/3AS	KRVT90LL/3AS	KRVT90XLL/3AS	$30^{\ 0}_{-0.021}$	35	38	37	100	63	M30×1.5

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRVT··X and KRVT··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるKRVT··X形，KRVT··XLLの外輪外径 D の許容差はJIS 0級である。
2）タップ穴は正面（上図左側面）にだけ設けている。

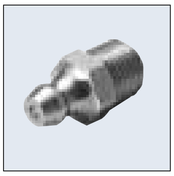


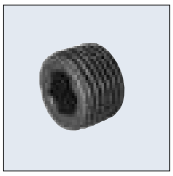
KRVT··LL type
(Full-complement roller type, with seal)
KRVT··LL形（総ころシール形）

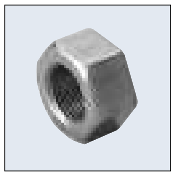
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable Hexagonal Nut Number 適用六角ナット 呼び番号
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～32	JIS-A-M6F	M6×0.75×6 ℓ	1M12×1.5
35～90	JIS-A PT1/8	PT1/8×7 ℓ	1M16×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


JIS A PT1/8


PT1/8


1M12

Dimensions 寸法 mm				Basic load ratings N / kgf		Track load capacity トラック負荷容量 N / kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m / kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	C_1	m	e	dynamic 基本動定格荷重 C_r	static 基本静定格荷重 C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
8	0.6	M4X0.7[2)]	12	6 500 665	9 350 955	1 080 110	3 400 350	※13 000	※16 000	3 0.3	0.020	**6**
10	0.6	M4X0.7[2)]	14	7 450 760	11 700 1 190	1 380 141	4 050 415	10 000	※13 000	8 0.8	0.032	**8**
12	0.6	M4X0.7	17	8 200 840	14 000 1 420	1 690 172	5 150 525	8 500	※11 000	14 1.4	0.047	**10**
12	0.6	M4X0.7	17	8 200 840	14 000 1 420	2 120 216	6 100 620	8 500	※11 000	14 1.4	0.061	**10**
13	0.6	M6X0.75	23	12 000 1 230	20 300 2 070	2 620 267	7 700 785	6 500	8 500	20 2	0.089	**12**
13	0.6	M6X0.75	23	12 000 1 230	20 300 2 070	2 860 291	8 200 835	6 500	8 500	20 2	0.100	**12**
17	0.8	PT1/8	27	17 600 1 790	34 000 3 500	3 200 325	11 900 1 220	5 500	7 000	52 5.3	0.172	**16**
19	0.8	PT1/8	32	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	4 500	6 000	76 7.8	0.252	**18**
21	0.8	PT1/8	37	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	4 000	5 000	98 10	0.390	**20**
21	0.8	PT1/8	37	28 800 2 940	61 000 6 250	5 550 565	23 300 2 370	4 000	5 000	98 10	0.465	**20**
25	0.8	PT1/8	44	39 500 4 000	98 500 10 000	6 950 710	34 500 3 500	3 300	4 500	178 18	0.800	**24**
25	0.8	PT1/8	44	39 500 4 000	98 500 10 000	8 050 820	38 500 3 900	3 300	4 500	178 18	1.05	**24**
32	1	PT1/8	53	58 000 5 900	147 000 15 000	9 800 1 000	53 000 5 400	2 600	3 500	360 37	1.56	**30**
32	1	PT1/8	53	58 000 5 900	147 000 15 000	11 400 1 160	59 000 6 100	2 600	3 500	360 37	1.97	**30**

Note: The limiting speed of the KRVT··LL and KRVT··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考 ※印シール有りKRVT··LL形，KRVT··XLL形の許容回転速度はおおよそ10 000 r/minである。

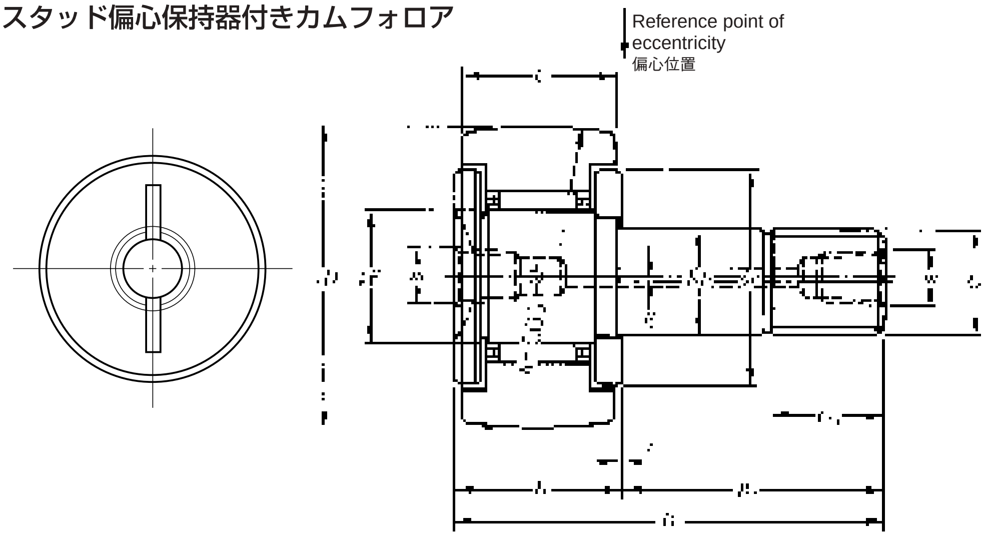
Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole / Slot for screwdriver	
Without seal	With seal
Eccentric stud	
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴 / ドライバ溝	
シールなし	シール付
軸　偏　心	

Eccentric-Stud Cam Followers with Cage

スタッド偏心保持器付きカムフォロア

KRU type
KRU··X type
KRU··LL type
KRU··XLL type

KRU形
KRU··X形
KRU··LL形
KRU··XLL形

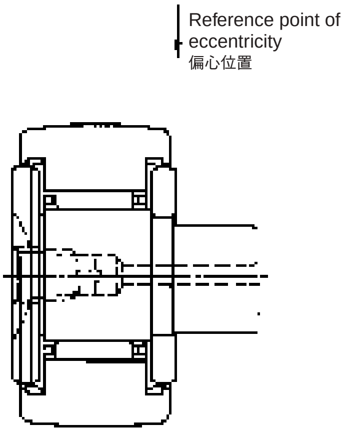


KRU type (with cage)
KRU形（保持器付）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number 呼び番号 — Without seal シールなし — Spherical outer rings 球面外輪	Without seal — Cylindrical outer rings 円筒外輪	With seal シール有り — Spherical outer rings 球面外輪	With seal — Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm d_1	C	F	B	B_1	B_2	G
16	KRU16	KRU16X	KRU16LL/3AS	KRU16XLL/3AS	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1
19	KRU19	KRU19X	KRU19LL/3AS	KRU19XLL/3AS	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25
22	KRU22	KRU22X	KRU22LL/3AS	KRU22XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
26	KRU26	KRU26X	KRU26LL/3AS	KRU26XLL/3AS	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25
30	KRU30	KRU30X	KRU30LL/3AS	KRU30XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
32	KRU32	KRU32X	KRU32LL/3AS	KRU32XLL/3AS	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5
35	KRU35	KRU35X	KRU35LL/3AS	KRU35XLL/3AS	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5
40	KRU40	KRU40X	KRU40LL/3AS	KRU40XLL/3AS	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5
47	KRU47	KRU47X	KRU47LL/3AS	KRU47XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
52	KRU52	KRU52X	KRU52LL/3AS	KRU52XLL/3AS	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5
62	KRU62	KRU62X	KRU62LL/3AS	KRU62XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
72	KRU72	KRU72X	KRU72LL/3AS	KRU72XLL/3AS	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5
80	KRU80	KRU80X	KRU80LL/3AS	KRU80XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
85	KRU85	KRU85X	KRU85LL/3AS	KRU85XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5
90	KRU90	KRU90X	KRU90LL/3AS	KRU90XLL/3AS	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRU··X and KRU··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるKRU··X形，KRU··XLL形の外輪外径 D の許容差はJIS 0級である。
2）タップ穴は正面（上図左側面）にだけ設けている。



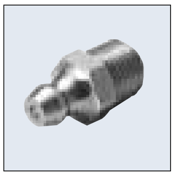
KRU··LL type (with cage)

KRU··LL形（保持器付）

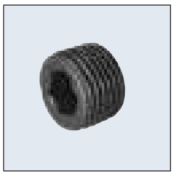
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable Hexagonal Nut Number 適用六角ナット 呼び番号
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～35	JIS-A-M6F	M6×0.75×6 ℓ	1M12×1.5～1M16×1.5
40～90	JIS-A PT1/8	PT1/8×7 ℓ	1M18×1.5～1M30×1.5

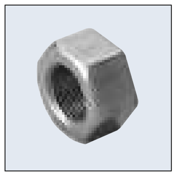
Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



JIS A PT1/8



PT1/8



1M12

Dimensions 寸法 mm					Basic load ratings 基本動定格荷重 dynamic / static 基本静定格荷重 N kgf		Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)(参考)	Stud dia. スタッド径 mm
G_1	Eccentricity 偏心量 E	C_1	m	e	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
8	0.25	0.6	M4X0.7[2)]	12	4 050 415	4 200 430	1 080 110	3 400 350	※19 000	※25000	3 0.3	0.019	**6**
10	0.25	0.6	M4X0.7[2)]	14	4 750 480	5 400 555	1 380 141	4 050 415	※15 000	※20 000	8 0.8	0.031	**8**
12	0.3	0.6	M4X0.7	17	5 300 540	6 650 680	1 690 172	5 150 525	※12 000	※16 000	14 1.4	0.046	**10**
12	0.3	0.6	M4X0.7	17	5 300 540	6 650 680	2 120 216	6 100 620	※12 000	※16 000	14 1.4	0.059	**10**
13	0.4	0.6	M6X0.75	23	7 850 800	9 650 985	2 620 267	7 700 785	10 000	※13 000	20 2	0.087	**12**
13	0.4	0.6	M6X0.75	23	7 850 800	9 650 985	2 860 291	8 200 835	10 000	※13 000	20 2	0.097	**12**
17	0.5	0.8	M6X0.75	27	12 500 1 280	18 000 1 930	3 200 325	11 900 1 220	8 000	※11 000	52 5.3	0.169	**16**
19	0.6	0.8	PT1/8	32	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	9 000	76 7.8	0.248	**18**
21	0.7	0.8	PT1/8	37	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	8 000	98 10	0.386	**20**
21	0.7	0.8	PT1/8	37	20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	6 000	8 000	98 10	0.461	**20**
25	0.8	0.8	PT1/8	44	28 900 2 950	55 000 5 600	6 950 710	34 500 3 500	5 000	6 500	178 18	0.790	**24**
25	0.8	0.8	PT1/8	44	28 900 2 950	55 000 5 600	8 050 820	38 500 3 900	5 000	6 500	178 18	1.04	**24**
32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050	9 800 1 000	53 000 5 400	4 000	5 500	360 37	1.55	**30**
32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050	10 400 1 060	56 000 5 750	4 000	5 500	360 37	1.74	**30**
32	1.0	1	PT1/8	53	45 000 4 600	88 500 9 050	11 400 1 160	59 000 6 100	4 000	5 500	360 37	1.95	**30**

Note: The limiting speed of the KRU··LL and KRU··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考 ※印シール有りKRU··LL形，KRU··XLL形の許容回転速度はおおよそ10 000 r/minである。

Metric series	Inch series
With cage	Full-complement roller

Hexagonal socket | Tapped hole | Slot for screwdriver

Without seal | With seal

Eccentric stud

ミリ系 | インチ系

保持器付 | 総ころ

六角穴 | タップ穴 | ドライバ溝

シールなし | シール付

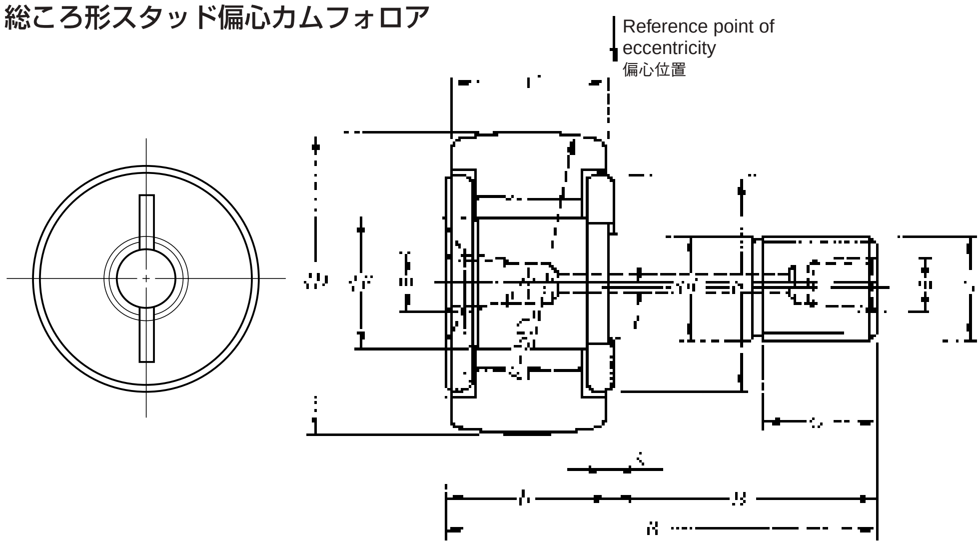
軸　偏　心

Eccentric-Stud Full-Complement Roller-Type Cam Followers

総ころ形スタッド偏心カムフォロア

KRVU type
KRVU··X type
KRVU··LL type
KRVU··XLL type

KRVU形
KRVU··X形
KRVU··LL形
KRVU··XLL形



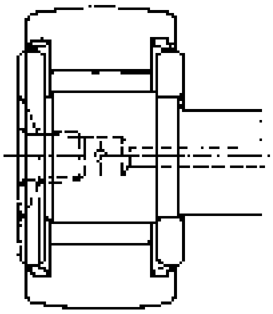
KRVU type (Full-complement roller type)
KRVU形（総ころ形）

OD[1] 外径 mm D $_{-0.05}^{\ 0}$	Cam Follower number 呼び番号 — Without seal シールなし: Spherical outer rings 球面外輪	Without seal シールなし: Cylindrical outer rings 円筒外輪	With seal シール有り: Spherical outer rings 球面外輪	With seal シール有り: Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm: d_1	C	F	B	B_1	B_2	G
16	KRVU16/3AS	KRVU16X/3AS	KRVU16LL/3AS	KRVU16XLL/3AS	$6_{-0.012}^{\ 0}$	11	8	12	28	16	M6×1
19	KRVU19/3AS	KRVU19X/3AS	KRVU19LL/3AS	KRVU19XLL/3AS	$8_{-0.015}^{\ 0}$	11	10	12	32	20	M8×1.25
22	KRVU22/3AS	KRVU22X/3AS	KRVU22LL/3AS	KRVU22XLL/3AS	$10_{-0.015}^{\ 0}$	12	12	13	36	23	M10×1.25
26	KRVU26/3AS	KRVU26X/3AS	KRVU26LL/3AS	KRVU26XLL/3AS	$10_{-0.015}^{\ 0}$	12	12	13	36	23	M10×1.25
30	KRVU30/3AS	KRVU30X/3AS	KRVU30LL/3AS	KRVU30XLL/3AS	$12_{-0.018}^{\ 0}$	14	15	15	40	25	M12×1.5
32	KRVU32/3AS	KRVU32X/3AS	KRVU32LL/3AS	KRVU32XLL/3AS	$12_{-0.018}^{\ 0}$	14	15	15	40	25	M12×1.5
35	KRVU35/3AS	KRVU35X/3AS	KRVU35LL/3AS	KRVU35XLL/3AS	$16_{-0.018}^{\ 0}$	18	19	19.5	52	32.5	M16×1.5
40	KRVU40/3AS	KRVU40X/3AS	KRVU40LL/3AS	KRVU40XLL/3AS	$18_{-0.018}^{\ 0}$	20	22	21.5	58	36.5	M18×1.5
47	KRVU47/3AS	KRVU47X/3AS	KRVU47LL/3AS	KRVU47XLL/3AS	$20_{-0.021}^{\ 0}$	24	25	25.5	66	40.5	M20×1.5
52	KRVU52/3AS	KRVU52X/3AS	KRVU52LL/3AS	KRVU52XLL/3AS	$20_{-0.021}^{\ 0}$	24	25	25.5	66	40.5	M20×1.5
62	KRVU62/3AS	KRVU62X/3AS	KRVU62LL/3AS	KRVU62XLL/3AS	$24_{-0.021}^{\ 0}$	29	30	30.5	80	49.5	M24×1.5
72	KRVU72/3AS	KRVU72X/3AS	KRVU72LL/3AS	KRVU72XLL/3AS	$24_{-0.021}^{\ 0}$	29	30	30.5	80	49.5	M24×1.5
80	KRVU80/3AS	KRVU80X/3AS	KRVU80LL/3AS	KRVU80XLL/3AS	$30_{-0.021}^{\ 0}$	35	38	37	100	63	M30×1.5
90	KRVU90/3AS	KRVU90X/3AS	KRVU90LL/3AS	KRVU90XLL/3AS	$30_{-0.021}^{\ 0}$	35	38	37	100	63	M30×1.5

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRVU··X and KRVU··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるKRVU··X形，KRVU··XLL形の外輪外径 D の許容差はJIS 0級である。
2）タップ穴は正面（上図左側面）にだけ設けている。

Reference point of
eccentricity
偏心位置

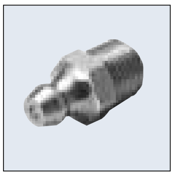


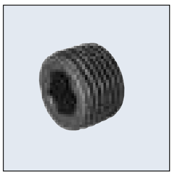
KRVU‥LL type
(Full-complement roller type, with seal)
KRVU‥LL形（総ころシール形）

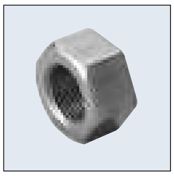
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable Hexagonal Nut Number 適用六角ナット 呼び番号
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～35	JIS-A-M6F	M6×0.75×6 ℓ	1M12×1.5～1M16×1.5
40～90	JIS-A PT⅛	PT⅛×7 ℓ	1M18×1.5～1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


JIS A PT⅛


PT⅛


1M12

Dimensions 寸法 mm					Basic load ratings dynamic 基本動定格荷重 / static 基本静定格荷重 N (kgf)		Track load capacity トラック負荷容量 N (kgf)		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m (kgf·m)	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
G_1	Eccentricity 偏心量 E	C_1	m	e	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
8	0.25	0.6	M4X0.7[2)]	12	6 500 665	9 350 955	1 080 110	3 400 350	※13 000	※16 000	3 0.3	0.020	**6**
10	0.25	0.6	M4X0.7[2)]	14	7 450 760	11 700 1 190	1 380 141	4 050 415	10 000	※13 000	8 0.8	0.032	**8**
12	0.3	0.6	M4X0.7	17	8 200 840	14 000 1 420	1 690 172	5 150 525	8 500	※11 000	14 1.4	0.047	**10**
12	0.3	0.6	M4X0.7	17	8 200 840	14 000 1 420	2 120 216	6 100 620	8 500	※11 000	14 1.4	0.061	**10**
13	0.4	0.6	M6X0.75	23	12 000 1 230	20 300 2 070	2 620 267	7 700 785	6 500	8 500	20 2	0.089	**12**
13	0.4	0.6	M6X0.75	23	12 000 1 230	20 300 2 070	2 860 291	8 200 835	6 500	8 500	20 2	0.100	**12**
17	0.5	0.8	M6X0.75	27	18 000 1 840	36 500 3 700	3 200 325	11 900 1 220	5 500	7 000	52 5.3	0.172	**16**
19	0.6	0.8	PT⅛	32	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	4 500	6 000	76 7.8	0.252	**18**
21	0.7	0.8	PT⅛	37	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	4 000	5 000	98 10	0.390	**20**
21	0.7	0.8	PT⅛	37	28 800 2 940	61 000 6 250	5 550 565	23 300 2 370	4 000	5 000	98 10	0.465	**20**
25	0.8	0.8	PT⅛	44	39 500 4 000	98 500 10 000	6 950 710	34 500 3 500	3 300	4 500	178 18	0.800	**24**
25	0.8	0.8	PT⅛	44	39 500 4 000	98 500 10 000	8 050 820	38 500 3 900	3 300	4 500	178 18	1.05	**24**
32	1.0	1	PT⅛	53	58 000 5 900	147 000 15 000	9 800 1 000	53 000 5 400	2 600	3 500	360 37	1.56	**30**
32	1.0	1	PT⅛	53	58 000 5 900	147 000 15 000	11 400 1 160	59 000 6 100	2 600	3 500	360 37	1.97	**30**

Note: The limiting speed of the KRVU‥LL and KRVU‥XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考 ※印シール有りKRVU‥LL形，KRVU‥XLL形の許容回転速度はおおよそ10 000 r/minである。

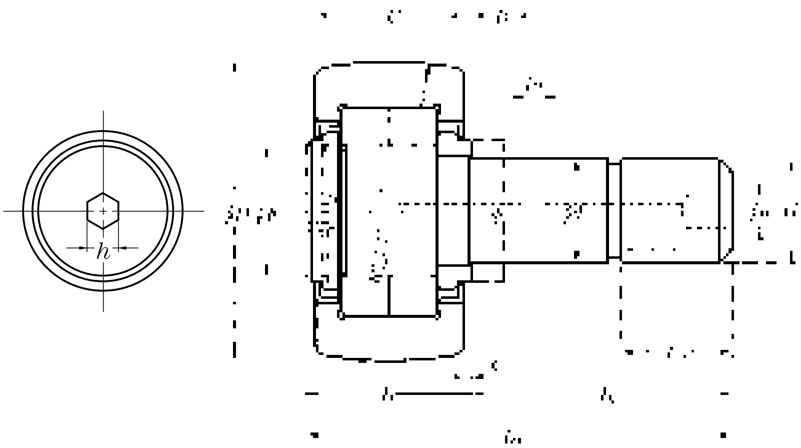
Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without shield	With shield	
ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールドなし	シールド付	

Full-Complement Double-Row Cylindrical Roller-Type Cam Followers

総ころ複列円筒ころ形カムフォロア

NUKR··H type
NUKR··XH type

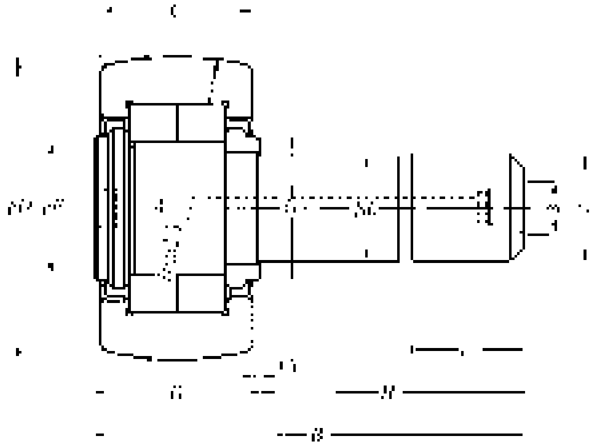
NUKR··H形
NUKR··XH形



NUKR··H type (D<100mm)
(Shielded full-complement double-row cylindrical roller type)
NUKR··H形（D<100mm）
（シールド付総ころ複列円筒ころ形）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number 呼び番号		Dimensions 寸法 mm										
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n
30	NUKR30H/3AS	NUKR30XH/3AS	$12^{\ 0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6
35	NUKR35H/3AS	NUKR35XH/3AS	$16^{\ 0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6
40	NUKR40H/3AS	NUKR40XH/3AS	$18^{\ 0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6
47	NUKR47H/3AS	NUKR47XH/3AS	$20^{\ 0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8
52	NUKR52H/3AS	NUKR52XH/3AS	$20^{\ 0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8
62	NUKR62H/3AS	NUKR62XH/3AS	$24^{\ 0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8
72	NUKR72H/3AS	NUKR72XH/3AS	$24^{\ 0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8
80	NUKR80H/3AS	NUKR80XH/3AS	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8
90	NUKR90H/3AS	NUKR90XH/3AS	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8
100	NUKR100H/3AS	NUKR100XH/3AS	$36^{\ 0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	—
120	NUKR120H/3AS	NUKR120XH/3AS	$42^{\ 0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	—
140	NUKR140H/3AS	NUKR140XH/3AS	$48^{\ 0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	—	1.5	—
150	NUKR150H/3AS	NUKR150XH/3AS	$52^{\ 0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	—
160	NUKR160H/3AS	NUKR160XH/3AS	$56^{\ 0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	—	2	—
170	NUKR170H/3AS	NUKR170XH/3AS	$60^{\ 0}_{-0.030}$	66	86	70	190	120	M60×3	58	—	2	—
180	NUKR180H/3AS	NUKR180XH/3AS	$64^{\ 0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	—	2	—

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NUKR··XH type whose outside surface form is cylindrical.
注1）外径面が円筒であるNUKR··XH形の外輪外径 D の許容差はJIS 0級である。

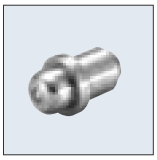


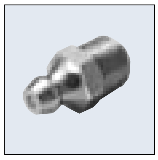
NUKR･･H type（D≧100mm）
NUKR･･H形（D≧100mm）

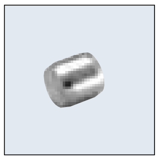
Accessories / 付属部品

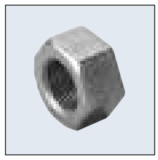
Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
30～40	NIP-B6	SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN8	1M20×1.5～1M30×1.5
100～180	JIS A-PT⅛	—	M36×1.5～ M64×3

Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


NIP-B6


JIS A PT⅛


SEN6


1M12

Dimensions 寸法 mm				Basic load ratings dynamic 基本動定格荷重 N kgf	static 基本静定格荷重	Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min	Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg	Stud dia. スタッド径
m	a	e	h	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑		(approx.)（参考）	mm
—	3	15	6	13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	0.088	**12**
—	3	21	6	22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	0.165	**16**
—	3	23	6	24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	0.242	**18**
—	4	27	8	38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	0.380	**20**
—	4	31	8	42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	0.450	**20**
—	4	38	8	56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	0.795	**24**
—	4	44	8	62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	1.01	**24**
—	4	51	8	101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	1.54	**30**
—	4	51	8	101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	1.96	**30**
PT⅛	—	53	14	119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	3.08	**36**
PT⅛	—	66	14	172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	5.17	**42**
PT⅛	—	72.5	14	201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	7.98	**48**
PT⅛	—	85.5	17	258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	9.70	**52**
PT⅛	—	89.5	17	274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	11.7	**56**
PT⅛	—	96.5	17	320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	13.9	**60**
PT⅛	—	103.5	17	365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	17.0	**64**

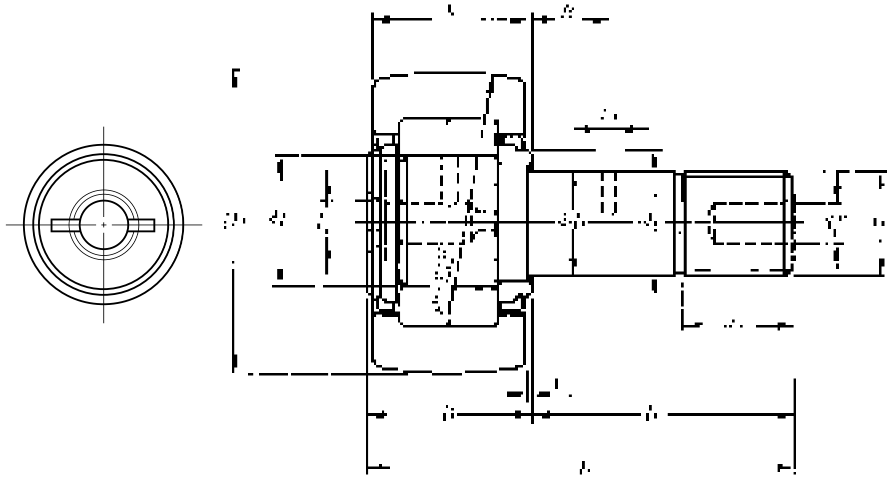
Metric series	Inch series
With cage	**Full-complement roller**
Hexagonal socket / Tapped hole	**Slot for screwdriver**
Without shield	**With shield**
ミリ系	インチ系
保持器付	**総ころ**
六角穴 / タップ穴	**ドライバ溝**
シールドなし	**シールド付**

Full-Complement Double-Row Cylindrical Roller-Type Cam Followers

総ころ複列円筒ころ形カムフォロア

NUKR type
NUKR‥X type

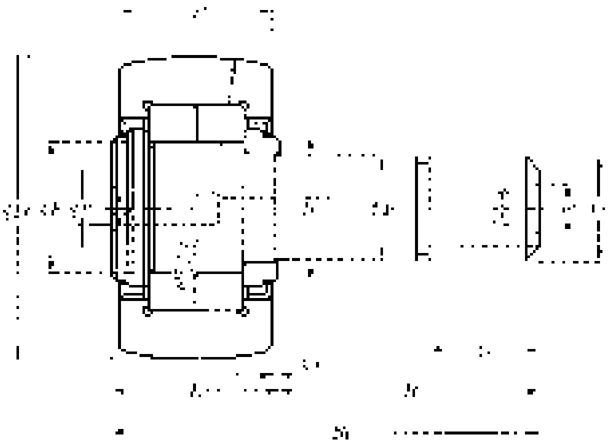
NUKR形
NUKR‥X形



NUKR type (D<100mm)
(Shielded full-complement double-row cylindrical roller type)
NUKR形（D<100mm）（シールド付総ころ複列円筒ころ形）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number 呼び番号		Dimensions 寸法 mm										
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n
30	**NUKR 30/3AS**	**NUKR 30X/3AS**	12 $^{0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6
35	**NUKR 35/3AS**	**NUKR 35X/3AS**	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6
40	**NUKR 40/3AS**	**NUKR 40X/3AS**	18 $^{0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6
47	**NUKR 47/3AS**	**NUKR 47X/3AS**	20 $^{0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8
52	**NUKR 52/3AS**	**NUKR 52X/3AS**	20 $^{0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8
62	**NUKR 62/3AS**	**NUKR 62X/3AS**	24 $^{0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8
72	**NUKR 72/3AS**	**NUKR 72X/3AS**	24 $^{0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8
80	**NUKR 80/3AS**	**NUKR 80X/3AS**	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8
90	**NUKR 90/3AS**	**NUKR 90X/3AS**	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8
100	**NUKR 100/3AS**	**NUKR 100X/3AS**	36 $^{0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	8
120	**NUKR 120/3AS**	**NUKR 120X/3AS**	42 $^{0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	8
140	**NUKR 140/3AS**	**NUKR 140X/3AS**	48 $^{0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	—	1.5	8
150	**NUKR 150/3AS**	**NUKR 150X/3AS**	52 $^{0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	8
160	**NUKR 160/3AS**	**NUKR 160X/3AS**	56 $^{0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	—	2	8
170	**NUKR 170/3AS**	**NUKR 170X/3AS**	60 $^{0}_{-0.030}$	66	86	70	190	120	M60×3	58	—	2	8
180	**NUKR 180/3AS**	**NUKR 180X/3AS**	64 $^{0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	—	2	8

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NUKR‥X type whose outside surface form is cylindrical.
注1）外径面が円筒であるNUKR‥X形の外輪外径 D の許容差はJIS 0級である。

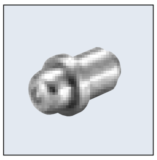


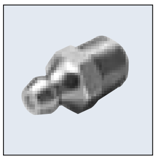
NUKR type（D≧100mm）
NUKR形（D≧100mm）

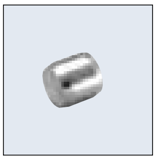
Accessories / 付属部品

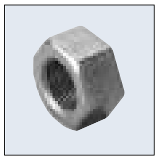
Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル呼び番号	Plug number プラグ呼び番号	Applicable hexagonal nut 適用六角ナット
30～40	NIP-B6	SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN8	1M20×1.5～1M30×1.5
100～180	JIS A-PT⅛	SEN8	M36×1.5～ M64×3

Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


NIP-B6


JIS A PT⅛


SEN6


1M12

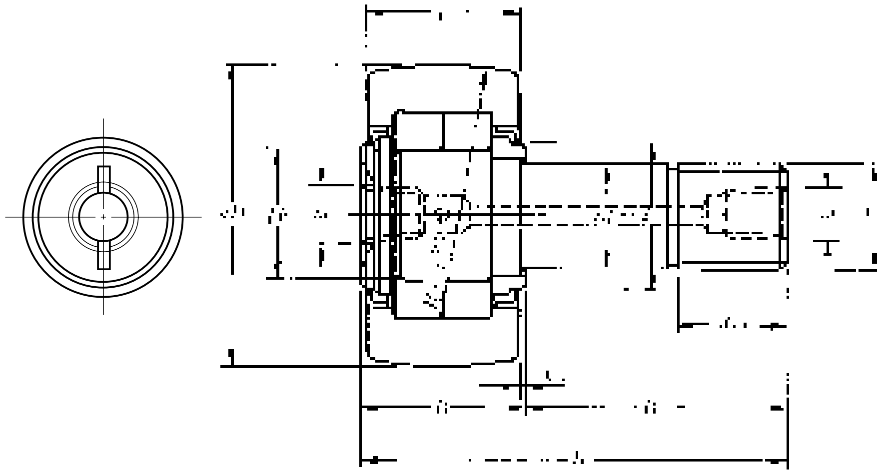
Dimensions 寸法 mm			Basic load ratings N kgf: dynamic 基本動定格荷重	static 基本静定格荷重	Track load capacity トラック負荷容量 N kgf: Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
m	a	e	C_r	C_{or}						
—	3	15	13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	0.088	**12**
—	3	21	22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	0.165	**16**
—	3	23	24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	0.242	**18**
—	4	27	38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	0.380	**20**
—	4	31	42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	0.450	**20**
—	4	38	56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	0.795	**24**
—	4	44	62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	1.01	**24**
—	4	51	101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	1.54	**30**
—	4	51	101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	1.96	**30**
PT⅛	—	53	119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	3.08	**36**
PT⅛	—	66	172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	5.17	**42**
PT⅛	—	72.5	201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	7.98	**48**
PT⅛	—	85.5	258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	9.70	**52**
PT⅛	—	89.5	274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	11.7	**56**
PT⅛	—	96.5	320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	13.9	**60**
PT⅛	—	103.5	365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	17.0	**64**

Full-Complement Double-Row Cylindrical Roller-Type Cam Followers

総ころ複列円筒ころ形カムフォロア

NUKRT type
NUKRT‥X type

NUKRT形
NUKRT‥X形



NUKRT type
(Shielded full-complement double-row cylindrical roller type)
NUKRT形（シールド付総ころ複列円筒ころ形）

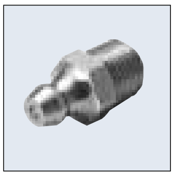
OD[1)] 外径 mm D $^{0}_{-0.05}$	Cam Follower number 呼び番号		Dimensions 寸法 mm										
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e
30	NUKRT 30/3AS	NUKRT 30X/3AS	12 $^{0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15
35	NUKRT 35/3AS	NUKRT 35X/3AS	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	0.8	PT1/8	21
40	NUKRT 40/3AS	NUKRT 40X/3AS	18 $^{0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT1/8	23
47	NUKRT 47/3AS	NUKRT 47X/3AS	20 $^{0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	27
52	NUKRT 52/3AS	NUKRT 52X/3AS	20 $^{0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT1/8	31
62	NUKRT 62/3AS	NUKRT 62X/3AS	24 $^{0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	38
72	NUKRT 72/3AS	NUKRT 72X/3AS	24 $^{0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT1/8	44
80	NUKRT 80/3AS	NUKRT 80X/3AS	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51
90	NUKRT 90/3AS	NUKRT 90X/3AS	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	PT1/8	51
100	NUKRT 100/3AS	NUKRT 100X/3AS	36 $^{0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	1.5	PT1/8	53
120	NUKRT 120/3AS	NUKRT 120X/3AS	42 $^{0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	1.5	PT1/8	66
140	NUKRT 140/3AS	NUKRT 140X/3AS	48 $^{0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	1.5	PT1/8	72.5
150	NUKRT 150/3AS	NUKRT 150X/3AS	52 $^{0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	1.5	PT1/8	85.5
160	NUKRT 160/3AS	NUKRT 160X/3AS	56 $^{0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	2	PT1/8	89.5
170	NUKRT 170/3AS	NUKRT 170X/3AS	60 $^{0}_{-0.030}$	66	86	70	190	120	M60×3	58	2	PT1/8	96.5
180	NUKRT 180/3AS	NUKRT 180X/3AS	64 $^{0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	2	PT1/8	103.5

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NUKRT‥X type whose outside surface form is cylindrical.
注1）外径面が円筒であるNUKRT‥X形の外輪外径Dの許容差はJIS 0級である。

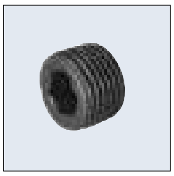
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
30	JIS A-M6F	M6×0.75×6 ℓ	1M12×1.5
35～180	JIS A-PT⅛	PT⅛×7 ℓ	1M16×1.5～1M64×3

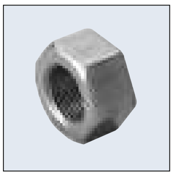
Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



JIS A PT⅛



PT⅛



1M12

Basic load ratings dynamic 基本動定格荷重 C_r (N / kgf)	Basic load ratings static 基本静定格荷重 C_{or} (N / kgf)	Track load capacity トラック負荷容量 Spherical outer ring 球面外輪 (N / kgf)	Track load capacity Cylindrical outer ring 円筒外輪 (N / kgf)	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Maximum tightening torque 締付最大トルク N·m / kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	0.088	**12**
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	0.165	**16**
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	0.242	**18**
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	0.380	**20**
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	0.450	**20**
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	0.795	**24**
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	1.01	**24**
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	1.54	**30**
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	1.96	**30**
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	3.08	**36**
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	5.17	**42**
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	7.98	**48**
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	9.70	**52**
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	11.7	**56**
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	13.9	**60**
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	17.0	**64**

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without shield	With shield	
Eccentric stud		

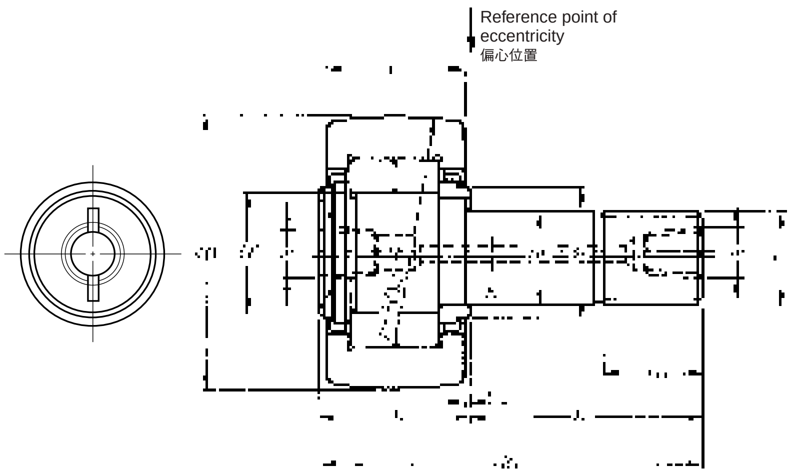
ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールドなし	シールド付	
軸　偏　心		

Eccentric-Stud Full-Complement Double-Row Cylindrical Roller-Type Cam Followers

総ころスタッド偏心複列円筒ころ形カムフォロア

NUKRU type
NUKRU‥X type

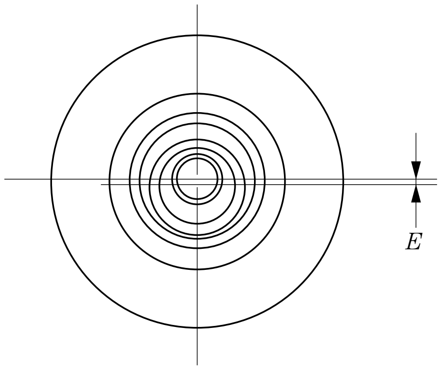
NUKRU形
NUKRU‥X形



NUKRU type
(Shielded full-complement double-row cylindrical roller type)
NUKRU形（シールド付総ころ複列円筒ころ形）

OD[1)] 外径 mm D 0 −0.05	Cam Follower number 呼び番号		Dimensions 寸法 mm												
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1		C	F	B	B_1	B_2	G	G_1	C_1	m	e	Eccentricity 偏心量 E
30	NUKRU 30/3AS	NUKRU 30X/3AS	12	0 −0.018	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	0.4
35	NUKRU 35/3AS	NUKRU 35X/3AS	16	0 −0.018	18	19	19.5	52	32.5	M16×1.5	17	0.8	M6×0.75	21	0.5
40	NUKRU 40/3AS	NUKRU 40X/3AS	18	0 −0.018	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT 1/8	23	0.6
47	NUKRU 47/3AS	NUKRU 47X/3AS	20	0 −0.021	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT 1/8	27	0.7
52	NUKRU 52/3AS	NUKRU 52X/3AS	20	0 −0.021	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT 1/8	31	0.7
62	NUKRU 62/3AS	NUKRU 62X/3AS	24	0 −0.021	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT 1/8	38	0.8
72	NUKRU 72/3AS	NUKRU 72X/3AS	24	0 −0.021	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT 1/8	44	1.0
80	NUKRU 80/3AS	NUKRU 80X/3AS	30	0 −0.021	35	47.5	37	100	63	M30×1.5	32	1	PT 1/8	51	1.0
90	NUKRU 90/3AS	NUKRU 90X/3AS	30	0 −0.021	35	47.5	37	100	63	M30×1.5	32	1	PT 1/8	51	1.0
100	NUKRU 100/3AS	NUKRU 100X/3AS	36	0 −0.025	43	48.5	46	120	74	M36×1.5	38	1.5	PT 1/8	53	1.5
120	NUKRU 120/3AS	NUKRU 120X/3AS	42	0 −0.025	50	60.5	53	140	87	M42×1.5	44	1.5	PT 1/8	66	1.5
140	NUKRU 140/3AS	NUKRU 140X/3AS	48	0 −0.025	57	65	60	160	100	M48×1.5	52	1.5	PT 1/8	72.5	2
150	NUKRU 150/3AS	NUKRU 150X/3AS	52	0 −0.030	60	75.5	63	170	107	M52×1.5	52	1.5	PT 1/8	85.5	2
160	NUKRU 160/3AS	NUKRU 160X/3AS	56	0 −0.030	63	80.5	67	180	113	M56×3	58	2	PT 1/8	89.5	2
170	NUKRU 170/3AS	NUKRU 170X/3AS	60	0 −0.030	66	86	70	190	120	M60×3	58	2	PT 1/8	96.5	2.5
180	NUKRU 180/3AS	NUKRU 180X/3AS	64	0 −0.030	72	91.5	76	200	124	M64×3	65	2	PT 1/8	103.5	2.5

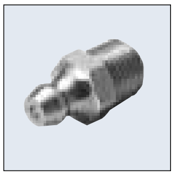
Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NUKRU‥X type whose outside surface form is cylindrical.
注1）外径面が円筒であるNUKRU‥X形の外輪外径 D の許容差はJIS 0級である。

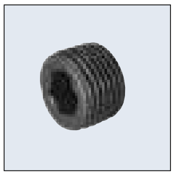


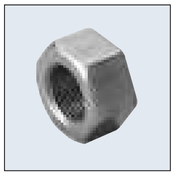
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
30〜35	JIS A-M6F	M6×0.75×6 ℓ	1M12×1.5〜1M16×1.5
40〜180	JIS A-PT⅛	PT⅛×7 ℓ	1M18×1.5〜1M64×3

Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。


JIS A PT⅛


PT⅛


1M12

Basic load ratings dynamic 基本動定格荷重 N (kgf) C_r	static 基本静定格荷重 N (kgf) C_{or}	Track load capacity トラック負荷容量 N (kgf) Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Maximum tightening torque 締付最大トルク N·m (kgf·m)	Mass 質量 kg (approx.) (参考)	Stud dia. スタッド径 mm
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	0.088	**12**
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	0.165	**16**
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	0.242	**18**
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	0.380	**20**
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	0.450	**20**
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	0.795	**24**
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	1.01	**24**
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	1.54	**30**
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	1.96	**30**
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	3.08	**36**
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	5.17	**42**
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	7.98	**48**
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	9.70	**52**
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	11.7	**56**
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	13.9	**60**
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	17.0	**64**

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

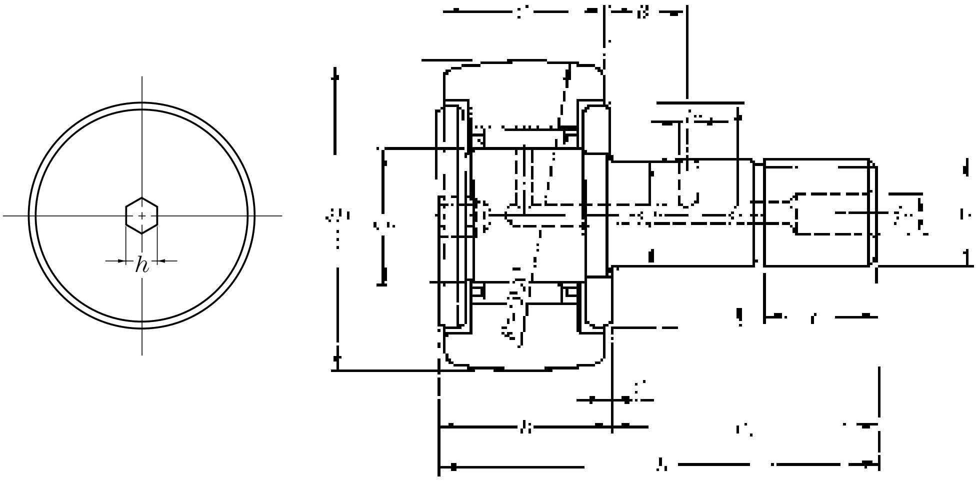
ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールなし	シール付	

Cam Followers with Cage

保持器付カムフォロア

CR··H type
CR··XH type
CR··LLH type
CR··XLLH type

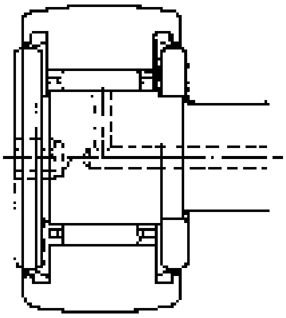
CR··H形
CR··XH形
CR··LLH形
CR··XLLH形



CR··H type (with cage)
CR··H形（保持器付）

OD[1] 外径 mm (in) D $^{0}_{-0.05}$	Cam Follower number 呼び番号 — Without seal シールなし: Spherical outer rings 球面外輪	Without seal シールなし: Cylindrical outer rings 円筒外輪	With seal シール有り: Spherical outer rings 球面外輪	With seal シール有り: Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm (in): d_1 $^{+0.025}_{0}$	C $^{0}_{-0.130}$	F	B	B_1	B_2	G
12.700 (1/2)	CR8T2H/3AS	CR8XT2H/3AS	———	———	4.762 (3/16)	8.731(11/32)	6	10.3	23	12.7	NO-10-32UNF
12.700 (1/2)	CR8-1T2H/3AS	CR8-1XT2H/3AS	———	———	4.762 (3/16)	9.525 (3/8)	6	11.1	27	15.9	NO-10-32UNF
15.875 (5/8)	CR10H/3AS	CR10XH/3AS	———	———	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF
15.875 (5/8)	CR10-1H/3AS	CR10-1XH/3AS	CR10-1LLH/3AS	CR10-1XLLH/3AS	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF
19.050 (3/4)	CR12H	CR12XH	CR12LLH/3AS	CR12XLLH/3AS	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF
22.225 (7/8)	CR14H	CR14XH	CR14LLH/3AS	CR14XLLH/3AS	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF
25.400 (1)	CR16H	CR16XH	CRV16LLH/3AS	CR16XLLH/3AS	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF
28.575 (1-1/8)	CR18H	CR18XH	CR18LLH/3AS	CR18XLLH/3AS	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF
31.750 (1-1/4)	CR20H	CR20XH	CR20LLH/3AS	CR20XLLH/3AS	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF
34.925 (1-3/8)	CR22H	CR22XH	CR22LLH/3AS	CR22XLLH/3AS	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF
38.100 (1-1/2)	CR24H	CR24XH	CR24LLH/3AS	CR24XLLH/3AS	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF
41.275 (1-5/8)	CR26H	CR26XH	CR26LLH/3AS	CR26XLLH/3AS	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF
44.450 (1-3/4)	CR28H	CR28XH	CR28LLH/3AS	CR28XLLH/3AS	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF
47.625 (1-7/8)	CR30H	CR30XH	CR30LLH/3AS	CR30XLLH/3AS	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF
50.800 (2)	CR32H	CR32XH	CR32LLH/3AS	CR32XLLH/3AS	22.225 (7/8)	31.750 (1-1/4)	30	33.3	84.1	50.8	7/8-14UNF
57.150 (2-1/4)	CR36H	CR36XH	CR36LLH/3AS	CR36XLLH/3AS	22.225 (7/8)	31.750 (1-1/4)	30	33.3	84.1	50.8	7/8-14UNF

Note:1. $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CR··XH and CR··XLLH types whose outside surface form is cylindrical.
注1）外径面が円筒であるCR··XH形，CR··XLLH形の外輪外径 D の許容差は $^{0}_{-0.025}$ である。



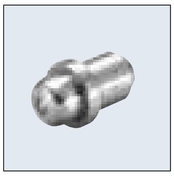
CR··LLH type (with cage, sealed)

CR··LLH形（保持器付シール形）

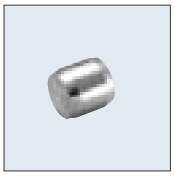
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
8,8-1	NIP-B3	SEN3	No. 10 32UNF
10～18	NIP-B4	SEN4	¼-28UNF～7/16 20UNF
20～36	NIP-B6	SEN6	½-20UNF～⅞ 14UNF

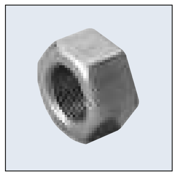
Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6



½-20UNF

Dimensions 寸法 mm						in	Basic load ratings 基本動定格荷重 dynamic N kgf	基本静定格荷重 static	Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)(参考)	Stud dia. スタッド径 mm (in)
G_1	B_3	C_1	n	a	e	h	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
6.4	—	0.8	—	—	10	⅛	2 820 287	2 450 250	790 81	2 090 213	20 000	28 000	2 0.2	0.009	**4.762** (3/18)
6.4	—	0.8	—	—	10	⅛	2 820 287	2 450 250	790 81	2 310 235	20 000	28 000	2 0.2	0.010	**4.762** (3/18)
7.9	—	0.8	—	—	12.5	⅛	4 050 415	4 000 405	1 080 110	3 000 310	18 000	25 000	4 0.4	0.020	**6.350** (¼)
7.9	—	0.8	—	—	12.5	⅛	4 050 415	4 000 405	1 080 110	3 300 335	※18 000	※25 000	4 0.4	0.022	**6.350** (¼)
9.5	6.35	0.8	4	3	16.5	3/16	5 300 540	6 650 680	1 380 140	4 600 470	※13 000	※16 000	13 1.3	0.037	**9.525** (⅜)
9.5	6.35	0.8	4	3	16.5	3/16	5 300 540	6 650 680	1 710 174	5 350 545	※13 000	※16 000	13 1.3	0.048	**9.525** (⅜)
12.7	6.35	0.8	4	3	21	¼	7 250 740	8 350 850	2 060 210	7 400 755	※12 000	※15 000	18 1.9	0.087	**11.112** (7/16)
12.7	6.35	0.8	4	3	21	¼	7 250 740	8 350 850	2 430 248	8 350 850	※12 000	※15 000	18 1.9	0.100	**11.112** (7/16)
15.9	7.94	0.8	6	3	25	¼	11 400 1 160	15 900 1 620	2 840 290	11 400 1 160	9 000	※13 000	24 2.4	0.150	**12.700** (½)
15.9	7.94	0.8	6	3	25	¼	11 400 1 160	15 900 1 620	3 250 330	12 500 1 280	9 000	※13 000	24 2.4	0.166	**12.700** (½)
19.1	9.53	0.8	6	4	30	5/16	13 300 1 360	20 100 2 120	3 600 365	16 300 1 660	7 500	10 000	51 5.2	0.225	**15.875** (⅝)
19.1	9.53	0.8	6	4	30	5/16	13 300 1 360	20 100 2 120	4 050 410	17 600 1 800	7 500	10 000	51 5.2	0.265	**15.875** (⅝)
22.2	11.11	0.8	6	4	36.5	5/16	20 700 2 110	33 500 3 450	4 400 450	21 600 2 200	6 000	8 000	92 9.3	0.375	**19.050** (¾)
22.2	11.11	0.8	6	4	36.5	5/16	20 700 2 110	33 500 3 450	4 850 495	23 200 2 360	6 000	8 000	92 9.3	0.420	**19.050** (¾)
25.4	12.7	0.8	8	5	42	7/16	28 900 2 950	55 000 5 600	5 300 540	31 000 3 150	5 000	6 600	150 15	0.505	**22.225** (⅞)
25.4	12.7	0.8	8	5	42	7/16	28 900 2 950	55 000 5 600	6 200 635	35 000 3 550	5 000	6 600	150 15	0.750	**22.225** (⅞)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考※印シール有りの場合の許容回転速度はおおよそ10 000r/minである。

Metric series | Inch series
With cage | Full-complement roller
Hexagonal socket | Tapped hole | Slot for screwdriver
Without seal | With seal

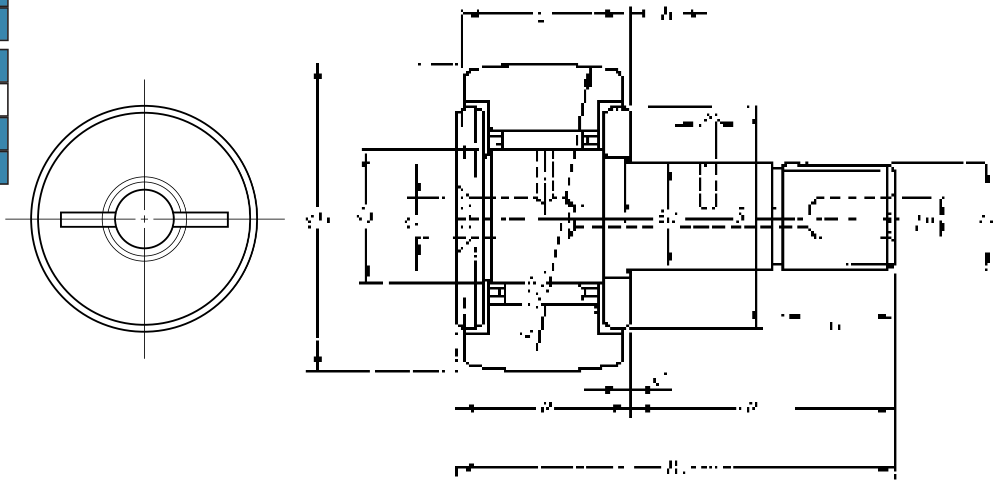
ミリ系 | インチ系
保持器付 | 総ころ
六角穴 | タップ穴 | ドライバ溝
シールなし | シール付

Cam Followers with Cage

保持器付カムフォロア

CR type
CR··X type
CR··LL type
CR··XLL type

CR形
CR··X形
CR··LL形
CR··XLL形

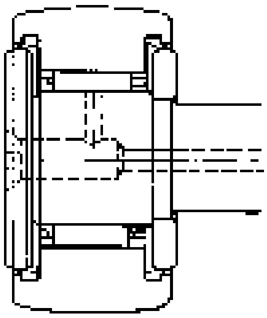


CR type (with cage)
CR形（保持器付）

OD[1)] 外径 mm (in) D $^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm (in)						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	$d_1\ ^{+0.025}_{0}$	$C\ ^{0}_{-0.130}$	F	B	B_1	B_2	G
12.700 (1/2)	CR8T2	CR8XT2	———	———	4.762 (3/16)	8.731 (11/32)	6	10.3	23	12.7	NO-10-32UNF
12.700 (1/2)	CR8-1T2	CR8-1XT2	———	———	4.762 (3/16)	9.525 (3/8)	6	11.1	27	15.9	NO-10-32UNF
15.875 (5/8)	CR10	CR10X	———	———	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF
15.875 (5/8)	CR10-1	CR10-1X	CR10-1LL/3AS	CR10-1XLL/3AS	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF
19.050 (3/4)	CR12	CR12X	CR12LL/3AS	CR12XLL/3AS	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF
22.225 (7/8)	CR14	CR14X	CR14LL/3AS	CR14XLL/3AS	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF
25.400 (1)	CR16	CR16X	CRV16LL/3AS	CR16XLL/3AS	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF
28.575 (1 1/8)	CR18	CR18X	CR18LL/3AS	CR18XLL/3AS	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF
31.750 (1 1/4)	CR20	CR20X	CR20LL/3AS	CR20XLL/3AS	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF
34.925 (1 3/8)	CR22	CR22X	CR22LL/3AS	CR22XLL/3AS	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF
38.100 (1 1/2)	CR24	CR24X	CR24LL/3AS	CR24XLL/3AS	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF
41.275 (1 5/8)	CR26	CR26X	CR26LL/3AS	CR26XLL/3AS	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF
44.450 (1 3/4)	CR28	CR28X	CR28LL/3AS	CR28XLL/3AS	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF
47.625 (1 7/8)	CR30	CR30X	CR30LL/3AS	CR30XLL/3AS	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF
50.800 (2)	CR32	CR32X	CR32LL/3AS	CR32XLL/3AS	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF
57.150 (2 1/4)	CR36	CR36X	CR36LL/3AS	CR36XLL/3AS	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF

Notes:1. $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CR··X and CR··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるCR··X形，CR··XLL形の外輪外径 D の許容差は $^{0}_{-0.025}$ である。
2）グリースの補給穴は正面（上図左側面）にだけ設けている。



CR··LL type (with cage, sealed)

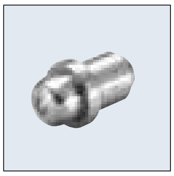
CR··LL形（保持器付シール形）

Accessories / 付属部品

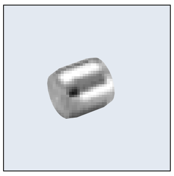
Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
8,8-1	NIP-B3	SEN3	No. 10 32UNF
10～18	NIP-B4	SEN4	¼-28UNF～7⁄16 20UNF
20～36	NIP-B6	SEN6	½-20UNF～⅞ 14UNF

Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.

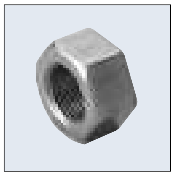
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6



½-20UNF

Dimensions 寸法 mm (in)						Basic load ratings 基本動定格荷重 / 基本静定格荷重 N kgf		Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm (in)
G_1	B_3	C_1	n	a	e	dynamic C_r	static C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
6.4	—	0.8	3[2)]	—	10	2 820 287	2 450 250	790 81	2 090 213	20 000	28 000	2 0.2	0.009	**4.762** (3⁄18)
6.4	—	0.8	3[2)]	—	10	2 820 287	2 450 250	790 81	2 310 235	20 000	28 000	2 0.2	0.010	**4.762** (3⁄18)
7.9	—	0.8	4[2)]	—	12.5	4 050 415	4 000 405	1 080 110	3 000 310	18 000	25 000	4 0.4	0.020	**6.350** (¼)
7.9	—	0.8	4[2)]	—	12.5	4 050 415	4 000 405	1 080 110	3 300 335	※18 000	※25 000	4 0.4	0.022	**6.350** (¼)
9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680	1 380 140	4 600 470	※13 000	※16 000	13 1.3	0.037	**9.525** (⅜)
9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680	1 710 174	5 350 545	※13 000	※16 000	13 1.3	0.048	**9.525** (⅜)
12.7	6.35	0.8	4	3	21	7 250 740	8 350 850	2 060 210	7 400 755	※12 000	※15 000	18 1.9	0.087	**11.112** (7⁄16)
12.7	6.35	0.8	4	3	21	7 250 740	8 350 850	2 430 248	8 350 850	※12 000	※15 000	18 1.9	0.100	**11.112** (7⁄16)
15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620	2 840 290	11 400 1 160	9 000	※13 000	24 2.4	0.150	**12.700** (½)
15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620	3 250 330	12 500 1 280	9 000	※13 000	24 2.4	0.166	**12.700** (½)
19.1	9.53	0.8	6	4	30	13 300 1 360	20 100 2 120	3 600 365	16 300 1 660	7 500	10 000	51 5.2	0.225	**15.875** (⅝)
19.1	9.53	0.8	6	4	30	13 300 1 360	20 100 2 120	4 050 410	17 600 1 800	7 500	10 000	51 5.2	0.265	**15.875** (⅝)
22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450	4 400 450	21 600 2 200	6 000	8 000	92 9.3	0.375	**19.050** (¾)
22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450	4 850 495	23 200 2 360	6 000	8 000	92 9.3	0.420	**19.050** (¾)
25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600	5 300 540	31 000 3 150	5 000	6 600	150 15	0.505	**22.225** (⅞)
25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600	6 200 635	35 000 3 550	5 000	6 600	150 15	0.750	**22.225** (⅞)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.

備考※印シール有りの場合の許容回転速度はおおよそ10 000r/minである。

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal	With seal	

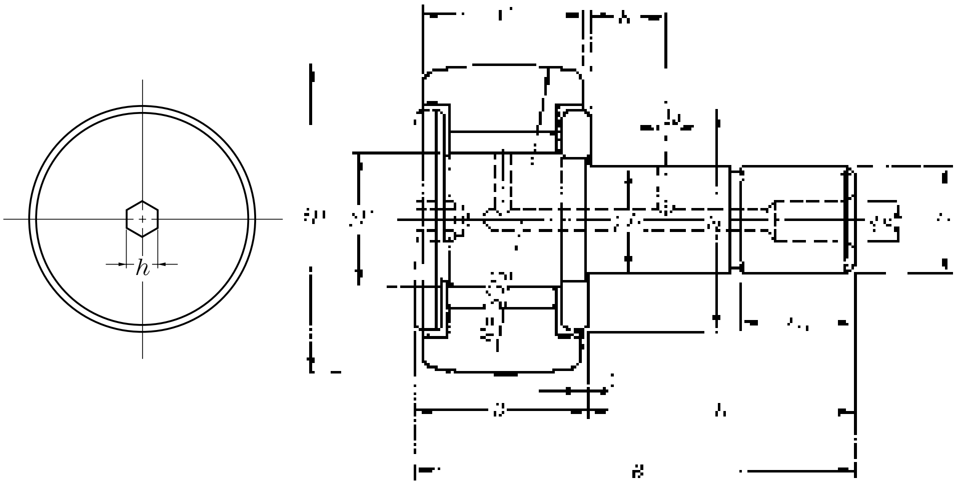
ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
シールなし	シール付	

Full-Complement Roller-Type Cam Followers

総ころ形カムフォロア

CRV･･H type
CRV･･XH type
CRV･･LLH type
CRV･･XLLH type

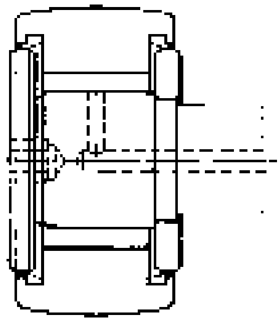
CRV･･H形
CRV･･XH形
CRV･･LLH形
CRV･･XLLH形



CRV･･H type (Full-complement roller type)
CRV･･H形（総ころ形）

OD[1)] 外径 mm (in) D $^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm (in)						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	$d_1\ ^{+0.025}_{0}$	$C\ ^{0}_{-0.130}$	F	B	B_1	B_2	G
12.700 (1/2)	CRV8H/3AS	CRV8XH/3AS	CRV8LLH/3AS	CRV8XLLH/3AS	4.826 (—)	8.731 (11/32)	5.75	10.3	23	12.7	NO-10-32UNF
12.700 (1/2)	CRV8-1H/3AS	CRV8-1XH/3AS	CRV8-1LLH/3AS	CRV8-1XLLH/3AS	4.826 (—)	9.525 (3/8)	5.75	11.1	27	15.9	NO-10-32UNF
15.875 (5/8)	CRV10H/3AS	CRV10XH/3AS	CRV10LLH/3AS	CRV10XLLH/3AS	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF
15.875 (5/8)	CRV10-1H/3AS	CRV10-1XH/3AS	CRV10-1LLH/3AS	CRV10-1XLLH/3AS	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF
19.050 (3/4)	CRV12H/3AS	CRV12XH/3AS	CRV12LLH/3AS	CRV12XLLH/3AS	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF
22.225 (7/8)	CRV14H/3AS	CRV14XH/3AS	CRV14LLH/3AS	CRV14XLLH/3AS	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF
25.400 (1)	CRV16H/3AS	CRV16XH/3AS	CRV16LLH/3AS	CRV16XLLH/3AS	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF
28.575 (1 1/8)	CRV18H/3AS	CRV18XH/3AS	CRV18LLH/3AS	CRV18XLLH/3AS	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF
31.750 (1 1/4)	CRV20H/3AS	CRV20XH/3AS	CRV20LLH/3AS	CRV20XLLH/3AS	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF
34.925 (1 3/8)	CRV22H/3AS	CRV22XH/3AS	CRV22LLH/3AS	CRV22XLLH/3AS	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF
38.100 (1 1/2)	CRV24H/3AS	CRV24XH/3AS	CRV24LLH/3AS	CRV24XLLH/3AS	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF
41.275 (1 5/8)	CRV26H/3AS	CRV26Xh/3AS	CRV26LLH/3AS	CRV26XLLH/3AS	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF
44.450 (1 3/4)	CRV28H/3AS	CRV28XH/3AS	CRV28LLH/3AS	CRV28XLLH/3AS	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF
47.625 (1 7/8)	CRV30H/3AS	CRV30XH/3AS	CRV30LLH/3AS	CRV30XLLH/3AS	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF
50.800 (2)	CRV32H/3AS	CRV32XH/3AS	CRV32LLH/3AS	CRV32XLLH/3AS	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF
57.150 (2 1/4)	CRV36H/3AS	CRV36XH/3AS	CRV36LLH/3AS	CRV36XLLH/3AS	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF
63.500 (2 1/2)	CRV40H/3AS	CRV40XH/3AS	CRV40LLH/3AS	CRV40XLLH/3AS	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF
69.850 (2 3/4)	CRV44H/3AS	CRV44XH/3AS	CRV44LLH/3AS	CRV44XLLH/3AS	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF
76.200 (3)	CRV48H/3AS	CRV48XH/3AS	CRV48LLH/3AS	CRV48XLLH/3AS	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF
82.550 (3 1/4)	CRV52H/3AS	CRV52XH/3AS	CRV52LLH/3AS	CRV52XLLH/3AS	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF
88.900 (3 1/2)	CRV56H/3AS	CRV56XH/3AS	CRV56LLH/3AS	CRV56XLLH/3AS	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF
101.600 (4)	CRV64H/3AS	CRV64XH/3AS	CRV64LLH/3AS	CRV64XLLH/3AS	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF
127.000 (5)	CRV80H/3AS	CRV80XH/3AS	CRV80LLH/3AS	CRV80XLLH/3AS	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF
152.400 (6)	CRV96H/3AS	CRV96XH/3AS	CRV96LLH/3AS	CRV96XLLH/3AS	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF

Note:1. $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CRV･･XH and CRV･･XLLH types whose outside surface form is cylindrical.
注1）外径面が円筒であるCRV･･XH形，CRV･･XLLH形の外輪外径 D の許容差は $^{0}_{-0.025}$ である。



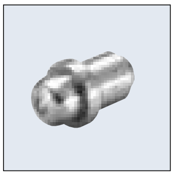
CRV‥LLH type
(Full-complement roller type, with seal)

CRV‥LLH形（総ころシール形）

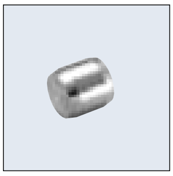
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
8～10-1	—	—	No.10-32UNF～ 1/4-28UNF
12～18	NIP-B4	SEN4	3/8-24UNF～7/16-20UNF
20～44	NIP-B6	SEN6	1/2-20UNF～ 1 -14UNF
48～96	NIP-B8	SEN8	1 1/4-12UNF～2 1/2-12UNF

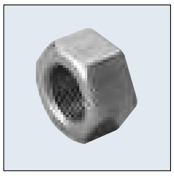
Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6



1/2-20UNF

Dimensions 寸法 mm						in	Basic load ratings 基本動定格荷重 dynamic N kgf	static 基本静定格荷重	Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm (in)
G_1	B_3	C_1	n	a	e	h	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
6.4	—	0.8	—	—	10	1/8	3 400 350	3 750 385	790 81	2 090 213	※17 000	※22 000	2 0.2	0.010	**4.826** (—)
6.4	—	0.8	—	—	10	1/8	3 400 350	3 750 385	790 81	2 310 235	※17 000	※22 000	2 0.2	0.011	**4.826** (—)
7.9	—	0.8	—	—	12.5	1/8	5 550 565	7 600 770	1 080 110	3 000 310	※12 000	※15 000	4 0.4	0.020	**6.350** (1/4)
7.9	—	0.8	—	—	12.5	1/8	6 200 630	8 700 885	1 080 110	3 300 335	※12 000	※15 000	4 0.4	0.022	**6.350** (1/4)
9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360	1 380 140	4 600 470	9 000	※11 000	13 1.3	0.038	**9.525** (3/8)
9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360	1 710 174	5 350 545	9 000	※11 000	13 1.3	0.048	**9.525** (3/8)
12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920	2 060 210	7 400 755	7 100	9 200	18 1.9	0.080	**11.112** (7/16)
12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920	2 430 248	8 350 850	7 100	9 200	18 1.9	0.096	**11.112** (7/16)
15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600	2 840 290	11 400 1 160	5 400	7 000	24 2.4	0.140	**12.700** (1/2)
15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600	3 250 330	12 500 1 280	5 400	7 000	24 2..4	0.165	**12.700** (1/2)
19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650	3 600 365	16 300 1 660	4 800	6 200	51 5.2	0.240	**15.875** (5/8)
19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650	4 050 410	17 600 1 800	4 800	6 200	51 5.2	0.280	**15.875** (5/8)
22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150	4 400 450	21 600 2 200	4 100	5 300	92 9.3	0.400	**19.050** (3/4)
22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150	4 850 495	23 200 2 360	4 100	5 300	92 9.3	0.440	**19.050** (3/4)
25.4	12.7	0.8	6	5	36.5	7/16	41 000 4 200	87 500 8 950	5 300 540	31 000 3 150	3 700	4 800	150 15	0.650	**22.225** (7/8)
25.4	12.7	0.8	6	5	36.5	7/16	41 000 4 200	87 500 8 950	6 200 635	35 000 3 550	3 700	4 800	150 15	0.780	**22.225** (7/8)
28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200	7 200 735	44 500 4 550	3 200	4 100	230 23	1.20	**25.400** (1)
28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200	8 250 840	49 000 5 000	3 200	4 100	230 23	1.34	**25.400** (1)
31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000	9 150 935	64 000 6 500	2 700	3 500	435 45	1.92	**31.750** (1 1/4)
31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000	10 000 1 020	69 000 7 050	2 700	3 500	435 45	2.20	**31.750** (1 1/4)
34.9	17.46	0.8	8	5	60	5/8	84 500 8 650	214 000 21 800	11 100 1 130	86 500 8 800	2 200	2 800	580 60	2.92	**34.925** (1 3/8)
38.1	19.05	0.8	8	5	63	3/4	106 000 10 800	244 000 24 900	13 200 1 350	113 000 11 500	2 200	2 800	760 78	4.32	**38.100** (1 1/2)
65.1	22.23	0.8	8	5	89	7/8	189 000 19 300	520 000 53 000	17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	8.80	**50.800** (2)
76.2	25.4	0.8	8	5	110	1	260 000 26 500	675 000 68 500	22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	15.3	**63.500** (2 1/2)

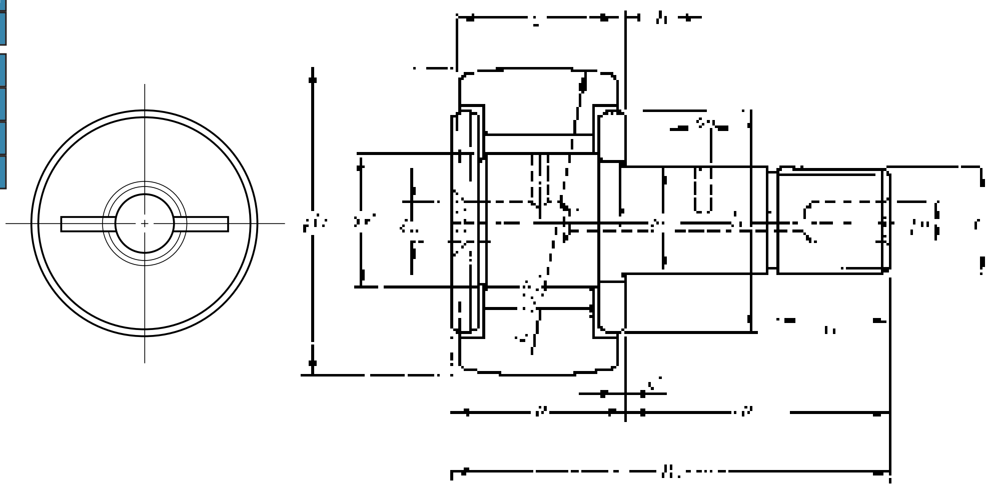
Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考※印シール有りの場合の許容回転速度はおおよそ10 000r/minである。

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket / Tapped hole	Slot for screwdriver
Without seal	With seal
ミリ系	インチ系
保持器付	総ころ
六角穴 / タップ穴	ドライバ溝
シールなし	シール付

Full-Complement Roller-Type Cam Followers
総ころ形カムフォロア

CRV type
CRV··X type
CRV··LL type
CRV··XLL type

CRV形
CRV··X形
CRV··LL形
CRV··XLL形

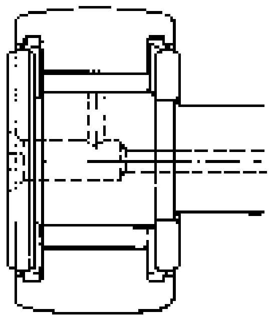


CRV type (Full-complement roller type)
CRV形（総ころ形）

OD[1)] 外径 mm (in) D $\,^{0}_{-0.05}$	Cam Follower number 呼び番号				Dimensions 寸法 mm (in)						
	Without seal シールなし		With seal シール有り								
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	$d_1\,^{+0.025}_{0}$	$C\,^{0}_{-0.130}$	F	B	B_1	B_2	G
12.700 (1/2)	CRV8/3AS	CRV8X/3AS	CRV8LL/3AS	CRV8XLL/3AS	4.826 (—)	8.731 (11/32)	5.75	10.3	23	12.7	NO-10-32UNF
12.700 (1/2)	CRV8-1/3AS	CRV8-1X/3AS	CRV8-1LL/3AS	CRV8-1XLL/3AS	4.826 (—)	9.525 (3/8)	5.75	11.1	27	15.9	NO-10-32UNF
15.875 (5/8)	CRV10/3AS	CRV10X/3AS	CRV10LL/3AS	CRV10XLL/3AS	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF
15.875 (5/8)	CRV10-1/3AS	CRV10-1X/3AS	CRV10-1LL/3AS	CRV10-1XLL/3AS	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF
19.050 (3/4)	CRV12/3AS	CRV12X/3AS	CRV12LL/3AS	CRV12XLL/3AS	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF
22.225 (7/8)	CRV14/3AS	CRV14X/3AS	CRV14LL/3AS	CRV14XLL/3AS	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF
25.400 (1)	CRV16/3AS	CRV16X/3AS	CRV16LL/3AS	CRV16XLL/3AS	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF
28.575 (1 1/8)	CRV18/3AS	CRV18X/3AS	CRV18LL/3AS	CRV18XLL/3AS	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF
31.750 (1 1/4)	CRV20/3AS	CRV20X/3AS	CRV20LL/3AS	CRV20XLL/3AS	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF
34.925 (1 3/8)	CRV22/3AS	CRV22X/3AS	CRV22LL/3AS	CRV22XLL/3AS	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF
38.100 (1 1/2)	CRV24/3AS	CRV24X/3AS	CRV24LL/3AS	CRV24XLL/3AS	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF
41.275 (1 5/8)	CRV26/3AS	CRV26X/3AS	CRV26LL/3AS	CRV26XLL/3AS	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF
44.450 (1 3/4)	CRV28/3AS	CRV28X/3AS	CRV28LL/3AS	CRV28XLL/3AS	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF
47.625 (1 7/8)	CRV30/3AS	CRV30X/3AS	CRV30LL/3AS	CRV30XLL/3AS	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF
50.800 (2)	CRV32/3AS	CRV32X/3AS	CRV32LL/3AS	CRV32XLL/3AS	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF
57.150 (2 1/4)	CRV36/3AS	CRV36X/3AS	CRV36LL/3AS	CRV36XLL/3AS	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF
63.500 (2 1/2)	CRV40/3AS	CRV40X/3AS	CRV40LL/3AS	CRV40XLL/3AS	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF
69.850 (2 3/4)	CRV44/3AS	CRV44X/3AS	CRV44LL/3AS	CRV44XLL/3AS	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF
76.200 (3)	CRV48/3AS	CRV48X/3AS	CRV48LL/3AS	CRV48XLL/3AS	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF
82.550 (3 1/4)	CRV52/3AS	CRV52X/3AS	CRV52LL/3AS	CRV52XLL/3AS	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF
88.900 (3 1/2)	CRV56/3AS	CRV56X/3AS	CRV56LL/3AS	CRV56XLL/3AS	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF
101.600 (4)	CRV64/3AS	CRV64X/3AS	CRV64LL/3AS	CRV64XLL/3AS	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF
127.000 (5)	CRV80/3AS	CRV80X/3AS	CRV80LL/3AS	CRV80XLL/3AS	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF
152.400 (6)	CRV96/3AS	CRV96X/3AS	CRV96LL/3AS	CRV96XLL/3AS	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF

Notes:1. $\,^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the CRV··X and CRV··XLL types whose outside surface form is cylindrical.
2. The grease port is situated only in the front (in the left side face in the diagram above).

注1）外径面が円筒であるCRV··X形，CRV··XLL形の外輪外径 D の許容差は $\,^{0}_{-0.025}$ である。
2）グリースの補給穴は正面（上図左側面）にだけ設けている。

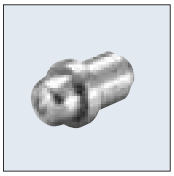


CRV‥LL type
(Full-complement roller type, with seal)
CRV‥LL形（総ころシール形）

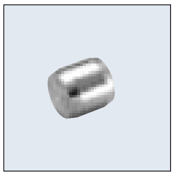
Accessories / 付属部品

Applicable bearing number 適用軸受 呼び番号	Grease nipple number グリースニップル 呼び番号	Plug number プラグ 呼び番号	Applicable hexagonal nut 適用六角ナット
8,8-1	NIP-B3	SEN3	No.10-32UNF
10～18	NIP-B4	SEN4	1/4-28UNF～7/16-20UNF
20～44	NIP-B6	SEN6	1/2-20UNF～ 1 -14UNF
48～96	NIP-B8	SEN8	1 1/4-12UNF～2 1/2-12UNF

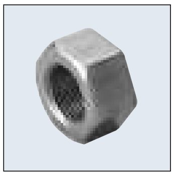
Note: The boundary dimensions of the grease nipples and plugs are listed in **Table 3** on page 9 and **Table 5** on page 10.
※グリースニップル及びプラグの主要寸法は9ページ**表3**，10ページ**表5**に示す。



NIP-B6



SEN6

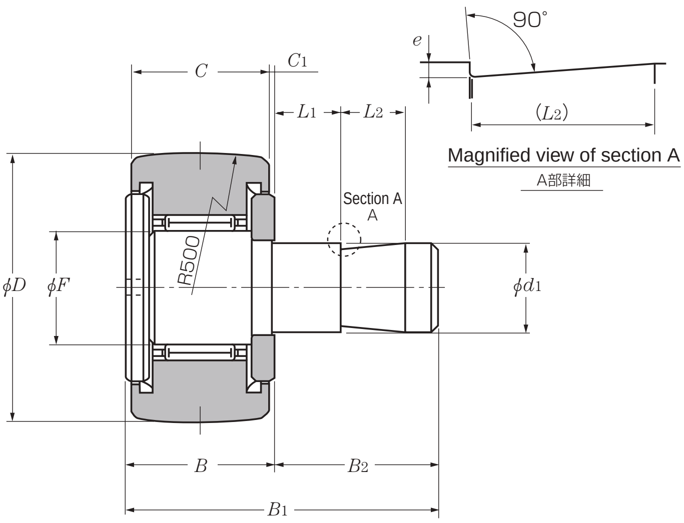


1/2-20UNF

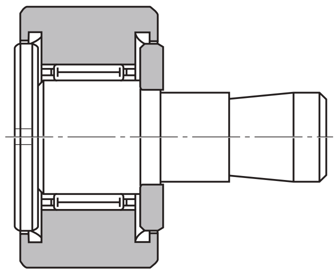
Dimensions 寸法 mm (in)						Basic load ratings 基本動定格荷重 dynamic / 基本静定格荷重 static N kgf		Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Maximum tightening torque 締付最大トルク N·m kgf·m	Mass 質量 kg (approx.)（参考）	Stud dia. スタッド径 mm (in)
G_1	B_3	C_1	n	a	e	C_r	C_{or}	Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑			
6.4	—	0.8	3[2)]	—	10	3 400 350	3 750 385	790 81	2 090 213	※17 000	※22 000	2 0.2	0.010	**4.826** (—)
6.4	—	0.8	3[2)]	—	10	3 400 350	3 750 385	790 81	2 310 235	※17 000	※22 000	2 0.2	0.011	**4.826** (—)
7.9	—	0.8	4[2)]	—	12.5	5 550 565	7 600 770	1 080 110	3 000 310	※12 000	※15 000	4 0.4	0.020	**6.350** (1/4)
7.9	—	0.8	4[2)]	—	12.5	6 200 630	8 700 885	1 080 110	3 300 335	※12 000	※15 000	4 0.4	0.022	**6.350** (1/4)
9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360	1 380 140	4 600 470	9 000	※11 000	13 1.3	0.038	**9.525** (3/8)
9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360	1 710 174	5 350 545	9 000	※11 000	13 1.3	0.048	**9.525** (3/8)
12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920	2 060 210	7 400 755	7 100	9 200	18 1.9	0.080	**11.112** (7/16)
12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920	2 430 248	8 350 850	7 100	9 200	18 1.9	0.096	**11.112** (7/16)
15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600	2 840 290	11 400 1 160	5 400	7 000	24 2.4	0.140	**12.700** (1/2)
15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600	3 250 330	12 500 1 280	5 400	7 000	24 2.4	0.165	**12.700** (1/2)
19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650	3 600 365	16 300 1 660	4 800	6 200	51 5.2	0.240	**15.875** (5/8)
19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650	4 050 410	17 600 1 800	4 800	6 200	51 5.2	0.280	**15.875** (5/8)
22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150	4 400 450	21 600 2 200	4 100	5 300	92 9.3	0.400	**19.050** (3/4)
22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150	4 850 495	23 200 2 360	4 100	5 300	92 9.3	0.440	**19.050** (3/4)
25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950	5 300 540	31 000 3 150	3 700	4 800	150 15	0.650	**22.225** (7/8)
25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950	6 200 635	35 000 3 550	3 700	4 800	150 15	0.780	**22.225** (7/8)
28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200	7 200 735	44 500 4 550	3 200	4 100	230 23	1.20	**25.400** (1)
28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200	8 250 840	49 000 5 000	3 200	4 100	230 23	1.34	**25.400** (1)
31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000	9 150 935	64 000 6 500	2 700	3 500	435 45	1.92	**31.750** (1 1/4)
31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000	10 000 1 020	69 000 7 050	2 700	3 500	435 45	2.20	**31.750** (1 1/4)
34.9	17.46	0.8	8	5	60	84 500 8 650	214 000 21 800	11 100 1 130	86 500 8 800	2 200	2 800	580 60	2.92	**34.925** (1 3/8)
38.1	19.05	0.8	8	5	63	106 000 10 800	244 000 24 900	13 200 1 350	113 000 11 500	2 200	2 800	760 78	4.32	**38.100** (1 1/2)
65.1	22.23	0.8	8	5	89	189 000 19 300	520 000 53 000	17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	8.80	**50.800** (2)
76.2	25.4	0.8	8	5	110	260 000 26 500	675 000 68 500	22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	15.3	**63.500** (2 1/2)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考※印シール有りの場合の許容回転速度はおおよそ10 000r/minである。

Cam Followers for Pallet Changers
パレットチェンジャー用カムフォロア



Spherical Outer Ring
（外輪外径球面）

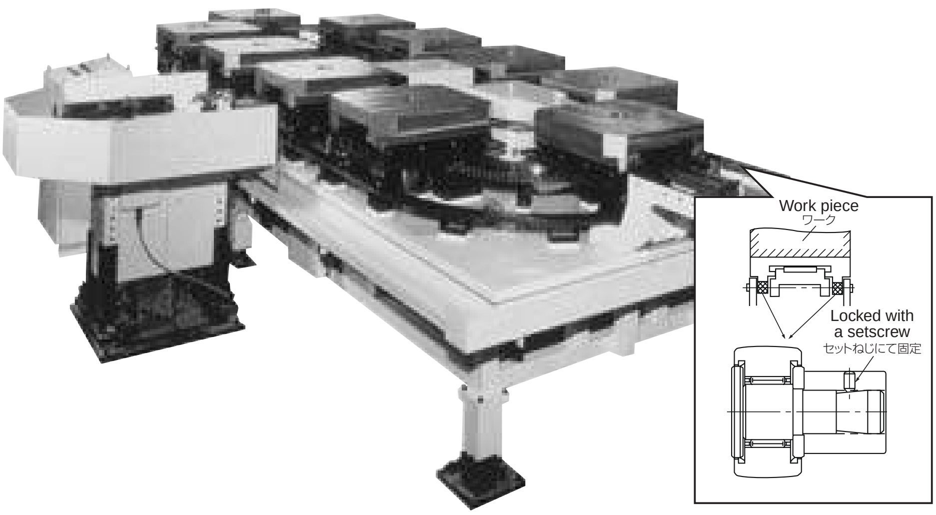


Cylindrical Outer Ring
（外輪外径円筒）

OD 外径 mm D	Cam Follower number 呼び番号		Dimensions 寸法 mm									
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d_1	C	F	B_1	B_2	B	L_1	L_2	e	C_1
16	KRX6×16×32-4/3AS	KRX6×16×32-2/3AS	$6^{\ 0}_{-0.012}$	11	8	32	20	12	5	10	0.3	0.6
19	KRX8×19×32-9/3AS	KRX8×19×32-7/3AS	$8^{\ 0}_{-0.015}$	11	10	32	20	12	5	10	0.5	0.6
22	KRX10×22×33-3/3AS	KRX10×22×33-1/3AS	$10^{\ 0}_{-0.015}$	12	12	33	20	13	5	10	0.5	0.6
26	KRX10×26×33-4/3AS	KRX10×26×33-2/3AS	$10^{\ 0}_{-0.015}$	12	12	33	20	13	5	10	0.5	0.6
30	KRX12×30×35-3/3AS	KRX12×30×35/3AS	$12^{\ 0}_{-0.018}$	14	15	35	20	15	5	10	1	0.6
32	KRX12×32×35-3/3AS	KRX12×32×35-1/3AS	$12^{\ 0}_{-0.018}$	14	15	35	20	15	5	10	1	0.6
35	KRX16×35×44.5-1/3AS	KRX16×35×44.5-3/3AS	$16^{\ 0}_{-0.018}$	18	18	44.5	25	19.5	10	10	1	0.8
40	KRX18×40×46.5-6/3AS	KRX18×40×46.5-4/3AS	$18^{\ 0}_{-0.018}$	20	22	46.5	25	21.5	10	10	1	0.8
47	KRX20×47×50.5-1/3AS	KRX20×47×50.5-3/3AS	$20^{\ 0}_{-0.021}$	24	25	50.5	25	25.5	10	10	1	0.8
52	KRX20×52×50.5-3/3AS	KRX20×52×50.5-1/3AS	$20^{\ 0}_{-0.021}$	24	25	50.5	25	25.5	10	10	1	0.8

Notes: 1. The grease for prelubrication is 3AS.
2. **NTN** can provide cam followers without seals on request.
3. The dimensional tolerance of outside diameter D of the outer ring of the spherical form is $^{\ 0}_{-0.05}$ and that of the cylindrical form is JIS Class 0.

※封入グリースは3AS。
※シールなしタイプも対応可。
※外輪外径寸法（D 寸法）許容差は球面外輪のものは $^{\ 0}_{-0.05}$ ，円筒外輪のものはJIS 0級である。



Typical application of a cam follower for a pallet changer
Photo courtesy of Tsudakoma Corp.
（パレットチェンジャー用カムフォロア使用例）
写真提供：津田駒工業（株）殿

Basic load ratings dynamic 基本動定格荷重 N kgf C_r	static 基本静定格荷重 C_{or}	Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Stud dia. スタッド径 mm
4 050 415	4200 430	1 080 110	3 400 350	10 000	**6**
4 750 480	5 400 555	1 380 141	4 050 415	10 000	**8**
5 300 540	6 650 680	1 690 172	5 150 525	10 000	**10**
5 300 540	6 650 680	2 120 216	6 100 620	10 000	**10**
7 850 800	9 650 985	2 620 267	7 700 785	10 000	**12**
7 850 800	9 650 985	2 860 291	8 200 835	10 000	**12**
12 200 1 240	17 900 1 830	3 200 325	11 900 1 220	8 000	**16**
14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	**18**
20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	**20**
20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	6 000	**20**

Roller Followers
(Yoke-Type Track Rollers)
ローラフォロア（ヨーク形トラックローラ）

CONTENTS

Construction and Characteristics

NTN roller followers are track rollers each comprise a thick-walled outer ring encompassing integral rollers. Roller followers are designed to operate with outer rings rolling on the track.

Because it is run in direct contact with the track, the outer ring is designed with a thick wall capable of withstanding an impact load.

The outside surface of the outer ring is either spherical or cylindrical in shape. A spherical outer ring can effectively withstand edge loads that result from mounting error.

Because the cylindrical outer ring is in contact with a larger area of the associated track surface, the contact surface pressure is decreased. Thus, this type of outer ring can bear a larger load compared with spherical outer rings and can be used even if the hardness of the associated track surface is low.

NTN roller followers can be categorized into caged and full-complement roller types. With the caged type, the rollers are guided by the cage, making this type suitable for high-speed applications.

The full-complement roller type, by contrast, has an increased load rating, making it suitable for high-load applications (low-speed operation). The double-row cylindrical roller types (NUTR and NUTW types) can bear a even higher load.

In addition to unsealed configurations, **NTN** roller followers are available in with either rubber seals or labyrinth seals (shield plates). Roller followers with seals and full-complement roller-type roller followers are prelubricated with standard grease (lithium soap grease).

構造と特徴

NTNローラフォロアは，肉厚の外輪にころを組込んだトラッククローラで，軌道（トラック）上を外輪が転がり運動する。

外輪は，直接トラックに接触させて使用するため，肉厚の外輪として衝撃荷重にも有効な設計にしている。

外輪外径は球面と円筒面があり，球面外輪は取付誤差によるエッジロード緩和に有効である。

また，円筒外輪は相手トラック面との接触面積が大きいので，接触面圧が軽減され球面外輪に比べ大きな荷重や相手トラック面の硬度が低い場合でも使用できる。

NTNローラフォロアは，保持器付き形と総ころ形とがあり，保持器付き形は保持器によってころが案内されるため，高速回転での使用に適している。

また，総ころ形は保持器付き形に比べ定格荷重が大きく高荷重（低速運転）での用途に適しており，複列円筒ころ形（NUTR形，NUTW形）はさらに高荷重を負荷することができる。

NTNローラフォロアは，シールなしの他にシールあり，ラビリンスシール（シールド板）付きの形式が用意されており，シール付き及び総ころ形は標準グリース（リチウム石けん基グリース）が封入されている。

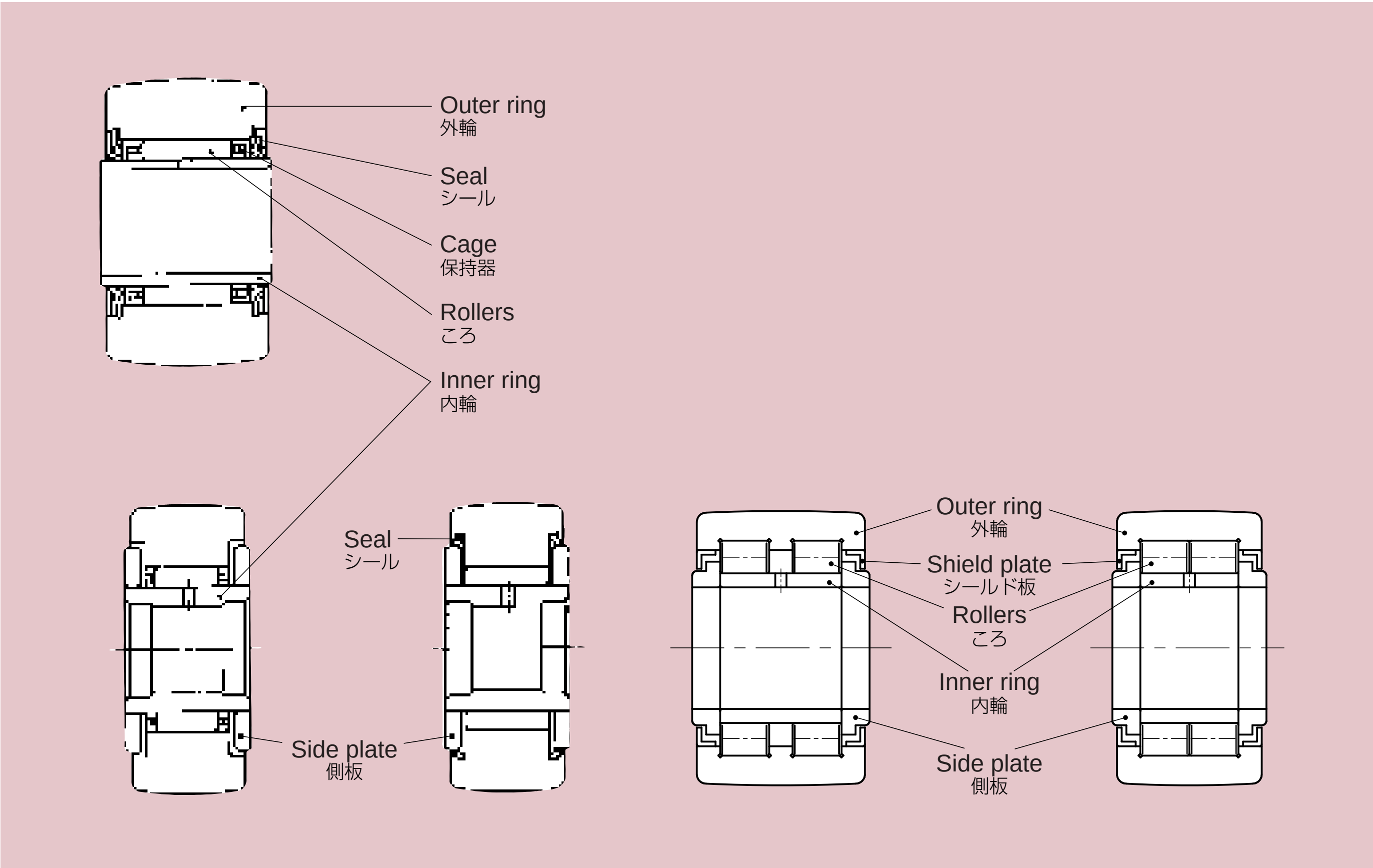
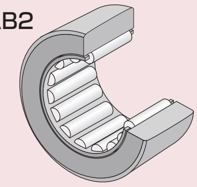
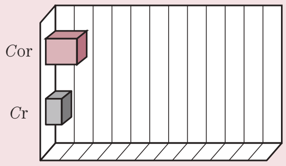
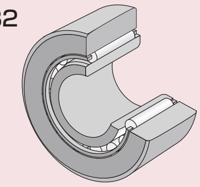
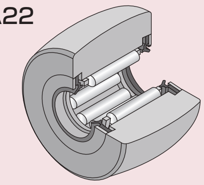
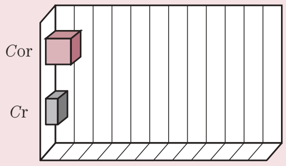
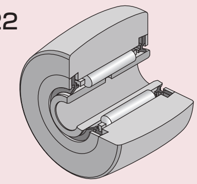
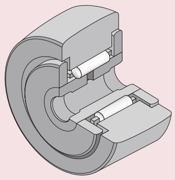
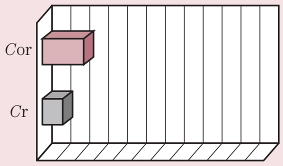
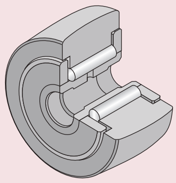
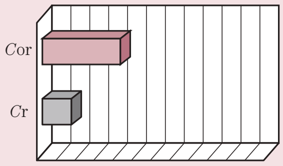
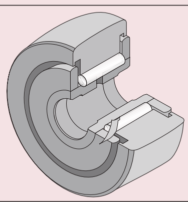
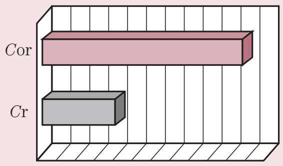
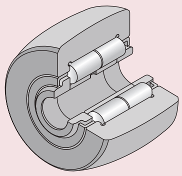
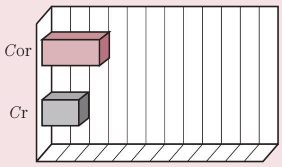
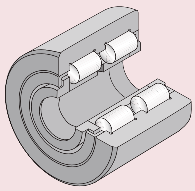
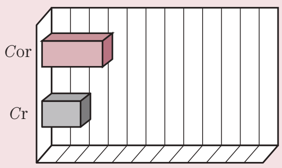


Fig.9 Roller follower components
部品名称

Construction and Characteristics
構造と特徴

Follower type 形　式	Shaft diameter (mm) 適用軸径	Load capacity 負荷容量	Bearing nomenclate 呼び番号の構成
RNAB2 	ϕ7～ϕ60	 NAB210	**RNAB 2 02** Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号
NAB2 	ϕ6～ϕ50		**NAB 2 06 X** Suffix 接尾記号 Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号
RNA22 	ϕ10～ϕ58	 NA2210LL	**RNA 22 / 6 LL / 3AS** Suffix 接尾記号 LL ：Seal シール 3AS：grease グリース Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号
NA22 	ϕ6～ϕ50		**NA 22 06 X LL / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 LL ：Seal シール 3AS：grease グリース Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号
NATR 	ϕ5～ϕ50	 NATR50	**NATR 30 X LL / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 LL ：Seal シール 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
NATV 	ϕ5～ϕ50	 NATV50	**NATV 25 LL / 3AS** Suffix 接尾記号 LL ：Seal シール 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
NACV 	ϕ6.35～ϕ57.15	 NACV80	**NACV 32 X LL / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 LL ：Seal シール 3AS：grease グリース Dimension code 寸法記号 Type code 形式記号
NUTR 	ϕ15～ϕ50	 NUTR310	**NUTR 3 10 / 3AS** Suffix 接尾記号 3AS：grease グリース Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号
NUTW 	ϕ15～ϕ50	 NUTW210	**NUTW 2 05 X / 3AS** Suffix 接尾記号 X ：Cylindrical outside surface 円筒外径 3AS：grease グリース Dimension code 寸法記号 Dimension series code 寸法系列記号 Type code 形式記号

※Each listed load capacity refers to a bearing diameter of ϕ50 (NACV ϕ44.45).
負荷容量の基準軸受内径は，ϕ50（NACVはϕ44.45）時の値である。

Follower components 構成内容	Features 特　徴
Inscribed circle diameter : φ20 Type with cage Inner ring : not included Outer profile : spherical 内接円径 ： φ20 保持器付き形 内輪 ：なし 外径形状 ：球面形状	● Inner ring (NAB2 type only) is separable from outer ring, needle rollers, and cage. ● The cage guides needle rollers. ● Use a shaft (pin) with a flange or a thrust washer to guide the outer ring. ● The accuracy and hardness of the shaft (pin) impact the performance of the RNAB2 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (page 62 to 63). ● 内輪（NAB2形のみ），外輪，保持器付き針状ころが分離するタイプ。 ● 保持器が針状ころを案内。 ● 軸（ピン）に外輪を案内できるスラストワッシャ又は，フランジを設ける必要がある。 ● 内輪のないRNAB2形を使用する場合，軸（ピン）の精度，硬度に留意が必要。軌道面の精度の項，軌道に用いる材料と硬さの項（共に62～63ページ）を参照。
Nominal bore diameter : φ30 Type with cage Inner ring : included Outer profile : cylindrical 内径 ：φ30 保持器付き形 内輪 ：有り 外径形状 ：円筒形状	
Inscribed circle diameter : φ6 Type with cage Inner ring : not included Outer profile : spherical Seal : included Grease : prelubricated 内接円径 ： φ6 保持器付き形 内輪 ：なし 外径形状 ：球面形状 シール ：シール付き グリース ：封入済	● The needle rollers and the cage are retained in the outer ring by a steel-plate-reinforced synthetic rubber seal. ● The cage guides needle rollers. ● Use a shaft (pin) with a flange or a thrust washer to guide the outer ring. ● The accuracy and hardness of the shaft (pin) impact the performance of the RNA22 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (page 62 to 63). ● 外輪に針状ころ，保持器が鋼板で補強された合成ゴムシールで保持されそれぞれが分離しない。 ● 保持器が針状ころを案内。 ● 軸（ピン）に外輪を案内できるスラストワッシャ又は，フランジを設ける必要がある。 ● 内輪のないRNA22形を使用する場合，軸（ピン）の精度，硬度に留意が必要。軌道面の精度の項，軌道に用いる材料と硬さの項（共に62～63ページ）を参照。
Nominal bore diameter : φ30 Type with cage Inner ring : included Outer profile : cylindrical Seal : included Grease : prelubricated 内径 ： φ30 保持器付き形 内輪 ：有り 外径形状 ：円筒形状 シール ：シール付き グリース ：封入済	
Nominal bore diameter : φ30 Type with cage Outer profile : cylindrical Seal : included Grease : prelubricated 内径 ： φ30 保持器付き形 外径形状 ：円筒形状 シール ：シール付き グリース ：封入済	● Needle rollers guided by cage. ● Outer ring is guided in axial direction by thrust washer press-fit into inner ring. ● Labyrinth is formed between the outer ring and the thrust washer. ● 保持器が針状ころを案内。 ● 内輪に圧入されたスラストワッシャが外輪のアキシアル方向の案内をしている。 ● 外輪とスラストワッシャの間は，ラビリンスを形成している。
Nominal bore diameter : φ25 Full complement roller type Outer profile : spherical Seal : included Grease : prelubricated 内径 ： φ25 総ころ形 外径形状 ：球面形状 シール ：シール付き グリース ：封入済	● Outer ring is guided in axial direction by thrust washer press-fit into inner ring. ● High load rating due to the full complement of needle rollers. ● Lower allowable running speed than bearing with cage. ● Labyrinth is formed between the outer ring and the thrust washer. ● 内輪に圧入されたスラストワッシャが外輪のアキシアル方向の案内をしている。 ● 総ころ形式のため定格荷重が大きい。 ● 許容回転速度が保持器付きより低い。 ● 外輪とスラストワッシャの間はラビリンスを形成している。
Nominal bore diameter : φ15.875 Full complement roller type Outer profile : spherical Seal : included Grease : prelubricated 内径 ： φ15.875 総ころ形 外径形状 ：円筒形状 シール ：シール付き グリース ：封入済	
Nominal bore diameter : φ50 Labyrinth seal Outer profile : spherical Grease : prelubricated 内径 ：φ50 複列円筒ころ総ころ形 ラビリンスシール 外径形状 ：球面形状 グリース ：封入済	● High load rating, best-suited to applications subjected to high load and shock load. ● A steel plate is press-fit into the outer ring to form a labyrinth with the side plates on both sides of the inner ring, and the side plates are held so as not to separate from one another and make a good seal. ● The inner ring and the side plates are tightened together in axial direction to prevent axial movement. ● The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical rollers. Type NUTW provides the following additional features. ● The highest load rating of all roller follower types. ● Due to the outer ring with inner rib, this type is good for axial and moment loads and runs smoothly depending on actual operating conditions. ● Good lubrication and longer life can be expected due to increase grease fill volume. ● 定格荷重が大きく高荷重，衝撃荷重が作用する用途に適する。 ● 外輪に鋼板プレートを圧入して内輪両側の側板との間にラビリンスを形成し密封性能をもたせるとともに側板が分離しないように保持している。 ● 内輪と側板とはすきまのないようにアキシアル方向に締付けて用いる。 ● 外輪は外輪つばと円筒ころ端面でアキシアル方向に案内されている。 特にNUTW形については下記の特徴がある。 ● ローラフォロアの中で最も定格荷重が大きい。 ● 外輪中つば付き形式のため使用条件にもよるが，アキシアル荷重，モーメント荷重にも有利で，円滑な回転をする。 ● グリース封入容積アップによる潤滑効果，長寿命が期待できる。
Nominal bore diameter : φ50 Labyrinth seal Outer profile : cylindrical Grease : prelubricated 内径 ：φ25 中つば付き 複列円筒ころ総ころ形 ラビリンスシール 外径形状 ：円筒形状 グリース ：封入済	

Bearing Tolerances

The dimensional accuracies and form accuracies of the bearing bore dia. (d), cylinder outside diameter (D), outer ring width (C) and inner ring width (B) for **NAB2** and **NA22** types, as well as the running accuracy of bearing assemblies, are summarized in **Table 12** on page 93 (JIS Class 0). The allowable deviations of the assembled bearing width of the inner ring (B) and spherical OD (D), as well as roller inscribed diameter (F_W) of the **RNAB2 type** and the **RNA22 type**, are found in the associated dimension tables.

軸受の精度

軸受の内径（d），円筒面外径（D），外輪幅（C）及び**NAB2形**，**NA22形**の内輪幅（B）の寸法精度，形状精度及び回転精度は，93ページの**表12**に示す（JIS 0級）。内輪組立幅（B），球面外径（D）及び**RNAB2形**，**RNA22形**のころ内接円径（F_W）の寸法許容差は寸法表に示している。

Fits and Radial Clearances

The tolerance class of the shaft relative to a bearing with an inner ring is g6 (h6). When the shaft is used as a track surface (**RNAB2 type** and **RNA22 type**), the tolerance class of the shaft is k5 (k6). The outer ring is usually not built into the housing.

はめあいとラジアルすきま

内輪付き軸受に対する軸の公差域クラスはg6（h6），軸を直接軌道面とする場合（**RNAB2形**，**RNA22形**）には軸の公差域クラスk5（k6）とする。外輪は，一般にハウジングに組込まれることはない。

Table 9. Radial Internal Clearances
ラジアルすきま

Unit: μm

Nominal roller inscribed circle dia. ころ内接円径の呼び F_W (mm)		Clearance すきま							
		C2		Ordinary 普通		C3		C4	
over を超え	Incl. 以下	min 最小	max 最大	min 最小	max 最大	min 最小	max 最大	min 最小	max 最大
3	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

Installation

(1) The face height at the roller follower mounting location must be greater than the dimension "e" specified in the dimension table (**Fig. 10**). The chamfer of the stud mounting hole must be minimal (approx. 0.5 × 45°) so that the side face of side plate is firmly seated on the inner ring.

取付け関係

（1）ローラフォロアの取付け部における側面高さは，寸法表記載の"e"寸法より大きくとる（**図10**）。取付けの面取りは，なるべく小さくし（0.5×45°程度），内輪と側板の側面を正確に当てるようにする。

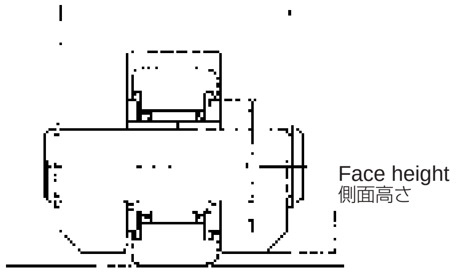


Fig.10

(2) When installing the roller follower, ensure that the lubrication hole on the inner ring is situated in the no-load area (the side not subjected to loading) (**Fig. 11**). Positioning the lubrication hole in the load area may reduce the life of the roller follower.

（2）ローラフォロアを取付ける場合は，内輪の油穴位置は非負荷域（荷重を受けない側）に取付ける（**図11**）。
油穴が負荷域にあると，短寿命の原因となる。

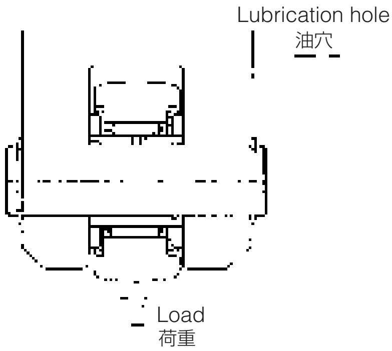


Fig.11

NTN roller followers are normally installed in a cantilever configuration. For this reason, an increasingly loose fit resulting from extended use of the roller follower may result in an uneven load being exerted on the bearing. To ensure reliable operation of the equipment, continually monitor any looseness in the bearing fit.

NTNローラフォロアを片持ちで取付けた場合，継続使用によるはめあいのゆるみの影響で不均一な荷重（片当り）が軸受に作用する場合があります。設備安定稼動のため，はめあいのゆるみには十分な注意が必要です。

(3) The **NA··22LL** and **RNA22** types are separable types, and their outer ring is guided by a flange or thrust washer mounted on the shaft (pin). For this reason, the guide surface must be machined to a fine finish, and burrs must be removed to ensure the smoothness of the surface. If the guide surface is not hardened, the guideway must have the dimension A indicated in **Fig. 12**. If the guide surface is hardened, the width of the guideway may be somewhat smaller than dimension A.
When assembling this type of bearing, take care to ensure that the seal does not roll up or become damaged.

(3) NA··22LL，RNA22形は分離形で軸（ピン）にフランジまたはスラストワッシャを取付けて外輪が案内されるため，案内面は旋削仕上げより良好な仕上げ面とし，バリなどを除去し滑らかな面とする。また案内面が硬化していない場合は**図12**に示すA寸法で案内しなければならない。表面硬化されているときはこれより若干小さくても使用できる。

この軸受の組立時にはシールのリップがまくれないように，また傷を付けないように注意して取扱うことが必要である。

$A \geqq \frac{1}{2}(D+e)$

For dimensions D and e, refer to the dimension table.
D及びe寸法は寸法表参照

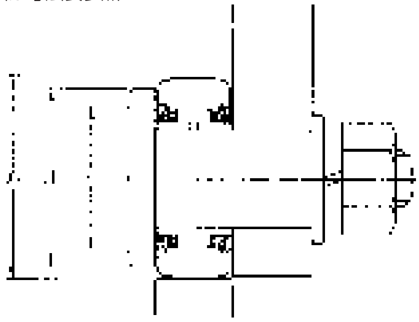


Fig.12

Lubrication

Bearings with synthetic rubber seals (suffix LL) as well as full-complement roller-type bearings are prelubricated with lithium soap grease and can operate in a temperature range of -20˚C to 100˚C. If a grease with better low-temperature characteristics is required for continuous operation below 0˚C, contact **NTN**.

Grease is fed into the bearing through the lubrication hole on the inner ring. When installing the bearing, ensure that the lubrication hole is opposite the area where load is applied.

For full-complement roller-type bearings lacking a cage (**NATV**, **NACV**, **NUTR** and **NUTW types**), relubrication with grease must be repeated more frequently.

Products having a cage but lacking a seal are not prelubricated with grease. If you require a prelubricated type, contact **NTN**.

潤滑

合成ゴムシールを装着した形式（接尾記号：LL）及び総ころ形にはリチウム石けん基のグリースが封入されていて，−20〜+100℃の温度範囲で使用できる。なお，常時0℃以下の場合には，低温特性に優れたグリースの封入品使用を推奨しますので，**NTN**に御照会ください。

軸受内部への潤滑剤の供給又は補給は，内輪に設けた油穴より行う。油穴の位置が非負荷域になるように取付ける。(NAB2形には油穴は設けてありません。)

保持器をもたない総ころ形のNATV形，NACV形，NUTR形及びNUTW形では，グリース補給間隔を短くする必要がある。

保持器付き形でシールなし品にはグリースは封入されておりません。封入品が必要な場合は**NTN**へ御照会ください。

Lubrication is also required between the outer surfaces of the bearing and the track. If lubrication is inadequate, the bearing may wear prematurely.

軸受の外輪外径面と軌道（トラック）間にも潤滑が必要です。潤滑されていないと，軸受の損傷が早期に発生する場合があります。

Track Load Capacity

The maximum allowable static radial load exerted on the contact surfaces between the roller and track is known as "track load capacity". Track load capacity values relative to a HRC40 track hardness are listed in the dimension table. If the hardness of the track is not HRC40, correct for the track load capacity using the correction factor G specified in **Table 8** on page 14.

トラック負荷容量

トラックローラとトラック（軌道）の接触面で静的に許容できる最大ラジアル荷重をトラック負荷容量と呼び，トラック（軌道）の硬さがHRC40のときの値を寸法表に記載している。HRC40と異なる場合は14ページ，**表8**に示す補正係数Gを用いて補正する。

Raceway Surface Accuracy

The raceway dimensional accuracy, profile accuracy and surface roughness of shaft must be equivalent to the raceway accuracy of bearing itself. **Table 10** shows the specified surface accuracy and surface roughness of the shaft raceway.

軌道面の精度

軸の外径面を軌道面として用いるときは，軌道面の寸法精度，形状精度及び表面粗さは，軸受の軌道面と同等でなければならない。軌道面の精度及び表面粗さの仕様を**表10**に示す。

Table 10 Recommended raceway surface accuracy
軌道面の精度（推奨）

Characteristic item 特　性	Shaft 軸
Dimensional accuracy 寸法精度	IT5
Roundness 真円度 (max)（最大） cylindricality 円筒度	IT3
Shoulder perpendicularity (max) 肩の直角度（最大）	IT3
Axial run-out アキシアル振れ (max)（最大） Thrust bearing スラスト軸受	IT5
Surface roughness 表面粗さ	0.2a

Material and Hardness of Raceway Surface

When the outer surface of a shaft (hollowed) is used as raceway, it must be hardened to HRC58 to 64 for sufficient load capacity. The materials shown in **Table 11** can be used if properly heat treated.

When the steel is surface-hardened by carburizing or carbonitriding, the effective hardened layer depth as defined by the applicable JIS standard is the depth at which the hardness decreases to HV550. The approximate minimum value for the effective hardened layer depth is expressed in the following formula.

$$E_{ht\ \min} \geqq 0.8 D_w (0.1 + 0.002 D_w)$$

Where

$E_{ht\ \min}$: Minimum effective hardened layer depth mm

D_w : Roller diameter mm

軌道に用いる材料と硬さ

軸の外径面を軌道面として用いるときは，十分な負荷容量を得るため，表面硬さをHRC58～64にする必要があり，**表11**に示す材料などに適切な熱処理をして使用する。

鋼を浸炭焼入れ又は浸炭浸窒焼入れにより表面硬化させるとき，JISでは表面からHV550までの深さを有効硬化層と定義している。有効硬化層深さの最小値は下記の式にて概略で表わされる。

$$E_{ht\ \min} \geqq 0.8 D_w (0.1 + 0.002 D_w)$$

ここで，

$E_{ht\ \min}$ ：最小有効硬化層深さ　mm

D_w ：ころの直径　mm

Table 11 Materials used for raceway
軌道に用いる材料

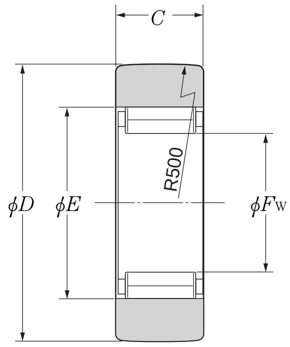
Type of steel 鋼　種	Representative example 代表例	Related standards 規　格
High carbon chrome bearing steel 高炭素クロム軸受鋼	SUJ2	JIS G 4805
Carbon tool steel 炭素工具鋼	SK3	JIS G 4401
Nickel chrome molybdenum steel ニッケルクロムモリブデン鋼	SNCM420	JIS G 4103
Chrome steel クロム鋼	SCr420	JIS G 4104
Chrome molybdenum steel クロムモリブデン鋼	SCM420	JIS G 4105
Nickel chrome steel ニッケルクロム鋼	SNC420	JIS G 4102

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

Roller Followers with Cage
保持器付ローラフォロア

RNAB2 type
RNAB2・・X type

RNAB2形
RNAB2・・X形



RNAB2 type
RNAB2形

OD[1)] 外径 mm D 0 −0.05	Roller Follower number 呼び番号 Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm F_w		C	E	Basic load ratings dynamic 基本動定格荷重 N kgf C_r	static 基本静定格荷重 C_{or}
16	**RNAB 2/5T2**	**RNAB 2/5XT2**	7	+0.022 +0.013	7.8	10	2 820 287	2 520 257
19	**RNAB 2/6T2**	**RNAB 2/6XT2**	10	+0.022 +0.013	9.8	13	4 700 480	5 350 550
24	**RNAB 2/8**	**RNAB 2/8X**	12	+0.027 +0.016	9.8	15	5 200 530	6 400 655
30	**RNAB 200**	**RNAB 200X**	14	+0.027 +0.016	11.8	20	9 700 990	5 200 530
32	**RNAB 201**	**RNAB 201X**	16	+0.027 +0.016	11.8	22	12 100 1 230	13 100 1 330
35	**RNAB 202**	**RNAB 202X**	20	+0.033 +0.020	11.8	26	13 300 1 360	15 700 1 610
40	**RNAB 203**	**RNAB 203X**	22	+0.033 +0.020	15.8	29	19 500 1 980	23 800 2 430
47	**RNAB 204**	**RNAB 204X**	25	+0.033 +0.020	15.8	32	20 300 2 070	25 900 2 640
52	**RNAB 205**	**RNAB 205X**	30	+0.033 +0.020	15.8	37	22 700 2 320	32 000 3 250
62	**RNAB 206**	**RNAB 206X**	38	+0.041 +0.025	19.8	46	35 000 3 550	54 000 5 500
72	**RNAB 207**	**RNAB 207X**	42	+0.041 +0.025	19.8	50	35 000 3 550	56 000 5 700
80	**RNAB 208**	**RNAB 208X**	50	+0.041 +0.025	19.8	58	39 500 4 050	69 500 7 100
85	**RNAB 209**	**RNAB 209X**	55	+0.049 +0.030	19.8	63	40 000 4 100	72 500 7 400
90	**RNAB 210**	**RNAB 210X**	60	+0.049 +0.030	19.8	68	41 500 4 250	78 000 8 000

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the RNAB2・・X type whose outside surface form is cylindrical.
注1）外径面が円筒であるRNAB2・・X形の外輪外径 D の許容差はJIS 0級である。

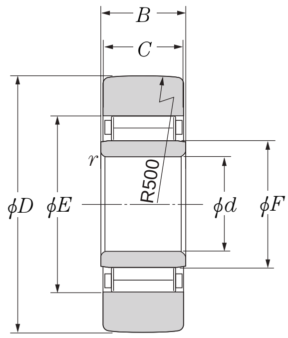
Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Mass 質量 kg	OD[1)] 外径 mm D
Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑	(approx.) (参考)	0 −0.05
1 080 110	2 320 237	21 000	27 000	0.0085	16
1 370 140	3 570 364	15 000	20 000	0.013	19
1 890 193	4 500 459	12 000	16 000	0.021	24
2 600 265	6 910 705	11 000	14 000	0.042	30
2 850 291	7 360 751	9 500	12 500	0.049	32
3 210 327	8 060 822	7 500	10 000	0.05	35
3 820 390	12 700 1 290	6 800	9 000	0.088	40
4 760 485	14 800 1 510	6 000	8 000	0.13	47
5 470 558	16 400 1 670	5 000	6 500	0.15	52
6 920 706	23 500 2 400	4 000	5 500	0.255	62
8 400 857	27 400 2 790	3 500	4 600	0.375	72
9 660 985	28 600 2 920	3 000	4 000	0.42	80
10 600 1 080	30 500 3 110	2 700	3 600	0.435	85
11 400 1 160	32 300 3 290	2 500	3 300	0.481	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

Roller Followers with Cage
保持器付ローラフォロア

NAB2 type
NAB2‥X type

NAB2形
NAB2‥X形



NAB2 type
NAB2形

OD[1] 外径 mm D 0 −0.05	Roller Follower number 呼び番号 Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm d	B	C	E	F	$r_{s\,min}$[2]	Basic load ratings dynamic 基本動定格荷重 N kgf C_r	static 基本静定格荷重 C_{or}
19	**NAB 2/6T2**	**NAB 2/6XT2**	6	10	9.8	13	10	0.5	4 700 480	5 350 550
24	**NAB 2/8**	**NAB 2/8X**	8	10	9.8	15	12	0.5	5 200 530	6 400 655
30	**NAB 200**	**NAB 200X**	10	12	11.8	20	14	0.5	9 700 990	5 200 530
32	**NAB 201**	**NAB 201X**	12	12	11.8	22	16	0.5	12 100 1 230	13 100 1 330
35	**NAB 202**	**NAB 202X**	15	12	11.8	26	20	0.5	13 300 1 360	15 700 1 610
40	**NAB 203**	**NAB 203X**	17	16	15.8	29	22	0.5	19 500 1 980	23 800 2 430
47	**NAB 204**	**NAB 204X**	20	16	15.8	32	25	0.5	20 300 2 070	25 900 2 640
52	**NAB 205**	**NAB 205X**	25	16	15.8	37	30	0.5	22 700 2 320	32 000 3 250
62	**NAB 206**	**NAB 206X**	30	20	19.8	46	38	1	35 000 3 550	54 000 5 500
72	**NAB 207**	**NAB 207X**	35	20	19.8	50	42	1	35 000 3 550	56 000 5 700
80	**NAB 208**	**NAB 208X**	40	20	19.8	58	50	1.5	39 500 4 050	69 500 7 100
85	**NAB 209**	**NAB 209X**	45	20	19.8	63	55	1.5	40 000 4 100	72 500 7 400
90	**NAB 210**	**NAB 210X**	50	20	19.8	68	60	1.5	41 500 4 250	78 000 8 000

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NAB2‥X type whose outside surface form is cylindrical.
2. The minimum value of chamfer dimension r.

注1）外径面が円筒であるNAB2‥X形の外輪外径 D の許容差はJIS 0級である。
2）面取寸法 r の最小寸法です。

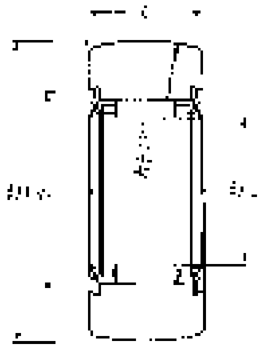
Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min		Mass 質量 kg	OD[1)] 外径 mm *D*
Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	Oil lubrication 油潤滑	(approx.) (参考)	0 −0.05
1 370 140	3 570 364	15 000	20 000	0.017	19
1 890 193	4 500 459	12 000	16 000	0.026	24
2 600 265	6 910 705	11 000	14 000	0.049	30
2 850 291	7 360 751	9 500	12 500	0.057	32
3 210 327	8 060 822	7 500	10 000	0.062	35
3 820 390	12 700 1 290	6 800	9 000	0.107	40
4 760 485	14 800 1 510	6 000	8 000	0.151	47
5 470 558	16 400 1 670	5 000	6 500	0.174	52
6 920 706	23 500 2 400	4 000	5 500	0.32	62
8 400 857	27 400 2 790	3 500	4 600	0.439	72
9 660 985	28 600 2 920	3 000	4 000	0.526	80
10 600 1080	30 500 3 110	2 700	3 600	0.551	85
11 400 1160	32 300 3 290	2 500	3 300	0.61	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

Roller Followers with Cage
保持器付ローラフォロア

RNA22··LL type
RNA22··XLL type

RNA22··LL形
RNA22··XLL形



RNA22··LL type
RNA22··LL形

OD[1)] 外径 mm D 0 −0.05	Roller Follower number 呼び番号 Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm F_w		C	e	Basic load ratings dynamic 基本動定格荷重 C_r N kgf	static 基本静定格荷重 C_{or} N kgf
19	**RNA22/6LL/3AS**	**RNA22/6XLL/3AS**	10	+0.022 +0.013	11.8	16	4 550 460	4 250 435
24	**RNA22/8LL/3AS**	**RNA22/8XLL/3AS**	12	+0.027 +0.016	11.8	18	5 150 525	5 250 535
30	**RNA2200LL/3AS**	**RNA2200XLL/3AS**	14	+0.027 +0.016	13.8	20	7 550 770	9 000 915
32	**RNA2201LL/3AS**	**RNA2201XLL/3AS**	16	+0.027 +0.016	13.8	22	8 100 830	10 300 1 050
35	**RNA2202LL/3AS**	**RNA2202XLL/3AS**	20	+0.033 +0.020	13.8	26	9 850 1 010	14 100 1 440
40	**RNA2203LL/3AS**	**RNA2203XLL/3AS**	22	+0.033 +0.020	15.8	28	10 400 1 060	15 600 1 590
47	**RNA2204LL/3AS**	**RNA2204XLL/3AS**	25	+0.033 +0.020	17.8	33	16 900 1 730	22 900 2 340
52	**RNA2205LL/3AS**	**RNA2205XLL/3AS**	30	+0.033 +0.020	17.8	38	17 900 1 820	25 900 2 640
62	**RNA2206LL/3AS**	**RNA2206XLL/3AS**	35	+0.041 +0.025	19.8	43	21 400 2 190	34 500 3 500
72	**RNA2207LL/3AS**	**RNA2207XLL/3AS**	42	+0.041 +0.025	22.7	50	26 300 2 690	47 500 4 850
80	**RNA2208LL/3AS**	**RNA2208XLL/3AS**	48	+0.041 +0.025	22.7	57	28 400 2 900	55 000 5 600
85	**RNA2209LL/3AS**	**RNA2209XLL/3AS**	52	+0.049 +0.030	22.7	62	29 300 2 990	58 500 5 950
90	**RNA2210LL/3AS**	**RNA2210XLL/3AS**	58	+0.049 +0.030	22.7	68	31 000 3 200	66 000 6 700

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the RNA22··XLL type whose outside surface form is cylindrical.
注1）外径面が円筒であるRNA22··XLL形の外輪外径 D の許容差はJIS 0級である。

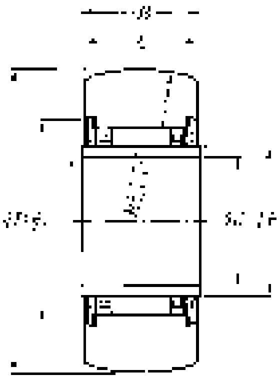
Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min	Mass 質量 kg	OD[1)] 外径 mm
Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	(approx.) （参考）	D 0 −0.05
1 380 141	4 400 445	10 000	0.018	**19**
1 900 193	5 500 565	10 000	0.027	**24**
2 620 267	7 550 770	10 000	0.052	**30**
2 860 291	8 050 820	9 500	0.057	**32**
3 200 325	8 800 900	7 500	0.060	**35**
3 850 390	10 900 1 110	7 000	0.094	**40**
4 700 480	14 800 1 510	6 000	0.152	**47**
5 550 565	16 400 1 670	5 000	0.179	**52**
6 950 710	22 200 2 260	4 300	0.284	**62**
8 050 820	28 700 2 930	3 600	0.432	**72**
9 800 1 000	32 000 3 250	3 100	0.530	**80**
10 400 1 060	34 000 3 450	2 900	0.545	**85**
11 400 1 160	36 000 3 650	2 600	0.563	**90**

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

Roller Followers with Cage
保持器付ローラフォロア

NA22··LL type
NA22··XLL type

NA22··LL形
NA22··XLL形



NA22··LL type
NA22··LL形

OD[1] 外径 mm D 0 −0.05	Roller Follower number 呼び番号		Dimensions 寸法 mm						Basic load ratings dynamic 基本動定格荷重 N kgf	static 基本静定格荷重
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d	B	C	e	F	$r_{s\ min}$[2]	C_r	C_{or}
19	**NA22/6LL/3AS**	**NA22/6XLL/3AS**	6	12	11.8	16	10	0.3	4 550 460	4 250 435
24	**NA22/8LL/3AS**	**NA22/8XLL/3AS**	8	12	11.8	18	12	0.3	5 150 525	5 250 535
30	**NA2200LL/3AS**	**NA2200XLL/3AS**	10	14	13.8	20	14	0.3	7 550 770	9 000 915
32	**NA2201LL/3AS**	**NA2201XLL/3AS**	12	14	13.8	22	16	0.3	8 100 830	10 300 1 050
35	**NA2202LL/3AS**	**NA2202XLL/3AS**	15	14	13.8	26	20	0.3	9 850 1 010	14 100 1 440
40	**NA2203LL/3AS**	**NA2203XLL/3AS**	17	16	15.8	28	22	0.3	10 400 1 060	15 600 1 590
47	**NA2204LL/3AS**	**NA2204XLL/3AS**	20	18	17.8	33	25	0.3	16 900 1 730	22 900 2 340
52	**NA2205LL/3AS**	**NA2205XLL/3AS**	25	18	17.8	38	30	0.3	17 900 1 820	25 900 2 640
62	**NA2206LL/3AS**	**NA2206XLL/3AS**	30	20	19.8	43	35	0.3	21 400 2 190	34 500 3 500
72	**NA2207LL/3AS**	**NA2207XLL/3AS**	35	23	22.7	50	42	0.6	26 300 2 690	47 500 4 850
80	**NA2208LL/3AS**	**NA2208XLL/3AS**	40	23	22.7	57	48	0.6	28 400 2 900	55 000 5 600
85	**NA2209LL/3AS**	**NA2209XLL/3AS**	45	23	22.7	62	52	0.6	29 300 2 990	58 500 5 950
90	**NA2210LL/3AS**	**NA2210XLL/3AS**	50	23	22.7	68	58	0.6	31 000 3 200	66 000 6 700

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NA22··XLL type whose outside surface form is cylindrical.
2. The minimum value of chamfering dimension r.
注1）外径面が円筒であるNA22··XLL形の外輪外径 D の許容差はJIS 0級である。
2）面取寸法 r の最小寸法です。

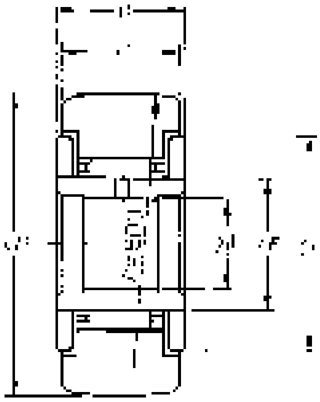
Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Mass 質量 kg (approx.) （参考）	OD[1)] 外径 mm *D* 0 −0.05
1 380 141	4 400 445	10 000	0.023	**19**
1 900 193	5 500 565	10 000	0.035	**24**
2 620 267	7 550 770	10 000	0.060	**30**
2 860 291	8 050 820	9 500	0.067	**32**
3 200 325	8 800 900	7 500	0.075	**35**
3 850 390	10 900 1 110	7 000	0.113	**40**
4 700 480	14 800 1 510	6 000	0.176	**47**
5 550 565	16 400 1 670	5 000	0.209	**52**
6 950 710	22 200 2 260	4 300	0.322	**62**
8 050 820	28 700 2 930	3 600	0.506	**72**
9 800 1 000	32 000 3 250	3 100	0.623	**80**
10 400 1 060	34 000 3 450	2 900	0.638	**85**
11 400 1 160	36 000 3 650	2 600	0.682	**90**

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

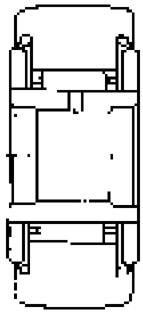
Roller Followers with Cage
保持器付ローラフォロア

NATR type
NATR‥X type
NATR‥LL type
NATR‥XLL type

NATR形
NATR‥X形
NATR‥LL形
NATR‥XLL形



NATR type (with cage)
NATR形（保持器付き）



NATR‥LL type (sealed, with cage)
NATR ‥LL形（保持器付シール形）

OD[1] 外径 mm D $^{0}_{-0.05}$	Roller Follower number 呼び番号				Dimensions 寸法 mm				
	Without seal シールなし		With seal シール有り						
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d	B	C	e	F
16	NATR5	NATR5X	NATR5LL/3AS	NATR5XLL/3AS	5	12 $^{0}_{-0.180}$	11	12	8
19	NATR6	NATR6X	NATR6LL/3AS	NATR6XLL/3AS	6	12 $^{0}_{-0.180}$	11	14	10
24	NATR8	NATR8X	NATR8LL/3AS	NATR8XLL/3AS	8	15 $^{0}_{-0.180}$	14	19	12
30	NATR10	NATR10X	NATR10LL/3AS	NATR10XLL/3AS	10	15 $^{0}_{-0.180}$	14	23	15
32	NATR12	NATR12X	NATR12LL/3AS	NATR12XLL/3AS	12	15 $^{0}_{-0.180}$	14	25	17
35	NATR15	NATR15X	NATR15LL/3AS	NATR15XLL/3AS	15	19 $^{0}_{-0.210}$	18	27	20
40	NATR17	NATR17X	NATR17LL/3AS	NATR17XLL/3AS	17	21 $^{0}_{-0.210}$	20	32	22
47	NATR20	NATR20X	NATR20LL/3AS	NATR20XLL/3AS	20	25 $^{0}_{-0.210}$	24	37	25
52	NATR25	NATR25X	NATR25LL/3AS	NATR25XLL/3AS	25	25 $^{0}_{-0.210}$	24	42	30
62	NATR30	NATR30X	NATR30LL/3AS	NATR30XLL/3AS	30	29 $^{0}_{-0.210}$	28	51	38
72	NATR35	NATR35X	NATR35LL/3AS	NATR35XLL/3AS	35	29 $^{0}_{-0.210}$	28	58	44.5
80	NATR40	NATR40X	NATR40LL/3AS	NATR40XLL/3AS	40	32 $^{0}_{-0.250}$	30	66	50
85	NATR45	NATR45X	NATR45LL/3AS	NATR45XLL/3AS	45	32 $^{0}_{-0.250}$	30	71	55
90	NATR50	NATR50X	NATR50LL/3AS	NATR50XLL/3AS	50	32 $^{0}_{-0.250}$	30	76	60

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NATR‥X and NATR‥XLL types whose outside surface form is cylindrical.
注1）外径面が円筒であるNATR‥X形，NATR‥XLL形の外輪外径 D の許容差はJIS 0級である。

NTN

Basic load ratings dynamic 基本動定格荷重 C_r N (kgf)	Basic load ratings static 基本静定格荷重 C_{or} N (kgf)	Track load capacity トラック負荷容量 N (kgf) Spherical outer ring 球面外輪	Track load capacity N (kgf) Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Limiting speed r/min Oil lubrication 油潤滑	Mass 質量 kg (approx.) (参考)	OD[1)] 外径 mm D 0 −0.05
4 050 415	4 200 430	1 080 110	3 400 350	※19 000	※25 000	0.018	**16**
4 750 480	5 400 555	1 380 141	4 050 415	※15 000	※20 000	0.025	**19**
6 900 705	7 700 785	1 900 193	6 650 680	※12 000	※16 000	0.042	**24**
7 850 800	9 650 985	2 620 267	7 700 785	10 000	※13 000	0.061	**30**
8 850 900	11 700 1 190	2 860 291	8 200 835	9 000	※12 000	0.069	**32**
13 300 1 360	2 0800 2 120	3 200 325	11 900 1 220	7 500	10 000	0.098	**35**
14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	7 000	9 000	0.140	**40**
20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	6 000	8 000	0.246	**47**
22 800 2 320	40 500 4 100	5 500 565	23 300 2 370	5 000	6 500	0.275	**52**
36 000 3 650	66 000 6 750	6 950 710	33 000 3 350	4 000	5 500	0.470	**62**
39 000 3 950	77 000 7 850	8 050 820	37 000 3 750	3 300	4 500	0.635	**72**
49 500 5 050	92 500 9 400	9 800 1 000	44 500 4 500	3 000	4 000	0.875	**80**
51 500 5 250	100 000 10 200	10 400 1 060	47 000 4 800	2 700	3 600	0.910	**85**
53 000 5 450	108 000 11 000	11 400 1 160	50 000 5 100	2 500	3 300	0.960	**90**

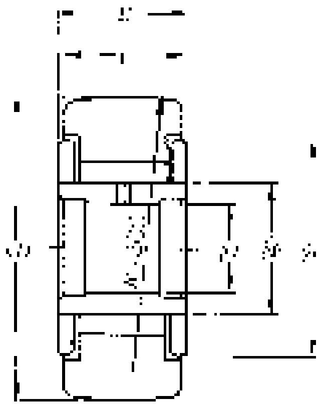
Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール付きの場合の許容回転速度は，おおよそ10 000r/minである。

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールなし	シール付き

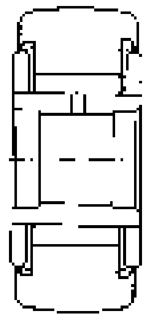
Full-Complement Roller-Type Roller Followers
総ころ形ローラフォロア

NATV type
NATV‥X type
NATV‥LL type
NATV‥XLL type

NATV形
NATV‥X形
NATV‥LL形
NATV‥XLL形



NATV type
(Full-complement roller type)
NATV形（総ころ形）



NATV‥LL type
(Full-complement roller type, sealed)
NATV ‥LL形（総ころシール形）

OD[1)] 外径 mm D 0 −0.05	Roller Follower number 呼び番号				Dimensions 寸法 mm				
	Without seal シールなし		With seal シール有り						
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d	B	C	e	F
16	NATV5/3AS	NATV5X/3AS	NATV5LL/3AS	NATV5XLL/3AS	5	12 $^{0}_{-0.180}$	11	12	8
19	NATV6/3AS	NATV6X/3AS	NATV6LL/3AS	NATV6XLL/3AS	6	12 $^{0}_{-0.180}$	11	14	10
24	NATV8/3AS	NATV8X/3AS	NATV8LL/3AS	NATV8XLL/3AS	8	15 $^{0}_{-0.180}$	14	19	12
30	NATV10/3AS	NATV10X/3AS	NATV10LL/3AS	NATV10XLL/3AS	10	15 $^{0}_{-0.180}$	14	23	15
32	NATV12/3AS	NATV12X/3AS	NATV12LL/3AS	NATV12XLL/3AS	12	15 $^{0}_{-0.180}$	14	25	17
35	NATV15/3AS	NATV15X/3AS	NATV15LL/3AS	NATV15XLL/3AS	15	19 $^{0}_{-0.210}$	18	27	20
40	NATV17/3AS	NATV17X/3AS	NATV17LL/3AS	NATV17XLL/3AS	17	21 $^{0}_{-0.210}$	20	32	22
47	NATV20/3AS	NATV20X/3AS	NATV20LL/3AS	NATV20XLL/3AS	20	25 $^{0}_{-0.210}$	24	37	25
52	NATV25/3AS	NATV25X/3AS	NATV25LL/3AS	NATV25XLL/3AS	25	25 $^{0}_{-0.210}$	24	42	30
62	NATV30/3AS	NATV30X/3AS	NATV30LL/3AS	NATV30XLL/3AS	30	29 $^{0}_{-0.210}$	28	51	38
72	NATV35/3AS	NATV35X/3AS	NATV35LL/3AS	NATV35XLL/3AS	35	29 $^{0}_{-0.210}$	28	58	44.5
80	NATV40/3AS	NATV40X/3AS	NATV40LL/3AS	NATV40XLL/3AS	40	32 $^{0}_{-0.250}$	30	66	50
90	NATV50/3AS	NATV50X/3AS	NATV50LL/3AS	NATV50XLL/3AS	50	32 $^{0}_{-0.250}$	30	76	60

Note:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NATV‥X and NATV‥XLL types whose outside surface form is cylindrical.
注1）外径面が円筒であるNATV‥X形，NATV‥XLL形の外輪外径 D の許容差はJIS 0級である。

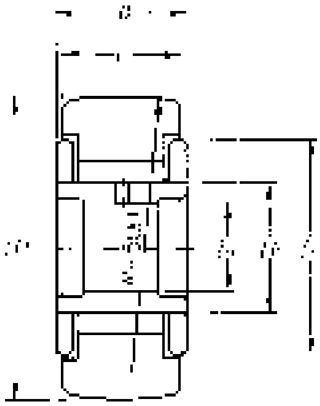
Basic load ratings dynamic 基本動定格荷重 C_r N kgf	static 基本静定格荷重 C_{or}	Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Oil lubrication 油潤滑	Mass 質量 kg (approx.) (参考)	OD[1)] 外径 mm D 0 −0.05
6 500 665	9 350 955	1 080 110	3 400 350	※13 000	※16 000	0.020	16
7 450 760	11 700 1 190	1 380 141	4 050 415	10 000	※13 000	0.027	19
10 700 1 090	16 200 1 650	1 900 193	6 650 680	8 500	※11 000	0.044	24
12 000 1 230	20 300 2 070	2 620 267	7 700 785	6 500	8 500	0.065	30
13 000 1 330	23 000 2 350	2 860 291	8 200 835	6 000	7 500	0.074	32
18 400 1 870	38 000 3 900	3 200 325	11 900 1 220	5 000	6 500	0.102	35
19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	4 500	6 000	0.145	40
28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	4 000	5 000	0.254	47
31 500 3 200	73 500 7 500	5 500 565	23 300 2 370	3 300	4 500	0.285	52
47 500 4 850	115 000 11 700	6 950 710	33 000 3 350	2 600	3 500	0.481	62
52 000 5 300	134 000 13 600	8 050 820	37 000 3 750	2 200	2 900	0.647	72
68 500 7 000	171 000 17 500	9 800 1 000	44 500 4 500	2 000	2 600	0.890	80
76 000 7 750	205 000 20 900	11 400 1 160	50 000 5 100	1 600	2 100	0.990	90

Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール付きの場合の許容回転速度は，おおよそ10 000r/minである。

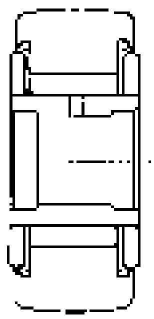
Full-Complement Roller-Type Roller Followers
総ころ形ローラフォロア

NACV type
NACV··X type
NACV··LL type
NACV··XLL type

NACV形
NACV··X形
NACV··LL形
NACV··XLL形



NACV type
(Full-complement roller type)
NACV形（総ころ形）



NACV··LL type
(Full-complement roller type, sealed)
NACV ··LL形（総ころシール形）

OD / 外径[1)] mm (in) D $^{0}_{-0.05}$	Roller Follower number 呼び番号 Without seal シールなし Spherical outer rings 球面外輪	Without seal シールなし Cylindrical outer rings 円筒外輪	With seal シール有り Spherical outer rings 球面外輪	With seal シール有り Cylindrical outer rings 円筒外輪	Dimensions / 寸法 mm (in) d	Dimensions / 寸法 mm (in) B $^{0}_{-0.250}$
19.050 (3/4)	NACV12/3AS	NACV12X/3AS	NACV12LL/3AS	NACV12XLL/3AS	6.350 (1/4) $^{+0.005}_{-0.010}$	14.288 (9/16)
22.225 (7/8)	NACV14/3AS	NACV14X/3AS	NACV14LL/3AS	NACV14XL/3ASL	6.350 (1/4) $^{+0.005}_{-0.010}$	14.288 (9/16)
25.400 (1)	NACV16/3AS	NACV16X/3AS	NACV16LL/3AS	NACV16XL/3ASL	7.938 (5/16) $^{+0.005}_{-0.010}$	17.462 (11/16)
28.575 (1 1/8)	NACV18/3AS	NACV18X/3AS	NACV18LL/3AS	NACV18XL/3ASL	7.938 (5/16) $^{+0.005}_{-0.010}$	17.462 (11/16)
31.750 (1 1/4)	NACV20/3AS	NACV20X/3AS	NACV20LL/3AS	NACV20XL/3ASL	9.525 (3/8) $^{+0.005}_{-0.010}$	20.638 (13/16)
34.925 (1 3/8)	NACV22/3AS	NACV22X/3AS	NACV22LL/3AS	NACV22XL/3ASL	9.525 (3/8) $^{+0.005}_{-0.010}$	20.638 (13/16)
38.100 (1 1/2)	NACV24/3AS	NACV24X/3AS	NACV24LL/3AS	NACV24XL/3ASL	11.112 (7/16) $^{+0.005}_{-0.010}$	23.812 (15/16)
41.275 (1 5/8)	NACV26/3AS	NACV26X/3AS	NACV26LL/3AS	NACV26XL/3ASL	11.112 (7/16) $^{+0.005}_{-0.010}$	23.812 (15/16)
44.450 (1 3/4)	NACV28/3AS	NACV28X/3AS	NACV28LL/3AS	NACV28XL/3ASL	12.700 (1/2) $^{+0.005}_{-0.010}$	26.988 (1 1/16)
47.625 (1 7/8)	NACV30/3AS	NACV30X/3AS	NACV30LL/3AS	NACV30XL/3ASL	12.700 (1/2) $^{+0.005}_{-0.010}$	26.988 (1 1/16)
50.800 (2)	NACV32/3AS	NACV32X/3AS	NACV32LL/3AS	NACV32XL/3ASL	15.875 (5/8) $^{+0.005}_{-0.010}$	33.338 (1 5/16)
57.150 (2 1/4)	NACV36/3AS	NACV36X/3AS	NACV36LL/3AS	NACV36XL/3ASL	15.875 (5/8) $^{+0.005}_{-0.010}$	33.338 (1 5/16)
63.500 (2 1/2)	NACV40/3AS	NACV40X/3AS	NACV40LL/3AS	NACV40XL/3ASL	19.050 (3/4) $^{+0.005}_{-0.010}$	39.688 (1 9/16)
69.850 (2 3/4)	NACV44/3AS	NACV44X/3AS	NACV44LL/3AS	NACV44XL/3ASL	19.050 (3/4) $^{+0.005}_{-0.010}$	39.688 (1 9/16)
76.200 (3)	NACV48/3AS	NACV48X/3AS	NACV48LL/3AS	NACV48XL/3ASL	25.400 (1) $^{+0.002}_{-0.013}$	46.038 (1 13/16)
82.550 (3 1/4)	NACV52/3AS	NACV52X/3AS	NACV52LL/3AS	NACV52XL/3ASL	25.400 (1) $^{+0.002}_{-0.013}$	46.038 (1 13/16)
88.900 (3 1/2)	NACV56/3AS	NACV56X/3AS	NACV56LL/3AS	NACV56XL/3ASL	28.575 (1 1/8) $^{+0.002}_{-0.013}$	52.388 (2 1/16)
101.600 (4)	NACV64/3AS	NACV64X/3AS	NACV64LL/3AS	NACV64XL/3ASL	31.750 (1 1/4) $^{+0.002}_{-0.013}$	58.738 (2 5/16)
127.000 (5)	NACV80/3AS	NACV80X/3AS	NACV80LL/3AS	NACV80XL/3ASL	44.450 (1 3/4) $^{+0.002}_{-0.013}$	73.025 (2 7/8)
152.400 (6)	NACV96/3AS	NACV96X/3AS	NACV96LL/3AS	NACV96XL/3ASL	57.150 (2 1/4) $^{+0.002}_{-0.013}$	85.725 (3 3/8)

Note:1. $^{0}_{-0.025}$ is the dimensional tolerance of the outside diameter D of the outer rings of the NACV··X and NACV··XLL types whose outside surface form is cylindrical.
注1）外径面が円筒であるNACV··X形，NACV··XLL形の外輪外径 D の許容差は $^{0}_{-0.025}$ である。

Dimensions / 寸法 mm (in)			Basic load ratings N kgf dynamic 基本動定格荷重	static 基本静定格荷重	Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Oil lubrication 油潤滑	Mass 質量 kg (approx.) (参考)	OD / 外径 1) mm (in)
C $^{0}_{-0.130}$	e	F	C_r	C_{or}						D $^{0}_{-0.05}$
12.700 (1/2)	15.5	11	8 050 825	13 300 1 360	1 380 140	4 600 470	9 000	※11 000	0.027	19.050 (3/4)
12.700 (1/2)	15.5	11	8 050 825	13 300 1 360	1 710 174	5 350 545	9 000	※11 000	0.036	22.225 (7/8)
15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920	2 060 210	7 400 755	7 100	9 200	0.059	25.400 (1)
15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920	2 430 248	8 350 850	7 100	9 200	0.073	28.575 (1 1/8)
19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600	2 840 290	11 400 1 160	5 400	7 000	0.109	31.750 (1 1/4)
19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600	3 250 330	12 500 1 280	5 400	7 000	0.132	34.925 (1 3/8)
22.225 (7/8)	27	21	21 100 2 150	45 500 4 650	3 600 365	16 300 1 660	4 800	6 200	0.177	38.100 (1 1/2)
22.225 (7/8)	27	21	21 100 2 150	45 500 4 650	4 050 410	17 600 1 800	4 800	6 200	0.218	41.275 (1 5/8)
25.400 (1)	27	24.65	28 400 2 900	60 500 6 150	4 400 450	21 600 2 200	4 100	5 300	0.281	44.450 (1 3/4)
25.400 (1)	27	24.65	28 400 2 900	60 500 6 150	4 850 495	23 200 2 360	4 100	5 300	0.327	47.625 (1 7/8)
31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950	5 300 540	31 000 3 150	3 700	4 800	0.454	50.800 (2)
31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950	6 200 635	35 000 3 550	3 700	4 800	0.585	57.150 (2 1/4)
38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200	7 200 735	44 500 4 550	3 200	4 100	0.902	63.500 (2 1/2)
38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200	8 250 840	49 000 5 000	3 200	4 100	1.05	69.850 (2 3/4)
44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000	9 150 935	64 000 6 500	2 700	3 500	1.39	76.200 (3)
44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000	10 000 1 020	69 000 7 050	2 700	3 500	1.66	82.550 (3 1/4)
50.800 (2)	60	44.5	84 500 8 650	214 000 21 800	11 100 1 130	86 000 8 800	2 200	2 800	2.19	88.900 (3 1/2)
57.150 (2 1/4)	63	44.5	106 000 10 800	244 000 24 900	13 200 1 350	112 500 11 500	2 200	2 800	3.22	101.600 (4)
69.850 (2 3/4)	89	68.7	189 000 19 300	520 000 53 000	17 900 1 830	165 500 16 900	1 500	1 900	6.08	127.000 (5)
82.550 (3 1/4)	110	81.35	260 000 26 500	675 000 68 500	22 100 2 250	239 500 24 400	1 200	1 500	10.0	152.400 (6)

Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 rpm.
備考　※印シール付きの場合の許容回転速度は，おおよそ10 000r/minである。

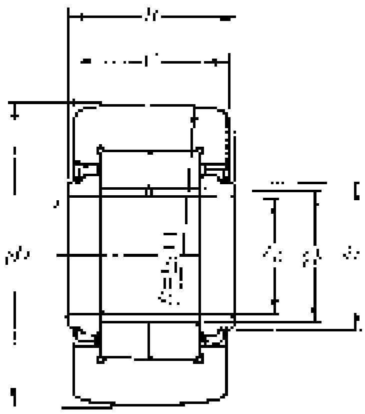
Metric series	Inch series
with cage	**Full-complement roller**
without inner ring	**with inner ring**
without shield	**with shield**
ミリ系	インチ系
保持器付き	**総ころ**
内輪なし	**内輪付き**
シールドなし	**シールド付き**

Double-Row Cylindrical Roller Type Roller Followers

複列円筒ころ形ローラフォロア

NUTR2 type
NUTR2‥X type
NUTR3 type
NUTR3‥X type

NUTR2形
NUTR2‥X形
NUTR3形
NUTR3‥X形



NUTR2 type
NUTR3 type
NUTR2形
NUTR3形

OD[1] 外径 mm D 0 −0.05	Roller Follower number 呼び番号		Dimensions 寸法 mm						Basic load ratings dynamic 基本動定格荷重 N kgf	static 基本静定格荷重
	Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	d	B	C	e	F	$r_{s\,min}$[2]	C_r	C_{or}
35	NUTR202/3AS	NUTR202X/3AS	15	19 $^{0}_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620
40	NUTR203/3AS	NUTR203X/3AS	17	21 $^{0}_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970
42	NUTR302/3AS	NUTR302X/3AS	15	19 $^{0}_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620
47	NUTR303/3AS	NUTR303X/3AS	17	21 $^{0}_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970
	NUTR204/3AS	NUTR204X/3AS	20	25	24	27	25.5	0.3	38 500 3 950	48 000 4 900
52	NUTR304/3AS	NUTR304X/3AS	20	25 $^{0}_{-0.210}$	24	27	25.5	0.3	38 500 3 950	48 000 4 900
	NUTR205/3AS	NUTR205X/3AS	25	25	24	31	30	0.3	42 500 4 350	57 500 5 850
62	NUTR305/3AS	NUTR305X/3AS	25	25 $^{0}_{-0.210}$	24	31	30	0.3	42 500 4 350	57 500 5 850
	NUTR206/3AS	NUTR206X/3AS	30	29	28	38	35	0.3	56 500 5 750	72 500 7 400
72	NUTR306/3AS	NUTR306X/3AS	30	29 $^{0}_{-0.210}$	28	38	35	0.3	56 500 5 750	72 500 7 400
	NUTR207/3AS	NUTR207X/3AS	35	29	28	44	41.5	0.6	62 000 6 350	85 500 8 700
80	NUTR307/3AS	NUTR307X/3AS	35	29 $^{0}_{-0.210}$	28	44	41.5	0.6	62 000 6 350	85 500 8 700
	NUTR208/3AS	NUTR208X/3AS	40	32 $^{0}_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700
85	NUTR209/3AS	NUTR209X/3AS	45	32 $^{0}_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000
90	NUTR308/3AS	NUTR308X/3AS	40	32 $^{0}_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700
	NUTR210/3AS	NUTR210X/3AS	50	32	30	60	57	0.6	96 500 9 800	150 000 15 300
100	NUTR309/3AS	NUTR309X/3AS	45	32 $^{0}_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000
110	NUTR310/3AS	NUTR310X/3AS	50	32 $^{0}_{-0.250}$	30	60	57	0.6	96 500 9 800	150 000 15 300

Notes:1. JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the NUTR2‥X and NUTR3‥X types whose outside surface form is cylindrical.
2. The minimum value of chamfer dimension r.

注1）外径面が円筒であるNUTR2‥X形，NUTR3‥X形の外輪外径 D の許容差はJIS 0級である。
2）面取寸法 r の最小寸法です。

Track load capacity トラック負荷容量 N kgf Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Limiting speed 許容回転速度 r/min Grease lubrication グリース潤滑	Mass 質量 kg (approx.) (参考)	OD[1)] 外径 mm *D* 0 −0.05
3 200 325	11 900 1 220	5 500	0.100	**35**
3 850 390	14 500 1 480	4 700	0.147	**40**
4 100 415	14 300 1 460	5 500	0.160	**42**
4 700 480	17 000 1 740	4 700	0.222	**47**
4 700 480	21 000 2 150	4 000	0.245	
5 550 565	23 300 2 370	4 000	0.321	**52**
5 550 565	23 300 2 370	3 300	0.281	
6 950 710	27 800 2 830	3 300	0.450	**62**
6 950 710	33 000 3 350	2 900	0.466	
8 050 820	38 500 3 900	2 900	0.697	**72**
8 050 820	37 000 3 750	2 400	0.630	
9 800 1 000	41 000 4 150	2 400	0.840	**80**
9 800 1 000	44 500 4 500	2 100	0.817	
10 400 1 060	47 000 4 800	1 900	0.883	**85**
11 400 1 160	50 000 5 100	2 100	1.13	**90**
11 400 1 160	50 000 5 100	1 800	0.950	
13 000 1 330	55 500 5 650	1 900	1.40	**100**
14 700 1 500	61 000 6 200	1 800	1.69	**110**

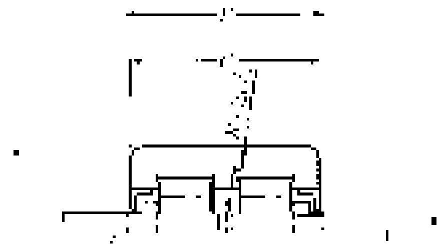
Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without shield	with shield

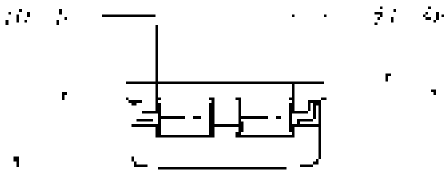
ミリ系	インチ系
保持器付き	総ころ
内輪なし	内輪付き
シールドなし	シールド付き

Center-Ribbed Double-Row Cylindrical Roller Type Roller Followers
中つば付複列円筒ころ形ローラフォロア

NUTW type
NUTW‥X type

NUTW形
NUTW‥X形





NUTW2 type
NUTW2形

OD[1] 外径 mm D 0 −0.05	Roller Follower number 呼び番号 Spherical outer rings 球面外輪	Cylindrical outer rings 円筒外輪	Dimensions 寸法 mm d	B	C	e	F	$r_{s\,min}$[2]	Basic load ratings dynamic 基本動定格荷重 N kgf C_r	static 基本静定格荷重 C_{or}
35	NUTW202/3AS	NUTW202X/3AS	15	22 $^{0}_{-0.210}$	21	20	19	0.3	24 100 2 460	28 300 2 880
40	NUTW203/3AS	NUTW203X/3AS	17	24 $^{0}_{-0.210}$	23	22	21.5	0.3	26 000 2 650	32 000 3 250
47	NUTW204/3AS	NUTW204X/3AS	20	29 $^{0}_{-0.210}$	28	27	25.5	0.3	40 500 4 150	51 500 5 250
52	NUTW205/3AS	NUTW205X/3AS	25	29 $^{0}_{-0.210}$	28	31	30	0.3	45 000 4 600	61 500 6 250
62	NUTW206/3AS	NUTW206X/3AS	30	35 $^{0}_{-0.210}$	34	38	35	0.3	59 500 6 050	77 000 7 900
72	NUTW207/3AS	NUTW207X/3AS	35	35 $^{0}_{-0.210}$	34	44	41.5	0.6	65 000 6 650	91 000 9 250
80	NUTW208/3AS	NUTW208X/3AS	40	38 $^{0}_{-0.250}$	36	51	47.5	0.6	90 500 9 250	131 000 13 400
85	NUTW209/3AS	NUTW209X/3AS	45	38 $^{0}_{-0.250}$	36	55	52.5	0.6	95 500 9 750	144 000 14 700
90	NUTW210/3AS	NUTW210X/3AS	50	38 $^{0}_{-0.250}$	36	60	57	0.6	100 000 10 200	158 000 16 100

Notes:1. The bearing numbers of bearings whose outer ring surface is cylindrical have the suffix "X" JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the bearings whose outside surface form is cylindrical.　Example: NUTW203X
2. The minimum value of chamfer dimension r.

注1）外輪面が円筒状の軸受は，呼び番号の後に記号"X"をつける。この場合，円筒状軸受の外輪外径 D の許容差はJIS 0級である。　例　NUTW203X
2）面取寸法 r の最小寸法です。

Track load capacity トラック負荷容量 N kgf		Limiting speed 許容回転速度 r/min	Mass 質量 kg	OD[1)] 外径 mm
Spherical outer ring 球面外輪	Cylindrical outer ring 円筒外輪	Grease lubrication グリース潤滑	(approx.) (参考)	D 0 −0.05
3 200 325	14 200 1 450	5500	0.115	**35**
3 850 390	17 100 1 740	4700	0.167	**40**
4 700 480	25 100 2 560	4000	0.280	**47**
5 550 565	27 700 2 830	3300	0.322	**52**
6 950 710	41 000 4 200	2900	0.549	**62**
8 050 820	46 000 4 700	2400	0.747	**72**
9 800 1 000	54 500 5 550	2100	0.953	**80**
10 400 1 060	58 000 5 900	1900	1.03	**85**
11 400 1 160	61 500 6 250	1800	1.11	**90**

Cam Followers & Roller Followers with Solid Grease

ポリルーブカムフォロア・ローラフォロア

Overview 概 要

Solid grease for cam and roller followers is composed principally of a lubricating grease and a polymer. Solid grease has the same properties at normal temperature as ordinary greases before heat treatment. However, when heated and cooled, the polymer solidifies retaining a larger portion of the lubricant. Even when severe vibration or a large centrifugal force is exerted on the bearing, the solid grease rarely leaks. Solid grease greatly contributes to longer bearing life, prevents bearing contamination, and improves the work environment.

ポリルーブカムフォロア，ローラフォロアに封入される熱固化型グリースは潤滑グリースと樹脂を主成分とする潤滑剤です。常温ではグリース状ですが一度加熱冷却する（熱処理と呼ぶ）と，多量の潤滑剤が保持されたまま硬化する。ポリルーブは熱処理後固形となるため，強い振動や大きな遠心力が作用する場合でも潤滑剤が漏れにくく，軸受の長寿命，軸受まわりの汚染防止，環境改善に貢献する。

Features 特 徴

1. Low grease leakage

Once heated and cooled, the grease/polymer mixture solidifies, ensuring that a large portion of the lubricant is retained in the bearing. As heat and centrifugal force act on the bearing, the lubricant is gradually supplied to the rolling contact surface while rarely leaking from the bearing. Therefore, unlike ordinary greases, solid grease allows a clean work environment.

2. Good lubricity

Even when severe vibration or centrifugal force is exerted on a cam or roller follower, the lubricant rarely leaks ensuring good lubrication. Also, solid grease does not readily emulsify and flow out even if water enters the bearing.

3. Sealing effect

Solid grease functions as a shield against the ingress of foreign matter, providing a moderately effective dust prevention effect. However, the solid grease alone is not a secure sealant. Therefore, **NTN** recommends that a bearing with a seal be selected and/or a seal be provided around the bearing.

（1）潤滑剤の漏れが少ない

ポリルーブは熱処理後固形となるため，内部に多量の潤滑剤を保持する。この潤滑剤が，軸受の発熱，遠心力により，転動面に徐々に供給されるため潤滑剤の漏れが少なくなる。このため一般の潤滑グリースに比べ周囲環境への汚染防止となる。

（2）潤滑特性が良い

強い振動や大きな遠心力がカムフォロア，ローラフォロアに作用する場合でも，潤滑剤が漏れにくく，また，ポリルーブは固形であるため水分の浸入があっても乳化して流出しにくいので，潤滑特性が一般の潤滑グリースに比べ優れている。

（3）シール効果

ポリルーブは外部からの浸入物（水分，塵埃など）に対して防壁となり一定の防塵効果が期待できるが，密封装置としては十分ではないのでシール付き軸受の選定，更には軸受まわりにシール設計の検討を推奨します。

Available Cam Followers & Roller Followers 製作対応可能形番

- Cam followers and roller followers with a cage (excluding those with a synthetic resin cage)
- Full-complement roller type (cylindrical roller) cam followers and roller followers (Not available for full-complement needle roller types)

■保持器付カムフォロア，ローラフォロア（ただし，保持器が合成樹脂製のものは除く）
■総ころ形（円筒ころ）カムフォロア，ローラフォロア（針状ころの総ころ形は対応不可）

■Nomenclature for cam followers & roller followers with solid grease
ポリルーブカムフォロア，ローラフォロアの呼び番号例

KR 30 LL DO H ／LP03

- Lubricant code (/LP03: solid grease) 潤滑記号（／LP03：ポリルーブ）
- Supplementary suffix (H: Stud head with hexagonal socket) 補助記号（H：スタッド頭部六角穴付き）
- Bearing ring code (DO: Oil hole. No oil groove.) 軌道輪形状記号（DO：油穴，油溝なし）
- Seal & shield code シール・シールド記号
- Dimension code 寸法記号
- Type code 形式記号

NATR 8 LL ／LP03

- Lubricant code (/LP03: solid grease) 潤滑記号（／LP03：ポリルーブ）
- Seal & shield code シール・シールド記号
- Dimension code 寸法記号
- Type code 形式記号

Usage Precautions 使用上の注意点

1. Allowable temperature range

The allowable temperature range of cam and roller followers with solid grease is –20°C to 80°C. The maximum allowable temperature for continuous long-term operation is 60°C. The operating temperature must be closely monitored.

2. Limiting speed

Cam and roller followers with the solid grease can be used for $F_w \times n$ values up to 30,000.

$F_w \times n$ value: (F_w =roller inscribed circle diameter [mm]) ×(n=operating speed [rpm])

3. Minimum required load

To ensure the rolling elements turn without slipping, provide a load of at least 1% of the basic dynamic load rating.

4. Other precautions

Solid grease serves to shield against the ingress of foreign matter. However, solid grease alone is not an effective sealant. Therefore, **NTN** recommends that a bearing with a seal be selected. Water ingress can lead to corrosion problems. **NTN** recommends that the customer assess the probability for rust.

Do not use cam and roller followers with the solid grease in an environment where organic solvents (acetone, petroleum benzene, kerosene, etc.) are present.

(1) 許容温度範囲

許容温度範囲は－20℃～80℃であるが，連続長時間使用の場合は60℃以下のため使用温度には充分注意ください。

(2) 許容回転速度

カムフォロア，ローラフォロアは $F_w \cdot n$ 値＝30 000以下でご使用ください。

$F_w \cdot n$ 値：
(F_w＝ころ内接円径寸法［mm］)×(n＝使用回転速度［r／min］)

(3) 最小必要荷重

転動体が滑ることなく回転させるために少なくとも基本動定格荷重の1％程度の荷重が必要です。

(4) その他

ポリルーブは，外部からの浸入物に対して防壁となりますが密封装置としては充分ではないのでシール付型番を推奨します。また水分に対しては別途錆の問題も懸念されますので一度評価いただくことを推奨します。

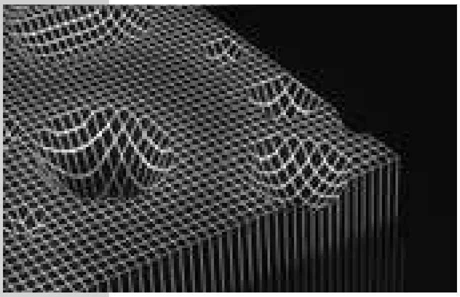
他方，有機溶剤（アセトン，石油ベンジン，白灯油など）のかかる条件下では使用できないので注意ください。

Typical Applications 使用用途例

- Printing presses : Cam mechanism
- Press machine : Guide rollers
- Food processing machinery, packaging machinery : Conveyors, guide rollers
- Steel production machinery : Guide rollers
- Car manufacturing lines : Conveyors, guide rollers
- Logistics & material handling equipment : Guide rollers
- Textile machinery : Cam mechanism
- Medical equipment : Guide rollers, etc.

- 印刷機械：カム機構部
- プレス機械：ガイドローラ
- 食品，包装機械：コンベア部，ガイドローラ
- 鉄鋼設備：ガイドローラ
- 自動車製造ライン：コンベア，ガイドローラ
- 物揚・送搬機：ガイドローラ
- 繊維機械（織機）：カム機構
- 医療機器：ガイドローラ　等々

HL Outer Ring Roller Followers
HL外輪ローラフォロア



Overview 概要

The HL (High Lubrication) surface contains countless dimples ranging in size from 10 µm to 100 µm. These “micro oil pots” are scattered in a random pattern. **NTN** has often incorporated this type of surface on bearing rollers and is now using it on the outside surface on the outer rings of cam followers and roller followers to provide improved lubrication.

HL（High Lublicationの略）表面は，大きさ数10μm程度の凹部（マイクロオイルポット）を無数にランダムにつけた表面で，一般的にはころ単品での実績が多くありますが，カムフォロア，ローラフォロア外輪外径面に適用するものです。

Available Roller Followers 製作対応形番

Cam followers and roller followers whose outer rings do not exceed 30 mm in outside diameter can be manufactured with HL. For outside diameters exceeding 30 mm, contact **NTN**.

カムフォロア，ローラフォロアの外輪外径がφ30mm以下の形番を原則とする。なお外径がφ30mmを超えてのご要望の場合，**NTN**へ御照会ください。

Features 特徴

Micro oil pots scattered in a random pattern on the HL surface to create a high capacity for oil film formation. This feature is especially useful in difficult-to-lubricate areas where peeling problems tend to occur. This helps to resist wear and extend the service life.

HL表面は微小凹部を無数にランダムにつけたことにより油膜形成能力が高く，特にピーリング損傷などの発生しやすい潤滑条件の厳しい使用箇所で実力を発揮し，摩耗対策や長寿命効果が期待できる。

Applications 用途

- Engine roller rocker (see photo above)
- Cam roller on automatic weaving machine
- Cam roller on printing press

- エンジンローラロッカ（上図参照下さい）
- 自動織機 カムローラ
- 印刷機械 カムローラ

Stainless Steel Cam Followers

ステンレス製カムフォロア

Overview 概 要

NTN cam followers are used in a wide variety of applications due to their ease of installation and reliable performance.

Recently, customer have requested improved corrosion resistance in wet or humid environments. To meet this need, **NTN has** developed stainless steel cam followers.

カムフォロアはその取り扱いの容易さより，幅広い用途で使用され耐食性のニーズに対し，材質をステンレス鋼で製作したものです。

Available Cam Followers 製作対応形番

1. 2F-○○○○ : The outer ring, stud, side plate, and included hexagonal nut are made of stainless steel. All externally visible areas are made of stainless steel in this cost-effective cam follower.
2. F-○○○○ : All the components other than the seal are made of stainless steel. (○○○○—represents the cam follower number in the dimension tables).

（1）2F−○○○○：外輪，スタッド，側板，添付六角ナットがステンレス材である。外から見える部分はすべてステンレス製で，経済的なカムフォロアである。

（2）F−○○○○：全部品（シール除く）ステンレス材での設計，製作品である。（○○○○—前述寸法表のカムフォロア名称がつく。）

Features 特 徴

This type of cam follower resists corrosion in severe operating conditions such as very wet environments with high humidity; rugged and wet terrain; and environments where water intermittently contaminates the area around the bearing. Under these conditions, the service life of stainless steel cam followers exceeds that of standard cam followers.

水蒸気をはじめ湿気の多い雰囲気，水たまり不整地用途，水が軸受及び軸受まわりに間欠的にかかる条件等に対して，一定の防錆効果が期待でき，標準カムフォロアに比べて長寿命である。

Usage Precautions 使用上の注意

1. Before employing a stainless steel cam follower in order to counteract corrosion (especially when caused by water), assess the corrosion resistance and expected life of the intended stainless steel cam follower.
2. The calculated fatigue life of stainless steel cam followers is approximately 50% that of standard cam followers. However, corrosion rather than fatigue is generally the limiting factor in bearing life in corrosive environments.

（1）錆対策でのステンレス製カムフォロア選定（特に水分がらみ案件）にあたっては本格採用前に防錆効果と寿命についてご確認ください。

（2）材質がステンレス製より，計算寿命は標準品の概ね50%である。

Cam Followers & Roller Followers with Grooved Outer Rings
外輪溝付きカムフォロア・ローラフォロア





Cam follower with grooved outer ring (above) and roller followers with various types of grooved outer rings (right)
外輪溝付きカムフォロア（写真上）と
各種外輪溝付きローラフォロア（写真右）

Overview 概 要

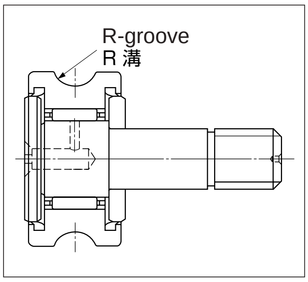
This type of bearing has an outer ring whose outside surface is grooved to conform to the shape of its mating surface. It is used as a guide roller. The available grooves include R-grooves and V-grooves. The installation procedure is identical to that of standard bearings.

外輪外径に，相手材の形状に合わせた溝を設けた軸受で，ガイドローラとして使用する。溝形状は，R形状やV形状などの加工が可能であり，取付け要領などは標準軸受と同一である。

Features 特 徴

- The R-groove can be finished to a mirror surface for specific applications.
  (The standard finish is produced by turning and lapping.)
- The basic design is identical to that of standard cam followers.
- Installation is simple.
- This product can be an economical alternative to purchasing a bearing and separate housing to serve as a guide roller.

(1) R溝形状は用途に応じて鏡面仕上げも可能である。
(一般：旋削→ラップ仕上げ)
(2) 基本設計はカムフォロア標準に準じている。
(3) 取付けが容易である。
(4) 直動装置のガイドローラとしても使用でき，経済的な場合もある。

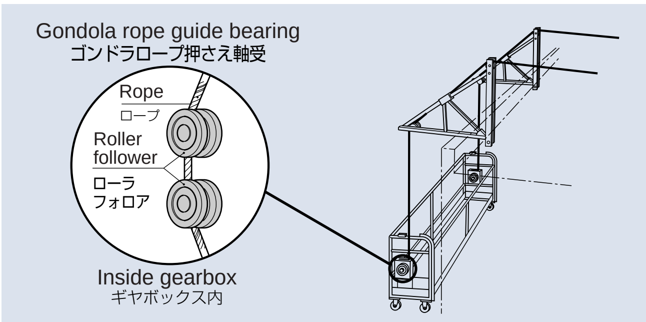


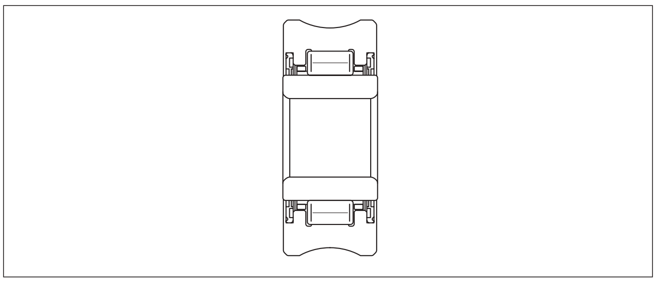
Applications 用 途

- Guide rollers for steel wire and steel pipe
- Straightening rollers
- Rope gripper on gondola hoisting device for window washing

- 鋼線及び鋼管のガイドローラ
- 矯正ローラ
- ビル清掃ゴンドラ巻上げ機ロープつかみ装置など

Typical applications of bearings with solid grease ポリルーブ軸受応用例





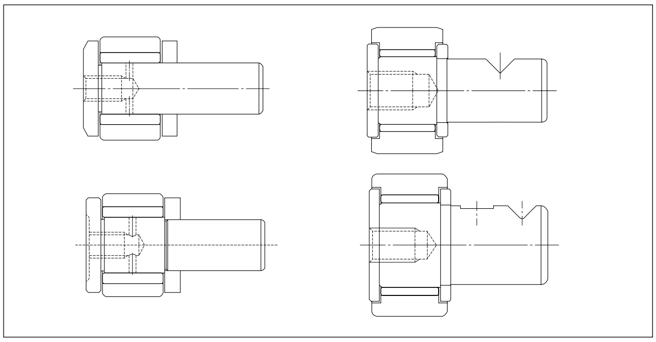
Index Cam Followers

インデックス用カムフォロア

Overview 概 要

Automatic machinery performs various operations including intermittent motion, oscillation and continuous rotation at high speed and with a high degree of precision. Index cam followers are used in the roller cam mechanism of the drives in such machinery.

自動機は間欠，揺動，連続回転など多様な動きを高精度でかつ高速で行うが，この駆動部のローラカム機構にカムフォロアが使用される。

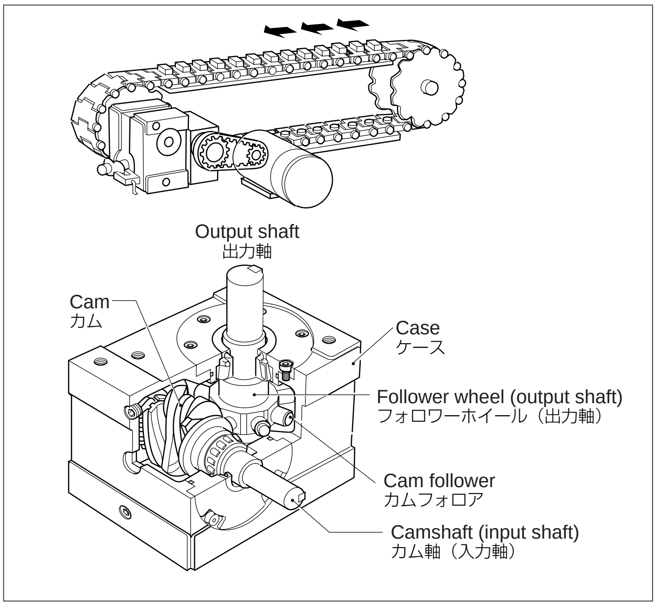


index cam followers
インデックスカムフォロアの形状例

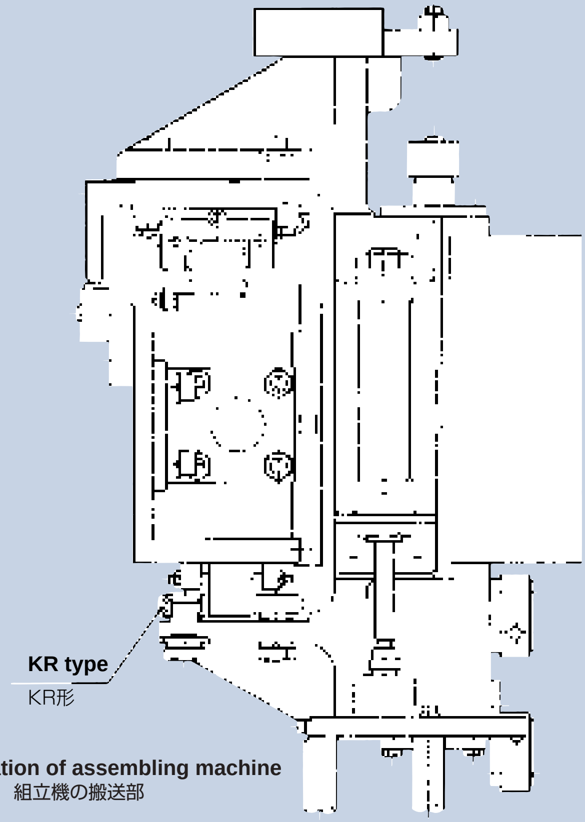
Features 特 徴

1. A rigid outer ring and stud can be housed in limited space.
2. This full-complement roller design offers greater load capacity and longer life than caged cam followers.
3. The dimensional & running accuracy of this cam follower are higher precision than standard.
4. This cam follower is easily installed by a setscrew.

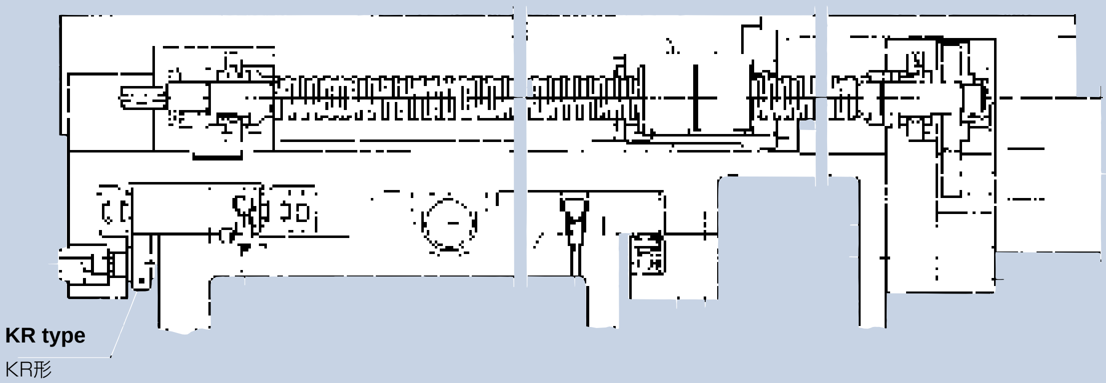
（1）限られたスペース内で適切な外輪及びスタッド剛性を有する。
（2）総ころ設計のため，保持器付きより負荷容量が大きく長寿命である。
（3）寸法·回転精度が精密級のカムフォロアである。
（4）セットねじにて位置固定をするため，取付けが容易である。



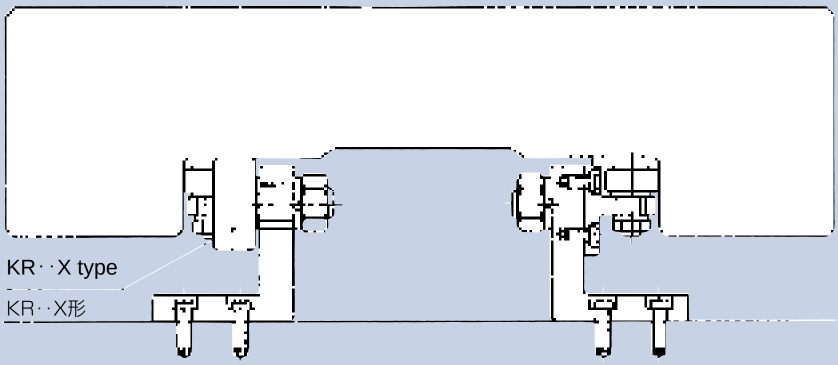
Typical structure of indexing drive
構造図例　インデキシングドライブ



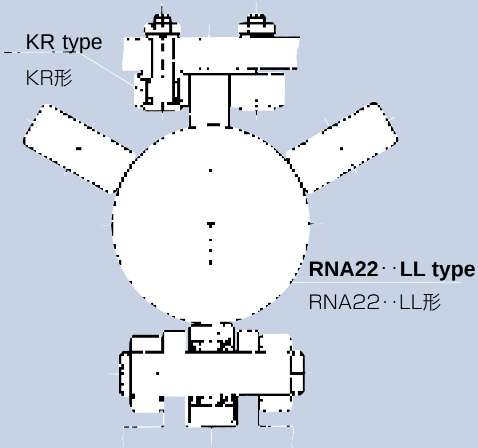
Carrying station of assembling machine
組立機の搬送部



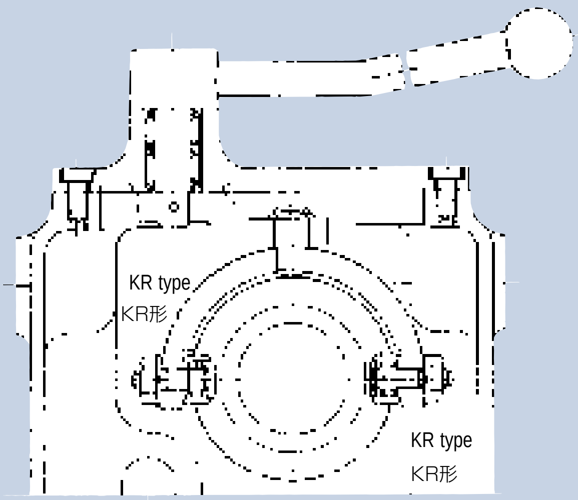
Cordinate axis of NC machining center
NCマシニングセンタの座標軸



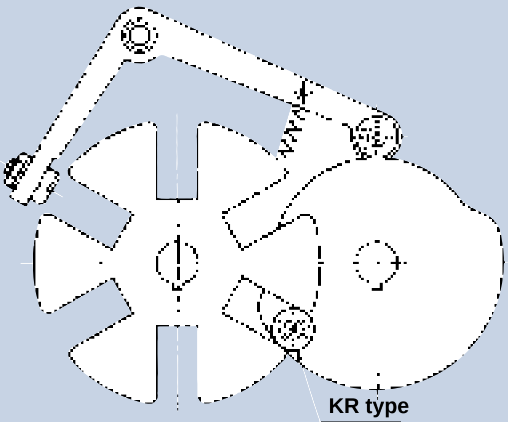
Loading and unloading system of pallet changer for machining center
マシニングセンタ用パレットチェンジャの搬入出装置



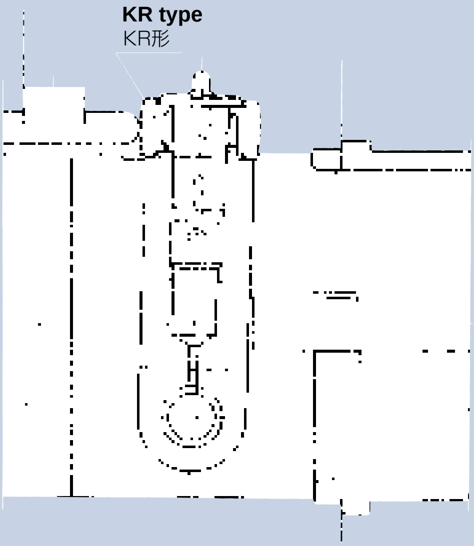
Arm guide of robot machine
ロボットマシンのアームガイド



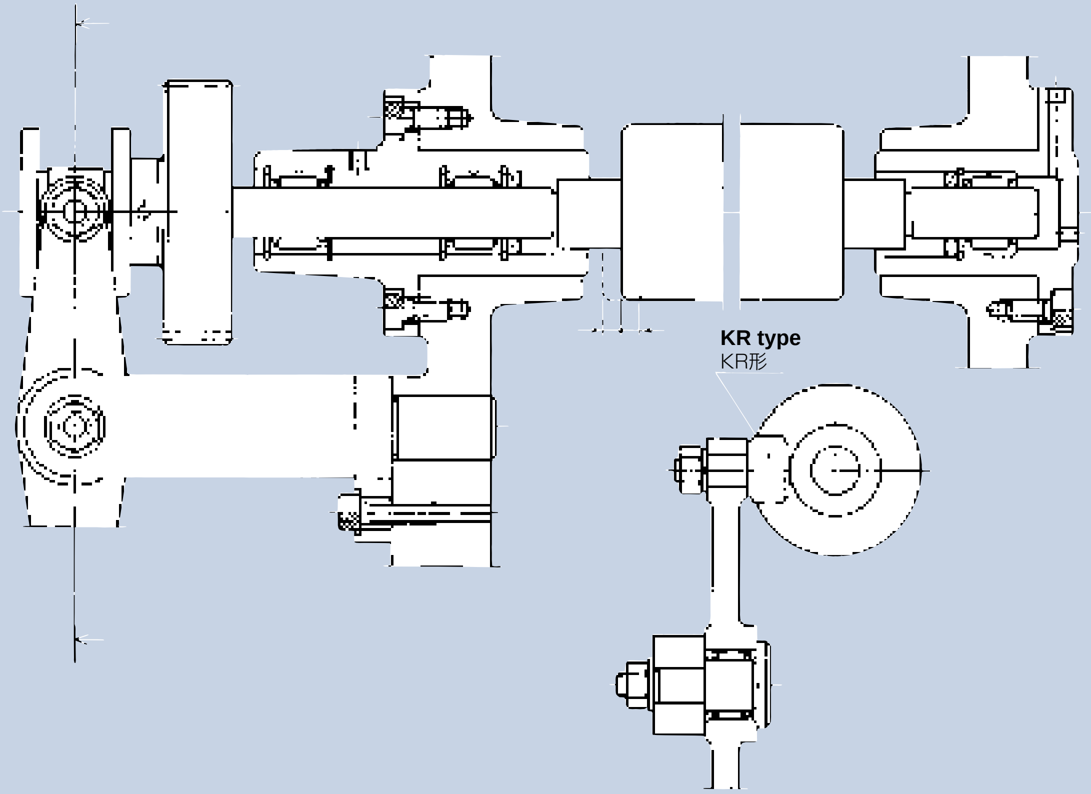
Lathe chuck mechanical coupling
旋盤チャックメカニカルカップリング



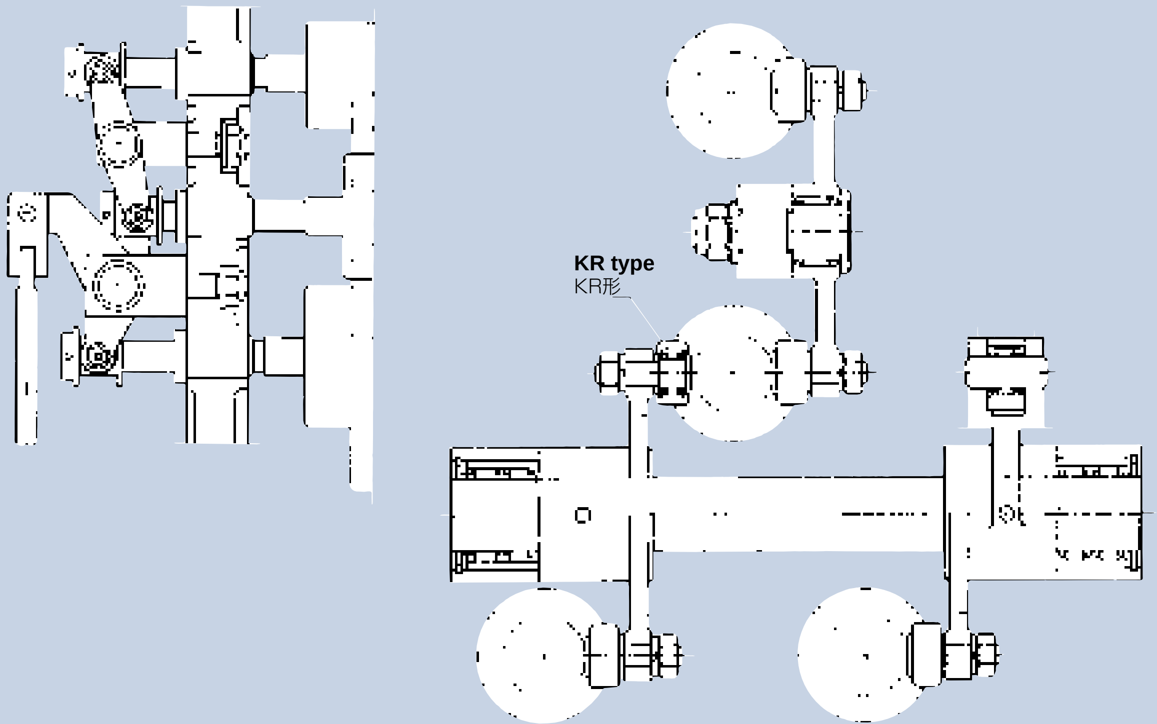
Turret machanism
ターレット機構



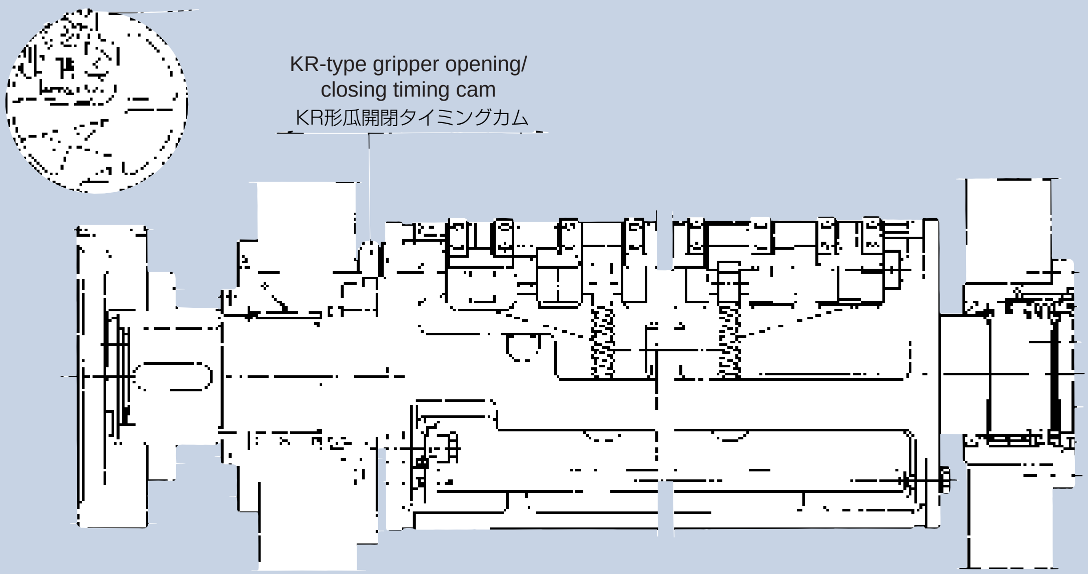
Cam follower used in press feeding system
プレス送り装置カムフォロア



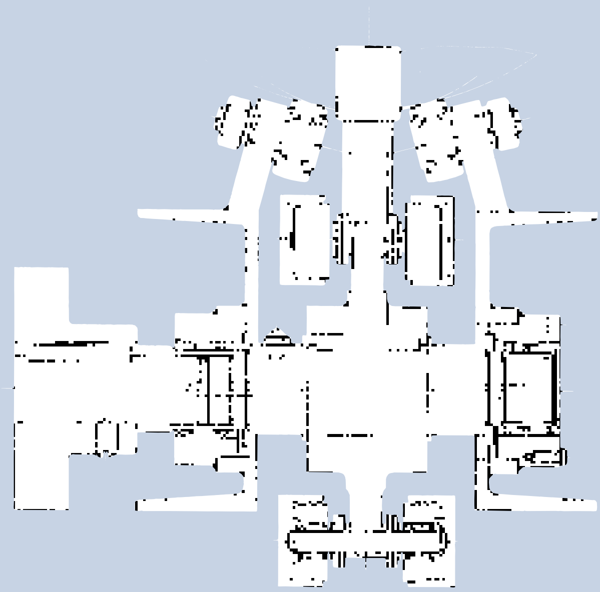
Printing press ink distributing roller
印刷機インクねりロール



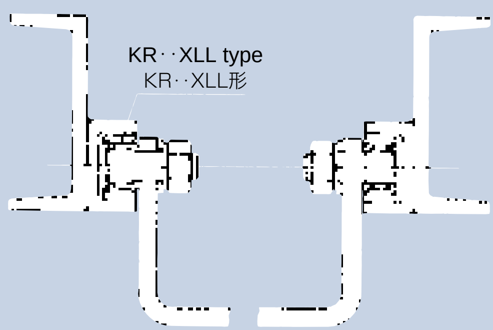
Printing press ink roller drive mechanism
印刷機インクロール駆動機構



Printing press impression cylinder
印刷機圧胴

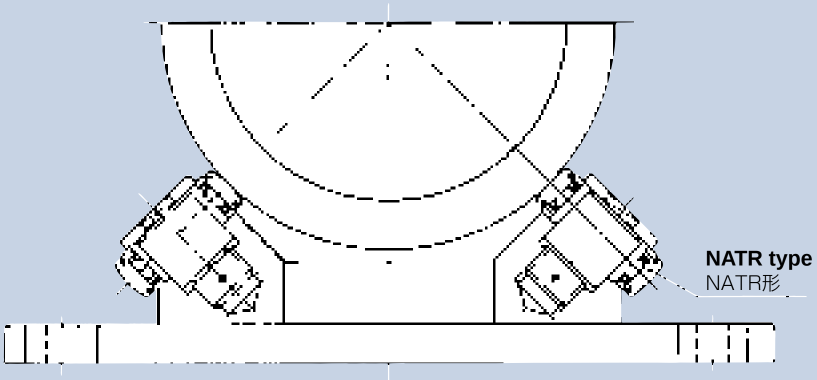


Roller frame of chain conveyor
チェーンコンベヤのローラフレーム

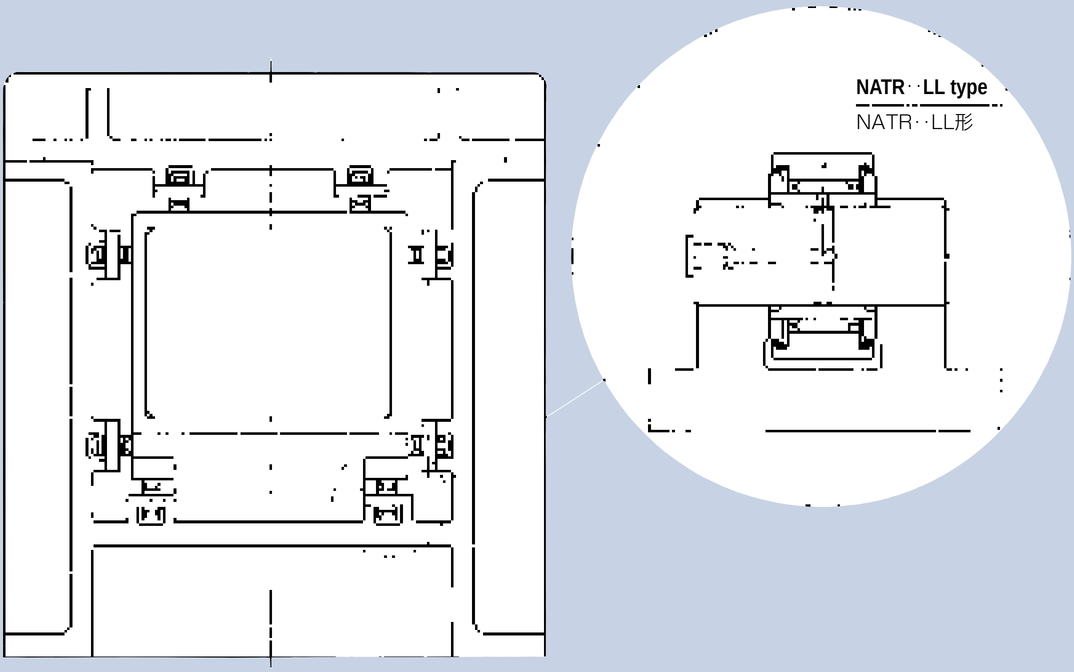


Circular conveyor supporting roller
円形コンベヤの支持ローラ

NATR type
NATR形



Drum supporting roller
ドラム支持ローラ



Sliding area of pressure cara
プレッシャーカースライド部

Bearing Tolerances　軸受の精度

Table 12 Tolerances for Radial Bearings ラジアル軸受の精度

Table 12-1 Inner rings 内輪

Unit μm

Nominal bore diameter 呼び軸受内径 d mm		Mean bore diameter deviation 平均内径の寸法差 Δ_{dmp} Class 0 0級		Bore diameter variation 内径不同 V_{dp} Class 0 0級	Mean bore diameter variation 平均内径の不同 V_{dmp} Class 0 0級	Inner ring radial runout ラジアル振れ K_{ia} Class 0 0級	Inner ring width deviation 幅の寸法差 Δ_{Bs} Class 0 0級		Inner ring width variation 幅不同 V_{Bs} Class 0 0級
over を超え	incl. 以下	high 上	low 下	max 最大	max 最大	max 最大	high 上	low 下	max 最大
2.5 [1]	10	0	−8	10	6	10	0	−120	15
10	18	0	−8	10	6	10	0	−120	20
18	30	0	−10	13	8	13	0	−120	20
30	50	0	−12	15	9	15	0	−120	20
50	80	0	−15	19	11	20	0	−150	25
80	120	0	−20	25	15	25	0	−200	25

1) This dimensional category includes 2.5 mm.
2.5mmは，この寸法区分に含まれる。

Table 12-2 Outer rings 外輪

Unit μm

Nominal outside diameter 呼び軸受外径 D mm		Mean outside diameter deviation 平均外径の寸法差 Δ_{Dmp} Class 0 0級		Outside diameter variation 外径不同 V_{Dp} Class 0 0級	Mean outside diameter variation 平均外径の不同 V_{Dmp} Class 0 0級	Outer ring radial runout ラジアル振れ K_{ea} Class 0 0級	Outer ring width deviation 幅の寸法差 Δ_{Cs} Class 0 0級	Outer ring width variation 幅不同 V_{Cs} Class 0 0級
over を超え	incl. 以下	high 上	low 下	max 最大	max 最大	max 最大		
6 [2]	18	0	−8	10	6	15	According to tolerance of "Δ_{Bs}" against "d" of the same bearings. 同じ軸受のdに対するΔ_{Bs}の許容差による。	According to tolerance of "V_{Bs}" against "d" of the same bearings. 同じ軸受のdに対するV_{Bs}の許容値による。
18	30	0	−9	12	7	15		
30	50	0	−11	14	8	20		
50	80	0	−13	16	10	25		
80	120	0	−15	19	11	35		
120	150	0	−18	23	14	40		
150	180	0	−25	31	19	45		
180	250	0	−30	38	23	50		

2) This dimensional category includes 6 mm.
6mmは，この寸法区分に含まれる。

Note: **NTN** can supply products of classes 4, 5 and 6 on request. For more information, contact **NTN** CORP.
備考：6級，5級，4級についても製作できますので，必要な場合は**NTN**に御照会ください。

Comparison Table: Comparison of NTN Cam Followers with Competitors' Products
カムフォロア各社対照表

Series	Type		NTN	Reference page 記載ページ	IKO	THK	NSK	KOYO	INA・SKF	TORR.	Mc.GILL	RBC
Miniature metric series ミニアチュア ミリ系列	With cage 保持器付	With hexagonal socket 六角穴付	KRM··XH 2F-KRM··XH	95	CFS·· CFS··F		FCJMB-···					
Miniature metric series ミニアチュア ミリ系列	Full-complement roller/ 総ころ	With hexagonal socket 六角穴付	KRMV··XH 2F-KRMV··XH	95	CFS··V CFS··FV		FCRMB-···					
Metric series ミリ系列	With cage 保持器付	With hexagonal socket/ 六角穴付	KR··H KR··LLH KR··XH KR··XLLH	96·97	CF··BR CF··BUUR CF··B CF··BUU	CF··R-A CF··UUR-A CF··-A CF··UU-A	FCJB-··R FCJSB-··R FCJB-·· FCJSB-··	KM··RHM KM··UURHM KM··HMM KM··UUHM	KR··PP		MCFR-···-B MCFR-···-SB MCFR-···-BX MCFR-···-SBX	
Metric series ミリ系列	With cage 保持器付		KR KR··LL KR··X KR··XLL	98·99	CF··R CF··UUR CF CF··UU	CF··R CF··UUR CF CF··UU	FCJ-··R FCJS-··R FCJ-·· FCJS-··	KM··RM KM··UURM KM··M KM··UUM	KR KR··PP KR··X KR··PPX	FRJSC-···	MCFR-·· MCFR-···-S MCFR-···-X MCFR-···-SX	
Metric series ミリ系列	Full-complement roller 総ころ	With hexagonal socket/ 六角穴付	KRV··H KRV··LLH KRV··XH KRV··XLLH	100·101	CF··VBR CF··VBUUR CF··VB CF··VBUU	CF··V-A CF··VUU-A	FCRB-··R FCRSB-··R FCRB-·· FCRSB-··	CM··RHM CM··UURHM CM··HM CM··UUHM	KRV··PP		MCF-···-B MCF-···-SB MCF-···-BX MCF-···-SBX	
Metric series ミリ系列	Full-complement roller 総ころ		KRV KRV··LL KRV··X KRV··XLL	102·103	CF··VR CF··VUUR CF··V CF··VUU		FCR-··R FCRS-··R FCR-·· FCRS-··	CM··RM CM··UURM CM··M CM··UUM	KRV KRV··PP KRV··X KRV··PPX		MCF-·· MCF-···-S MCF-···-X MCF-···-SX	
Metric series ミリ系列	With cage 保持器付	With tapped hole/ タップ穴付	KRT KRT··LL KRT··X KRT··XLL	104	CF-RU1·· CF-FU1··	CFT··R CFT··UUR CFT CFT··UU						
Metric series ミリ系列	With cage 保持器付	Eccentric stud 軸偏心	KRU KRU··LL KRU··X KRU··XLL	105	CFES··BR CFES··BUUR CFES··B CFES··BUU	CFH··R-A CFH··UUR-A CFH··A CFH··UU-A						
Metric series ミリ系列	Full-complement roller/ 総ころ	With hexagonal socket 六角穴付	NUKR··H	106					NUKR			
Metric series ミリ系列	Full-complement roller/ 総ころ		NUKR	106	NUCF··R							
Inch series インチ系列	With cage (sub-series) 保持器付(準シリーズ)		CR CR··LL CR··X CR··XLL	106	CR··R CR··UUR CR CR··UU							
Inch series インチ系列	Full-complement roller/ 総ころ	With hexagonal socket/ 六角穴付	CRV··H CRV··LLH CRV··XH CRV··XLLH	107			CRBC-·· CRSBC-·· CRB-·· CRSB-··			CRSB-··	CCF-···-B CCF-···-SB CF-···-B CF-···-SB	
Inch series インチ系列	Full-complement roller/ 総ころ		CRV CRV··LL CRV··X CRV··XLL	108·109			CRC-·· CRSC-·· CR-·· CRS-··	CR··M CR··UUM	CF-···-Y CF-···-PPY CF-···- CF-···-PP	CRC-·· CRSC-·· CR-·· CRS-··	CCF-·· CCF-···-S CF-·· CF-···-S	CS-·· CS-···-S S- S-···-S

KRM··XH

Metric series	ミリ系
with cage	保持器付
with hexagonal socket	六角穴
Cylindrical outer rings	円筒外輪
Steel	鋼製

NTN	IKO	NSK
KRM4XT2H/3AS		
KRM4.5XT2H/3AS	CFS2	
KRM5XT2H/3AS	CFS2.5	
KRM6XT2H/3AS	CFS3	
KRM8XT2H/3AS	CFS4	
KRM10XT2H/3AS	CFS5	
KRM12XT2H/3AS	CFS6	

KRMV··XH

Metric series	ミリ系
Full-complement roller	総ころ
with hexagonal socket	六角穴
Cylindrical outer rings	円筒外輪
Steel	鋼製

NTN	IKO	NSK
KRMV4XH/3AS		
KRMV4.5XH/3AS	CFS2V	
KRMV5XH/3AS	CFS2.5V	
KRMV6XH/3AS	CFS3V	
KRMV8XH/3AS	CFS4V	
KRMV10XH/3AS	CFS5V	
KRMV12XH/3AS	CFS6V	

2F-KRM··XH

Metric series	ミリ系
with cage	保持器付
with hexagonal socket	六角穴
Cylindrical outer rings	円筒外輪
Stainless	ステンレス製

NTN	IKO	NSK
2F-KRM4XT2H/3AS		
2F-KRM4.5XT2H/3AS		
2F-KRM5XT2H/3AS	CFS2.5F	FCJMB-5
2F-KRM6XT2H/3AS	CFS3F	FCJMB-6
2F-KRM8XT2H/3AS	CFS4F	FCJMB-8
2F-KRM10XT2H/3AS	CFS5F	FCJMB-10
2F-KRM12XT2H/3AS	CFS6F	FCJMB-12

2F-KRMV··XH

Metric series	ミリ系
Full-complement roller	総ころ
with hexagonal socket	六角穴
Cylindrical outer rings	円筒外輪
Stainless	ステンレス製

NTN	IKO	NSK
2F-KRMV4XH/3AS		
2F-KRMV4.5XH/3AS		
2F-KRMV5XH/3AS	CFS2.5FV	FCRMB-5
2F-KRMV6XH/3AS	CFS3FV	FCRMB-6
2F-KRMV8XH/3AS	CFS4FV	FCRMB-8
2F-KRMV10XH/3AS	CFS5FV	FCRMB-10
2F-KRMV12XH/3AS	CFS6FV	FCRMB-12

Comparison Table: Comparison of NTN Cam Followers with Competitors' Products

カムフォロア各社対照表

KR··H

Metric series		Inch series	ミリ系		インチ系
With cage		Full-complement roller	保持器付		総ころ
Hexagonal socket	Tapped hole	Slot for screwdriver	六角穴	タップ穴	ドライバ溝
Spherical outer surface		Cylindrical outer surface	球面外径		円筒外径
Without seal		With seal	シールなし		シール付

NTN	IKO	THK	NSK	KOYO	Mc.GILL
KR10T2H/3AS	—	CF 3R	FCJB-10R	—	—
KR12T2H/3AS	—	CF 4R	FCJB-12R	—	—
KR13T2H/3AS	—	CF 5R-A	—	—	MCFR-13-B
KR16H/3AS	CF 6BR	CF 6R-A	FCJB-16R	KM 6RHM	MCFR-16-B
KR19H/3AS	CF 8BR	CF 8R-A	FCJB-19R	KM 8RHM	MCFR-19-B
KR22H	CF10BR	CF10R-A	FCJB-22R	KM10RHM	MCFR-22-B
KR26H	CF10-1BR	CF10-1R-A	FCJB-26R	KM10-1RHM	MCFR-26-B
KR30H	CF12BR	CF12R-A	FCJB-30R	KM12RHM	MCFR-30-B
KR32H	CF12-1BR	CF12-1R-A	FCJB-32R	KM12-1RHM	MCFR-32-B
KR35H	CF16BR	CF16R-A	FCJB-35R	KM16RHM	MCFR-35-B
KR40H	CF18BR	CF18R-A	FCJB-40R	KM18RHM	MCFR-40-B
KR47H	CF20-1BR	CF20-1R-A	FCJB-47R	KM20RHM	MCFR-47-B
KR52H	CF20BR	CF20R-A	FCJB-52R	KM20-1RHM	MCFR-52-B
KR62H	CF24BR	CF24R-A	FCJB-62R	KM24RHM	MCFR-62-B
KR72H	CF24-1BR	CF24-1R-A	FCJB-72R	KM24-1RHM	MCFR-72-B
KR80H	CF30BR	CF30R-A	FCJB-80R	KM30RHM	MCFR-80-B
KR85H	CF30-1BR	CF30-1R-A	FCJB-85R	KM30-1RHM	MCFR-85-B
KR90H	CF30-2BR	CF30-2R-A	FCJB-90R	KM30-2RHM	MCFR-90-B

KR··LLH

Metric series		Inch series	ミリ系		インチ系
With cage		Full-complement roller	保持器付		総ころ
Hexagonal socket	Tapped hole	Slot for screwdriver	六角穴	タップ穴	ドライバ溝
Spherical outer surface		Cylindrical outer surface	球面外径		円筒外径
Without seal		With seal	シールなし		シール付

NTN	IKO	THK	NSK	KOYO	INA	Mc.GILL
KR10T2LLH/3AS	—	CF 3UUR	—	—	—	—
KR12T2LLH/3AS	—	CF 4UUR	—	—	—	—
KR13T2LLH/3AS	—	CF 5UUR-A	—	—	—	MCFR-13-SB
KR16LLH/3AS	CF 6BUUR	CF 6UUR-A	FCJSB-16R	KM 6UURHM	—	MCFR-16-SB
KR19LLH/3AS	CF 8BUUR	CF 8UUR-A	FCJSB-19R	KM 8UURHM	—	MCFR-19-SB
KR22LLH/3AS	CF10BUUR	CF10UUR-A	FCJSB-22R	KM10UURHM	—	MCFR-22-SB
KR26LLH/3AS	CF10-1BUUR	CF10-1UUR-A	FCJSB-26R	KM10-1UURHM	—	MCFR-26-SB
KR30LLH/3AS	CF12BUUR	CF12UUR-A	FCJSB-30R	KM12UURHM	—	MCFR-30-SB
KR32LLH/3AS	CF12-1BUUR	CF12-1UUR-A	FCJSB-32R	KM12-1UURHM	—	MCFR-32-SB
KR35LLH/3AS	CF16BUUR	CF16UUR-A	FCJSB-35R	KM16UURHM	—	MCFR-35-SB
KR40LLH/3AS	CF18BUUR	CF18UUR-A	FCJSB-40R	KM18UURHM	—	MCFR-40-SB
KR47LLH/3AS	CF20-1BUUR	CF20-1UUR-A	FCJSB-47R	KM20UURHM	—	MCFR-47-SB
KR52LLH/3AS	CF20BUUR	CF20UUR-A	FCJSB-52R	KM20-1UURHM	—	MCFR-52-SB
KR62LLH/3AS	CF24BUUR	CF24UUR-A	FCJSB-62R	KM24UURHM	KR62PP	MCFR-62-SB
KR72LLH/3AS	CF24-1BUUR	CF24-1UUR-A	FCJSB-72R	KM24-1UURHM	KR72PP	MCFR-72-SB
KR80LLH/3AS	CF30BUUR	CF30UUR-A	FCJSB-80R	KM30UURHM	KR80PP	MCFR-80-SB
KR85LLH/3AS	CF30-1BUUR	CF30-1UUR-A	FCJSB-85R	KM30-1UURHM	KR85PP	MCFR-85-SB
KR90LLH/3AS	CF30-2BUUR	CF30-2UUR-A	FCJSB-90R	KM30-2UURHM	KR90PP	MCFR-90-SB

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付	総ころ
Hexagonal socket / Tapped hole / Slot for screwdriver		六角穴 / タップ穴 / ドライバ溝	
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

KR･･XH

NTN	IKO	THK	NSK	KOYO	Mc.GILL
KR10XT2H/3AS	CF 3B	CF 3	FCJB-10	―――	―――
KR12XT2H/3AS	CF 4B	CF 4	FCJB-12	―――	―――
KR13XT2H/3AS	CF 5B	CF 5-A	―――	―――	MCFR-13-BX
KR16XH/3AS	CF 6B	CF 6-A	FCJB-16	KM 6HM	MCFR-16-BX
KR19XH/3AS	CF 8B	CF 8-A	FCJB-19	KM 8HM	MCFR-19-BX
KR22XH	CF10B	CF10-A	FCJB-22	KM10HM	MCFR-22-BX
KR26XH	CF10-1B	CF10-1-A	FCJB-26	KM10-1HM	MCFR-26-BX
KR30XH	CF12B	CF12-A	FCJB-30	KM12HM	MCFR-30-BX
KR32XH	CF12-1B	CF12-1-A	FCJB-32	KM12-1HM	MCFR-32-BX
KR35XH	CF16B	CF16-A	FCJB-35	KM16HM	MCFR-35-BX
KR40XH	CF18B	CF18-A	FCJB-40	KM18HM	MCFR-40-BX
KR47XH	CF20-1B	CF20-1-A	FCJB-47	KM20HM	MCFR-47-BX
KR52XH	CF20B	CF20-A	FCJB-52	KM20-1HM	MCFR-52-BX
KR62XH	CF24B	CF24-A	FCJB-62	KM24HM	MCFR-62-BX
KR72XH	CF24-1B	CF24-1-A	FCJB-72	KM24-1HM	MCFR-72-BX
KR80XH	CF30B	CF30-A	FCJB-80	KM30HM	MCFR-80-BX
KR85XH	CF30-1B	CF30-1-A	FCJB-85	KM30-1HM	MCFR-85-BX
KR90XH	CF30-2B	CF30-2-A	FCJB-90	KM30-2HM	MCFR-90-BX

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付	総ころ
Hexagonal socket / Tapped hole / Slot for screwdriver		六角穴 / タップ穴 / ドライバ溝	
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

KR･･XLLH

NTN	IKO	THK	NSK	KOYO	Mc.GILL
KR10XT2LLH/3AS	CF 3BUU	CF 3UU	―――	―――	―――
KR12XT2LLH/3AS	CF 4BUU	CF 4UU	―――	―――	―――
KR13XT2LLH/3AS	CF 5BUU	CF 5UU-A	―――	―――	MCFR-13-SBX
KR16XLLH/3AS	CF 6BUU	CF 6UU-A	FCJSB-16	KM 6UUHM	MCFR-16-SBX
KR19XLLH/3AS	CF 8BUU	CF 8UU-A	FCJSB-19	KM 8UUHM	MCFR-19-SBX
KR22XLLH/3AS	CF10BUU	CF10UU-A	FCJSB-22	KM10UUHM	MCFR-22-SBX
KR26XLLH/3AS	CF10-1BUU	CF10-1UU-A	FCJSB-26	KM10-1UUHM	MCFR-26-SBX
KR30XLLH/3AS	CF12BUU	CF12UU-A	FCJSB-30	KM12UUHM	MCFR-30-SBX
KR32XLLH/3AS	CF12-1BUU	CF12-1UU-A	FCJSB-32	KM12-1UUHM	MCFR-32-SBX
KR35XLLH/3AS	CF16BUU	CF16UU-A	FCJSB-35	KM16UUHM	MCFR-35-SBX
KR40XLLH/3AS	CF18BUU	CF18UU-A	FCJSB-40	KM18UUHM	MCFR-40-SBX
KR47XLLH/3AS	CF20-1BUU	CF20-1UU-A	FCJSB-47	KM20UUHM	MCFR-47-SBX
KR52XLLH/3AS	CF20BUU	CF20UU-A	FCJSB-52	KM20-1UUHM	MCFR-52-SBX
KR62XLLH/3AS	CF24BUU	CF24UU-A	FCJSB-62	KM24UUHM	MCFR-62-SBX
KR72XLLH/3AS	CF24-1BUU	CF24-1UU-A	FCJSB-72	KM24-1UUHM	MCFR-72-SBX
KR80XLLH/3AS	CF30BUU	CF30UU-A	FCJSB-80	KM30UUHM	MCFR-80-SBX
KR85XLLH/3AS	CF30-1BUU	CF30-1UU-A	FCJSB-85	KM30-1UUHM	MCFR-85-SBX
KR90XLLH/3AS	CF30-2BUU	CF30-2UU-A	FCJSB-90	KM30-2UUHM	MCFR-90-SBX

Comparison Table: Comparison of NTN Cam Followers with Competitors' Products
カムフォロア各社対照表

Metric series	Inch series		**ミリ系**	インチ系	
With cage	Full-complement roller		**保持器付**	総ころ	
Hexagonal socket	Tapped hole	**Slot for screwdriver**	六角穴	タップ穴	**ドライバ溝**
Spherical outer surface	Cylindrical outer surface		**球面外径**	円筒外径	
Without seal	With seal		**シールなし**	シール付	

KR

NTN	IKO	THK	NSK	KOYO	INA	TORR.	Mc.GILL
Note: / 注)	———	CF 5R	———	———	———		MCFR-13
KR16	CF 6R	CF 6R	FCJ-16R	KM 6RM	KR16		MCFR-16
KR19	CF 8R	CF 8R	FCJ-19R	KM 8RM	KR19		MCFR-19
KR22	CF10R	CF10R	FCJ-22R	KM10RM	KR22		MCFR-22
KR26	CF10-1R	CF10-1R	FCJ-26R	KM10-1RM	KR26		MCFR-26
KR30	CF12R	CF12R	FCJ-30R	KM12RM	KR30		MCFR-30
KR32	CF12-1R	CF12-1R	FCJ-32R	KM12-1RM	KR32		MCFR-32
KR35	CF16R	CF16R	FCJ-35R	KM16RM	KR35		MCFR-35
KR40	CF18R	CF18R	FCJ-40R	KM18RM	KR40		MCFR-40
KR47	CF20-1R	CF20-1R	FCJ-47R	KM20RM	KR47		MCFR-47
KR52	CF20R	CF20R	FCJ-52R	KM20-1RM	KR52		MCFR-52
KR62	CF24R	CF24R	FCJ-62R	KM24RM	Sizes 62 and larger have a hexagonal socket. #62以上は六角穴付き		MCFR-62
KR72	CF24-1R	CF24-1R	FCJ-72R	KM24-1RM			MCFR-72
KR80	CF30R	CF30R	FCJ-80R	KM30RM			MCFR-80
KR85	CF30-1R	CF30-1R	FCJ-85R	KM30-1RM			MCFR-85
KR90	CF30-2R	CF30-2R	FCJ-90R	KM30-2RM			MCFR-90

Note: For information on **NTN**'s small-diameter products, see the sections describing products provided with a hexagonal socket.
注）**NTN**小径品は六角穴付き品の項を参照ください。

Metric series	Inch series		**ミリ系**	インチ系	
With cage	Full-complement roller		**保持器付**	総ころ	
Hexagonal socket	Tapped hole	**Slot for screwdriver**	六角穴	タップ穴	**ドライバ溝**
Spherical outer surface	Cylindrical outer surface		**球面外径**	円筒外径	
Without seal	**With seal**		シールなし	**シール付**	

KR··LL

NTN	IKO	THK	NSK	KOYO	INA	TORR.	Mc.GILL
Note: / 注)	———	CF 5UUR	———	———	———	FRJSC-13	MCFR-13-S
KR16LL/3AS	CF 6UUR	CF 6UUR	FCJS-16R	KM 6UURM	KR16PP	FRJSC-16	MCFR-16-S
KR19LL/3AS	CF 8UUR	CF 8UUR	FCJS-19R	KM 8UURM	KR19PP	FRJSC-19	MCFR-19-S
KR22LL/3AS	CF10UUR	CF10UUR	FCJS-22R	KM10UURM	KR22PP	FRJSC-22	MCFR-22-S
KR26LL/3AS	CF10-1UUR	CF10-1UUR	FCJS-26R	KM10-1UURM	KR26PP	FRJSC-26	MCFR-26-S
KR30LL/3AS	CF12UUR	CF12UUR	FCJS-30R	KM12UURM	KR30PP	FRJSC-30	MCFR-30-S
KR32LL/3AS	CF12-1UUR	CF12-1UUR	FCJS-32R	KM12-1UURM	KR32PP	FRJSC-32	MCFR-32-S
KR35LL/3AS	CF16UUR	CF16UUR	FCJS-35R	KM16UURM	KR35PP	———	MCFR-35-S
KR40LL/3AS	CF18UUR	CF18UUR	FCJS-40R	KM18UURM	KR40PP	———	MCFR-40-S
KR47LL/3AS	CF20-1UUR	CF20-1UUR	FCJS-47R	KM20UURM	KR47PP	———	MCFR-47-S
KR52LL/3AS	CF20UUR	CF20UUR	FCJS-52R	KM20-1UURM	KR52PP	———	MCFR-52-S
KR62LL/3AS	CF24UUR	CF24UUR	FCJS-62R	KM24UURM	Sizes 62 and larger have a hexagonal socket. #62以上は六角穴付き	———	MCFR-62-S
KR72LL/3AS	CF24-1UUR	CF24-1UUR	FCJS-72R	KM24-1UURM		———	MCFR-72-S
KR80LL/3AS	CF30UUR	CF30UUR	FCJS-80R	KM30UURM		———	MCFR-80-S
KR85LL/3AS	CF30-1UUR	CF30-1UUR	FCJS-85R	KM30-1UURM		———	MCFR-85-S
KR90LL/3AS	CF30-2UUR	CF30-2UUR	FCJS-90R	KM30-2UURM		———	MCFR-90-S

Note: For information on **NTN**'s small-diameter products, see the sections describing products provided with a hexagonal socket.
注）**NTN**小径品は六角穴付き品の項を参照ください。

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	シール付	

KR··X

NTN	IKO	THK	NSK	KOYO	INA	TORR.	Mc.GILL
Note: / 注)	CF 3	——	——	——	——		——
Note: / 注)	CF 4	——	——	——	——		——
Note: / 注)	CF 5	CF 5	——	——	——		MCFR-13-X
KR16X	CF 6	CF 6	FCJ-16	KM 6M	KR16X		MCFR-16-X
KR19X	CF 8	CF 8	FCJ-19	KM 8M	KR19X		MCFR-19-X
KR22X	CF10	CF10	FCJ-22	KM10M	KR22X		MCFR-22-X
KR26X	CF10-1	CF10-1	FCJ-26	KM10-1M	KR26X		MCFR-26-X
KR30X	CF12	CF12	FCJ-30	KM12M	KR30X		MCFR-30-X
KR32X	CF12-1	CF12-1	FCJ-32	KM12-1M	KR32X		MCFR-32-X
KR35X	CF16	CF16	FCJ-35	KM16M	KR35X		MCFR-35-X
KR40X	CF18	CF18	FCJ-40	KM18M	KR40X		MCFR-40-X
KR47X	CF20-1	CF20-1	FCJ-47	KM20M	KR47X		MCFR-47-X
KR52X	CF20	CF20	FCJ-52	KM20-1M	KR52X		MCFR-52-X
KR62X	CF24	CF24	FCJ-62	KM24M	KR62X		MCFR-62-X
KR72X	CF24-1	CF24-1	FCJ-72	KM24-1M	KR72X		MCFR-72-X
KR80X	CF30	CF30	FCJ-80	KM30M	KR80X		MCFR-80-X
KR85X	CF30-1	CF30-1	FCJ-85	KM30-1M	KR85X		MCFR-85-X
KR90X	CF30-2	CF30-2	FCJ-90	KM30-2M	KR90X		MCFR-90-X

Note: For information on NTN's small-diameter products, see the sections describing products provided with a hexagonal socket.
注）NTN小径品は六角穴付き品の項を参照ください。

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	**With seal**	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	**シール付**	

KR··XLL

NTN	IKO	THK	NSK	KOYO	INA	TORR.	Mc.GILL
Note: / 注)	CF 3UU	——	——	——	——		——
Note: / 注)	CF 4UU	——	——	——	——		——
Note: / 注)	CF 5UU	CF 5UU	——	——	——		MCFR-13-SX
KR16XLL/3AS	CF 6UU	CF 6UU	FCJS-16	KM 6UUM	KR16PPX		MCFR-16-SX
KR19XLL/3AS	CF 8UU	CF 8UU	FCJS-19	KM 8UUM	KR19PPX		MCFR-19-SX
KR22XLL/3AS	CF10UU	CF10UU	FCJS-22	KM10UUM	KR22PPX		MCFR-22-SX
KR26XLL/3AS	CF10-1UU	CF10-1UU	FCJS-26	KM10-1UUM	KR26PPX		MCFR-26-SX
KR30XLL/3AS	CF12UU	CF12UU	FCJS-30	KM12UUM	KR30PPX		MCFR-30-SX
KR32XLL/3AS	CF12-1UU	CF12-1UU	FCJS-32	KM12-1UUM	KR32PPX		MCFR-32-SX
KR35XLL/3AS	CF16UU	CF16UU	FCJS-35	KM16UUM	KR35PPX		MCFR-35-SX
KR40XLL/3AS	CF18UU	CF18UU	FCJS-40	KM18UUM	KR40PPX		MCFR-40-SX
KR47XLL/3AS	CF20-1UU	CF20-1UU	FCJS-47	KM20UUM	KR47PPX		MCFR-47-SX
KR52XLL/3AS	CF20UU	CF20UU	FCJS-52	KM20-1UUM	KR52PPX		MCFR-52-SX
KR62XLL/3AS	CF24UU	CF24UU	FCJS-62	KM24UUM	KR62PPX		MCFR-62-SX
KR72XLL/3AS	CF24-1UU	CF24-1UU	FCJS-72	KM24-1UUM	KR72PPX		MCFR-72-SX
KR80XLL/3AS	CF30UU	CF30UU	FCJS-80	KM30UUM	KR80PPX		MCFR-80-SX
KR85XLL/3AS	CF30-1UU	CF30-1UU	FCJS-85	KM30-1UUM	KR85PPX		MCFR-85-SX
KR90XLL/3AS	CF30-2UU	CF30-2UU	FCJS-90	KM30-2UUM	KR90PPX		MCFR-90-SX

Note: For information on NTN's small-diameter products, see the sections describing products provided with a hexagonal socket.
注）NTN小径品は六角穴付き品の項を参照ください。

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	

KRV・・H

NTN	IKO	NSK	KOYO	Mc.GILL
KRV10H/3AS	—	—	—	—
KRV12H/3AS	—	—	—	—
KRV13H/3AS	—	—	—	MCF-13-B
KRV16H/3AS	CF 6VBR	FCRB-16R	CM 6RHM	MCF-16-B
KRV19H/3AS	CF 8VBR	FCRB-19R	CM 8RHM	MCF-19-B
KRV22H/3AS	CF10VBR	FCRB-22R	CM10RHM	MCF-22-B
KRV26H/3AS	CF10-1VBR	FCRB-26R	CM10-1RHM	MCF-26-B
KRV30H/3AS	CF12VBR	FCRB-30R	CM12RHM	MCF-30-B
KRV32H/3AS	CF12-1VBR	FCRB-32R	CM12-1RHM	MCF-32-B
KRV35H/3AS	CF16VBR	FCRB-35R	CM16RHM	MCF-35-B
KRV40H/3AS	CF18VBR	FCRB-40R	CM18RHM	MCF-40-B
KRV47H/3AS	CF20-1VBR	FCRB-47R	CM20RHM	MCF-47-B
KRV52H/3AS	CF20VBR	FCRB-52R	CM20-1RHM	MCF-52-B
KRV62H/3AS	CF24VBR	FCRB-62R	CM24RHM	MCF-62-B
KRV72H/3AS	CF24-1VBR	FCRB-72R	CM24-1RHM	MCF-72-B
KRV80H/3AS	CF30VBR	FCRB-80R	CM30RHM	MCF-80-B
—	CF30-1VBR	FCRB-85R	CM30-1RHM	MCF-85-B
KRV90H/3AS	CF30-2VBR	FCRB-90R	CM30-2RHM	MCF-90-B

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	**With seal**	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	**シール付**	

KRV・・LLH

NTN	IKO	NSK	KOYO	INA	Mc.GILL
KRV10LLH/3AS	—	—	—	—	—
KRV12LLH/3AS	—	—	—	—	—
KRV13LLH/3AS	—	—	—	—	MCF-13-SB
KRV16LLH/3AS	CF 6VBUUR	FCRSB-16R	CM 6UURHM	—	MCF-16-SB
KRV19LLH/3AS	CF 8VBUUR	FCRSB-19R	CM 8UURHM	—	MCF-19-SB
KRV22LLH/3AS	CF10VBUUR	FCRSB-22R	CM10UURHM	—	MCF-22-SB
KRV26LLH/3AS	CF10-1VBUUR	FCRSB-26R	CM10-1UURHM	—	MCF-26-SB
KRV30LLH/3AS	CF12VBUUR	FCRSB-30R	CM12UURHM	—	MCF-30-SB
KRV32LLH/3AS	CF12-1VBUUR	FCRSB-32R	CM12-1UURHM	—	MCF-32-SB
KRV35LLH/3AS	CF16VBUUR	FCRSB-35R	CM16UURHM	—	MCF-35-SB
KRV40LLH/3AS	CF18VBUUR	FCRSB-40R	CM18UURHM	—	MCF-40-SB
KRV47LLH/3AS	CF20-1VBUUR	FCRSB-47R	CM20UURHM	—	MCF-47-SB
KRV52LLH/3AS	CF20VBUUR	FCRSB-52R	CM20-1UURHM	—	MCF-52-SB
KRV62LLH/3AS	CF24VBUUR	FCRSB-62R	CM24UURHM	KRV62PP	MCF-62-SB
KRV72LLH/3AS	CF24-1VBUUR	FCRSB-72R	CM24-1UURHM	KRV72PP	MCF-72-SB
KRV80LLH/3AS	CF30VBUUR	FCRSB-80R	CM30UURHM	KRV82PP	MCF-80-SB
—	CF30-1VBUUR	FCRSB-85R	CM30-1UURHM	—	MCF-85-SB
KRV90LLH/3AS	CF30-2VBUUR	FCRSB-90R	CM30-2UURHM	KRV90PP	MCF-90-SB

Metric series		Inch series	
With cage		**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Spherical outer surface		**Cylindrical outer surface**	
Without seal		With seal	

ミリ系		インチ系
保持器付		**総ころ**
六角穴	タップ穴	ドライバ溝
球面外径		**円筒外径**
シールなし		シール付

KRV··XH

NTN	IKO	THK	NSK	KOYO	Mc.GILL
KRV10XH/3AS	—	—	—	—	—
KRV12XH/3AS	—	—	—	—	—
KRV13XH/3AS	—	—	—	—	MCF-13-BX
KRV16XH/3AS	CF 6VB	CF 6V-A	FCRB-16	CM 6HM	MCF-16-BX
KRV19XH/3AS	CF 8VB	CF 8V-A	FCRB-19	CM 8HM	MCF-19-BX
KRV22XH/3AS	CF10BVB	CF10V-A	FCRB-22	CM10HM	MCF-22-BX
KRV26XH/3AS	CF10-1VB	CF10-1V-A	FCRB-26	CM10-1HM	MCF-26-BX
KRV30XH/3AS	CF12VB	CF12V-A	FCRB-30	CM12HM	MCF-30-BX
KRV32XH/3AS	CF12-1VB	CF12-1V-A	FCRB-32	CM12-1HM	MCF-32-BX
KRV35XH/3AS	CF16VB	CF16V-A	FCRB-35	CM16HM	MCF-35-BX
KRV40XH/3AS	CF18VB	CF18V-A	FCRB-40	CM18HM	MCF-40-BX
KRV47XH/3AS	CF20-1VB	CF20-1V-A	FCRB-47	CM20HM	MCF-47-BX
KRV52XH/3AS	CF20VB	CF20V-A	FCRB-52	CM20-1HM	MCF-52-BX
KRV62XH/3AS	CF24VB	CF24V-A	FCRB-62	CM24HM	MCF-62-BX
KRV72XH/3AS	CF24-1VB	CF24-1V-A	FCRB-72	CM24-1HM	MCF-72-BX
KRV80XH/3AS	CF30VB	CF30V-A	FCRB-80	CM30HM	MCF-80-BX
—	CF30-1VB	CF30-1V-A	FCRB-85	CM30-1HM	MCF-85-BX
KRV90XH/3AS	CF30-2VB	CF30-2V-A	FCRB-90	CM30-2HM	MCF-90-BX

Metric series		Inch series	
With cage		**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Spherical outer surface		**Cylindrical outer surface**	
Without seal		**With seal**	

ミリ系		インチ系
保持器付		**総ころ**
六角穴	タップ穴	ドライバ溝
球面外径		**円筒外径**
シールなし		**シール付**

KRV··XLLH

NTN	IKO	THK	NSK	KOYO	Mc.GILL
KRV10XLLH/3AS	—	—	—	—	—
KRV12XLLH/3AS	—	—	—	—	—
KRV13XLLH/3AS	—	—	—	—	MCF-13-SBX
KRV16XLLH/3AS	CF 6VBUU	CF 6VUU-A	FCRSB-16	CM 6UUHM	MCF-16-SBX
KRV19XLLH/3AS	CF 8VBUU	CF 8VUU-A	FCRSB-19	CM 8UUHM	MCF-19-SBX
KRV22XLLH/3AS	CF10VBUU	CF10VUU-A	FCRSB-22	CM10UUHM	MCF-22-SBX
KRV26XLLH/3AS	CF10-1VBUU	CF10-1VUU-A	FCRSB-26	CM10-1UUHM	MCF-26-SBX
KRV30XLLH/3AS	CF12VBUU	CF12VUU-A	FCRSB-30	CM12UUHM	MCF-30-SBX
KRV32XLLH/3AS	CF12-1VBUU	CF12-1VUU-A	FCRSB-32	CM12-1UUHM	MCF-32-SBX
KRV35XLLH/3AS	CF16VBUU	CF16VUU-A	FCRSB-35	CM16UUHM	MCF-35-SBX
KRV40XLLH/3AS	CF18VBUU	CF18VUU-A	FCRSB-40	CM18UUHM	MCF-40-SBX
KRV47XLLH/3AS	CF20-1VBUU	CF20-1VUU-A	FCRSB-47	CM20UUHM	MCF-47-SBX
KRV52XLLH/3AS	CF20VBUU	CF20VUU-A	FCRSB-52	CM20-1UUHM	MCF-52-SBX
KRV62XLLH/3AS	CF24VBUU	CF24VUU-A	FCRSB-62	CM24UUHM	MCF-62-SBX
KRV72XLLH/3AS	CF24-1VBUU	CF24-1VUU-A	FCRSB-72	CM24-1UUHM	MCF-72-SBX
KRV80XLLH/3AS	CF30VBUU	CF30VUU-A	FCRSB-80	CM30UUHM	MCF-80-SBX
—	CF30-1VBUU	CF30-1VUU-A	FCRSB-85	CM30-1UUHM	MCF-85-SBX
KRV90XLLH/3AS	CF30-2VBUU	CF30-2VUU-A	FCRSB-90	CM30-2UUHM	MCF-90-SBX

KRV

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	**ドライバ溝**
球面外径	円筒外径	
シールなし	シール付	

NTN	IKO	NSK	KOYO	INA	Mc.GILL
KRV16/3AS	CF 6VR	FCR-16R	CM 6RM	KRV16	MCF-16
KRV19/3AS	CF 8VR	FCR-19R	CM 8RM	KRV19	MCF-19
KRV22/3AS	CF10VR	FCR-22R	CM10RM	KRV22	MCF-22
KRV26/3AS	CF10-1VR	FCR-26R	CM10-1RM	KRV26	MCF-26
KRV30/3AS	CF12VR	FCR-30R	CM12RM	KRV30	MCF-30
KRV32/3AS	CF12-1VR	FCR-32R	CM12-1RM	KRV32	MCF-32
KRV35/3AS	CF16VR	FCR-35R	CM16RM	KRV35	MCF-35
KRV40/3AS	CF18VR	FCR-40R	CM18RM	KRV40	MCF-40
KRV47/3AS	CF20-1VR	FCR-47R	CM20RM	KRV47	MCF-47
KRV52/3AS	CF20VR	FCR-52R	CM20-1RM	KRV52	MCF-52
KRV62/3AS	CF24VR	FCR-62R	CM24RM	KRV62	MCF-62
KRV72/3AS	CF24-1VR	FCR-72R	CM24-1RM	KRV72	MCF-72
KRV80/3AS	CF30VR	FCR-80R	CM30RM	KRV80	MCF-80
———	CF30-1VR	FCR-85R	CM30-1RM	———	MCF-85
KRV90/3AS	CF30-2VR	FCR-90R	CM30-2RM	KRV90	MCF-90

KRV··LL

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	**With seal**	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	**ドライバ溝**
球面外径	円筒外径	
シールなし	**シール付**	

NTN	IKO	NSK	KOYO	INA	Mc.GILL
KRV16LL/3AS	CF 6VUUR	FCRS-16R	CM 6UURM	KRV16PP	MCF-16-S
KRV19LL/3AS	CF 8VUUR	FCRS-19R	CM 8UURM	KRV19PP	MCF-19-S
KRV22LL/3AS	CF10VUUR	FCRS-22R	CM10UURM	KRV22PP	MCF-22-S
KRV26LL/3AS	CF10-1VUUR	FCRS-26R	CM10-1UURM	KRV26PP	MCF-26-S
KRV30LL/3AS	CF12VUUR	FCRS-30R	CM12UURM	KRV30PP	MCF-30-S
KRV32LL/3AS	CF12-1VUUR	FCRS-32R	CM12-1UURM	KRV32PP	MCF-32-S
KRV35LL/3AS	CF16VUUR	FCRS-35R	CM16UURM	KRV35PP	MCF-35-S
KRV40LL/3AS	CF18VUUR	FCRS-40R	CM18UURM	KRV40PP	MCF-40-S
KRV47LL/3AS	CF20-1VUUR	FCRS-47R	CM20UURM	KRV47PP	MCF-47-S
KRV52LL/3AS	CF20VUUR	FCRS-52R	CM20-1UURM	KRV52PP	MCF-52-S
KRV62LL/3AS	CF24VUUR	FCRS-62R	CM24UURM	Sizes 62 and larger have a hexagonal socket. #62以上は六角穴付き	MCF-62-S
KRV72LL/3AS	CF24-1VUUR	FCRS-72R	CM24-1UURM		MCF-72-S
KRV80LL/3AS	CF30VUUR	FCRS-80R	CM30UURM		MCF-80-S
———	CF30-1VUUR	FCRS-85R	CM30-1UURM		MCF-85-S
KRV90LL/3AS	CF30-2VUUR	FCRS-90R	CM30-2UURM		MCF-90-S

KRV··X

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	

NTN	IKO	NSK	KOYO	INA	Mc.GILL
KRV16X/3AS	CF 6V	FCR-16	CM 6M	KRV16X	MCF-16-X
KRV19X/3AS	CF 8V	FCR-19	CM 8M	KRV19X	MCF-19-X
KRV22X/3AS	CF10V	FCR-22	CM10M	KRV22X	MCF-22-X
KRV26X/3AS	CF10-1V	FCR-26	CM10-1M	KRV26X	MCF-26-X
KRV30X/3AS	CF12V	FCR-30	CM12M	KRV30X	MCF-30-X
KRV32X/3AS	CF12-1V	FCR-32	CM12-1M	KRV32X	MCF-32-X
KRV35X/3AS	CF16V	FCR-35	CM16M	KRV35X	MCF-35-X
KRV40X/3AS	CF18V	FCR-40	CM18M	KRV40X	MCF-40-X
KRV47X/3AS	CF20-1V	FCR-47	CM20M	KRV47X	MCF-47-X
KRV52X/3AS	CF20V	FCR-52	CM20-1M	KRV52X	MCF-52-X
KRV62X/3AS	CF24V	FCR-62	CM24M	KRV62X	MCF-62-X
KRV72X/3AS	CF24-1V	FCR-72	CM24-1M	KRV72X	MCF-72-X
KRV80X/3AS	CF30V	FCR-80	CM30M	KRV80X	MCF-80-X
———	CF30-1V	FCR-85	CM30-1M	———	MCF-85-X
KRV90X/3AS	CF30-2V	FCR-90	CM30-2M	KRV90X	MCF-90-X

KRV··XLL

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	

NTN	IKO	NSK	KOYO	INA	Mc.GILL
KRV16XLL/3AS	CF 6VUU	FCRS-16	CM 6UUM	KRV16PPX	MCF-16-SX
KRV19XLL/3AS	CF 8VUU	FCRS-19	CM 8UUM	KRV19PPX	MCF-19-SX
KRV22XLL/3AS	CF10VUU	FCRS-22	CM10UUM	KRV22PPX	MCF-22-SX
KRV26XLL/3AS	CF10-1VUU	FCRS-26	CM10-1UUM	KRV26PPX	MCF-26-SX
KRV30XLL/3AS	CF12VUU	FCRS-30	CM12UUM	KRV30PPX	MCF-30-SX
KRV32XLL/3AS	CF12-1VUU	FCRS-32	CM12-1UUM	KRV32PPX	MCF-32-SX
KRV35XLL/3AS	CF16VUU	FCRS-35	CM16UUM	KRV35PPX	MCF-35-SX
KRV40XLL/3AS	CF18VUU	FCRS-40	CM18UUM	KRV40PPX	MCF-40-SX
KRV47XLL/3AS	CF20-1VUU	FCRS-47	CM20UUM	KRV47PPX	MCF-47-SX
KRV52XLL/3AS	CF20VUU	FCRS-52	CM20-1UUM	KRV52PPX	MCF-52-SX
KRV62XLL/3AS	CF24VUU	FCRS-62	CM24UUM	KRV62PPX	MCF-62-SX
KRV72XLL/3AS	CF24-1VUU	FCRS-72	CM24-1UUM	KRV72PPX	MCF-72-SX
KRV80XLL/3AS	CF30VUU	FCRS-80	CM30UUM	KRV80PPX	MCF-80-SX
———	CF30-1VUU	FCRS-85	CM30-1UUM	———	MCF-85-SX
KRV90XLL/3AS	CF30-2VUU	FCRS-90	CM30-2UUM	KRV90PPX	MCF-90-SX

KRT

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	**Tapped hole**	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	**タップ穴**	**ドライバ溝**
球面外径	円筒外径	
シールなし	シール付	

NTN	THK
KRT16	CFT 6R
KRT19	CFT 8R
KRT22	CFT10R
KRT26	CFT10-1R
KRT30	CFT12R
KRT32	CFT12-1R
KRT35	CFT16R
KRT40	CFT18R
KRT47	CFT20-1R
KRT52	CFT20R
KRT62	CFT24R
KRT72	CFT24-1R
KRT80	CFT30R
———	CFT30-1R
KRT90	CFT30-2R

KRT··LL

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	**Tapped hole**	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	**With seal**	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	**タップ穴**	**ドライバ溝**
球面外径	円筒外径	
シールなし	**シール付**	

NTN	THK	IKO
KRT16LL/3AS	CFT 6UUR	CF-RU1-6
KRT19LL/3AS	CFT 8UUR	CF-RU1-8
KRT22LL/3AS	CFT10UUR	CF-RU1-10
KRT26LL/3AS	CFT10-1UUR	CF-RU1-10-1
KRT30LL/3AS	CFT12UUR	CF-RU1-12
KRT32LL/3AS	CFT12-1UUR	CF-RU1-12-1
KRT35LL/3AS	CFT16UUR	CF-RU1-16
KRT40LL/3AS	CFT18UUR	CF-RU1-18
KRT47LL/3AS	CFT20-1UUR	CF-RU1-20-1
KRT52LL/3AS	CFT20UUR	CF-RU1-20
KRT62LL/3AS	CFT24UUR	CF-RU1-24
KRT72LL/3AS	CFT24-1UUR	CF-RU1-24-1
KRT80LL/3AS	CFT30UUR	CF-RU1-30
———	CFT30-1UUR	CF-RU1-30-1
KRT90LL/3AS	CFT30-2UUR	CF-RU1-30-2

KRT··X

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	**Tapped hole**	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	With seal	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	**タップ穴**	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	シール付	

NTN	THK
KRT16X	CFT 6
KRT19X	CFT 8
KRT22X	CFT10
KRT26X	CFT10-1
KRT30X	CFT12
KRT32X	CFT12-1
KRT35X	CFT16
KRT40X	CFT18
KRT47X	CFT20-1
KRT52X	CFT20
KRT62X	CFT24
KRT72X	CFT24-1
KRT80X	CFT30
———	CFT30-1
KRT90X	CFT30-2

KRT··XLL

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	**Tapped hole**	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	**With seal**	

ミリ系	インチ系	
保持器付	総ころ	
六角穴	**タップ穴**	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	**シール付**	

NTN	THK	IKO
KRT16XLL/3AS	CFT 6UU	CF-FU1-6
KRT19XLL/3AS	CFT 8UU	CF-FU1-8
KRT22XLL/3AS	CFT10UU	CF-FU1-10
KRT26XLL/3AS	CFT10-1UU	CF-FU1-10-1
KRT30XLL/3AS	CFT12UU	CF-FU1-12
KRT32XLL/3AS	CFT12-1UU	CF-FU1-12-1
KRT35XLL/3AS	CFT16UU	CF-FU1-16
KRT40XLL/3AS	CFT18UU	CF-FU1-18
KRT47XLL/3AS	CFT20-1UU	CF-FU1-20-1
KRT52XLL/3AS	CFT20UU	CF-FU1-20
KRT62XLL/3AS	CFT24UU	CF-FU1-24
KRT72XLL/3AS	CFT24-1UU	CF-FU1-24-1
KRT80XLL/3AS	CFT30UU	CF-FU1-30
———	CFT30-1UU	CF-FU1-30-1
KRT90XLL/3AS	CFT30-2UU	CF-FU1-30-2

KRU

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	
Eccentric stud		

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	
軸　偏　心		

NTN	THK	IKO
KRU16	CFH 6R-A	CFES 6R
KRU19	CFH 8R-A	CFES 8R
KRU22	CFH10R-A	CFES10R
KRU26	CFH10-1R-A	CFES10-1R
KRU30	CFH12R-A	CFES12R
KRU32	CFH12-1R-A	CFES12-1R
KRU35	CFH16R-A	CFES16R
KRU40	CFH18R-A	CFES18R
KRU47	CFH20-1R-A	———
KRU52	CFH20R-A	———
KRU62	CFH24R-A	———
KRU72	CFH24-1R-A	———
KRU80	CFH30R-A	———
———	CFH30-1R-A	———
KRU90	CFH30-2R-A	———

KRU‥LL

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	
Eccentric stud		

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	
軸　偏　心		

NTN	THK	IKO
KRU16LL/3AS	CFH 6UUR-A	CFES 6UUR
KRU19LL/3AS	CFH 8UUR-A	CFES 8UUR
KRU22LL/3AS	CFH10UUR-A	CFES10UUR
KRU26LL/3AS	CFH10-1UUR-A	CFES10-1UUR
KRU30LL/3AS	CFH12UUR-A	CFES12UUR
KRU32LL/3AS	CFH12-1UUR-A	CFES12-1UUR
KRU35LL/3AS	CFH16UUR-A	CFES16UUR
KRU40LL/3AS	CFH18UUR-A	CFES18UUR
KRU47LL/3AS	CFH20-1UUR-A	———
KRU52LL/3AS	CFH20UUR-A	———
KRU62LL/3AS	CFH24UUR-A	———
KRU72LL/3AS	CFH24-1UUR-A	———
KRU80LL/3AS	CFH30UUR-A	———
———	CFH30-1UUR-A	———
KRU90LL/3AS	CFH30-2UUR-A	———

KRU‥X

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	
Eccentric stud		

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	
軸　偏　心		

NTN	THK	IKO
KRU16X	CFH 6-A	CFES 6
KRU19X	CFH 8-A	CFES 8
KRU22X	CFH10-A	CFES10
KRU26X	CFH10-1-A	CFES10-1
KRU30X	CFH12-A	CFES12
KRU32X	CFH12-1-A	CFES12-1
KRU35X	CFH16-A	CFES16
KRU40X	CFH18-A	CFES18
KRU47X	CFH20-1-A	———
KRU52X	CFH20-A	———
KRU62X	CFH24-A	———
KRU72X	CFH24-1-A	———
KRU80X	CFH30-A	———
———	CFH30-1-A	———
KRU90X	CFH30-2-A	———

KRU‥XLL

Metric series	Inch series	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	
Eccentric stud		

ミリ系	インチ系	
保持器付	総ころ	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	
軸　偏　心		

NTN	THK	IKO
KRU16XLL/3AS	CFH 6UU-A	CFES 6UU
KRU19XLL/3AS	CFH 8UU-A	CFES 8UU
KRU22XLL/3AS	CFH10UU-A	CFES10UU
KRU26XLL/3AS	CFH10-1UU-A	CFES10-1UU
KRU30XLL/3AS	CFH12UU-A	CFES12UU
KRU32XLL/3AS	CFH12-1UU-A	CFES12-1UU
KRU35XLL/3AS	CFH16UU-A	CFES16UU
KRU40XLL/3AS	CFH18UU-A	CFES18UU
KRU47XLL/3AS	CFH20-1UU-A	———
KRU52XLL/3AS	CFH20UU-A	———
KRU62XLL/3AS	CFH24UU-A	———
KRU72XLL/3AS	CFH24-1UU-A	———
KRU80XLL/3AS	CFH30UU-A	———
———	CFH30-1UU-A	———
KRU90XLL/3AS	CFH30-2UU-A	———

Comparison Table: Comparison of NTN Cam Followers with Competitors' Products
カムフォロア各社対照表

NUKR··H

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without shield	**With shield**	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールドなし	**シールド付**	

NTN	INA
NUKR 30H/3AS	—
NUKR 35H/3AS	NUKR35
NUKR 40H/3AS	NUKR40
NUKR 47H/3AS	NUKR47
NUKR 52H/3AS	NUKR52
NUKR 62H/3AS	NUKR62
NUKR 72H/3AS	NUKR72
NUKR 80H/3AS	NUKR80
NUKR 90H/3AS	NUKR90
NUKR100H/3AS	—
NUKR120H/3AS	—
NUKR140H/3AS	—
NUKR150H/3AS	—
NUKR160H/3AS	—
NUKR170H/3AS	—
NUKR180H/3AS	—

NUKR

Metric series	Inch series	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without shield	**With shield**	

ミリ系	インチ系	
保持器付	**総ころ**	
六角穴	タップ穴	**ドライバ溝**
球面外径	円筒外径	
シールドなし	**シールド付**	

NTN	IKO
NUKR 30/3AS	NUCF12R
NUKR 35/3AS	NUCF16R
NUKR 40/3AS	NUCF18R
NUKR 47/3AS	NUCF20-1R
NUKR 52/3AS	NUCF20R
NUKR 62/3AS	NUCF24R
NUKR 72/3AS	NUCF24-1R
NUKR 80/3AS	NUCF30R
NUKR 90/3AS	NUCF30-2R
NUKR100/3AS	—
NUKR120/3AS	—
NUKR140/3AS	—
NUKR150/3AS	—
NUKR160/3AS	—
NUKR170/3AS	—
NUKR180/3AS	—

CR

Metric series	**Inch series**	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	**インチ系**	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	円筒外径	
シールなし	シール付	

NTN	IKO
CR 8T2	CR 8R
CR 8-1T2	CR 8-1R
CR10	CR10R
CR10-1	CR10-1R
CR12	CR12R
CR14	CR14R
CR16	CR16R
CR18	CR18R
CR20	CR20R
CR22	CR22R
CR24	CR24R
CR26	CR26R
CR28	CR28R
CR30	CR30R
CR32	CR32R
CR36	CR36R

CR··LL

Metric series	**Inch series**	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	Cylindrical outer surface	
Without seal	**With seal**	

ミリ系	**インチ系**	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	円筒外径	
シールなし	**シール付**	

NTN	IKO
—	CR 8UUR
—	CR 8-1UUR
—	CR10UUR
CR10-1LL/3AS	CR10-1UUR
CR12LL/3AS	CR12UUR
CR14LL/3AS	CR14UUR
CR16LL/3AS	CR16UUR
CR18LL/3AS	CR18UUR
CR20LL/3AS	CR20UUR
CR22LL/3AS	CR22UUR
CR24LL/3AS	CR24UUR
CR26LL/3AS	CR26UUR
CR28LL/3AS	CR28UUR
CR30LL/3AS	CR30UUR
CR32LL/3AS	CR32UUR
CR36LL/3AS	CR36UUR

CR··X

Metric series	**Inch series**	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	With seal	

ミリ系	**インチ系**	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	シール付	

NTN	IKO
CR 8XT2	CR 8
CR 8-1XT2	CR 8-1
CR10X	CR10
CR10-1X	CR10-1
CR12X	CR12
CR14X	CR14
CR16X	CR16
CR18X	CR18
CR20X	CR20
CR22X	CR22
CR24X	CR24
CR26X	CR26
CR28X	CR28
CR30X	CR30
CR32X	CR32
CR36X	CR36

CR··XLL

Metric series	**Inch series**	
With cage	Full-complement roller	
Hexagonal socket	Tapped hole	**Slot for screwdriver**
Spherical outer surface	**Cylindrical outer surface**	
Without seal	**With seal**	

ミリ系	**インチ系**	
保持器付	総ころ	
六角穴	タップ穴	**ドライバ溝**
球面外径	**円筒外径**	
シールなし	**シール付**	

NTN	IKO
—	CR 8UU
—	CR 8-1UU
—	CR10UU
CR10-1XLL/3AS	CR10-1UU
CR12XLL/3AS	CR12UU
CR14XLL/3AS	CR14UU
CR16XLL/3AS	CR16UU
CR18XLL/3AS	CR18UU
CR20XLL/3AS	CR20UU
CR22XLL/3AS	CR22UU
CR24XLL/3AS	CR24UU
CR26XLL/3AS	CR26UU
CR28XLL/3AS	CR28UU
CR30XLL/3AS	CR30UU
CR32XLL/3AS	CR32UU
CR36XLL/3AS	CR36UU

CRV··H

Metric series	**Inch series**	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	With seal	

ミリ系	**インチ系**	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	シール付	

NTN	NSK	Mc.GILL
CRV 8H/3AS	CRBC- 8	CCF-½-N-B
CRV 8-1H/3AS	CRBC- 8-1	CCF-½-B
CRV10H/3AS	CRBC-10	CCF-⅝-N-B
CRV10-1H/3AS	CRBC-10-1	CCF-⅝-B
CRV12H/3AS	CRBC-12	CCF-¾-B
CRV14H/3AS	CRBC-14	CCF-⅞-B
CRV16H/3AS	CRBC-16	CCF-1-B
CRV18H/3AS	CRBC-18	CCF-1⅛-B
CRV20H/3AS	CRBC-20	CCF-1¼-B
CRV22H/3AS	CRBC-22	CCF-1⅜-B
CRV24H/3AS	CRBC-24	CCF-1½-B
CRV26H/3AS	CRBC-26	CCF-1⅝-B
CRV28H/3AS	CRBC-28	CCF-1¾-B
CRV30H/3AS	CRBC-30	CCF-1⅞-B
CRV32H/3AS	CRBC-32	CCF-2-B
CRV36H/3AS	CRBC-36	CCF-2¼-B
CRV40H/3AS	CRBC-40	CCF-2½-B
CRV44H/3AS	CRBC-44	CCF-2¾-B
CRV48H/3AS	CRBC-48	CCF-3-B
CRV52H/3AS	CRBC-52	CCF-3¼-B
CRV56H/3AS	CRBC-56	CCF-3½-B
CRV64H/3AS	CRBC-64	CCF-4-B
CRV80H/3AS	CRBC-80	CCF-5-B
CRV96H/3AS	CRBC-96	CCF-6-B

CRV··XH

Metric series	**Inch series**	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	**Cylindrical outer surface**	
Without seal	With seal	

ミリ系	**インチ系**	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	**円筒外径**	
シールなし	シール付	

NTN	NSK	Mc.GILL
CRV 8XH/3AS	CRB- 8	CF-½-N-B
CRV 8-1XH/3AS	CRB- 8-1	CF-½-B
CRV10XH/3AS	CRB-10	CF-⅝-N-B
CRV10-1XH/3AS	CRB-10-1	CF-⅝-B
CRV12XH/3AS	CRB-12	CF-¾-B
CRV14XH/3AS	CRB-14	CF-⅞-B
CRV16XH/3AS	CRB-16	CF-1-B
CRV18XH/3AS	CRB-18	CF-1⅛-B
CRV20XH/3AS	CRB-20	CF-1¼-B
CRV22XH/3AS	CRB-22	CF-1⅜-B
CRV24XH/3AS	CRB-24	CF-1½-B
CRV26XH/3AS	CRB-26	CF-1⅝-B
CRV28XH/3AS	CRB-28	CF-1¾-B
CRV30XH/3AS	CRB-30	CF-1⅞-B
CRV32XH/3AS	CRB-32	CF-2-B
CRV36XH/3AS	CRB-36	CF-2¼-B
CRV40XH/3AS	CRB-40	CF-2½-B
CRV44XH/3AS	CRB-44	CF-2¾-B
CRV48XH/3AS	CRB-48	CF-3-B
CRV52XH/3AS	CRB-52	CF-3¼-B
CRV56XH/3AS	CRB-56	CF-3½-B
CRV64XH/3AS	CRB-64	CF-4-B
CRV80XH/3AS	CRB-80	—
CRV96XH/3AS	CRB-96	—

CRV··LLH

Metric series	**Inch series**	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	Cylindrical outer surface	
Without seal	**With seal**	

ミリ系	**インチ系**	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	円筒外径	
シールなし	**シール付**	

NTN	NSK	Mc.GILL
CRV 8LLH/3AS	CRSBC- 8	CCF-½-N-SB
CRV 8-1LLH/3AS	CRSBC- 8-1	CCF-½-SB
CRV10LLH/3AS	CRSBC-10	CCF-⅝-N-SB
CRV10-1LLH/3AS	CRSBC-10-1	CCF-⅝-SB
CRV12LLH/3AS	CRSBC-12	CCF-¾-SB
CRV14LLH/3AS	CRSBC-14	CCF-⅞-SB
CRV16LLH/3AS	CRSBC-16	CCF-1-SB
CRV18LLH/3AS	CRSBC-18	CCF-1⅛-SB
CRV20LLH/3AS	CRSBC-20	CCF-1¼-SB
CRV22LLH/3AS	CRSBC-22	CCF-1⅜-SB
CRV24LLH/3AS	CRSBC-24	CCF-1½-SB
CRV26LLH/3AS	CRSBC-26	CCF-1⅝-SB
CRV28LLH/3AS	CRSBC-28	CCF-1¾-SB
CRV30LLH/3AS	CRSBC-30	CCF-1⅞-SB
CRV32LLH/3AS	CRSBC-32	CCF-2-SB
CRV36LLH/3AS	CRSBC-36	CCF-2¼-SB
CRV40LLH/3AS	CRSBC-40	CCF-2½-SB
CRV44LLH/3AS	CRSBC-44	CCF-2¾-SB
CRV48LLH/3AS	CRSBC-48	CCF-3-SB
CRV52LLH/3AS	CRSBC-52	CCF-3¼-SB
CRV56LLH/3AS	CRSBC-56	CCF-3½-SB
CRV64LLH/3AS	CRSBC-64	CCF-4-SB
CRV80LLH/3AS	CRSBC-80	CCF-5-SB
CRV96LLH/3AS	CRSBC-96	CCF-6-SB

CRV··XLLH

Metric series	**Inch series**	
With cage	**Full-complement roller**	
Hexagonal socket	Tapped hole	Slot for screwdriver
Spherical outer surface	**Cylindrical outer surface**	
Without seal	**With seal**	

ミリ系	**インチ系**	
保持器付	**総ころ**	
六角穴	タップ穴	ドライバ溝
球面外径	**円筒外径**	
シールなし	**シール付**	

NTN	NSK	TORR.	Mc.GILL
CRV 8XLLH/3AS	CRSB- 8	CRSB- 8	CF-½-N-SB
CRV 8-1XLLH/3AS	CRSB- 8-1	CRSB- 8-1	CF-½-SB
CRV10XLLH/3AS	CRSB-10	CRSB-10	CF-⅝-N-SB
CRV10-1XLLH/3AS	CRSB-10-1	CRSB-10-1	CF-⅝-SB
CRV12XLLH/3AS	CRSB-12	CRSB-12	CF-¾-SB
CRV14XLLH/3AS	CRSB-14	CRSB-14	CF-⅞-SB
CRV16XLLH/3AS	CRSB-16	CRSB-16	CF-1-SB
CRV18XLLH/3AS	CRSB-18	CRSB-18	CF-1⅛-SB
CRV20XLLH/3AS	CRSB-20	CRSB-20	CF-1¼-SB
CRV22XLLH/3AS	CRSB-22	CRSB-22	CF-1¾-SB
CRV24XLLH/3AS	CRSB-24	CRSB-24	CF-1½-SB
CRV26XLLH/3AS	CRSB-26	CRSB-26	CF-1⅝-SB
CRV28XLLH/3AS	CRSB-28	CRSB-28	CF-1¾-SB
CRV30XLLH/3AS	CRSB-30	CRSB-30	CF-1⅞-SB
CRV32XLLH/3AS	CRSB-32	CRSB-32	CF-2-SB
CRV36XLLH/3AS	CRSB-36	CRSB-36	CF-2¼-SB
CRV40XLLH/3AS	CRSB-40	CRSB-40	CF-2½-SB
CRV44XLLH/3AS	CRSB-44	CRSB-44	CF-2¾-SB
CRV48XLLH/3AS	CRSB-48	CRSB-48	CF-3-SB
CRV52XLLH/3AS	CRSB-52	CRSB-52	CF-3¼-SB
CRV56XLLH/3AS	CRSB-56	CRSB-56	CF-3½-SB
CRV64XLLH/3AS	CRSB-64	CRSB-64	CF-4-SB
CRV80XLLH/3AS	CRSB-80	CRSB-80	—
CRV96XLLH/3AS	CRSB-96	CRSB-96	—

Comparison Table: Comparison of NTN Cam Followers with Competitors' Products
カムフォロア各社対照表

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付	**総ころ**
Hexagonal socket / Tapped hole / **Slot for screwdriver**		六角穴 / タップ穴 / **ドライバ溝**	
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	With seal	**シールなし**	シール付

CRV

NTN	NSK	KOYO	INA-SKF	TORR.	Mc.GILL	RBC
CRV 8/3AS	CRC- 8		———	CRC- 8	CCF-½-N	———
CRV 8-1/3AS	CRC- 8-1		CF- 8-1-Y	CRC- 8-1	CCF-½	CS-16
CRV10/3AS	CRC-10		———	CRC-10	CCF-⅝-N	———
CRV10-1/3AS	CRC-10-1		CF-10-1-Y	CRC-10-1	CCF-⅝	CS-20
CRV12/3AS	CRC-12		CF-12-Y	CRC-12	CCF-¾	CS-24
CRV14/3AS	CRC-14		CF-14-Y	CRC-14	CCF-⅞	CS-28
CRV16/3AS	CRC-16		CF-16-Y	CRC-16	CCF-1	CS-32
CRV18/3AS	CRC-18		CF-18-Y	CRC-18	CCF-1⅛	CS-36
CRV20/3AS	CRC-20		CF-20-Y	CRC-20	CCF-1¼	CS-40
CRV22/3AS	CRC-22		CF-22-Y	CRC-22	CCF-1⅜	CS-44
CRV24/3AS	CRC-24		CF-24-Y	CRC-24	CCF-1½	CS-48
CRV26/3AS	CRC-26		CF-26-Y	CRC-26	CCF-1⅝	CS-52
CRV28/3AS	CRC-28		CF-28-Y	CRC-28	CCF-1¾	CS-56
CRV30/3AS	CRC-30		CF-30-Y	CRC-30	CCF-1⅞	CS-60
CRV32/3AS	CRC-32		CF-32-Y	CRC-32	CCF-2	CS-64
CRV36/3AS	CRC-36		CF-36-Y	CRC-36	CCF-2¼	CS-72
CRV40/3AS	CRC-40		CF-40-Y	CRC-40	CCF-2½	CS-80
CRV44/3AS	CRC-44		CF-44-Y	CRC-44	CCF-2¾	CS-88
CRV48/3AS	CRC-48		CF-48-Y	CRC-48	CCF-3	CS-96
CRV52/3AS	CRC-52		CF-52-Y	CRC-52	CCF-3¼	CS-104
CRV56/3AS	CRC-56		CF-56-Y	CRC-56	CCF-3½	CS-112
CRV64/3AS	CRC-64		CF-64-Y	CRC-64	CCF-4	CS-128
CRV80/3AS	CRC-80		———	———	———	———
CRV96/3AS	CRC-96		———	———	———	———

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付	**総ころ**
Hexagonal socket / Tapped hole / **Slot for screwdriver**		六角穴 / タップ穴 / **ドライバ溝**	
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	**With seal**	シールなし	**シール付**

CRV‥LL

NTN	NSK	KOYO	INA-SKF	TORR.	Mc.GILL	RBC
CRV 8LL/3AS	CRSC- 8		———	CRSC- 8	CCF-½-N-S	———
CRV 8-1LL/3AS	CRSC- 8-1		CF- 8-1-PPY	CRSC- 8-1	CCF-½-S	CS-16-S
CRV10LL/3AS	CRSC-10		———	CRSC-10	CCF-⅝-N-S	———
CRV10-1LL/3AS	CRSC-10-1		CF-10-1-PPY	CRSC-10-1	CCF-⅝-S	CS-20-S
CRV12LL/3AS	CRSC-12		CF-12-PPY	CRSC-12	CCF-¾-S	CS-24-S
CRV14LL/3AS	CRSC-14		CF-14-PPY	CRSC-14	CCF-⅞-S	CS-28-S
CRV16LL/3AS	CRSC-16		CF-16-PPY	CRSC-16	CCF-1-S	CS-32-S
CRV18LL/3AS	CRSC-18		CF-18-PPY	CRSC-18	CCF-1⅛-S	CS-36-S
CRV20LL/3AS	CRSC-20		CF-20-PPY	CRSC-20	CCF-1¼-S	CS-40-S
CRV22LL/3AS	CRSC-22		CF-22-PPY	CRSC-22	CCF-1⅜-S	CS-44-S
CRV24LL/3AS	CRSC-24		CF-24-PPY	CRSC-24	CCF-1½-S	CS-48-S
CRV26LL/3AS	CRSC-26		CF-26-PPY	CRSC-26	CCF-1⅝-S	CS-52-S
CRV28LL/3AS	CRSC-28		CF-28-PPY	CRSC-28	CCF-1¾-S	CS-56-S
CRV30LL/3AS	CRSC-30		CF-30-PPY	CRSC-30	CCF-1⅞-S	CS-60-S
CRV32LL/3AS	CRSC-32		CF-32-PPY	CRSC-32	CCF-2-S	CS-64-S
CRV36LL/3AS	CRSC-36		CF-36-PPY	CRSC-36	CCF-2¼-S	CS-72-S
CRV40LL/3AS	CRSC-40		CF-40-PPY	CRSC-40	CCF-2½-S	CS-80-S
CRV44LL/3AS	CRSC-44		CF-44-PPY	CRSC-44	CCF-2¾-S	CS-88-S
CRV48LL/3AS	CRSC-48		CF-48-PPY	CRSC-48	CCF-3-S	CS-96-S
CRV52LL/3AS	CRSC-52		CF-52-PPY	CRSC-52	CCF-3¼-S	CS-104-S
CRV56LL/3AS	CRSC-56		CF-56-PPY	CRSC-56	CCF-3½-S	CS-112-S
CRV64LL/3AS	CRSC-64		CF-64-PPY	CRSC-64	CCF-4-S	CS-128-S
CRV80LL/3AS	CRSC-80		———	———	———	———
CRV96LL/3AS	CRSC-96		———	———	———	———

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付	**総ころ**
Hexagonal socket / Tapped hole / **Slot for screwdriver**		六角穴 / タップ穴 / **ドライバ溝**	
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	With seal	**シールなし**	シール付

CRV··X

NTN	NSK	KOYO	INA-SKF	TORR.	Mc.GILL	RBC
CRV 8X/3AS	CR- 8	CM 8M	—	CR- 8	CF-½-N	—
CRV 8-1X/3AS	CR- 8-1	CM 8-1M	CF- 8-1	CR- 8-1	CF-½	S-16
CRV10X/3AS	CR-10	CM10M	—	CR-10	CF-⅝-N	—
CRV10-1X/3AS	CR-10-1	CM10-1M	CF-10-1	CR-10-1	CF-⅝	S-20
CRV12X/3AS	CR-12	CM12M	CF-12	CR-12	CF-¾	S-24
CRV14X/3AS	CR-14	CM14M	CF-14	CR-14	CF-⅞	S-28
CRV16X/3AS	CR-16	CM16M	CF-16	CR-16	CF-1	S-32
CRV18X/3AS	CR-18	CM18M	CF-18	CR-18	CF-1⅛	S-36
CRV20X/3AS	CR-20	CM20M	CF-20	CR-20	CF-1¼	S-40
CRV22X/3AS	CR-22	CM22M	CF-22	CR-22	CF-1⅜	S-44
CRV24X/3AS	CR-24	CM24M	CF-24	CR-24	CF-1½	S-48
CRV26X/3AS	CR-26	CM26M	CF-26	CR-26	CF-1⅝	S-52
CRV28X/3AS	CR-28	CM28M	CF-28	CR-28	CF-1¾	S-56
CRV30X/3AS	CR-30	CM30M	CF-30	CR-30	CF-1⅞	S-60
CRV32X/3AS	CR-32	CM32M	CF-32	CR-32	CF-2	S-64
CRV36X/3AS	CR-36	CM36M	CF-36	CR-36	CF-2¼	S-72
CRV40X/3AS	CR-40	—	CF-40	CR-40	CF-2½	S-80
CRV44X/3AS	CR-44	—	CF-44	CR-44	CF-2¾	S-88
CRV48X/3AS	CR-48	—	CF-48	CR-48	CF-3	S-96
CRV52X/3AS	CR-52	—	CF-52	CR-52	CF-3¼	S-104
CRV56X/3AS	CR-56	—	CF-56	CR-56	CF-3½	S-112
CRV64X/3AS	CR-64	—	CF-64	CR-64	CF-4	S-128
CRV80X/3AS	CR-80	—	—	—	—	—
CRV96X/3AS	CR-96	—	—	—	—	—

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付	**総ころ**
Hexagonal socket / Tapped hole / **Slot for screwdriver**		六角穴 / タップ穴 / **ドライバ溝**	
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	**With seal**	シールなし	**シール付**

CRV··XLL

NTN	NSK	KOYO	INA-SKF	TORR.	Mc.GILL	RBC
CRV 8XLL/3AS	CRS- 8	CR8UUM	—	CRS- 8	CF-½-N-S	—
CRV 8-1XLL/3AS	CRS- 8-1	CR8-1UUM	CF- 8-1-PP	CRS- 8-1	CF-½-S	S-16-S
CRV10XLL/3AS	CRS-10	CR10UUM	—	CRS-10	CF-⅝-N-S	—
CRV10-1XLL/3AS	CRS-10-1	CR10-1UUM	CF-10-1-PP	CRS-10-1	CF-⅝-S	S-20-S
CRV12XLL/3AS	CRS-12	CR12UUM	CF-12-PP	CRS-12	CF-¾-S	S-24-S
CRV14XLL/3AS	CRS-14	CR14UUM	CF-14-PP	CRS-14	CF-⅞-S	S-28-S
CRV16XLL/3AS	CRS-16	CR16UUM	CF-16-PP	CRS-16	CF-1-S	S-32-S
CRV18XLL/3AS	CRS-18	CR18UUM	CF-18-PP	CRS-18	CF-1⅛-S	S-36-S
CRV20XLL/3AS	CRS-20	CR20UUM	CF-20-PP	CRS-20	CF-1¼-S	S-40-S
CRV22XLL/3AS	CRS-22	CR22UUM	CF-22-PP	CRS-22	CF-1⅜-S	S-44-S
CRV24XLL/3AS	CRS-24	CR24UUM	CF-24-PP	CRS-24	CF-1½-S	S-48-S
CRV26XLL/3AS	CRS-26	CR26UUM	CF-26-PP	CRS-26	CF-1⅝-S	S-52-S
CRV28XLL/3AS	CRS-28	CR28UUM	CF-28-PP	CRS-28	CF-1¾-S	S-56-S
CRV30XLL/3AS	CRS-30	CR30UUM	CF-30-PP	CRS-30	CF-1⅞-S	S-60-S
CRV32XLL/3AS	CRS-32	CR32UUM	CF-32-PP	CRS-32	CF-2-S	S-64-S
CRV36XLL/3AS	CRS-36	CR36UUM	CF-36-PP	CRS-36	CF-2¼-S	S-72-S
CRV40XLL/3AS	CRS-40	—	CF-40-PP	CRS-40	CF-2½-S	S-80-S
CRV44XLL/3AS	CRS-44	—	CF-44-PP	CRS-44	CF-2¾-S	S-88-S
CRV48XLL/3AS	CRS-48	—	CF-48-PP	CRS-48	CF-3-S	S-96-S
CRV52XLL/3AS	CRS-52	—	CF-52-PP	CRS-52	CF-3¼-S	S-104-S
CRV56XLL/3AS	CRS-56	—	CF-56-PP	CRS-56	CF-3½-S	S-112-S
CRV64XLL/3AS	CRS-64	—	CF-64-PP	CRS-64	CF-4-S	S-128-S
CRV80XLL/3AS	CRS-80	—	—	—	—	—
CRV96XLL/3AS	CRS-96	—	—	—	—	—

		NTN	Reference page 記載ページ	IKO	THK	NSK	KOYO	INA・SKF	TORR.	Mc.GILL
Metric series ミリ系列	With cage 保持器付	**RNAB** **NAB** **RNAB・・X** **NAB・・X**	**111**	RNAST・・R NAST・・R RNAST NAST	RNAST・・R NAST・・R RNAST NAST			RSTO STO RSTO・・X STO・・X		
		RNA22・・LL **NA22・・LL** **RNA22・・XLL** **NA22・・XLL**	**112**					RNA22・・. 2RS NA22・・. 2RS RNA22・・. 2RSX NA22・・. 2RSX		
		NATR **NATR・・LL** **NATR・・X** **NATR・・XLL**	**113・114**	NART・・R NART・・UUR	NART・・R NART・・UUR	FYCJ-・・R FYCJS-・・R FYCJ-・・ FYCJS-・・	CXM・・RM CXM・・UURM CXM・・M CXM・・UUM	NATR NATR・・PP NATR・・X NATR・・PPX	FYRJSC-・・	MCYRR-・・ MCYRR-・・・-S MCYRR-・・・-X MCYRR-・・・-SX
	Full-complement roller 総ころ	**NATV** **NATV・・LL** **NATV・・X** **NATV・・XLL**	**115・116**	NART・・VR NART・・VUUR	NART・・VR NART・・VUUR	FYCR-・・R FYCRS-・・R FYCR-・・ FYCRS-・・	CYM・・RM CYM・・UURM CYM・・M CYM・・UUM	NATV NATV・・PP NATV・・X NATV・・PPX		MCYR-・・ MCYR-・・・-S MCYR-・・・-X MCYR-・・・-SX
		NUTR **NUTR・・X**	**117**	NURT・・R				NUTR NUTR・・X		
	With cage (sub-series) 保持器付（準シリーズ）	**NABR** **NABR・・X**	**117**	NAST・・ZZR NAST・・ZZUUR NAST・・ZZ NAST・・ZZUU	NAST・・ZZR NAST・・ZZUUR NAST・・ZZ NAST・・ZZUU		CZM・・R CZM・・UUR CZM CZM・・UU	SKF only〈SKFのみ〉 NAST・・-2Z NAST・・P-2Z		
Inch series インチ系列	Full-complement roller 総ころ	**NACV** **NACV・・LL** **NACV・・X** **NACV・・XLL**	**118・119**			YCRC-・・ YCRSC-・・ YCR-・・ YCRS-・・		INA only〈INAのみ〉 RF-・・・-Y RF-・・・-PPY RF-・・ RF-・・・-PP	YCRC-・・ YCRSC-・・ YCR-・・ YCRS-・・	CCYR-・・ CCYR-・・・-S CYR- ・・ CYR- ・・-S

RNAB

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	**Without inner ring**	内輪付	**内輪なし**
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	INA・SKF
RNAB2/5T2	RNAST 5R	RNAST 5R	RSTO 5TN
RNAB2/6T2	RNAST 6R	RNAST 6R	RSTO 6TN
RNAB2/8	RNAST 8R	RNAST 8R	RSTO 8TN
RNAB200	RNAST10R	RNAST10R	RSTO10
RNAB201	RNAST12R	RNAST12R	RSTO12
RNAB202	RNAST15R	RNAST15R	RSTO15
RNAB203	RNAST17R	RNAST17R	RSTO17
RNAB204	RNAST20R	RNAST20R	RSTO20
RNAB205	RNAST25R	RNAST25R	RSTO25
RNAB206	RNAST30R	RNAST30R	RSTO30
RNAB207	RNAST35R	RNAST35R	RSTO35
RNAB208	RNAST40R	RNAST40R	RSTO40
RNAB209	RNAST45R	RNAST45R	RSTO45
RNAB210	RNAST50R	RNAST50R	RSTO50

NAB

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	INA・SKF
NAB2/6T2	NAST 6R	NAST 6R	STO 6TN
NAB2/8	NAST 8R	NAST 8R	STO 8TN
NAB200	NAST10R	NAST10R	STO10
NAB201	NAST12R	NAST12R	STO12
NAB202	NAST15R	NAST15R	STO15
NAB203	NAST17R	NAST17R	STO17
NAB204	NAST20R	NAST20R	STO20
NAB205	NAST25R	NAST25R	STO25
NAB206	NAST30R	NAST30R	STO30
NAB207	NAST35R	NAST35R	STO35
NAB208	NAST40R	NAST40R	STO40
NAB209	NAST45R	NAST45R	STO45
NAB210	NAST50R	NAST50R	STO50

RNAB··X

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	**Without inner ring**	内輪付	**内輪なし**
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	INA・SKF
RNAB2/5XT2	RNAST 5	RNAST 5	RSTO 5TNX
RNAB2/6XT2	RNAST 6	RNAST 6	RSTO 6TNX
RNAB2/8X	RNAST 8	RNAST 8	RSTO 8TNX
RNAB200X	RNAST10	RNAST10	RSTO10X
RNAB201X	RNAST12	RNAST12	RSTO12X
RNAB202X	RNAST15	RNAST15	RSTO15X
RNAB203X	RNAST17	RNAST17	RSTO17X
RNAB204X	RNAST20	RNAST20	RSTO20X
RNAB205X	RNAST25	RNAST25	RSTO25X
RNAB206X	RNAST30	RNAST30	RSTO30X
RNAB207X	RNAST35	RNAST35	RSTO35X
RNAB208X	RNAST40	RNAST40	RSTO40X
RNAB209X	RNAST45	RNAST45	RSTO45X
RNAB210X	RNAST50	RNAST50	RSTO50X

NAB··X

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	INA・SKF
NAB2/6XT2	NAST 6	NAST 6	STO 6TNX
NAB2/8X	NAST 8	NAST 8	STO 8TNX
NAB200X	NAST10	NAST10	STO10X
NAB201X	NAST12	NAST12	STO12X
NAB202X	NAST15	NAST15	STO15X
NAB203X	NAST17	NAST17	STO17X
NAB204X	NAST20	NAST20	STO20X
NAB205X	NAST25	NAST25	STO25X
NAB206X	NAST30	NAST30	STO30X
NAB207X	NAST35	NAST35	STO35X
NAB208X	NAST40	NAST40	STO40X
NAB209X	NAST45	NAST45	STO45X
NAB210X	NAST50	NAST50	STO50X

RNA22··LL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	**Without inner ring**	内輪付	**内輪なし**
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	**With seal**	シールなし	**シール付**

NTN	INA · SKF
RNA22/6LL/3AS	RNA22/6.2RS
RNA22/8LL/3AS	RNA22/8.2RS
RNA2200LL/3AS	RNA2200.2RS
RNA2201LL/3AS	RNA2201.2RS
RNA2202LL/3AS	RNA2202.2RS
RNA2203LL/3AS	RNA2203.2RS
RNA2204LL/3AS	RNA2204.2RS
RNA2205LL/3AS	RNA2205.2RS
RNA2206LL/3AS	RNA2206.2RS
RNA2207LL/3AS	RNA2207.2RS
RNA2208LL/3AS	RNA2208.2RS
RNA2209LL/3AS	RNA2209.2RS
RNA2210LL/3AS	RNA2210.2RS

NA22··LL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	**With seal**	シールなし	**シール付**

NTN	INA · SKF
NA22/6LL/3AS	NA22/6.2RS
NA22/8LL/3AS	NA22/8.2RS
NA2200LL/3AS	NA2200.2RS
NA2201LL/3AS	NA2201.2RS
NA2202LL/3AS	NA2202.2RS
NA2203LL/3AS	NA2203.2RS
NA2204LL/3AS	NA2204.2RS
NA2205LL/3AS	NA2205.2RS
NA2206LL/3AS	NA2206.2RS
NA2207LL/3AS	NA2207.2RS
NA2208LL/3AS	NA2208.2RS
NA2209LL/3AS	NA2209.2RS
NA2210LL/3AS	NA2210.2RS

RNA22··XLL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	**Without inner ring**	内輪付	**内輪なし**
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	**With seal**	シールなし	**シール付**

NTN	INA · SKF
RNA22/6XLL/3AS	RNA22/6.2RSX
RNA22/8XLL/3AS	RNA22/8.2RSX
RNA2200XLL/3AS	RNA2200.2RSX
RNA2201XLL/3AS	RNA2201.2RSX
RNA2202XLL/3AS	RNA2202.2RSX
RNA2203XLL/3AS	RNA2203.2RSX
RNA2204XLL/3AS	RNA2204.2RSX
RNA2205XLL/3AS	RNA2205.2RSX
RNA2206XLL/3AS	RNA2206.2RSX
RNA2207XLL/3AS	RNA2207.2RSX
RNA2208XLL/3AS	RNA2208.2RSX
RNA2209XLL/3AS	RNA2209.2RSX
RNA2210XLL/3AS	RNA2210.2RSX

NA22··XLL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	**With seal**	シールなし	**シール付**

NTN	INA · SKF
NA22/6XLL/3AS	NA22/6.2RSX
NA22/8XLL/3AS	NA22/8.2RSX
NA2200XLL/3AS	NA2200.2RSX
NA2201XLL/3AS	NA2201.2RSX
NA2202XLL/3AS	NA2202.2RSX
NA2203XLL/3AS	NA2203.2RSX
NA2204XLL/3AS	NA2204.2RSX
NA2205XLL/3AS	NA2205.2RSX
NA2206XLL/3AS	NA2206.2RSX
NA2207XLL/3AS	NA2207.2RSX
NA2208XLL/3AS	NA2208.2RSX
NA2209XLL/3AS	NA2209.2RSX
NA2210XLL/3AS	NA2210.2RSX

NATR

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATR 5	NART 5R	NART 5R	FYCJ- 5R	CXM 5RM	NATR 5		MCYRR- 5
NATR 6	NART 6R	NART 6R	FYCJ- 6R	CXM 6RM	NATR 6		MCYRR- 6
NATR 8	NART 8R	NART 8R	FYCJ- 8R	CXM 8RM	NATR 8		MCYRR- 8
NATR10	NART10R	NART10R	FYCJ-10R	CXM10RM	NATR10		MCYRR-10
NATR12	NART12R	NART12R	FYCJ-12R	CXM12RM	NATR12		MCYRR-12
NATR15	NART15R	NART15R	FYCJ-15R	CXM15RM	NATR15		MCYRR-15
NATR17	NART17R	NART17R	FYCJ-17R	CXM17RM	NATR17		MCYRR-17
NATR20	NART20R	NART20R	FYCJ-20R	CXM20RM	NATR20		MCYRR-20
NATR25	NART25R	NART25R	FYCJ-25R	CXM25RM	NATR25		MCYRR-25
NATR30	NART30R	NART30R	FYCJ-30R	CXM30RM	NATR30		MCYRR-30
NATR35	NART35R	NART35R	FYCJ-35R	CXM35RM	NATR35		MCYRR-35
NATR40	NART40R	NART40R	FYCJ-40R	CXM40RM	NATR40		MCYRR-40
NATR45	NART45R	NART45R	FYCJ-45R	CXM45RM	NATR45		MCYRR-45
NATR50	NART50R	NART50R	FYCJ-50R	CXM50RM	NATR50		MCYRR-50

NATR··LL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	**With seal**	シールなし	**シール付**

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATR 5LL/3AS	NART 5UUR	NART 5UUR	FYCJS- 5R	CXM 5UURM	NATR 5PP	FYRJSC- 516	MCYRR- 5-S
NATR 6LL/3AS	NART 6UUR	NART 6UUR	FYCJS- 6R	CXM 6UURM	NATR 6PP	FYRJSC- 619	MCYRR- 6-S
NATR 8LL/3AS	NART 8UUR	NART 8UUR	FYCJS- 8R	CXM 8UURM	NATR 8PP	FYRJSC- 824	MCYRR- 8-S
NATR10LL/3AS	NART10UUR	NART10UUR	FYCJS-10R	CXM10UURM	NATR10PP	FYRJSC-1030	MCYRR-10-S
NATR12LL/3AS	NART12UUR	NART12UUR	FYCJS-12R	CXM12UURM	NATR12PP	FYRJSC-1232	MCYRR-12-S
NATR15LL/3AS	NART15UUR	NART15UUR	FYCJS-15R	CXM15UURM	NATR15PP	—	MCYRR-15-S
NATR17LL/3AS	NART17UUR	NART17UUR	FYCJS-17R	CXM17UURM	NATR17PP	—	MCYRR-17-S
NATR20LL/3AS	NART20UUR	NART20UUR	FYCJS-20R	CXM20UURM	NATR20PP	—	MCYRR-20-S
NATR25LL/3AS	NART25UUR	NART25UUR	FYCJS-25R	CXM25UURM	NATR25PP	—	MCYRR-25-S
NATR30LL/3AS	NART30UUR	NART30UUR	FYCJS-30R	CXM30UURM	NATR30PP	—	MCYRR-30-S
NATR35LL/3AS	NART35UUR	NART35UUR	FYCJS-35R	CXM35UURM	NATR35PP	—	MCYRR-35-S
NATR40LL/3AS	NART40UUR	NART40UUR	FYCJS-40R	CXM40UURM	NATR40PP	—	MCYRR-40-S
NATR45LL/3AS	NART45UUR	NART45UUR	FYCJS-45R	CXM45UURM	NATR45PP	—	MCYRR-45-S
NATR50LL/3AS	NART50UUR	NART50UUR	FYCJS-50R	CXM50UURM	NATR50PP	—	MCYRR-50-S

NATR··X

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	With seal	**シールなし**	シール付

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATR 5X			FYCJ- 5	CXM 5M	NATR 5X		MCYRR- 5-X
NATR 6X			FYCJ- 6	CXM 6M	NATR 6X		MCYRR- 6-X
NATR 8X			FYCJ- 8	CXM 8M	NATR 8X		MCYRR- 8-X
NATR10X			FYCJ-10	CXM10M	NATR10X		MCYRR-10-X
NATR12X			FYCJ-12	CXM12M	NATR12X		MCYRR-12-X
NATR15X			FYCJ-15	CXM15M	NATR15X		MCYRR-15-X
NATR17X			FYCJ-17	CXM17M	NATR17X		MCYRR-17-X
NATR20X			FYCJ-20	CXM20M	NATR20X		MCYRR-20-X
NATR25X			FYCJ-25	CXM25M	NATR25X		MCYRR-25-X
NATR30X			FYCJ-30	CXM30M	NATR30X		MCYRR-30-X
NATR35X			FYCJ-35	CXM35M	NATR35X		MCYRR-35-X
NATR40X			FYCJ-40	CXM40M	NATR40X		MCYRR-40-X
NATR45X			FYCJ-45	CXM45M	NATR45X		MCYRR-45-X
NATR50X			FYCJ-50	CXM50M	NATR50X		MCYRR-50-X

NATR··XLL

Metric series	Inch series	**ミリ系**	インチ系
With cage	Full-complement roller	**保持器付き**	総ころ
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	**With seal**	シールなし	**シール付**

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATR 5XLL/3AS			FYCJS- 5	CXM 5UUM	NATR 5PPX		MCYRR- 5-SX
NATR 6XLL/3AS			FYCJS- 6	CXM 6UUM	NATR 6PPX		MCYRR- 6-SX
NATR 8XLL/3AS			FYCJS- 8	CXM 8UUM	NATR 8PPX		MCYRR- 8-SX
NATR10XLL/3AS			FYCJS-10	CXM10UUM	NATR10PPX		MCYRR-10-SX
NATR12XLL/3AS			FYCJS-12	CXM12UUM	NATR12PPX		MCYRR-12-SX
NATR15XLL/3AS			FYCJS-15	CXM15UUM	NATR15PPX		MCYRR-15-SX
NATR17XLL/3AS			FYCJS-17	CXM17UUM	NATR17PPX		MCYRR-17-SX
NATR20XLL/3AS			FYCJS-20	CXM20UUM	NATR20PPX		MCYRR-20-SX
NATR25XLL/3AS			FYCJS-25	CXM25UUM	NATR25PPX		MCYRR-25-SX
NATR30XLL/3AS			FYCJS-30	CXM30UUM	NATR30PPX		MCYRR-30-SX
NATR35XLL/3AS			FYCJS-35	CXM35UUM	NATR35PPX		MCYRR-35-SX
NATR40XLL/3AS			FYCJS-40	CXM40UUM	NATR40PPX		MCYRR-40-SX
NATR45XLL/3AS			FYCJS-45	CXM45UUM	NATR45PPX		MCYRR-45-SX
NATR50XLL/3AS			FYCJS-50	CXM50UUM	NATR50PPX		MCYRR-50-SX

NATV

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATV 5/3AS	NART 5VR	NART 5VR	FYCR- 5R	CYM 5RM	NATV 5		MCYR- 5
NATV 6/3AS	NART 6VR	NART 6VR	FYCR- 6R	CYM 6RM	NATV 6		MCYR- 6
NATV 8/3AS	NART 8VR	NART 8VR	FYCR- 8R	CYM 8RM	NATV 8		MCYR- 8
NATV10/3AS	NART10VR	NART10VR	FYCR-10R	CYM10RM	NATV10		MCYR-10
NATV12/3AS	NART12VR	NART12VR	FYCR-12R	CYM12RM	NATV12		MCYR-12
NATV15/3AS	NART15VR	NART15VR	FYCR-15R	CYM15RM	NATV15		MCYR-15
NATV17/3AS	NART17VR	NART17VR	FYCR-17R	CYM17RM	NATV17		MCYR-17
NATV20/3AS	NART20VR	NART20VR	FYCR-20R	CYM20RM	NATV20		MCYR-20
NATV25/3AS	NART25VR	NART25VR	FYCR-25R	CYM25RM	NATV25		MCYR-25
NATV30/3AS	NART30VR	NART30VR	FYCR-30R	CYM30RM	NATV30		MCYR-30
NATV35/3AS	NART35VR	NART35VR	FYCR-35R	CYM35RM	NATV35		MCYR-35
NATV40/3AS	NART40VR	NART40VR	FYCR-40R	CYM40RM	NATV40		MCYR-40
———	NART45VR	NART45VR	FYCR-45R	CYM45RM	———		MCYR-45
NATV50/3AS	NART50VR	NART50VR	FYCR-50R	CYM50RM	NATV50		MCYR-50

NATV··LL

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATV 5LL/3AS	NART 5VUUR	NART 5VUUR	FYCRS- 5R	CYM 5UURM	NATV 5PP		MCYR- 5-S
NATV 6LL/3AS	NART 6VUUR	NART 6VUUR	FYCRS- 6R	CYM 6UURM	NATV 6PP		MCYR- 6-S
NATV 8LL/3AS	NART 8VUUR	NART 8VUUR	FYCRS- 8R	CYM 8UURM	NATV 8PP		MCYR- 8-S
NATV10LL/3AS	NART10VUUR	NART10VUUR	FYCRS-10R	CYM10UURM	NATV10PP		MCYR-10-S
NATV12LL/3AS	NART12VUUR	NART12VUUR	FYCRS-12R	CYM12UURM	NATV12PP		MCYR-12-S
NATV15LL/3AS	NART15VUUR	NART15VUUR	FYCRS-15R	CYM15UURM	NATV15PP		MCYR-15-S
NATV17LL/3AS	NART17VUUR	NART17VUUR	FYCRS-17R	CYM17UURM	NATV17PP		MCYR-17-S
NATV20LL/3AS	NART20VUUR	NART20VUUR	FYCRS-20R	CYM20UURM	NATV20PP		MCYR-20-S
NATV25LL/3AS	NART25VUUR	NART25VUUR	FYCRS-25R	CYM25UURM	NATV25PP		MCYR-25-S
NATV30LL/3AS	NART30VUUR	NART30VUUR	FYCRS-30R	CYM30UURM	NATV30PP		MCYR-30-S
NATV35LL/3AS	NART35VUUR	NART35VUUR	FYCRS-35R	CYM35UURM	NATV35PP		MCYR-35-S
NATV40LL/3AS	NART40VUUR	NART40VUUR	FYCRS-40R	CYM40UURM	NATV40PP		MCYR-40-S
———	NART45VUUR	NART45VUUR	FYCRS-45R	CYM45UURM	———		MCYR-45-S
NATV50LL/3AS	NART50VUUR	NART50VUUR	FYCRS-50R	CYM50UURM	NATV50PP		MCYR-50-S

NATV··X

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

Selected: Metric series / ミリ系, Full-complement roller / 総ころ, With inner ring / 内輪付, Cylindrical outer surface / 円筒外径, Without seal / シールなし

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATV 5X/3AS			FYCR- 5	CYM 5M	NATV 5X		MCYR- 5-X
NATV 6X/3AS			FYCR- 6	CYM 6M	NATV 6X		MCYR- 6-X
NATV 8X/3AS			FYCR- 8	CXM 8M	NATV 8X		MCYR- 8-X
NATV10X/3AS			FYCR-10	CYM10M	NATV10X		MCYR-10-X
NATV12X/3AS			FYCR-12	CYM12M	NATV12X		MCYR-12-X
NATV15X/3AS			FYCR-15	CYM15M	NATV15X		MCYR-15-X
NATV17X/3AS			FYCR-17	CYM17M	NATV17X		MCYR-17-X
NATV20X/3AS			FYCR-20	CYM20M	NATV20X		MCYR-20-X
NATV25X/3AS			FYCR-25	CYM25M	NATV25X		MCYR-25-X
NATV30X/3AS			FYCR-30	CYM30M	NATV30X		MCYR-30-X
NATV35X/3AS			FYCR-35	CYM35M	NATV35X		MCYR-35-X
NATV40X/3AS			FYCR-40	CYM40M	NATV40X		MCYR-40-X
———			FYCR-45	CYM45M	———		MCYR-45-X
NATV50X/3AS			FYCR-50	CYM50M	NATV50X		MCYR-50-X

NATV··XLL

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

Selected: Metric series / ミリ系, Full-complement roller / 総ころ, With inner ring / 内輪付, Cylindrical outer surface / 円筒外径, With seal / シール付

NTN	IKO	THK	NSK	KOYO	INA · SKF	TORR.	Mc,GILL
NATV 5XLL/3AS			FYCRS- 5	CYM 5UUM	NATV 5PPX		MCYR- 5-SX
NATV 6XLL/3AS			FYCRS- 6	CYM 6UUM	NATV 6PPX		MCYR- 6-SX
NATV 8XLL/3AS			FYCRS- 8	CYM 8UUM	NATV 8PPX		MCYR- 8-SX
NATV10XLL/3AS			FYCRS-10	CYM10UUM	NATV10PPX		MCYR-10-SX
NATV12XLL/3AS			FYCRS-12	CYM12UUM	NATV12PPX		MCYR-12-SX
NATV15XLL/3AS			FYCRS-15	CYM15UUM	NATV15PPX		MCYR-15-SX
NATV17XLL/3AS			FYCRS-17	CYM17UUM	NATV17PPX		MCYR-17-SX
NATV20XLL/3AS			FYCRS-20	CYM20UUM	NATV20PPX		MCYR-20-SX
NATV25XLL/3AS			FYCRS-25	CYM25UUM	NATV25PPX		MCYR-25-SX
NATV30XLL/3AS			FYCRS-30	CYM30UUM	NATV30PPX		MCYR-30-SX
NATV35XLL/3AS			FYCRS-35	CYM35UUM	NATV35PPX		MCYR-35-SX
NATV40XLL/3AS			FYCRS-40	CYM40UUM	NATV40PPX		MCYR-40-SX
———			FYCRS-45	CYM45UUM	———		MCYR-45-SX
NATV50XLL/3AS			FYCRS-50	CYM50UUM	NATV50PPX		MCYR-50-SX

NUTR

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without shield	With shield	シールドなし	シールド付

NTN	IKO	INA・SKF
NUTR202/3AS	NURT15R	NUTR 15
NUTR203/3AS	NURT17R	NUTR 17
NUTR302/3AS	NURT15-1R	NUTR1542
NUTR303/3AS	NURT17-1R	NUTR1747
NUTR204/3AS	NURT20R	NUTR 20
NUTR304/3AS	NURT20-1R	NUTR2052
NUTR205/3AS	NURT25R	NUTR 25
NUTR305/3AS	NURT25-1R	NUTR2562
NUTR206/3AS	NURT30R	NUTR30
NUTR306/3AS	NURT30-1R	NUTR3072
NUTR207/3AS	NURT35R	NUTR 35
NUTR307/3AS	NURT35-1R	NUTR3580
NUTR208/3AS	NURT40R	NUTR 40
NUTR209/3AS	NURT45R	NUTR 45
NUTR308/3AS	NURT40-1R	NUTR4090
NUTR210/3AS	NURT50R	NUTR 50
NUTR309/3AS	NURT45-1R	NUTR45100
NUTR310/3AS	NURT50-1R	NUTR50110

NUTR・・X

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without shield	With shield	シールドなし	シールド付

NTN	INA・SKF
NUTR202X/3AS	NUTR 15 X
NUTR203X/3AS	NUTR 17 X
NUTR302X/3AS	NUTR1542X
NUTR303X/3AS	NUTR1747X
NUTR204X/3AS	NUTR 20 X
NUTR304X/3AS	NUTR2052X
NUTR205X/3AS	NUTR 25 X
NUTR305X/3AS	NUTR2562X
NUTR206X/3AS	NUTR 30 X
NUTR306X/3AS	NUTR3072X
NUTR207X/3AS	NUTR 35 X
NUTR307X/3AS	NUTR3580X
NUTR208X/3AS	NUTR 40 X
NUTR209X/3AS	NUTR 45 X
NUTR308X/3AS	NUTR4090X
NUTR210X/3AS	NUTR 50 X
NUTR309X/3AS	NUTR45100X
NUTR310X/3AS	NUTR50110X

NABR

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

NTN	IKO	THK	KOYO	SKF
NABR 6	NAST 6ZZR	NAST 6ZZR	CZM 6R	NAST 6-2Z
NABR 8	NAST 8ZZR	NAST 8ZZR	CZM 8R	NAST 8-2Z
NABR10	NAST10ZZR	NAST10ZZR	CZM10R	NAST10-2Z
NABR12	NAST12ZZR	NAST12ZZR	CZM12R	NAST12-2Z
NABR15	NAST15ZZR	NAST15ZZR	CZM15R	NAST15-2Z
NABR17	NAST17ZZR	NAST17ZZR	CZM17R	NAST17-2Z
NABR20	NAST20ZZR	NAST20ZZR	CZM20R	NAST20-2Z
NABR25	NAST25ZZR	NAST25ZZR	CZM25R	NAST25-2Z
NABR30	NAST30ZZR	NAST30ZZR	CZM30R	NAST30-2Z
NABR35	NAST35ZZR	NAST35ZZR	CZM35R	NAST35-2Z
NABR40	NAST40ZZR	NAST40ZZR	CZM40R	NAST40-2Z
NABR45	NAST45ZZR	NAST45ZZR	CZM45R	NAST45-2Z
NABR50	NAST50ZZR	NAST50ZZR	CZM50R	――――

NABR・・X

Metric series	Inch series	ミリ系	インチ系
With cage	Full-complement roller	保持器付き	総ころ
With inner ring	Without inner ring	内輪付	内輪なし
Spherical outer surface	Cylindrical outer surface	球面外径	円筒外径
Without seal	With seal	シールなし	シール付

NTN	IKO	THK	KOYO	SKF
NABR 6X	NAST 6ZZ	NAST 6ZZ	CZM 6	NAST 6P-2Z
NABR 8X	NAST 8ZZ	NAST 8ZZ	CZM 8	NAST 8P-2Z
NABR10X	NAST10ZZ	NAST10ZZ	CZM10	NAST10P-2Z
NABR12X	NAST12ZZ	NAST12ZZ	CZM12	NAST12P-2Z
NABR15X	NAST15ZZ	NAST15ZZ	CZM15	NAST15P-2Z
NABR17X	NAST17ZZ	NAST17ZZ	CZM17	NAST17P-2Z
NABR20X	NAST20ZZ	NAST20ZZ	CZM20	NAST20P-2Z
NABR25X	NAST25ZZ	NAST25ZZ	CZM25	NAST25P-2Z
NABR30X	NAST30ZZ	NAST30ZZ	CZM30	NAST30P-2Z
NABR35X	NAST35ZZ	NAST35ZZ	CZM35	NAST35P-2Z
NABR40X	NAST40ZZ	NAST40ZZ	CZM40	NAST40P-2Z
NABR45X	NAST45ZZ	NAST45ZZ	CZM45	NAST45P-2Z
NABR50X	NAST50ZZ	NAST50ZZ	CZM50	――――

NACV

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付き	**総ころ**
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	With seal	**シールなし**	シール付

NTN	NSK	INA	TORR,	Mc.GILL
NACV12/3AS	YCRC-12	RF-12-Y	YCRC-12	CCYR-$\frac{3}{4}$
NACV14/3AS	YCRC-14	RF-14-Y	YCRC-14	CCYR-$\frac{7}{8}$
NACV16/3AS	YCRC-16	RF-16-Y	YCRC-16	CCYR-1
NACV18/3AS	YCRC-18	RF-18-Y	YCRC-18	CCYR-1$\frac{1}{8}$
NACV20/3AS	YCRC-20	RF-20-Y	YCRC-20	CCYR-1$\frac{1}{4}$
NACV22/3AS	YCRC-22	RF-22-Y	YCRC-22	CCYR-1$\frac{3}{8}$
NACV24/3AS	YCRC-24	RF-24-Y	YCRC-24	CCYR-1$\frac{1}{2}$
NACV26/3AS	YCRC-26	RF-26-Y	YCRC-26	CCYR-1$\frac{5}{8}$
NACV28/3AS	YCRC-28	RF-28-Y	YCRC-28	CCYR-1$\frac{3}{4}$
NACV30/3AS	YCRC-30	RF-30-Y	YCRC-30	CCYR-1$\frac{7}{8}$
NACV32/3AS	YCRC-32	RF-32-Y	YCRC-32	CCYR-2
NACV36/3AS	YCRC-36	RF-36-Y	YCRC-36	CCYR-2$\frac{1}{4}$
NACV40/3AS	YCRC-40	RF-40-Y	YCRC-40	CCYR-2$\frac{1}{2}$
NACV44/3AS	YCRC-44	RF-44-Y	YCRC-44	CCYR-2$\frac{3}{4}$
NACV48/3AS	YCRC-48	RF-48-Y	YCRC-48	CCYR-3
NACV52/3AS	YCRC-52	RF-52-Y	YCRC-52	CCYR-3$\frac{1}{4}$
NACV56/3AS	YCRC-56	RF-56-Y	YCRC-56	CCYR-3$\frac{1}{2}$
NACV64/3AS	YCRC-64	RF-64-Y	YCRC-64	CCYR-4
NACV80/3AS	YCRC-80	—	—	—
NACV96/3AS	YCRC-96	—	—	—

NACV··LL

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付き	**総ころ**
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	Cylindrical outer surface	**球面外径**	円筒外径
Without seal	**With seal**	シールなし	**シール付**

NTN	NSK	INA	TORR,	Mc.GILL
NACV12LL/3AS	YCRSC-12	RF-12-PPY	YCRSC-12	CCYR-$\frac{3}{4}$-S
NACV14LL/3AS	YCRSC-14	RF-14-PPY	YCRSC-14	CCYR-$\frac{7}{8}$-S
NACV16LL/3AS	YCRSC-16	RF-16-PPY	YCRSC-16	CCYR-1-S
NACV18LL/3AS	YCRSC-18	RF-18-PPY	YCRSC-18	CCYR-1$\frac{1}{8}$-S
NACV20LL/3AS	YCRSC-20	RF-20-PPY	YCRSC-20	CCYR-1$\frac{1}{4}$-S
NACV22LL/3AS	YCRSC-22	RF-22-PPY	YCRSC-22	CCYR-1$\frac{3}{8}$-S
NACV24LL/3AS	YCRSC-24	RF-24-PPY	YCRSC-24	CCYR-1$\frac{1}{2}$-S
NACV26LL/3AS	YCRSC-26	RF-26-PPY	YCRSC-26	CCYR-1$\frac{5}{8}$-S
NACV28LL/3AS	YCRSC-28	RF-28-PPY	YCRSC-28	CCYR-1$\frac{3}{4}$-S
NACV30LL/3AS	YCRSC-30	RF-30-PPY	YCRSC-30	CCYR-1$\frac{7}{8}$-S
NACV32LL/3AS	YCRSC-32	RF-32-PPY	YCRSC-32	CCYR-2-S
NACV36LL/3AS	YCRSC-36	RF-36-PPY	YCRSC-36	CCYR-2$\frac{1}{4}$-S
NACV40LL/3AS	YCRSC-40	RF-40-PPY	YCRSC-40	CCYR-2$\frac{1}{2}$-S
NACV44LL/3AS	YCRSC-44	RF-44-PPY	YCRSC-44	CCYR-2$\frac{3}{4}$-S
NACV48LL/3AS	YCRSC-48	RF-48-PPY	YCRSC-48	CCYR-3-S
NACV52LL/3AS	YCRSC-52	RF-52-PPY	YCRSC-52	CCYR-3$\frac{1}{4}$-S
NACV56LL/3AS	YCRSC-56	RF-56-PPY	YCRSC-56	CCYR-3$\frac{1}{2}$-S
NACV64LL/3AS	YCRSC-64	RF-64-PPY	YCRSC-64	CCYR-4-S
NACV80LL/3AS	YCRSC-80	—	—	—
NACV96LL/3AS	YCRSC-96	—	—	—

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付き	**総ころ**
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	With seal	**シールなし**	シール付

NACV··X

NTN	NSK	INA	TORR,	Mc.GILL
NACV12X/3AS	YCR-12	RF-12	YCR-12	CYR-¾
NACV14X/3AS	YCR-14	RF-14	YCR-14	CYR-⅞
NACV16X/3AS	YCR-16	RF-16	YCR-16	CYR-1
NACV18X/3AS	YCR-18	RF-18	YCR-18	CYR-1⅛
NACV20X/3AS	YCR-20	RF-20	YCR-20	CYR-1¼
NACV22X/3AS	YCR-22	RF-22	YCR-22	CYR-1⅜
NACV24X/3AS	YCR-24	RF-24	YCR-24	CYR-1½
NACV26X/3AS	YCR-26	RF-26	YCR-26	CYR-1⅝
NACV28X/3AS	YCR-28	RF-28	YCR-28	CYR-1¾
NACV30X/3AS	YCR-30	RF-30	YCR-30	CYR-1⅞
NACV32X/3AS	YCR-32	RF-32	YCR-32	CYR-2
NACV36X/3AS	YCR-36	RF-36	YCR-36	CYR-2¼
NACV40X/3AS	YCR-40	RF-40	YCR-40	CYR-2½
NACV44X/3AS	YCR-44	RF-44	YCR-44	CYR-2¾
NACV48X/3AS	YCR-48	RF-48	YCR-48	CYR-3
NACV52X/3AS	YCR-52	RF-52	YCR-52	CYR-3¼
NACV56X/3AS	YCR-56	RF-56	YCR-56	CYR-3½
NACV64X/3AS	YCR-64	RF-64	YCR-64	CYR-4
NACV80X/3AS	YCR-80	RF-80	YCR-80	CYR-5
NACV96X/3AS	YCR-96	RF-96	YCR-96	CYR-6

Metric series	**Inch series**	ミリ系	**インチ系**
With cage	**Full-complement roller**	保持器付き	**総ころ**
With inner ring	Without inner ring	**内輪付**	内輪なし
Spherical outer surface	**Cylindrical outer surface**	球面外径	**円筒外径**
Without seal	**With seal**	シールなし	**シール付**

NACV··XLL

NTN	NSK	INA	TORR,	Mc.GILL
NACV12XLL/3AS	YCRS-12	RF-12-PP	YCRS-12	CYR-¾-S
NACV14XLL/3AS	YCRS-14	RF-14-PP	YCRS-14	CYR-⅞-S
NACV16XLL/3AS	YCRS-16	RF-16-PP	YCRS-16	CYR-1-S
NACV18XLL/3AS	YCRS-18	RF-18-PP	YCRS-18	CYR-1⅛-S
NACV20XLL/3AS	YCRS-20	RF-20-PP	YCRS-20	CYR-1¼-S
NACV22XLL/3AS	YCRS-22	RF-22-PP	YCRS-22	CYR-1⅜-S
NACV24XLL/3AS	YCRS-24	RF-24-PP	YCRS-24	CYR-1½-S
NACV26XLL/3AS	YCRS-26	RF-26-PP	YCRS-26	CYR-1⅝-S
NACV28XLL/3AS	YCRS-28	RF-28-PP	YCRS-28	CYR-1¾-S
NACV30XLL/3AS	YCRS-30	RF-30-PP	YCRS-30	CYR-1⅞-S
NACV32XLL/3AS	YCRS-32	RF-32-PP	YCRS-32	CYR-2-S
NACV36XLL/3AS	YCRS-36	RF-36-PP	YCRS-36	CYR-2¼-S
NACV40XLL/3AS	YCRS-40	RF-40-PP	YCRS-40	CYR-2½-S
NACV44XLL/3AS	YCRS-44	RF-44-PP	YCRS-44	CYR-2¾-S
NACV48XLL/3AS	YCRS-48	RF-48-PP	YCRS-48	CYR-3-S
NACV52XLL/3AS	YCRS-52	RF-52-PP	YCRS-52	CYR-3¼-S
NACV56XLL/3AS	YCRS-56	RF-56-PP	YCRS-56	CYR-3½-S
NACV64XLL/3AS	YCRS-64	RF-64-PP	YCRS-64	CYR-4-S
NACV80XLL/3AS	YCRS-80	RF-80-PP	YCRS-80	CYR-5-S
NACV96XLL/3AS	YCRS-96	RF-96-PP	YCRS-96	CYR-6-S

Adapters
Withdrawal Sleeves
Locknuts, Lockwashers & Lockplates
Hydraulic Nuts

(Mounting & Dismounting Tools for Rolling Bearings)

CAT. No. 4201-Ⅳ／E

NTN

Adapters
Withdrawal Sleeves
Locknuts, Lockwashers & Lockplates
Hydraulic Nuts
(Mounting & Dismounting Tools for Rolling Bearings)

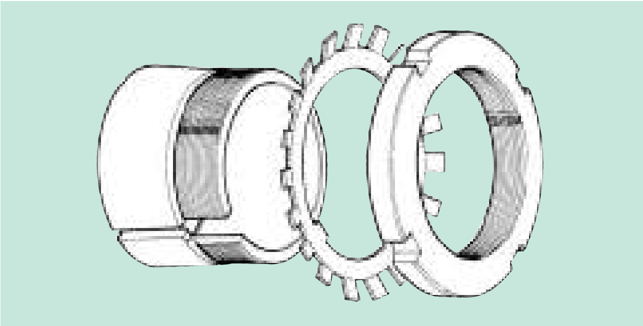
CONTENTS

PAGE

Applicable Bearings

Series		Applicable Bearings (tapered bore): Self-Aligning Ball Bearings	Applicable Bearings (tapered bore): Spherical Roller Bearings	Applicable Bearings (tapered bore): Insert Bearings for Bearing Units	Page
H 30 HE 30 H 30‥HF H 30‥HB	Adapters	–	23024EAK ～ 230/500BK	–	8
H 31 HE 31 H 31‥HF H 31‥HB	Adapters	–	23122EAK ～ 231/500BK; 22224EMK ～ 22264EMK	–	10
H 2 HE 2 HS 2	Adapters	1205SK ～ 1222SK	–	–	12
H 32 H 32‥HF H 32‥HB	Adapters	–	23260EMK ～ 23280BK	–	14
H 3 HE 3 HS 3	Adapters	1305SK ～ 1322SK; 2205SK ～ 2222SK	22208EAK ～ 22222EAK; 21308CK ～ 21322K	–	16
H 23 HE 23 HS 23 H 23‥HF H 23‥HB	Adapters	2305SK ～ 2322SK	23218EMK ～ 23256EMK; 22308EAK ～ 22356EAK	UK205 ～ UK218; UK305 ～ UK328; UKX05 ～ UKX20	18
H 39 H 39‥HF H 39‥HB	Adapters	–	23932EMK ～ 23996BK	–	20
AH 30 AH 30‥H	Withdrawal Sleeves	–	23024EAK ～ 23096BK	–	22
AH 31 AH 31‥H	Withdrawal Sleeves	2222SK	23122EAK ～ 23196BK; 22222EAK ～ 22234EMK	–	24
AH 2	Withdrawal Sleeves	1208SK ～ 1222SK	–	–	26
AH 22 AH 22‥H	Withdrawal Sleeves	–	22236EMK ～ 22264EMK	–	27
AH 32 AH 32‥H	Withdrawal Sleeves	–	23218EAK ～ 23240EMK; 23260EMK ～ 23296BK	–	28
AH 3	Withdrawal Sleeves	2208SK ～ 2220SK; 1308SK ～ 1322SK	22208EAK ～ 22220EMK; 21308CK ～ 21322K	–	30
AH 23 AH 23‥H	Withdrawal Sleeves	2308SK ～ 2322SK	23244EMK ～ 23256EMK; 22308EAK ～ 22356EMK	–	31
AH 240 AH 240‥H	Withdrawal Sleeves	–	24024EMK30 ～ 24088BK30	–	33
AH 241 AH 241‥H	Withdrawal Sleeves	–	24122EMK30 ～ 24192BK30	–	34
AH 39 AH 39‥H	Withdrawal Sleeves	–	23934EMK ～ 23996K	–	35
AN, AN‥SP, AN‥SPB, ANL, ANL‥SP, ANL‥SPB		Locknuts (for adapter sleeve, withdrawal sleeve and shaft)			36～43
HN, HNL		Nuts (for withdrawal sleeve and shaft)			44～45
AW, AWL, AL, ALL		Lockwashers and Lockplates			46～49
HPN, ANP		Hydraulic nuts (mounting & dismounting tools for rolling bearings) Protective plates			50

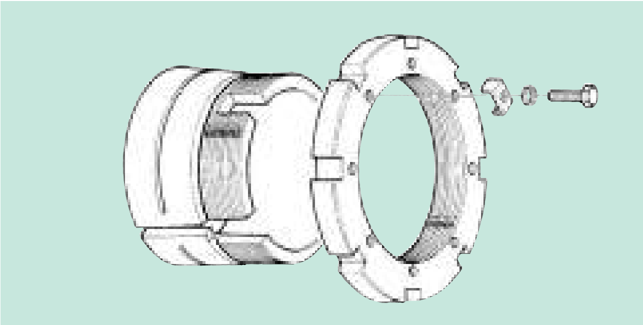
1. Types and Features



Adapters

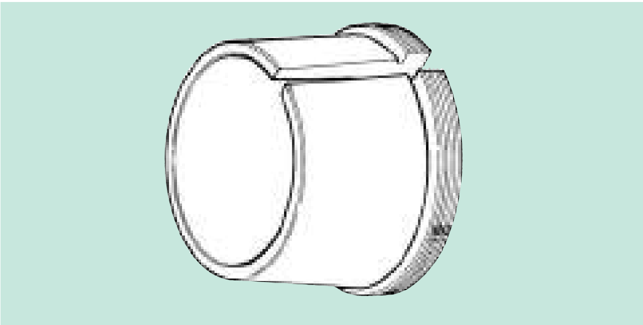
Adapters are made up of adapter sleeves, nuts, and washers or clasps.

These adapters are used to mount tapered bore bearings easily on specific positions of shafts.



Hydraulic Adapters

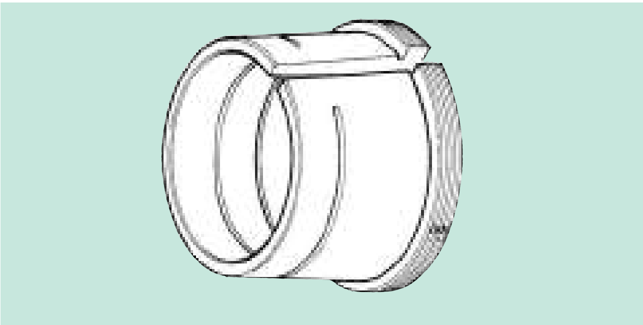
Hydraulic adapters feature an oil inlet and oil groove in the sleeve, which make installation to and removal from the shaft easier, particularly with large bearing.



Withdrawal Sleeves

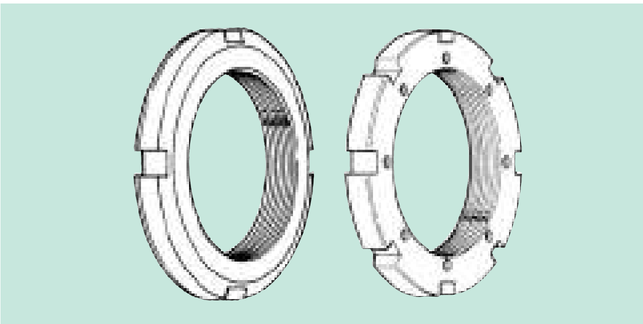
Withdrawal sleeves are used to mount tapered bore bearings on shafts.

Withdrawal sleeve nuts are used when removing bearing from shafts.



Hydraulic Withdrawal Sleeves

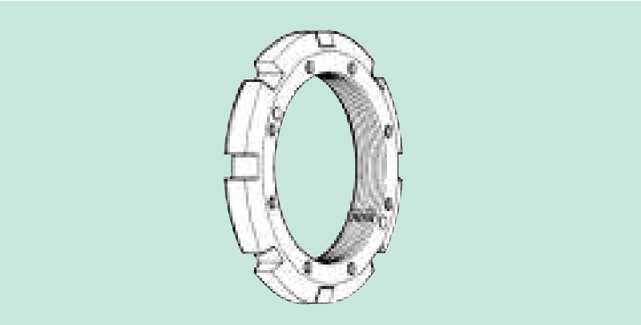
Hydraulic withdrawal sleeves feature an oil inlet and oil groove in the sleeve, which make mounting to the shaft and disassembly easier, particularly with large bearings.



Locknuts, Nuts

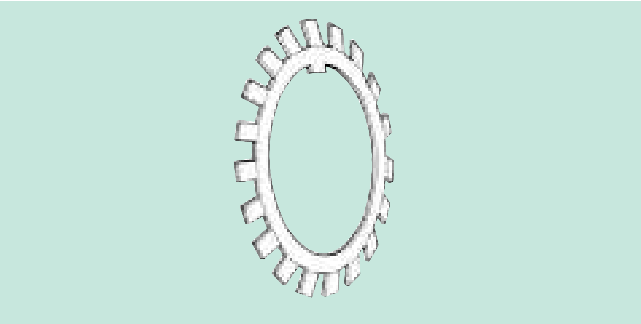
Locknuts are used with adapters, withdrawal sleeves and shafts.

Nuts are used with withdrawal sleeves and shafts.



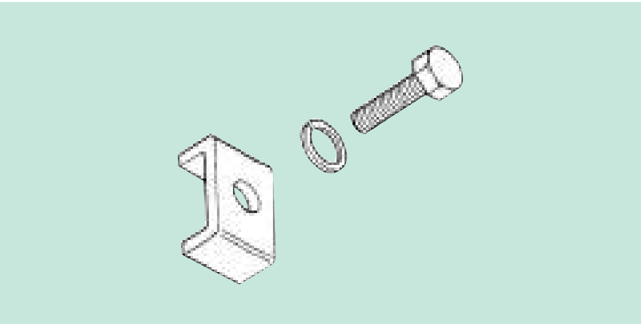
Hydraulic Sleeve Nuts

Hydraulic sleeve nuts feature threaded bolt holes for mounting and withdrawal, and holes for passing through hydraulic hoses.



Lockwashers

Lockwashers are used to stop nuts from rotating.

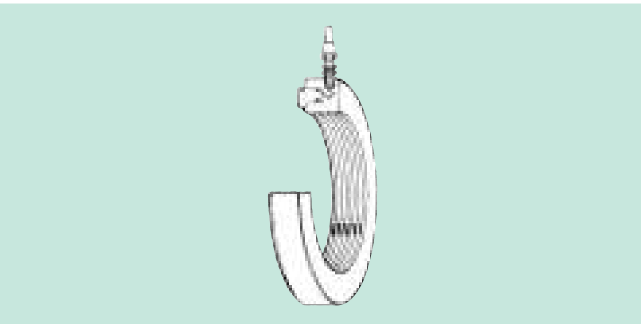


Lockplates

Lockplates are used to stop large nuts from rotating.

Protective Plates

Protective plates are inserted between the hydraulic sleeve and hydraulic sleeve nut during installation, and protects the sleeve from damage.



Hydraulic Nuts

(Mounting & Dismounting Tools for Rolling Bearings)

Using hydraulic nuts for mounting and dismounting bearings prevents excessive force being applied, so as to avoid damage to shafts and bearings. The force applied is also uniform for more efficient work.

2. Details of Special Hydraulic Sleeve

Hydraulic Adapters

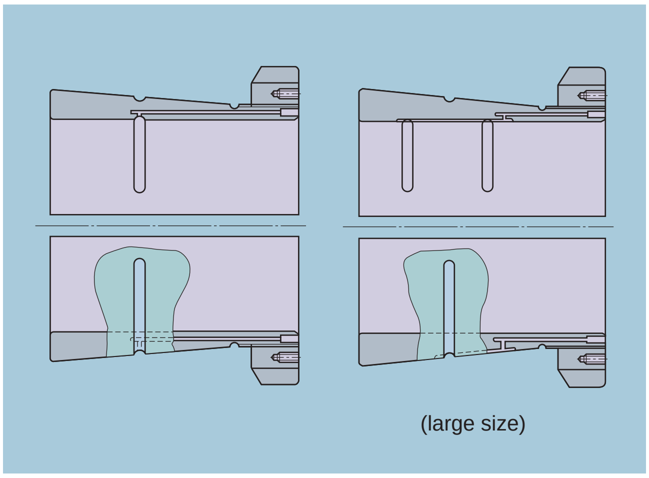


Fig. 1 HFW type

Features an oil groove added to the bore surface of the standard type hydraulic adapter sleeve to suit applications where movement is required between the shaft and adapter.

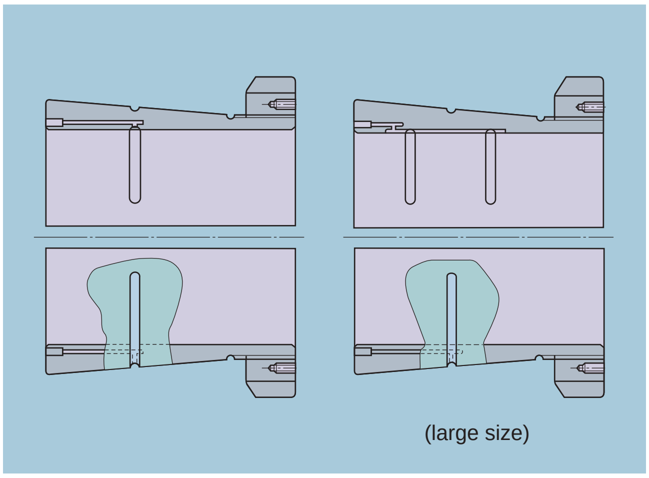


Fig. 2 HBW type

Similar to the HFW type adapter but with the oil inlet on the large side of the adapter sleeve.

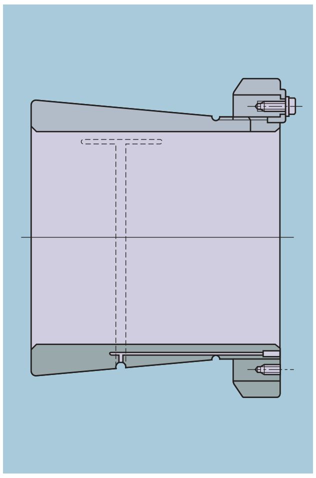


Fig. 3 HFT type

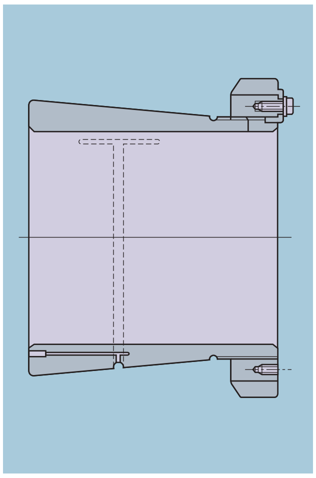


Fig. 4 HBT type

Features an oil groove added to the hydraulic adapter sleeve in an axial direction, which makes installation and removal of bearings even easier.

The HFT type features the HBT type oil inlet added to the large side of the adapter sleeve.

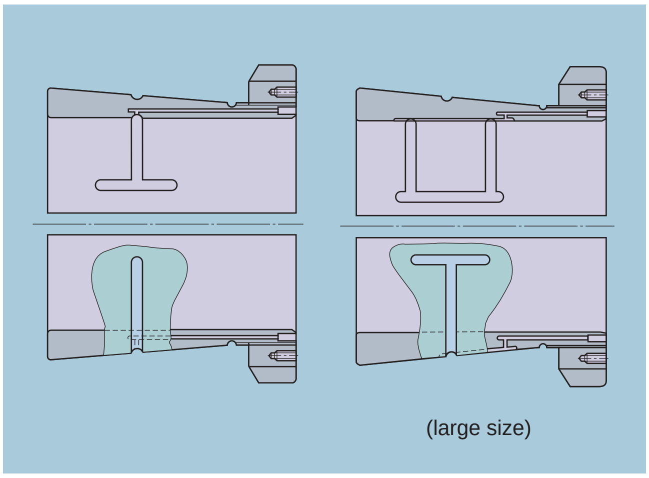


Fig. 5 HFWT type

Feature the HFW type with oil groove added in the axial direction.

Hydraulic Withdrawal Sleeves

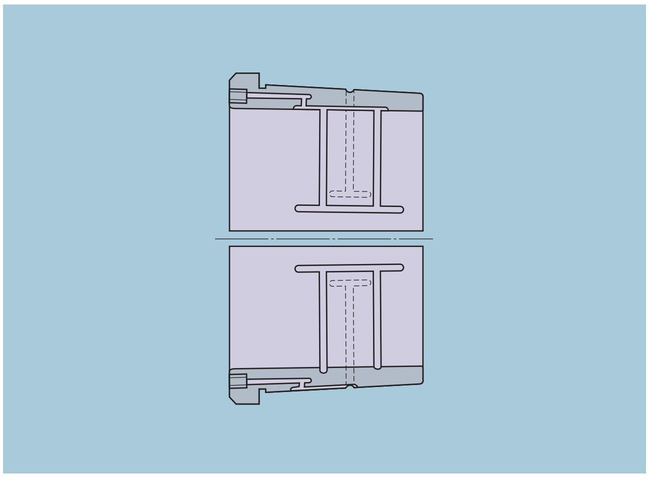


Fig. 6 HT type

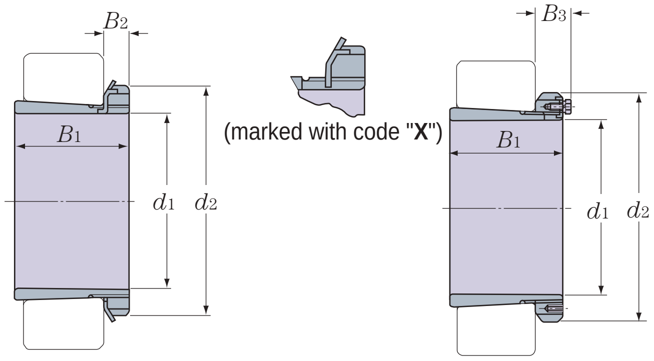
Features an oil groove added to the hydraulic withdrawal sleeve in an axial direction, which makes installation and removal of bearings even easier.

3. Dimensions

Contents

Adapters

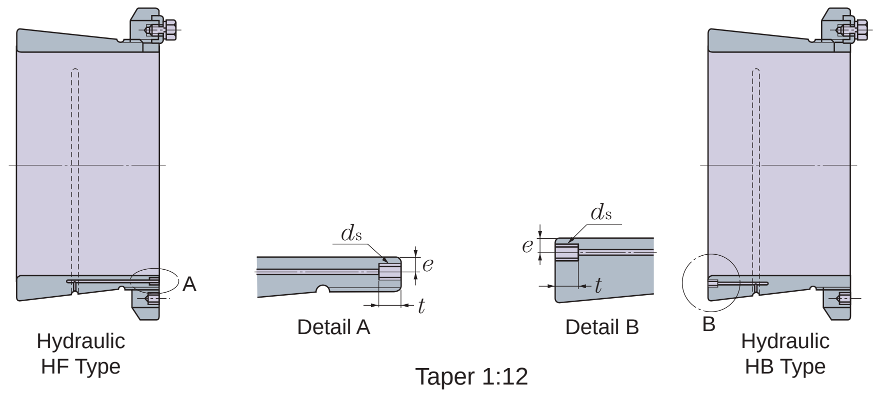
Series
H30
HE30
H30··HF (Hydraulic)
H30··HB (Hydraulic)



Taper 1:12

Part numbers		Dimensions mm											
		Sleeve bore diameter d_1		B_2	B_3	d_2	B_1	HF Type			HB Type		
H	HE	H	HE					d_s	e	t	d_s	e	t
H3024X	**HE3024X**	110	107.950(4¼)	22	–	145	72	–	–	–	–	–	–
H3026	**HE3026**	115	114.300(4½)	23	–	155	80	–	–	–	–	–	–
H3028	**HE3028**	125	127.000(5)	24	–	165	82	–	–	–	–	–	–
H3030	**HE3030**	135	133.350(5¼)	26	–	180	87	–	–	–	–	–	–
H3032	**HE3032**	140	139.700(5½)	28	–	190	93	–	–	–	–	–	–
H3034	**HE3034**	150	152.400(6)	29	–	200	101	–	–	–	–	–	–
H3036	**HE3036**	160	165.100(6½)	30	–	210	109	–	–	–	–	–	–
H3038	**HE3038**	170	171.450(6¾)	31	–	220	112	–	–	–	–	–	–
H3040	**HE3040**	180	177.800(7)	32	–	240	120	–	–	–	–	–	–
H3044	–	200	–	–	41	260	126	M6	4.2	9	M6	5	9
H3048	–	220	–	–	46	290	133	M6	4.2	9	M6	5	9
H3052	–	240	–	–	46	310	145	M6	4.2	9	M6	5	9
H3056	–	260	–	–	50	330	152	M6	4.2	9	M6	5	9
H3060	–	280	–	–	54	360	168	M6	4.2	9	M6	5	9
H3064	–	300	–	–	55	380	171	M6	3.5	9	M6	5	9
H3068	–	320	–	–	58	400	187	M6	3.5	9	M6	5	9
H3072	–	340	–	–	58	420	188	M6	3.5	9	M8	6.5	12
H3076	–	360	–	–	62	450	193	M6	3.5	9	M8	6.5	12
H3080	–	380	–	–	66	470	210	M6	3.5	9	M8	6.5	12
H3084	–	400	–	–	66	490	212	M6	3.5	9	M8	6.5	12
H3088	–	410	–	–	77	520	228	M8	6.5	12	M8	8	12
H3092	–	430	–	–	77	540	234	M8	6.5	12	M8	8	12
H3096	–	450	–	–	77	560	237	M8	6.5	12	M8	8	12
H30/500	–	470	–	–	85	580	247	M8	6.5	12	M8	8	12

Note : 1) Adapter sleeves with the code "X" appended after the adapter number indicate a narrow slit type adapter sleeves which use washers with straight inner tabs.
2) The part number for hydraulic adapters has the suffix at the end. E.g. **H3044HF**



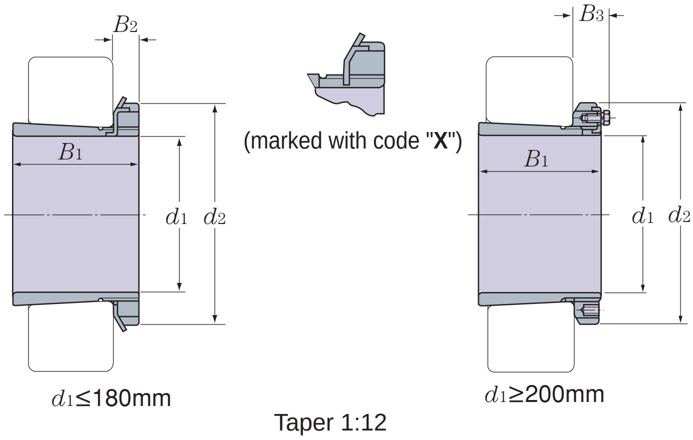
Taper 1:12

Mass kg (approx.)	Applicable components			
	Adapter ❶ sleeve	Locknut ❷	Lockwasher	Lockplate
1.93	A3024X	ANL24	AWL24X	–
2.85	A3026	ANL26	AWL26	–
3.16	A3028	ANL28	AWL28	–
3.89	A3030	ANL30	AWL30	–
5.21	A3032	ANL32	AWL32	–
5.99	A3034	ANL34	AWL34	–
6.83	A3036	ANL36	AWL36	–
7.45	A3038	ANL38	AWL38	–
9.19	A3040	ANL40	AWL40	–
10.3	A3044	ANL44	–	ALL44
13.2	A3048	ANL48	–	ALL48
15.3	A3052	ANL52	–	ALL48
17.7	A3056	ANL56	–	ALL56
22.8	A3060	ANL60	–	ALL60
24.6	A3064	ANL64	–	ALL64
28.7	A3068	ANL68	–	ALL64
30.5	A3072	ANL72	–	ALL72
35.8	A3076	ANL76	–	ALL76
41.3	A3080	ANL80	–	ALL76
43.7	A3084	ANL84	–	ALL84
65.2	A3088	ANL88	–	ALL88
69.5	A3092	ANL92	–	ALL88
73.3	A3096	ANL96	–	ALL96
81.8	A30/500	ANL100	–	ALL96

❶ The part number corresponding to H series adapter. For **HE30** series adapters, the adapter sleeve part number prefix code is **AE**.
❷ For hydraulic adapters, hydraulic sleeve nuts can also be used for mounting bearings (see Fig. 21 on P59).

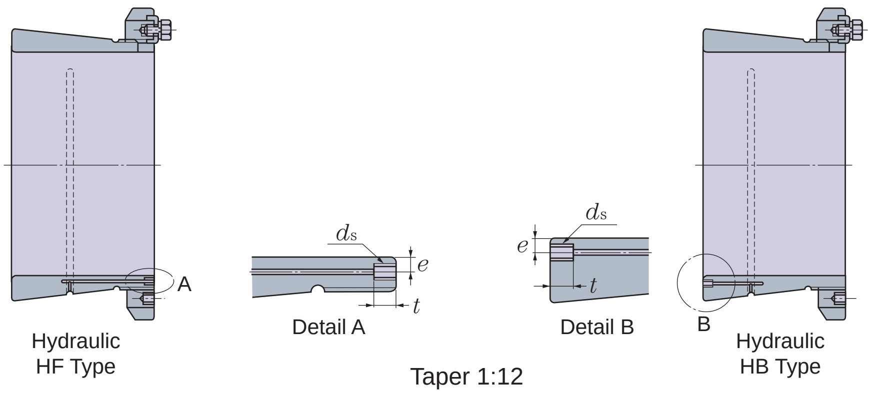
Adapters

Series
H31
HE31
H31・・HF (Hydraulic)
H31・・HB (Hydraulic)



Prat numbers H	Prat numbers HE	Dimensions mm: Sleeve bore diameter d_1 H	Sleeve bore diameter d_1 HE	B_2	B_3	d_2	B_1	HF Type d_s	HF Type e	HF Type t	HB Type d_s	HB Type e	HB Type t
H3120X	–	90	–	20	–	130	76	–	–	–	–	–	–
H3121X	–	95	–	20	–	140	80	–	–	–	–	–	–
H3122X	**HE3122X**	100	101.600(4)	21	–	145	81	–	–	–	–	–	–
H3124X	**HE3124X**	110	107.950($4\frac{1}{4}$)	22	–	155	88	–	–	–	–	–	–
H3126	**HE3126**	115	114.300($4\frac{1}{2}$)	23	–	165	92	–	–	–	–	–	–
H3128	**HE3128**	125	127.000(5)	24	–	180	97	–	–	–	–	–	–
H3130	**HE3130**	135	133.350($5\frac{1}{4}$)	26	–	195	111	–	–	–	–	–	–
H3132	**HE3132**	140	139.700($5\frac{1}{2}$)	28	–	210	119	–	–	–	–	–	–
H3134	**HE3134**	150	152.400(6)	29	–	220	122	–	–	–	–	–	–
H3136	**HE3136**	160	165.100($6\frac{1}{2}$)	30	–	230	131	–	–	–	–	–	–
H3138	**HE3138**	170	171.450($6\frac{3}{4}$)	31	–	240	141	–	–	–	–	–	–
H3140	**HE3140**	180	177.800(7)	32	–	250	150	–	–	–	–	–	–
H3144	–	200	–	–	44	280	158	M6	4.2	9	M6	5	9
H3148	–	220	–	–	46	300	169	M6	4.2	9	M6	5	9
H3152	–	240	–	–	49	330	187	M6	4.2	9	M6	5	9
H3156	–	260	–	–	51	350	192	M6	4.2	9	M6	5	9
H3160	–	280	–	–	53	380	208	M6	4.2	9	M6	5.5	9
H3164	–	300	–	–	56	400	226	M6	3.5	9	M6	5.5	9
H3168	–	320	–	–	72	440	254	M6	3.5	9	M6	5.5	9
H3172	–	340	–	–	75	460	259	M6	3.5	9	M8	6.5	12
H3176	–	360	–	–	77	490	264	M6	3.5	9	M8	6.5	12
H3180	–	380	–	–	82	520	272	M6	3.5	9	M8	6.5	12
H3184	–	400	–	–	90	540	304	M6	3.5	9	M8	6.5	12
H3188	–	410	–	–	90	560	307	M8	6.5	12	M8	6.5	12
H3192	–	430	–	–	95	580	326	M8	6.5	12	Rc$\frac{1}{8}$	8	15
H3196	–	450	–	–	95	620	335	M8	6.5	12	Rc$\frac{1}{8}$	8	15
H31/500	–	470	–	–	100	630	356	M8	6.5	12	Rc$\frac{1}{8}$	8	15

Note : 1) Adapter sleeves with the "X" appended after the adapter number indicate a narrow slit type adapter sleeves which use washers with straight inner tabs.
2) The part number for hydraulic adapters has the suffix at the end. E.g. **H3144HF**

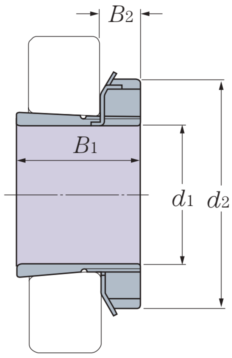


Mass kg (approx.)	Applicable components			
	Adapter ❶ sleeve	Locknut ❷	Lockwasher	Lockplate
1.78	A3120X	AN20	AW20X	—
2.10	A3121X	AN21	AW21X	—
2.25	A3122X	AN22	AW22X	—
2.64	A3124X	AN24	AW24X	—
3.66	A3126	AN26	AW26	—
4.34	A3128	AN28	AW28	—
5.52	A3130	AN30	AW30	—
7.67	A3132	AN32	AW32	—
8.38	A3134	AN34	AW34	—
9.5	A3136	AN36	AW36	—
10.8	A3138	AN38	AW38	—
12.1	A3140	AN40	AW40	—
14.7	A3144	AN44	—	AL44
17.3	A3148	AN48	—	AL44
22	A3152	AN52	—	AL52
24.5	A3156	AN56	—	AL52
30.2	A3160	AN60	—	AL60
34.9	A3164	AN64	—	AL64
49.5	A3168	AN68	—	AL68
54.2	A3172	AN72	—	AL68
61.7	A3176	AN76	—	AL76
70.6	A3180	AN80	—	AL80
84.2	A3184	AN84	—	AL80
104	A3188	AN88	—	AL88
116	A3192	AN92	—	AL88
133	A3196	AN96	—	AL96
143	A31/500	AN100	—	AL100

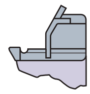
❶ The part number corresponding to **H** series adapter. For **HE31** series adapters, the adapter sleeve part number prefix code is **AE**.
❷ For hydraulic adapters, hydraulic sleeve nuts can also be used for mounting bearings (see Fig. 21 on P59).

Adapters

Series
H2
HE2
HS2



Taper 1:12



(marked with code "**X**")

Part numbers			Dimensions mm						Mass kg (approx.)
			Sleeve bore diameter d_1			B_2	d_2	B_1	
H	HE	HS	H	HE	HS				
H205X	**HE205**	—	20	19.050(3/4)	—	8	38	26	0.070
H206X	**HE206X**	**HS206**	25	25.400(1)	22.225(7/8)	8	45	27	0.099
H207X	—	**HS207**	30	—	28.575(1 1/8)	9	52	29	0.125
H208X	**HE208X**	**HS208X**	35	31.750(1 1/4)	34.925(1 3/8)	10	58	31	0.174
H209X	**HE209X**	**HS209X**	40	38.100(1 1/2)	41.275(1 5/8)	11	65	33	0.227
H210X	**HE210X**	**HS210**	45	44.450(1 3/4)	41.275(1 5/8)	12	70	35	0.274
H211X	**HE211XY**	**HS211**	50	50.800(2)	47.625(1 7/8)	12	75	37	0.308
H212X	—	**HS212**	55	—	53.975(2 1/8)	13	80	38	0.346
H213X	**HE213X**	**HS213X**	60	57.150(2 1/4)	60.325(2 3/8)	14	85	40	0.401
H214	—	—	60	—	—	14	92	41	0.593
H215X	**HE215X**	—	65	63.500(2 1/2)	—	15	98	43	0.707
H216X	**HE216X**	—	70	69.850(2 3/4)	—	17	105	46	0.882
H217X	**HE217X**	—	75	76.200(3)	—	18	110	50	1.02
H218X	—	—	80	—	—	18	120	52	1.19
H219X	**HE219X**	—	85	82.550(3 1/4)	—	19	125	55	1.37
H220X	**HE220X**	—	90	88.900(3 1/2)	—	20	130	58	1.49
H222X	**HE222X**	—	100	101.600(4)	—	21	145	63	1.93

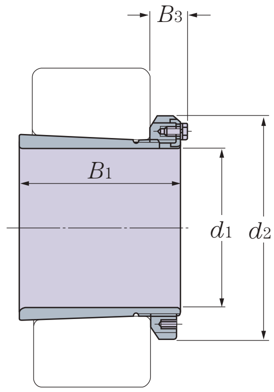
Note : 1) Adapter sleeves with the code "**X**" appended after the adapter number indicate a narrow slit type adapter sleeves which use washers with straight inner tabs.
2) Part number **HE211XY** uses a different thread pitch than standard due to the wall thickness of the adapter sleeve thread, and has the suffix code **Y** for identification purposes.
3) Part number **H214** indicates that it does not meet JIS B 1522 standards.

Applicable components		
Adapter ❶ sleeve	Locknut	Lockwasher
A205X	AN05	AW05X
A206X	AN06	AW06X
A207X	AN07	AW07X
A208X	AN08	AW08X
A209X	AN09	AW09X
A210X	AN10	AW10X
A211X	AN11	AW11X
A212X	AN12	AW12X
A213X	AN13	AW13X
A214	AN14	AW14
A215X	AN15	AW15X
A216X	AN16	AW16X
A217X	AN17	AW17X
A218X	AN18	AW18X
A219X	AN19	AW19X
A220X	AN20	AW20X
A222X	AN22	AW22X

❶ The part number corresponding to **H** series adapter. For **HE2** and **HS2** series adapters, the adapter sleeve part number prefix code is **AE** and **AS**

Adapters

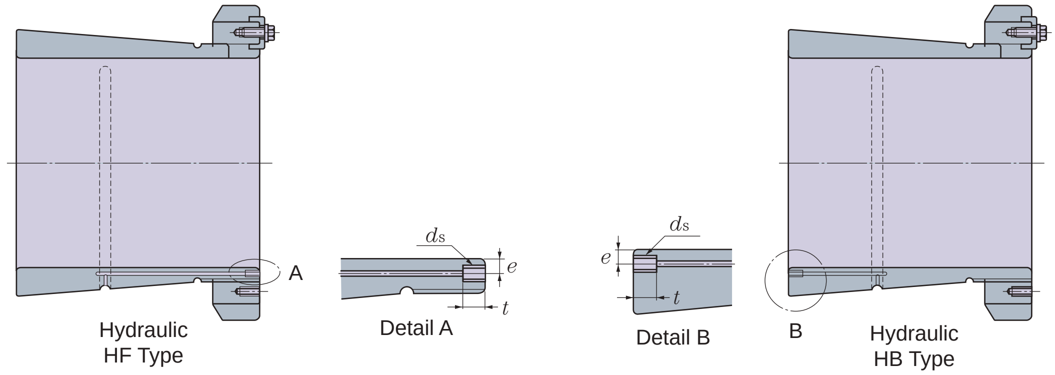
Series
H32
H32・・HF (Hydraulic)
H32・・HB (Hydraulic)



Taper 1:12

Part numbers	Dimensions mm									
	Sleeve bore diameter d_1	B_3	d_2	B_1	HF Type d_s	HF Type e	HF Type t	HB Type d_s	HB Type e	HB Type t
H3260	280	53	380	240	M6	4.2	9	M8	6.5	12
H3264	300	56	400	258	M6	3.5	9	M8	6.5	12
H3268	320	72	440	288	M6	3.5	9	M8	6.5	12
H3272	340	75	460	299	M6	3.5	9	M8	8	12
H3276	360	77	490	310	M6	3.5	9	M8	8	12
H3280	380	82	520	328	M6	3.5	9	M8	8	12

Note : The part number for hydraulic adapters has the suffix at the end. E.g. **H3260HF**



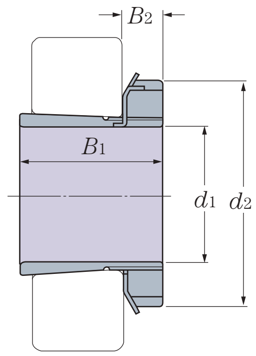
Taper 1:12

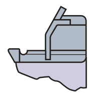
Mass kg (approx.)	Applicable components		
	Adapter ❶ sleeve	Locknut ❷	Lockwasher
34.1	A3260	AN60	AL60
39.3	A3264	AN64	AL64
54.6	A3268	AN68	AL68
60.2	A3272	AN72	AL68
69.6	A3276	AN76	AL76
81.0	A3280	AN80	AL80

❶ The part number corresponding to H series adapter.
❷ For hydraulic adapters, hydraulic sleeve nuts can also be used for mounting bearings (see Fig. 21 on P59).

Adapters

Series
H3
HE3
HS3





(marked with code "**X**")

Taper 1:12

Part numbers H	Part numbers HE	Part numbers HS	Dimensions mm: Sleeve bore diameter d_1 H	Sleeve bore diameter d_1 HE	Sleeve bore diameter d_1 HS	B_2	d_2	B_1	Mass kg (approx.)
H305X	**HE305**	—	20	19.050 (3/4)	—	8	38	29	0.075
H306X	**HE306X**	**HS306**	25	25.400 (1)	22.225 (7/8)	8	45	31	0.109
H307X	—	**HS307**	30	—	28.575 (1 1/8)	9	52	35	0.142
H308X	**HE308X**	**HS308X**	35	31.750 (1 1/4)	34.925 (1 3/8)	10	58	36	0.189
H309X	**HE309X**	**HS309X**	40	38.100 (1 1/2)	41.275 (1 5/8)	11	65	39	0.248
H310X	**HE310X**	**HS310**	45	44.450 (1 3/4)	41.275 (1 5/8)	12	70	42	0.303
H311X	**HE311XY**	**HS311**	50	50.800 (2)	47.625 (1 7/8)	12	75	45	0.345
H312X	—	**HS312**	55	—	53.975 (2 1/8)	13	80	47	0.394
H313X	**HE313X**	**HS313X**	60	57.150 (2 1/4)	60.325 (2 3/8)	14	85	50	0.458
H314	—	—	60	—	—	14	92	52	0.723
H315X	**HE315X**	—	65	63.500 (2 1/2)	—	15	98	55	0.831
H316X	**HE316X**	—	70	69.850 (2 3/4)	—	17	105	59	1.03
H317X	**HE317X**	—	75	76.200 (3)	—	18	110	63	1.18
H318X	—	—	80	—	—	18	120	65	1.37
H319X	**HE319X**	—	85	82.550 (3 1/4)	—	19	125	68	1.56
H320X	**HE320X**	—	90	88.900 (3 1/2)	—	20	130	71	1.69
H322X	**HE322X**	—	100	101.600 (4)	—	21	145	77	2.18

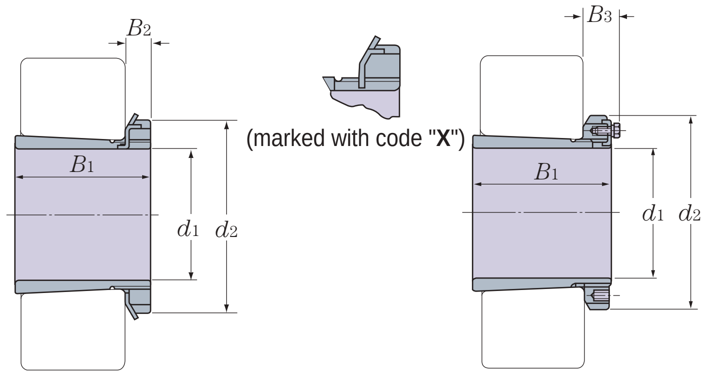
Note : 1) Adapter sleeves with the code "**X**" appended after the adapter number indicate a narrow slit type adapter sleeves which use washers with straight inner tabs.
2) Part number **HE311XY** uses a different thread pitch than standard due to the wall thickness of the adapter sleeve thread, and has the suffix code **Y** for identification purposes.

Applicable components		
Adapter ➊ sleeve	Locknut	Lockwasher
A305X	AN05	AW05X
A306X	AN06	AW06X
A307X	AN07	AW07X
A308X	AN08	AW08X
A309X	AN09	AW09X
A310X	AN10	AW10X
A311X	AN11	AW11X
A312X	AN12	AW12X
A313X	AN13	AW13X
A314	AN14	AW14
A315X	AN15	AW15X
A316X	AN16	AW16X
A317X	AN17	AW17X
A318X	AN18	AW18X
A319X	AN19	AW19X
A320X	AN20	AW20X
A322X	AN22	AW22X

➊ The part number corresponding to **H** series adapter. For **HE23** and **HS23** series adapters, the adapter sleeve part number prefix code is **AE** and **AS**.

Adapters

Series
H23
HE23
HS23
H23‥HF (Hydraulic)
H23‥HB (Hydraulic)



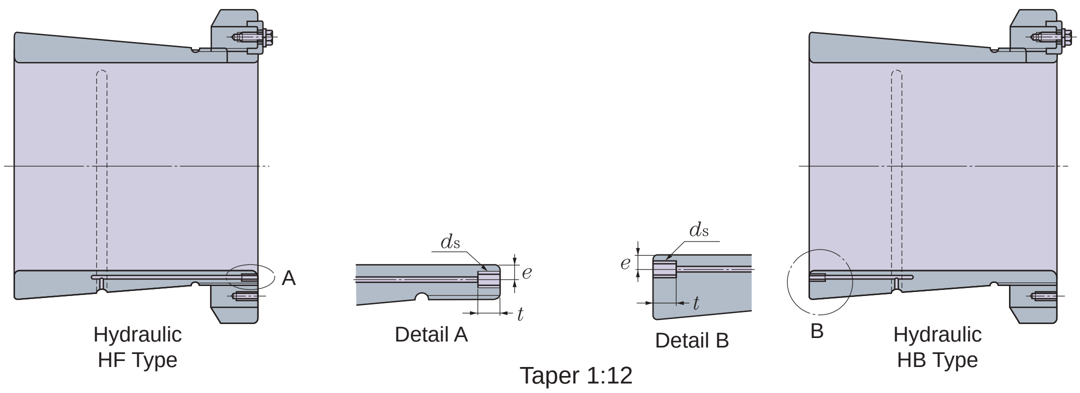
d_1≤180mm d_1≥200mm

Taper 1:12

Part numbers			Dimensions mm						
			Sleeve bore diameter d_1			B_2	B_3	d_2	B_1
H	HE	HS	H	HE	HS				
H2305X	**HE2305**	–	20	19.050 (¾)	–	8		38	35
H2306X	**HE2306X**	**HS2306**	25	25.400 (1)	22.225 (⅞)	8		45	38
H2307X	–	**HS2307**	30	–	28.575 (1⅛)	9		52	43
H2308X	**HE2308X**	**HS2308X**	35	31.750 (1¼)	34.925 (1⅜)	10		58	46
H2309X	**HE2309X**	**HS2309X**	40	38.100 (1½)	41.275 (1⅝)	11		65	50
H2310X	**HE2310X**	**HS2310**	45	44.450 (1¾)	41.275 (1⅝)	12		70	55
H2311X	**HE2311XY**	**HS2311**	50	50.800 (2)	47.625 (1⅞)	12		75	59
H2312X	–	**HS2312**	55	–	53.975 (2⅛)	13		80	62
H2313X	**HE2313X**	**HS2313X**	60	57.150 (2¼)	60.325 (2⅜)	14		85	65
H2314	–	–	60	–	–	14		92	68
H2315X	**HE2315X**	–	65	63.500 (2½)	–	15		98	73
H2316X	**HE2316X**	–	70	69.850 (2¾)	–	17		105	78
H2317X	**HE2317X**	–	75	76.200 (3)	–	18		110	82
H2318X	–	–	80	–	–	18		120	86
H2319X	**HE2319X**	–	85	82.550 (3¼)	–	19		125	90
H2320X	**HE2320X**	–	90	88.900 (3½)	–	20		130	97
H2322X	**HE2322X**	–	100	101.600 (4)	–	21		145	105
H2324X	**HE2324X**	–	110	107.950 (4¼)	–	22		155	112
H2326	**HE2326**	–	115	114.300 (4½)	–	23		165	121
H2328	**HE2328**	–	125	127.000 (5)	–	24		180	131
H2330	**HE2330**	–	135	133.350 (5¼)	–	26		195	139
H2332	**HE2332**	–	140	139.700 (5½)	–	28		210	147
H2334	**HE2334**	–	150	152.400 (6)	–	29		220	154
H2336	**HE2336**	–	160	165.100 (6½)	–	30	–	230	161
H2338	**HE2338**	–	170	171.450 (6.3/4)	–	31	–	240	169
H2340	**HE2340**	–	180	177.800 (7)	–	32	–	250	176
H2344	–	–	200	–	–	–	44	280	183
H2348	–	–	220	–	–	–	46	300	196
H2352	–	–	240	–	–	–	49	330	208
H2356	–	–	260	–	–	–	51	350	221

Note : 1) Adapter sleeves with the "X" appended after the adapter number indicate a narrow slit type adapter sleeves which use washers with straight inner ta
2) Part number **HE2311XY** uses a different thread pitch than standard due to the wall thickness of the adapter sleeve thread, and has the suffix code **Y** for identification purposes.
3) The part number for hydraulic adapters has the suffix at the end. E.g. **H2344HF**

Adapters & Hydraulic Adapters



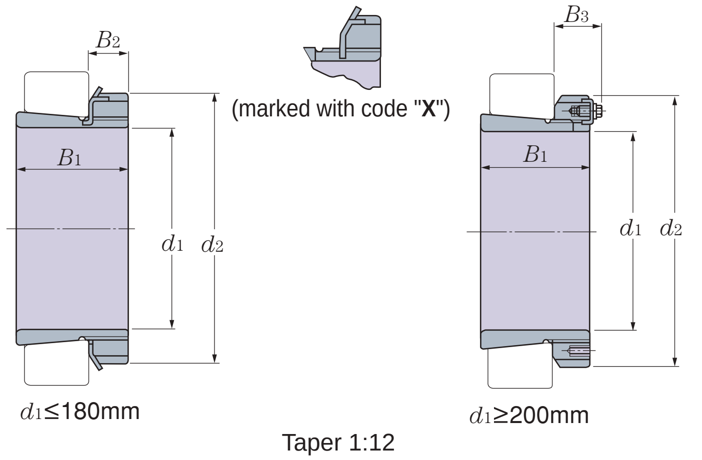
Taper 1:12

Dimensions mm						Mass	Applicable components			
HF Type			HB Type			kg (approx.)	Adapter ❶ sleeve	Locknut ❷	Washer	Lockwasher
d_s	e	t	d_s	e	t					
–	–	–	–	–	–	0.087	A2305X	AN05	AW05X	–
–	–	–	–	–	–	0.126	A2306X	AN06	AW06X	–
–	–	–	–	–	–	0.165	A2307X	AN07	AW07X	–
–	–	–	–	–	–	0.224	A2308X	AN08	AW08X	–
–	–	–	–	–	–	0.280	A2309X	AN09	AW09X	–
–	–	–	–	–	–	0.362	A2310X	AN10	AW10X	–
–	–	–	–	–	–	0.420	A2311X	AN11	AW11X	–
–	–	–	–	–	–	0.481	A2312X	AN12	AW12X	–
–	–	–	–	–	–	0.557	A2313X	AN13	AW13X	–
–	–	–	–	–	–	0.897	A2314	AN14	AW14	–
–	–	–	–	–	–	1.05	A2315X	AN15	AW15X	–
–	–	–	–	–	–	1.28	A2316X	AN16	AW16X	–
–	–	–	–	–	–	1.45	A2317X	AN17	AW17X	–
–	–	–	–	–	–	1.69	A2318X	AN18	AW18X	–
–	–	–	–	–	–	1.92	A2319X	AN19	AW19X	–
–	–	–	–	–	–	2.15	A2320X	AN20	AW20X	–
–	–	–	–	–	–	2.74	A2322X	AN22	AW22X	–
–	–	–	–	–	–	3.19	A2324X	AN24	AW24X	–
–	–	–	–	–	–	4.60	A2326	AN26	AW26	–
–	–	–	–	–	–	5.55	A2328	AN28	AW28	–
–	–	–	–	–	–	6.63	A2330	AN30	AW30	–
–	–	–	–	–	–	9.14	A2332	AN32	AW32	–
–	–	–	–	–	–	10.2	A2334	AN34	AW34	–
–	–	–	–	–	–	11.3	A2336	AN36	AW36	–
–	–	–	–	–	–	12.6	A2338	AN38	AW38	–
–	–	–	–	–	–	13.9	A2340	AN40	AW40	–
M6	4.2	9	M6	5	9	16.7	A2344	AN44	–	AL44
M6	4.2	9	M6	5	9	19.7	A2348	AN48	–	AL44
M6	4.2	9	M6	5	9	24.2	A2352	AN52	–	AL52
M6	4.2	9	M6	5	9	27.8	A2356	AN56	–	AL52

❶ The part number corresponding to **H** series adapter. For **HE23** and **HS23** series adapters, the adapter sleeve part number prefix code is **AE** and **AS**.
❷ For hydraulic adapters, hydraulic sleeve nuts can also be used for mounting bearings (see Fig. 21 on P59).

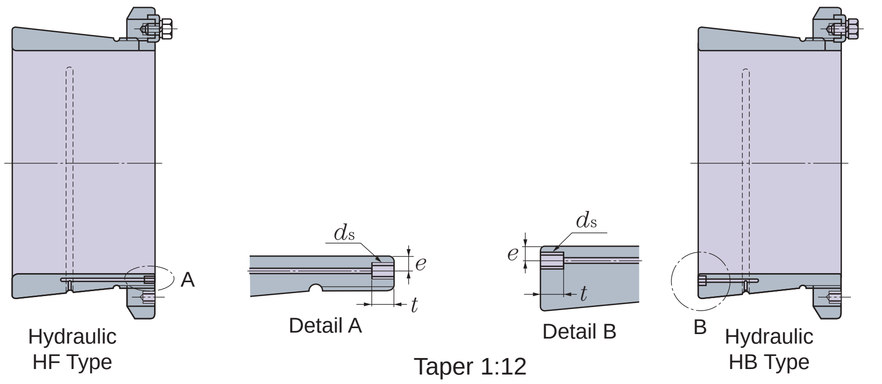
Adapters

Series
H39
H39··HF (Hydraulic)
H39··HB (Hydraulic)



Part numbers	Dimensions mm										
	Sleeve bore diameter d_1	B_2	B_3	d_2	B_1	HF Type d_s	HF Type e	HF Type t	HB Type d_s	HB Type e	HB Type t
H3924X	110	22	–	145	60	–	–	–	–	–	–
H3926	115	23	–	155	65	–	–	–	–	–	–
H3928	125	24	–	165	66	–	–	–	–	–	–
H3930	135	26	–	180	76	–	–	–	–	–	–
H3932	140	28	–	190	78	–	–	–	–	–	–
H3934	150	29	–	200	79	–	–	–	–	–	–
H3936	160	30	–	210	87	–	–	–	–	–	–
H3938	170	31	–	220	89	–	–	–	–	–	–
H3940	180	32	–	240	98	–	–	–	–	–	–
H3944	200	–	41	260	96	M6	4.2	9	M6	5	9
H3948	220	–	46	290	101	M6	4.2	9	M6	5	9
H3952	240	–	46	310	116	M6	4.2	9	M6	5	9
H3956	260	–	50	330	121	M6	4.2	9	M6	5	9
H3960	280	–	54	360	140	M6	4.2	9	M6	5	9
H3964	300	–	55	380	140	M6	3.5	9	M6	5	9
H3968	320	–	58	400	144	M6	3.5	9	M6	5	9
H3972	340	–	58	420	144	M6	3.5	9	M6	5	9
H3976	360	–	62	450	164	M6	3.5	9	M6	5	9
H3980	380	–	66	470	168	M6	3.5	9	M6	5	9
H3984	400	–	66	490	168	M6	3.5	9	M6	5	9
H3988	410	–	77	520	189	M8	6.5	12	M8	6.5	12
H3992	430	–	77	540	189	M8	6.5	12	M8	6.5	12
H3996	450	–	77	560	200	M8	6.5	12	M8	8	12

Note : The part number for hydraulic adapters has the suffix at the end. e.g. **H3944HF**.

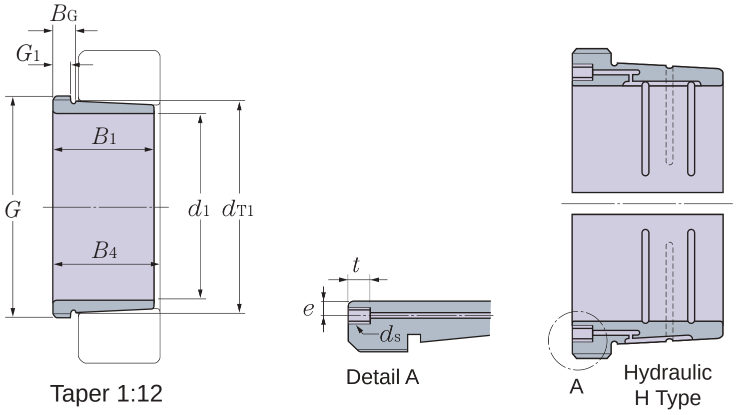


Mass kg (approx.)	Applicable components			
	Adapter ❶ sleeve	Locknut ❷	Lockwasher	Lockplate
1.86	A3924X	ANL24	AWL24X	—
2.65	A3926	ANL26	AWL26	—
2.94	A3928	ANL28	AWL28	—
3.85	A3930	ANL30	AWL30	—
4.57	A3932	ANL32	AWL32	—
4.95	A3934	ANL34	AWL34	—
5.7	A3936	ANL36	AWL36	—
6.19	A3938	ANL38	AWL38	—
7.89	A3940	ANL40	AWL40	—
8.16	A3944	ANL44	—	ALL44
10.7	A3948	ANL48	—	ALL48
12.8	A3952	ANL52	—	ALL48
14.8	A3956	ANL56	—	ALL56
19.8	A3960	ANL60	—	ALL60
21	A3964	ANL64	—	ALL64
23.5	A3968	ANL68	—	ALL64
24.5	A3972	ANL72	—	ALL72
31.5	A3976	ANL76	—	ALL76
35	A3980	ANL80	—	ALL76
36.6	A3984	ANL84	—	ALL84
57.3	A3988	ANL88	—	ALL88
59.9	A3992	ANL92	—	ALL88
64.9	A3996	ANL96	—	ALL96

❶ The part number corresponding to H series adapter.
❷ For hydraulic adapters, hydraulic sleeve nuts can also be used for mounting bearings (see Fig. 21 on P59).

Withdrawal Sleeves

Series
AH(X,Y)30
AH(X,Y)30··H (Hydraulic)



Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AHX3024	M130×2	115	60	64	124.00	16	–	–	–	0.750	13	AN26
AHX3026	M140×2	125	67	71	134.50	17	–	–	–	0.930	14	AN28
AHX3028	M150×2	135	68	73	144.67	17	–	–	–	1.01	14	AN30
AHX3030	M160×3	145	72	77	154.92	18	–	–	–	1.15	15	AN32
AH3032	M170×3	150	77	82	165.25	19	–	–	–	2.06	16	AN34
AH3034	M180×3	160	85	90	175.83	20	–	–	–	2.43	17	AN36
AH3036	M190×3	170	92	98	186.08	25	–	–	–	2.81	17	AN38
AHY3038	M200×3	180	96	102	196.50	24	–	–	–	3.32	18	AN40
AH3038	Tr205×4	180	96	102	196.50	24	–	–	–	3.32	18	HNL41
AHY3040	Tr210×4	190	102	108	206.92	25	–	–	–	3.80	19	HN42
AH3040	Tr215×4	190	102	108	206.92	25	–	–	–	3.80	19	HNL43
AHY3044	Tr230×4	200	111	117	227.58	26	–	–	–	7.40	20	HN46
AH3044	Tr235×4	200	111	117	227.58	26	Rc1/8	8.5	15	7.40	20	HNL47
AH3048	Tr260×4	220	116	123	248.00	27	Rc1/8	8.5	15	8.75	21	HNL52
AH3052	Tr280×4	240	128	135	268.83	29	Rc1/8	8.5	15	10.7	23	HNL56
AH3056	Tr300×4	260	131	139	289.08	30	Rc1/8	8.5	15	12.0	24	HNL60
AH3060	Tr320×5	280	145	153	310.08	32	Rc1/8	8.5	15	14.4	26	HNL64
AHY3064	Tr340×5	300	149	157	330.33	33	Rc1/8	8.5	15	16.0	27	HNL68
AH3064	Tr345×5	300	149	157	330.33	33	Rc1/8	8.5	15	16.0	27	HNL69
AHY3068	Tr360×5	320	162	171	351.42	34	Rc1/8	8.5	15	19.5	28	HNL72
AH3068	Tr365×5	320	162	171	351.42	34	Rc1/8	8.5	15	19.5	28	HNL73
AHY3072	Tr380×5	340	167	176	371.67	36	Rc1/8	8.5	15	21.0	30	HNL76
AH3072	Tr385×5	340	167	176	371.67	36	Rc1/8	8.5	15	21.0	30	HNL77
AHY3076	Tr400×5	360	170	180	391.92	37	Rc1/8	8.5	15	23.2	31	HNL80
AH3076	Tr410×5	360	170	180	391.92	37	Rc1/8	8.5	15	23.2	31	HNL82
AHY3080	Tr420×5	380	183	193	412.83	39	Rc1/8	8.5	15	27.3	33	HNL84
AH3080	Tr430×5	380	183	193	412.83	39	Rc1/8	8.5	15	27.3	33	HNL86

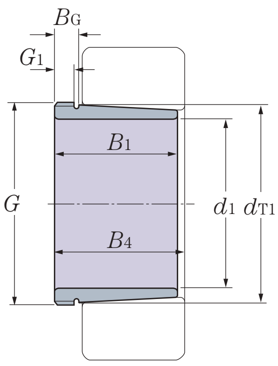
❶ Standard thread shapes and dimensions of the part numbers **AHX3024** to **AHY3038** are as per JIS B0205-1 and JIS B 0205-4 (general purpose metric screw threads). Standard thread shapes and dimensions of the part numbers **AH3038** to **AHX3096** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.

Prat numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹	d_s	e	t		G_1	
AHY3084	Tr440×5	400	186	196	433.00	40	Rc1/8	8.5	15	29.0	34	HNL88
AH3084	Tr450×5	400	186	196	433.00	40	Rc1/8	8.5	15	29.0	34	HNL90
AHY3088	Tr460×5	420	194	205	453.67	41	Rc1/8	8.5	15	32.0	35	HNL92
AHX3088	Tr470×5	420	194	205	453.67	41	Rc1/8	8.5	15	32.0	35	HNL94
AHY3092	Tr480×5	440	202	213	474.17	43	Rc1/8	8.5	15	35.2	37	HNL96
AHX3092	Tr490×5	440	202	213	474.17	43	Rc1/8	8.5	15	35.2	37	HNL98
AHY3096	Tr500×5	460	205	217	494.42	44	Rc1/8	8.5	15	39.2	38	HNL100
AHX3096	Tr520×6	460	205	217	494.42	44	Rc1/8	8.5	15	39.2	38	HNL104

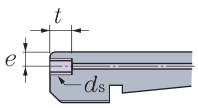
Note : The part number for hydraulic adapters has the suffix at the end. e.g. **AH3044H**

Withdrawal Sleeves

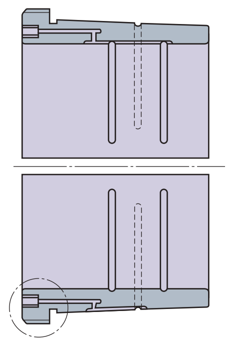
Series
AH(X,Y)31
AH(X,Y)31··H (Hydraulic)



Taper 1:12



Detail A



Hydraulic H Type

Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AH3120	M110×2	95	64	68	104.50	14	–	–	–	0.650	11	AN22
AH3121	M115×2	100	68	72	109.83	14	–	–	–	0.690	11	AN23
AHX3122	M120×2	105	68	72	114.83	14	–	–	–	0.760	11	AN24
AHX3124	M130×2	115	75	79	125.33	15	–	–	–	0.950	12	AN26
AHX3126	M140×2	125	78	82	135.58	15	–	–	–	1.08	12	AN28
AHX3128	M150×2	135	83	88	145.92	17	–	–	–	1.28	14	AN30
AHX3130	M165×3	145	96	101	156.92	18	–	–	–	1.79	15	AN33
AH3132	M180×3	150	103	108	167.42	19	–	–	–	3.21	16	AN36
AH3134	M190×3	160	104	109	177.50	19	–	–	–	3.40	16	AN38
AHY3136	M190×3	170	116	122	188.33	22	–	–	–	4.22	19	AN38
AH3136	M200×3	170	116	122	188.33	22	–	–	–	4.22	19	AN40
AHY3138	M200×3	180	125	131	198.75	26	–	–	–	4.89	20	AN40
AH3138	Tr210×4	180	125	131	198.75	26	–	–	–	4.89	20	HN42
AH3140	Tr220×4	190	134	140	209.42	27	–	–	–	5.49	21	HN44
AH3144	Tr240×4	200	145	151	230.17	29	Rc1/8	8.5	15	10.4	23	HN48
AH3148	Tr260×4	220	154	161	250.83	31	Rc1/8	8.5	15	12.0	25	HN52
AHY3152	Tr280×4	240	172	179	272.25	32	Rc1/8	8.5	15	16.2	26	HN56
AH3152	Tr290×4	240	172	179	272.25	32	Rc1/8	8.5	15	16.2	26	HN58
AHY3156	Tr300×4	260	175	183	292.42	34	Rc1/8	8.5	15	17.5	28	HN60
AH3156	Tr310×5	260	175	183	292.42	34	Rc1/8	8.5	15	17.5	28	HN62
AHY3160	Tr320×5	280	192	200	313.67	36	Rc1/8	8.5	15	20.8	30	HN64
AH3160	Tr330×5	280	192	200	313.67	36	Rc1/8	8.5	15	20.8	30	HN66
AHY3164	Tr340×5	300	209	217	335.00	37	Rc1/8	8.5	15	24.5	31	HN68
AH3164	Tr350×5	300	209	217	335.00	37	Rc1/8	8.5	15	24.5	31	HN70
AHY3168	Tr360×5	320	225	234	356.25	39	Rc1/8	8.5	15	29	33	HN72
AH3168	Tr370×5	320	225	234	356.25	39	Rc1/8	8.5	15	29	33	HN74
AHY3172	Tr380×5	340	229	238	376.42	41	Rc1/8	8.5	15	33	35	HN76

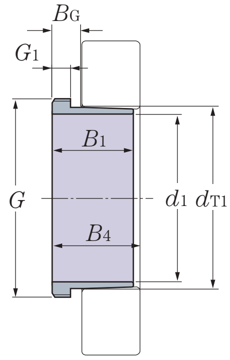
❶ Standard thread shapes and dimensions of the part numbers **AH3120** to **AHY3138** are as per JIS B0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers **AH3138** to **AHX3196** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.

Part numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹	d_s	e	t		G_1	
AH3172	Tr400×5	340	229	238	376.42	41	Rc1/8	8.5	15	33	35	HN80
AHY3176	Tr400×5	360	232	242	396.67	42	Rc1/8	8.5	15	35.7	36	HN80
AH3176	Tr420×5	360	232	242	396.67	42	Rc1/8	8.5	15	35.7	36	HN84
AHY3180	Tr420×5	380	240	250	417.17	44	Rc1/8	8.5	15	39.5	38	HN84
AH3180	Tr440×5	380	240	250	417.17	44	Rc1/8	8.5	15	39.5	38	HN88
AHY3184	Tr440×5	400	266	276	439.17	46	Rc1/8	8.5	15	46.5	40	HN88
AH3184	Tr460×5	400	266	276	439.17	46	Rc1/8	8.5	15	46.5	40	HN92
AHY3188	Tr460×5	420	270	281	459.42	48	Rc1/8	8.5	15	49.8	42	HN92
AHX3188	Tr480×5	420	270	281	459.42	48	Rc1/8	8.5	15	49.8	42	HN96
AHY3192	Tr480×5	440	285	296	480.58	49	Rc1/8	8.5	15	50.1	43	HN96
AHX3192	Tr510×6	440	285	296	480.58	49	Rc1/8	8.5	15	57.9	43	HN102
AHY3196	Tr500×5	460	295	307	501.33	51	Rc1/8	8.5	15	54.6	45	HN100
AHX3196	Tr530×6	460	295	307	501.33	51	Rc1/8	8.5	15	63.1	45	HN106

Note : The part number for hydraulic adapters has the suffix at the end. e.g. **AH3144H**

Withdrawal Sleeves

Series
AH(Y)2



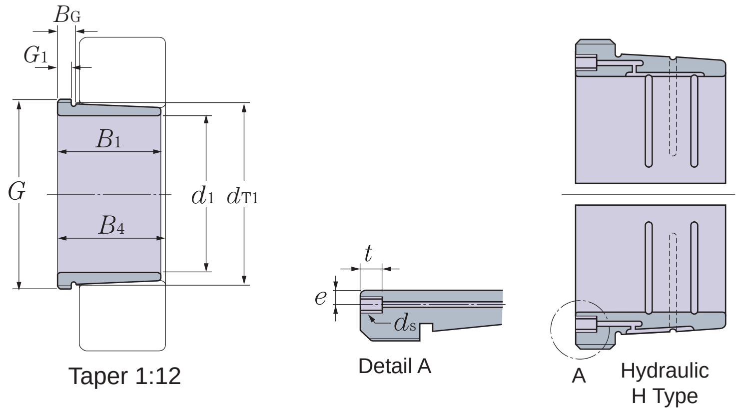
Taper 1:12

Part numbers	Thread ❶	Dimensions mm					Mass kg (approx.)		Applicable❺ Nut numbers
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹		G_1	
AH208	M45×1.5	35	25	27	41.50	9	0.081	6	AN09
AH209	M50×1.5	40	26	29	46.67	9	0.095	6	AN10
AH210	M55×2	45	28	31	51.75	10	0.114	7	AN11
AH211	M60×2	50	29	32	56.83	10	0.132	7	AN12
AH212	M65×2	55	32	35	62.00	11	0.161	8	AN13
AH213	M75×2	60	32.5	36	67.08	11	0.213	8	AN15
AH214	M80×2	65	33.5	37	72.17	11	0.240	8	AN16
AH215	M85×2	70	34.5	38	77.25	11	0.259	8	AN17
AH216	M90×2	75	35.5	39	82.33	11	0.284	8	AN18
AH217	M95×2	80	38.5	42	87.50	12	0.314	9	AN19
AH218	M100×2	85	40	44	92.67	12	0.351	9	AN20
AH219	M105×2	90	43	47	97.83	13	0.403	10	AN21
AH220	M110×2	95	45	49	103.00	13	0.481	10	AN22
AH221	M115×2	100	47	51	108.08	14	0.492	11	AN23
AH222	M120×2	105	50	54	113.33	14	0.547	11	AN24
AH224	M130×2	115	53	57	123.50	15	0.679	12	AN26
AH226	M140×2	125	53	57	133.50	15	0.725	12	AN28
AH228	M150×2	135	56	61	143.75	16	0.818	13	AN30
AH230	M160×3	145	60	65	154.00	17	0.963	14	AN32
AH232	M170×3	150	64	69	164.25	18	1.70	15	AN34
AH234	M180×3	160	69	74	174.58	19	1.98	16	AN36
AH236	M190×3	170	69	74	184.58	19	2.14	16	AN38
AHY238	M200×3	180	73	78	194.58	23	2.52	17	AN40
AH238	Tr205×4	180	73	78	194.58	23	2.52	17	HNL41
AHY240	Tr210×4	190	77	82	204.83	24	2.87	18	HN42
AH240	Tr215×4	190	77	82	204.83	24	2.87	18	HNL43
AHY244	Tr230×4	200	85	91	225.58	24	5.49	18	HN46
AH244	Tr235×4	200	85	91	225.58	24	5.49	18	HNL47
AH248	Tr260×4	220	96	102	246.17	28	7.34	22	HNL52
AH252	Tr280×4	240	105	111	266.83	29	8.80	23	HNL56
AH256	Tr300×4	260	105	113	287.00	29	9.42	23	HNL60

❶ Standard thread shapes and dimensions of the part numbers **AH208** to **AHY238** are as per JIS B0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers **AH238** to **AHX256** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.

Withdrawal Sleeves

Series
AH(Y)22
AH(Y)22··H (Hydraulic)



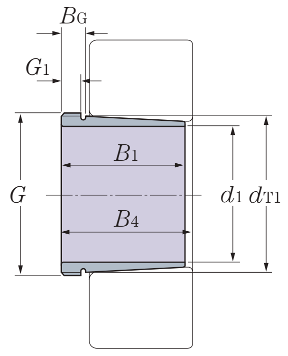
Taper 1:12

Part numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹	d_s	e	t		G_1	
AHY2236	M190×3	170	105	110	187.50	20	—	—	—	3.73	17	AN38
AH2236	M200×3	170	105	110	187.50	20	—	—	—	3.73	17	AN40
AHY2238	M200×3	180	112	117	197.75	24	—	—	—	4.25	18	AN40
AH2238	Tr210×4	180	112	117	197.75	24	—	—	—	4.25	18	HN42
AH2240	Tr220×4	190	118	123	208.17	25	—	—	—	4.68	19	HN44
AH2244	Tr240×4	200	130	136	229.17	26	Rc1/8	8.5	15	9.10	20	HN48
AH2248	Tr260×4	220	144	150	250.25	27	Rc1/8	8.5	15	11.1	21	HN52
AHY2252	Tr280×4	240	155	161	271.00	29	Rc1/8	8.5	15	14.0	23	HN56
AH2252	Tr290×4	240	155	161	271.00	29	Rc1/8	8.5	15	14.0	23	HN58
AHY2256	Tr300×4	260	155	163	291.08	30	Rc1/8	8.5	15	15.2	24	HN60
AH2256	Tr310×5	260	155	163	291.08	30	Rc1/8	8.5	15	15.2	24	HN62
AHY2260	Tr320×5	280	170	178	312.17	32	Rc1/8	8.5	15	18.1	26	HN64
AH2260	Tr330×5	280	170	178	312.17	32	Rc1/8	8.5	15	18.1	26	HN66
AHY2264	Tr340×5	300	180	190	333.08	33	Rc1/8	8.5	15	20.2	27	HN68
AH2264	Tr350×5	300	180	190	333.08	33	Rc1/8	8.5	15	20.2	27	HN70

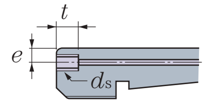
❶ Standard thread shapes and dimensions of the part numbers **AHY2236** to **AHY2238** are as per JIS B0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers **AH2238** to **AH2264** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : The part number for hydraulic adapters has the suffix H at the end. E.g. **AH2244H**

Withdrawal Sleeves

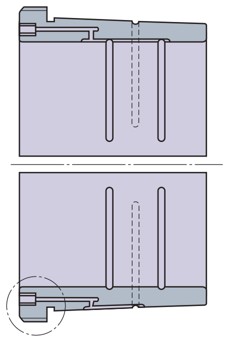
Series
AH(X,Y)32
AH(X,Y)32・・H (Hydraulic)



Taper 1:12



Detail A



Hydraulic
H Type

Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AHX3218	M100×2	85	63	67	94.50	13	–	–	–	0.576	10	AN20
AH3219	M105×2	90	67	71	99.75	14	–	–	–	0.655	11	AN21
AHX3220	M110×2	95	73	77	105.25	14	–	–	–	0.767	11	AN22
AH3221	M115×2	100	78	82	110.67	14	–	–	–	0.911	11	AN23
AHY3222	M120×2	105	82	86	116.00	14	–	–	–	1.04	11	AN24
AHX3222	M125×2	105	82	86	116.00	14	–	–	–	1.04	11	AN25
AHY3224	M130×2	115	90	94	126.50	16	–	–	–	1.30	13	AN26
AHX3224	M135×2	115	90	94	126.50	16	–	–	–	1.30	13	AN27
AHY3226	M140×2	125	98	102	137.00	18	–	–	–	1.58	15	AN28
AHX3226	M145×2	125	98	102	137.00	18	–	–	–	1.58	15	AN29
AHY3228	M150×2	135	104	109	147.58	18	–	–	–	1.84	15	AN30
AHX3228	M155×2	135	104	109	147.58	18	–	–	–	1.84	15	AN31
AHY3230	M160×3	145	114	119	158.25	20	–	–	–	2.22	17	AN32
AHX3230	M165×3	145	114	119	158.25	20	–	–	–	2.22	17	AN33
AHY3232	M170×3	150	124	130	168.92	23	–	–	–	4.08	20	AN34
AH3232	M180×3	150	124	130	168.92	23	–	–	–	4.08	20	AN36
AHY3234	M180×3	160	134	140	179.42	27	–	–	–	4.8	24	AN36
AH3234	M190×3	160	134	140	179.42	27	–	–	–	4.8	24	AN38
AHY3236	M190×3	170	140	146	189.92	27	–	–	–	5.32	24	AN38
AH3236	M200×3	170	140	146	189.92	27	–	–	–	5.32	24	AN40
AHY3238	M200×3	180	145	152	200.08	31	–	–	–	5.9	25	AN40
AH3238	Tr210×4	180	145	152	200.08	31	–	–	–	5.9	25	HN42
AH3240	Tr220×4	190	153	160	210.75	31	–	–	–	6.68	25	HN44
AH3244	Tr240×4	200	181	189	233.00	33	–	–	–	13.9	27	HN48
AH3248	Tr260×4	220	189	197	253.50	35	–	–	–	16.0	29	HN52
AH3252	Tr280×4	240	205	213	274.75	36	–	–	–	19.1	30	HN56
AH3256	Tr300×4	260	212	220	295.17	38	–	–	–	21.5	32	HN60

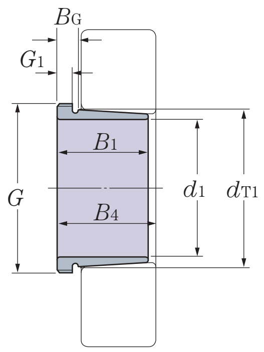
❶ Standard thread shapes and dimensions of the part numbers **AHX3218** to **AHY3238** are as per JIS B0205-1 and JIS B 0205-4 (general purpose metricscrew threads). Standard thread shapes and dimensions of the part numbers **AH3238** to **AH3296** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.

Part numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹	d_s	e	t		G_1	
AHY3260	Tr320×5	280	228	236	316.33	40	Rc 1/8	8.5	15	26.0	34	HN64
AH3260	Tr330×5	280	228	236	316.33	40	Rc 1/8	8.5	15	26.0	34	HN66
AHY3264	Tr340×5	300	246	254	337.67	42	Rc 1/8	8.5	15	30.6	36	HN68
AH3264	Tr350×5	300	246	254	337.67	42	Rc 1/8	8.5	15	30.6	36	HN70
AHY3268	Tr360×5	320	264	273	359.08	44	Rc 1/8	8.5	15	35.8	38	HN72
AH3268	Tr370×5	320	264	273	359.08	44	Rc 1/8	8.5	15	35.8	38	HN74
AHY3272	Tr380×5	340	274	283	379.75	46	Rc 1/8	8.5	15	41.6	40	HN76
AH3272	Tr400×5	340	274	283	379.75	46	Rc 1/8	8.5	15	41.6	40	HN80
AHY3276	Tr400×5	360	284	294	400.50	48	Rc 1/8	8.5	15	46.3	42	HN80
AH3276	Tr420×5	360	284	294	400.50	48	Rc 1/8	8.5	15	46.3	42	HN84
AHY3280	Tr420×5	380	302	312	421.83	50	Rc 1/8	8.5	15	52.5	44	HN84
AH3280	Tr440×5	380	302	312	421.83	50	Rc 1/8	8.5	15	52.5	44	HN88
AHY3284	Tr440×5	400	321	331	443.25	52	Rc 1/8	8.5	15	59.7	46	HN88
AH3284	Tr460×5	400	321	331	443.25	52	Rc 1/8	8.5	15	59.7	46	HN92
AHY3288	Tr460×5	420	330	341	463.92	54	Rc 1/8	8.5	15	64.8	48	HN92
AHX3288	Tr480×5	420	330	341	463.92	54	Rc 1/8	8.5	15	64.8	48	HN96
AHY3292	Tr480×5	440	349	360	485.33	56	Rc 1/8	8.5	15	75.2	50	HN96
AHX3292	Tr510×5	440	349	360	485.33	56	Rc 1/8	8.5	15	75.2	50	HN102
AHY3296	Tr500×5	460	364	376	506.50	58	Rc 1/8	8.5	15	83.1	52	HN100
AHX3296	Tr530×6	460	364	376	506.50	58	Rc 1/8	8.5	15	83.1	52	HN106

Note : The part number for hydraulic adapters has the suffix at the end e.g. **AHY3260H**

Withdrawal Sleeves

Series
AH(X,Y)3



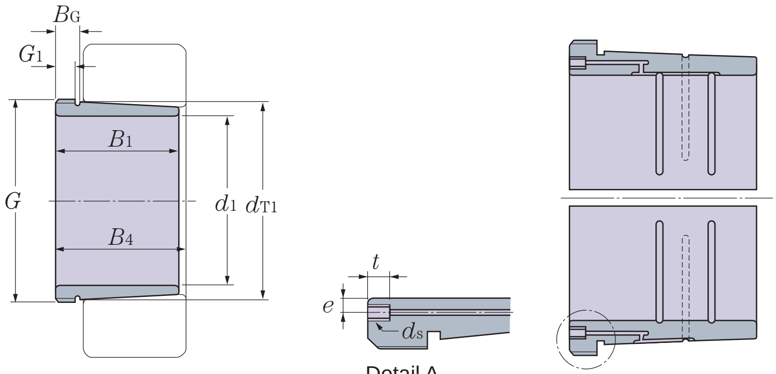
Taper 1:12

Part numbers	Thread ❶	Dimensions mm					Mass kg (approx.)		Applicable❺ Nut numbers
	G	d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹		G_1	
AH308	M45×1.5	35	29	32	41.92	9	0.090	6	AN09
AH309	M50×1.5	40	31	34	47.08	9	0.109	6	AN10
AHX310	M55×2	45	35	38	52.33	10	0.137	7	AN11
AHX311	M60×2	50	37	40	57.38	11.5	0.161	7	AN12
AHX312	M65×2	55	40	43	62.38	14.5	0.189	8	AN13
AHY313	M70×2	60	42	45	67.83	11	0.253	8	AN14
AH313	M75×2	60	42	45	67.83	11	0.253	8	AN15
AHY314	M75×2	65	43	47	73.00	11	0.28	8	AN15
AH314	M80×2	65	43	47	73.00	11	0.28	8	AN16
AHY315	M80×2	70	45	49	78.17	11	0.313	8	AN16
AH315	M85×2	70	45	49	78.17	11	0.313	8	AN17
AH316	M90×2	75	48	52	83.42	11	0.365	8	AN18
AHX317	M95×2	80	52	56	88.67	12	0.429	9	AN19
AHX318	M100×2	85	53	57	93.75	12	0.461	9	AN20
AHX319	M105×2	90	57	61	99.00	13	0.532	10	AN21
AHX320	M110×2	95	59	63	104.17	13	0.582	10	AN22
AHX321	M115×2	100	62	66	109.25	15	0.665	12	AN23
AHX322	M120×2	105	63	67	114.33	15	0.663	12	AN24
AHX324	M130×2	115	69	73	124.75	16	0.875	13	AN26
AHX326	M140×2	125	74	78	135.08	17	1.03	14	AN28
AHX328	M150×2	135	77	82	145.42	17	1.15	14	AN30
AHY330	M160×3	145	83	88	155.83	18	1.55	15	AN32
AHX330	M165×3	145	83	88	155.83	18	1.55	15	AN33
AHY332	M170×3	150	88	93	166.17	19	2.73	16	AN34
AH332	M180×3	150	88	93	166.17	19	2.73	16	AN36
AHY334	M180×3	160	93	98	176.50	20	3.19	17	AN36
AH334	M190×3	160	93	98	176.50	20	3.19	17	AN38

❶ Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.

Withdrawal Sleeves

Series
AH(X,Y)23
AH(X,Y)23・・H (Hydraulic)



Taper 1:12

Detail A

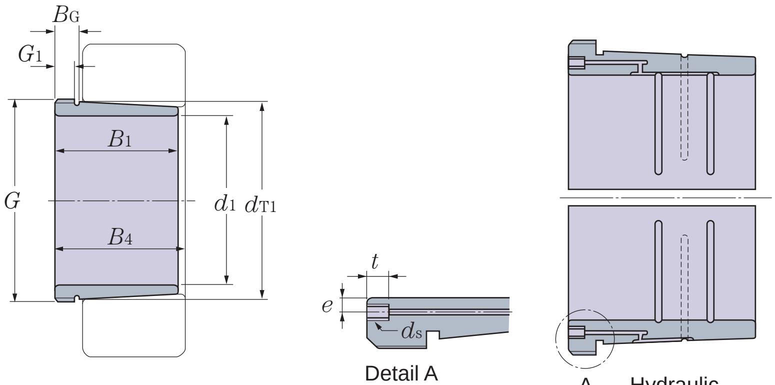
Hydraulic H Type

Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AH2308	M45×1.5	35	40	43	42.75	10	–	–	–	0.128	7	AN09
AH2309	M50×1.5	40	44	47	48.00	11	–	–	–	0.164	7	AN10
AHX2310	M55×2	45	50	53	53.17	15	–	–	–	0.209	9	AN11
AHX2311	M60×2	50	54	57	58.42	16	–	–	–	0.253	10	AN12
AHX2312	M65×2	55	58	61	63.63	17.5	–	–	–	0.297	11	AN13
AHY2313	M70×2	60	61	64	69.08	15	–	–	–	0.395	12	AN14
AH2313	M75×2	60	61	64	69.08	15	–	–	–	0.395	12	AN15
AHY2314	M75×2	65	64	68	74.42	15	–	–	–	0.466	12	AN15
AHX2314	M80×2	65	64	68	74.42	15	–	–	–	0.466	12	AN16
AHY2315	M80×2	70	68	72	79.75	15	–	–	–	0.534	12	AN16
AHX2315	M85×2	70	68	72	79.75	15	–	–	–	0.534	12	AN17
AHX2316	M90×2	75	71	75	85.00	15	–	–	–	0.597	12	AN18
AHX2317	M95×2	80	74	78	90.17	16	–	–	–	0.670	13	AN19
AHX2318	M100×2	85	79	83	95.50	17	–	–	–	0.779	14	AN20
AHX2319	M105×2	90	85	89	100.83	19	–	–	–	0.886	16	AN21
AHX2320	M110×2	95	90	94	106.25	19	–	–	–	0.998	16	AN22
AH2321	M120×2	100	94	98	111.58	19	–	–	–	1.29	16	AN24
AHY2322	M120×2	105	98	102	116.92	19	–	–	–	1.35	16	AN24
AHX2322	M125×2	105	98	102	116.92	19	–	–	–	1.35	16	AN25
AHY2324	M130×2	115	105	109	127.42	20	–	–	–	1.60	17	AN26
AHX2324	M135×2	115	105	109	127.42	20	–	–	–	1.60	17	AN27
AHY2326	M140×2	125	115	119	138.08	22	–	–	–	1.97	19	AN28
AHX2326	M145×2	125	115	119	138.08	22	–	–	–	1.97	19	AN29
AHY2328	M150×2	135	125	130	148.92	23	–	–	–	2.33	20	AN30
AHX2328	M155×3	135	125	130	148.92	23	–	–	–	2.33	20	AN31
AHY2330	M160×3	145	135	140	159.42	27	–	–	–	2.82	24	AN32
AHX2330	M165×3	145	135	140	159.42	27	–	–	–	2.82	24	AN33
AHY2332	M170×3	150	140	146	169.92	27	–	–	–	4.72	24	AN34
AH2332	M180×3	150	140	146	169.92	27	–	–	–	4.72	24	AN36
AHY2334	M180×3	160	146	152	180.42	27	–	–	–	5.25	24	AN36

❶ Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : Underlined numbers in the table differ from JIS B 1552.

Withdrawal Sleeves

Series
AH(X,Y)23
AH(X,Y)23･･H (Hydraulic)



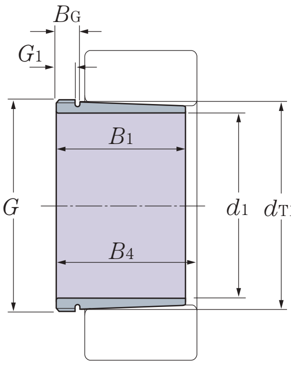
Taper 1:12
Detail A
Hydraulic H Type

Part numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	$B_4$❷	d_{T1}❸	B_G❹	d_s	e	t		G_1	
AH2334	M190×3	160	146	152	180.42	27	—	—	—	5.25	24	AN38
AHY2336	M190×3	170	154	160	190.92	29	—	—	—	5.83	26	AN38
AH2336	M200×3	170	154	160	190.92	29	—	—	—	5.83	26	AN40
AHY2338	M200×3	180	160	167	201.25	32	—	—	—	6.63	26	AN40
AH2338	Tr210×4	180	160	167	201.25	32	—	—	—	6.63	26	HN42
AH2340	Tr220×4	190	170	177	211.75	36	—	—	—	7.54	30	HN44
AH2344	Tr240×4	200	181	189	232.75	36	Rc$\frac{1}{8}$	8.5	15	13.5	30	HN48
AH2348	Tr260×4	220	189	197	253.42	36	Rc$\frac{1}{8}$	8.5	15	15.5	30	HN52
AH2352	Tr290×4	240	205	213	274.75	36	Rc$\frac{1}{8}$	8.5	15	19.6	30	HN58
AH2356	Tr310×5	260	212	220	295.33	36	Rc$\frac{1}{8}$	8.5	15	21.6	30	HN62

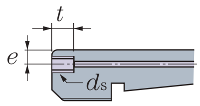
❶ Standard thread shapes and dimensions of the part numbers **AH2334** to **AHY2338** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers **AH2338** to **AH2356** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : The part number for hydraulic adapters has the suffix at the end. **AH2344H**.

Withdrawal Sleeves

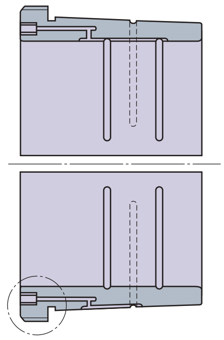
Series
AH(X)240
AH(X)240··H (Hydraulic)



Taper 1:30



Detail A



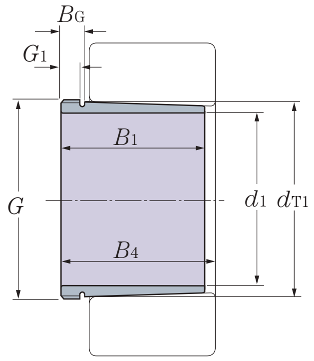
A Hydraulic H Type

Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AH24024	M125×2	115	73	82	122.20	16	–	–	–	0.650	13	AN25
AH24026	M135×2	125	83	93	132.53	17	–	–	–	0.840	14	AN27
AH24028	M145×2	135	83	93	142.53	17	–	–	–	0.910	14	AN29
AH24030	M155×3	145	90	101	152.47	18	–	–	–	1.04	15	AN31
AH24032	M170×3	150	95	106	162.93	18	–	–	–	2.33	15	AN34
AH24034	M180×3	160	106	117	173.23	20	–	–	–	2.80	16	AN36
AH24036	M190×3	170	116	127	183.57	20	–	–	–	3.10	16	AN38
AH24038	M200×3	180	118	131	193.57	24	–	–	–	3.50	18	AN40
AH24040	Tr210×4	190	127	140	203.87	24	–	–	–	3.93	18	HN42
AH24044	Tr230×4	200	138	152	224.20	26	M8	7.5	12	8.25	20	HN46
AH24048	Tr250×4	220	138	153	244.23	26	M8	7.5	12	8.98	20	HN50
AHX24052	Tr280×4	240	162	178	265.00	28	M8	7.5	12	11.8	22	HN56
AH24052	Tr270×4	240	162	178	265.00	28	M8	7.5	12	11.8	22	HN54
AHX24056	Tr300×4	260	162	179	285.03	28	M8	7.5	12	12.8	22	HN60
AH24056	Tr290×4	260	162	179	285.03	28	M8	7.5	12	12.8	22	HN58
AHX24060	Tr320×5	280	184	202	305.73	30	M8	7.5	12	15.5	24	HN64
AH24060	Tr310×5	280	184	202	305.73	30	M8	7.5	12	15.5	24	HN62
AHX24064	Tr330×5	300	184	202	325.73	30	M8	7.5	12	16.6	24	HN66
AH24064	Tr340×5	300	184	202	325.73	30	M8	7.5	12	16.6	24	HN68
AH24068	Tr360×5	320	206	225	346.43	32	Rc$\frac{1}{8}$	8.5	15	21.7	26	HNL72
AH24072	Tr380×5	340	206	226	366.47	32	Rc$\frac{1}{8}$	8.5	15	22.7	26	HNL76
AH24076	Tr400×5	360	208	228	386.47	34	Rc$\frac{1}{8}$	8.5	15	23.7	28	HNL80
AH24080	Tr420×5	380	228	248	407.13	34	Rc$\frac{1}{8}$	8.5	15	27.1	28	HNL84
AH24084	Tr440×5	400	230	252	427.20	36	Rc$\frac{1}{8}$	8.5	15	29.0	30	HNL88
AH24088	Tr460×5	420	242	264	447.60	36	Rc$\frac{1}{8}$	8.5	15	31.9	30	HNL92

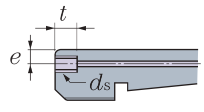
❶ Standard thread shapes and dimensions of the part numbers **AH24024** to **AH24038** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads). Standard thread shapes and dimensions of the part numbers **AH24040** to **AH24088** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : 1) The part number for hydraulic adapters has the suffix at the end. E.g. **AH24044H**
2) Underlined numbers in the table differ to JIS B 1552.

Withdrawal Sleeves

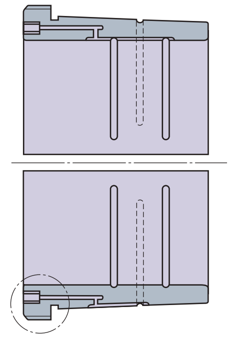
Series
AH241
AH241··H (Hydraulic)



Taper 1:30



Detail A



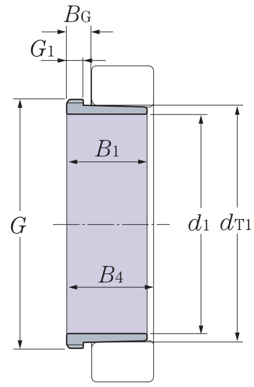
Hydraulic
H Type

Part numbers	Thread ❶	Dimensions mm								Mass kg (approx.)		Applicable❺ Nut numbers
							H Type					
	G	d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	d_s	e	t		G_1	
AH24122	M115×2	105	82	91	112.50	16	–	–	–	0.730	13	AN23
AH24124	M130×2	115	93	102	122.87	16	–	–	–	1.00	13	AN26
AH24126	M140×2	125	94	104	132.90	17	–	–	–	1.11	14	AN28
AH24128	M150×2	135	99	109	143.07	17	–	–	–	1.25	14	AN30
AH24130	M160×3	145	115	126	153.60	18	–	–	–	1.56	15	AN32
AH24132	M170×3	150	124	135	163.90	18	–	–	–	3.00	15	AN34
AH24134	M180×3	160	125	136	173.90	19	–	–	–	3.21	16	AN36
AH24136	M190×3	170	134	145	184.20	19	–	–	–	3.68	16	AN38
AH24138	M200×3	180	146	159	194.50	24	–	–	–	4.28	18	AN40
AH24140	Tr210×4	190	158	171	204.90	24	M6	3.5	9	5.10	18	HN42
AH24144	Tr230×4	200	170	184	225.27	26	M8	7.5	12	10.2	20	HN46
AH24148	Tr260×4	220	180	195	245.63	26	Rc1/8	8.5	15	12.5	20	HN52
AH24152	Tr280×4	240	202	218	266.33	28	Rc1/8	8.5	15	15.4	22	HN56
AH24156	Tr300×4	260	202	219	286.37	28	Rc1/8	8.5	15	16.3	22	HN60
AH24160	Tr320×5	280	224	242	307.07	30	Rc1/8	8.5	15	19.5	24	HN64
AH24164	Tr340×5	300	242	260	327.67	30	Rc1/8	8.5	15	21.4	24	HN68
AH24168	Tr360×5	320	269	288	348.53	32	Rc1/8	8.5	15	27.1	26	HNL72
AH24172	Tr380×5	340	269	289	368.57	32	Rc1/8	8.5	15	29.6	26	HNL76
AH24176	Tr400×5	360	271	291	388.57	34	Rc1/8	8.5	15	31.3	28	HNL80
AH24180	Tr420×5	380	278	298	408.80	34	Rc1/8	8.5	15	34.4	28	HNL84
AH24184	Tr440×5	400	310	332	429.87	36	Rc1/8	8.5	15	40.3	30	HNL88
AH24188	Tr460×5	420	310	332	449.87	36	Rc1/8	8.5	15	42.3	30	HNL92
AH24192	Tr480×5	440	332	355	470.57	38	Rc1/8	8.5	15	47.4	32	HNL96

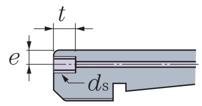
❶ Standard thread shapes and dimensions of the part numbers **AH24122** to **AH24138** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads). Standard thread shapes and dimensions of the part numbers **AH24140** to **AH24192** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : The part number for hydraulic adapters has the suffix at the end **AH24140H**

Withdrawal Sleeves

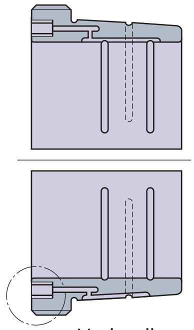
Series
AH39
AH39‥H (Hydraulic)



Taper 1:12



Detail A



A

Hydraulic
H Type

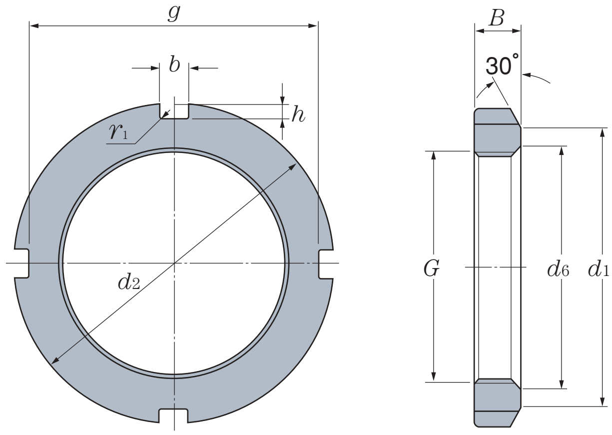
Part numbers	Thread ❶ G	Dimensions mm d_1	B_1	B_4 ❷	d_{T1} ❸	B_G ❹	H Type d_s	e	t	Mass kg (approx.)	G_1	Applicable❺ Nut numbers
AH3934	M180×3	160	59	64	174.00	16	–	–	–	1.59	13	ANL36
AH3936	M190×3	170	66	71	184.58	16	–	–	–	1.91	13	ANL38
AH3938	M200×3	180	66	71	194.33	19	–	–	–	2.02	13	ANL40
AH3940	Tr210×4	190	77	83	205.08	22	–	–	–	2.62	16	HN42
AH3944	Tr230×4	200	77	83	225.08	22	M8	7.5	12	4.83	16	HN46
AH3948	Tr250×4	220	77	83	245.08	22	M8	7.5	12	5.29	16	HN50
AH3952	Tr280×4	240	94	100	266.33	24	M8	7.5	12	7.06	18	HNL56
AH3956	Tr300×4	260	94	100	286.33	24	M8	7.5	12	7.70	18	HNL60
AH3960	Tr320×5	280	112	119	307.67	27	M8	7.5	12	10.1	21	HNL64
AH3964	Tr340×5	300	112	119	327.67	27	M8	7.5	12	10.8	21	HNL68
AH3968	Tr360×5	320	112	119	347.67	27	M8	7.5	12	12.4	21	HNL72
AH3972	Tr380×5	340	112	119	367.67	27	M8	7.5	12	13.1	21	HNL76
AH3976	Tr400×5	360	130	138	389.17	28	M8	7.5	12	15.9	22	HNL80
AH3980	Tr420×5	380	130	138	409.17	28	M8	7.5	12	17.2	20	HNL84
AH3984	Tr440×5	400	130	138	429.17	28	M8	7.5	12	18.1	22	HNL88
AH3988	Tr460×5	420	145	153	450.17	31	Rc1/8	8.5	15	21.5	25	HNL92
AH3992	Tr480×5	440	145	153	470.17	31	Rc1/8	8.5	15	22.5	25	HNL96
AH3996	Tr500×5	460	158	167	491.08	34	Rc1/8	8.5	15	26.0	28	HNL100

❶ Standard thread shapes and dimensions of the part numbers **AH3934** to **AH3938** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads). Standard thread shapes and dimensions of the part numbers **AH3940** to **AH3996** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ B_4 dimensions indicate reference dimensions before attachment of withdrawal sleeves.
❸ d_{T1} dimensions indicate that it does not meet JIS B 1552 standards.
❹ B_G dimensions indicate that it does not meet JIS B 1552 standards.
❺ Indicates nut to be used at time of disassembly.
Note : The part number for hydraulic adapters has the suffix at the end. E.g. **AH3944H**

Locknuts

Series
AN
(For adapter sleeve,
withdrawal sleeve and shaft)

Nut with Lockwasher



Part numbers	Thread ❶	Dimensions mm							
	G	d_1	d_2	B	b	h	d_6	g	r_1 max
AN00	M10×0.75	13.5	18	4	3	2	10.5	14	0.4
AN01	M12×1	17	22	4	3	2	12.5	18	0.4
AN02	M15×1	21	25	5	4	2	15.5	21	0.4
AN03	M17×1	24	28	5	4	2	17.5	24	0.4
AN04	M20×1	26	32	6	4	2	20.5	28	0.4
AN/22	M22×1	28	34	6	4	2	22.5	30	0.4
AN05	M25×1.5	32	38	7	5	2	25.8	34	0.4
AN/28	M28×1.5	36	42	7	5	2	28.8	38	0.4
AN06	M30×1.5	38	45	7	5	2	30.8	41	0.4
AN/32	M32×1.5	40	48	8	5	2	32.8	44	0.4
AN07	M35×1.5	44	52	8	5	2	35.8	48	0.4
AN08	M40×1.5	50	58	9	6	2.5	40.8	53	0.5
AN09	M45×1.5	56	65	10	6	2.5	45.8	60	0.5
AN10	M50×1.5	61	70	11	6	2.5	50.8	65	0.5
AN11	M55×2	67	75	11	7	3	56	69	0.5
AN12	M60×2	73	80	11	7	3	61	74	0.5
AN13	M65×2	79	85	12	7	3	66	79	0.5
AN14	M70×2	85	92	12	8	3.5	71	85	0.5
AN15	M75×2	90	98	13	8	3.5	76	91	0.5
AN16	M80×2	95	105	15	8	3.5	81	98	0.6
AN17	M85×2	102	110	16	8	3.5	86	103	0.6
AN18	M90×2	108	120	16	10	4	91	112	0.6
AN19	M95×2	113	125	17	10	4	96	117	0.6
AN20	M100×2	120	130	18	10	4	101	122	0.6
AN21	M105×2	126	140	18	12	5	106	130	0.7
AN22	M110×2	133	145	19	12	5	111	135	0.7
AN23	M115×2	137	150	19	12	5	116	140	0.7
AN24	M120×2	138	155	20	12	5	121	145	0.7
AN25	M125×2	148	160	21	12	5	126	150	0.7
AN26	M130×2	149	165	21	12	5	131	155	0.7
AN27	M135×2	160	175	22	14	6	136	163	0.7
AN28	M140×2	160	180	22	14	6	141	168	0.7
AN29	M145×2	171	190	24	14	6	146	178	0.7

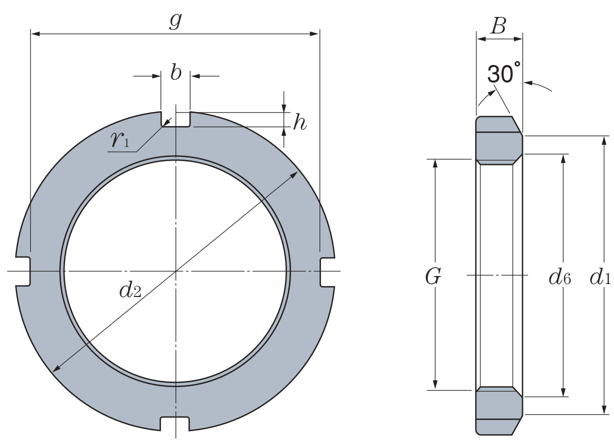
❶ Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Note : Locknut series AN is used for adapter sleeves **H (HE, HS)2**, **H (HE, HS)3**, **H (HE, HS)23** and **H (HE)31**

Mass kg (approx.)	Applicable parts	
	Lockwasher	Lockplate
0.005	AW00(X)	—
0.007	AW01(X)	—
0.010	AW02(X)	—
0.013	AW03(X)	—
0.019	AW04(X)	—
0.023	AW/22(X)	—
0.025	AW05(X)	—
0.040	AW/28(X)	—
0.043	AW06(X)	—
0.058	AW/32(X)	—
0.053	AW07(X)	—
0.085	AW08(X)	—
0.119	AW09(X)	—
0.148	AW10(X)	—
0.158	AW11(X)	—
0.174	AW12(X)	—
0.203	AW13(X)	—
0.242	AW14(X)	—
0.287	AW15(X)	—
0.397	AW16(X)	—
0.451	AW17(X)	—
0.556	AW18(X)	—
0.658	AW19(X)	—
0.698	AW20(X)	—
0.845	AW21(X)	—
0.965	AW22(X)	—
1.01	AW23(X)	—
1.08	AW24(X)	—
1.19	AW25(X)	—
1.25	AW26(X)	—
1.55	AW27(X)	—
1.56	AW28(X)	—
2.00	AW29(X)	—

Locknuts

Series
AN
(For adapter sleeve, withdrawal sleeve and shaft)
AN‥SP
AN‥SPB
(Hydraulic withdrawal sleeve nuts)

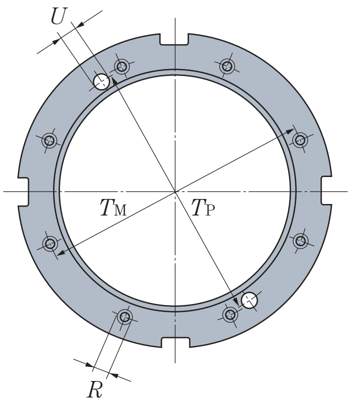
Nut with Lockwasher

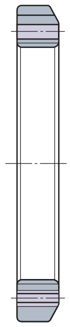


Part numbers	Thread ❶	Dimensions mm							
	G	d_1	d_2	B	b	h	d_6	g	r_1 max
AN30	M150×2	171	195	24	14	6	151	183	0.7
AN31	M155×3	182	200	25	16	7	156.5	186	0.7
AN32	M160×3	182	210	25	16	7	161.5	196	0.7
AN33	M165×3	193	210	26	16	7	166.5	196	0.7
AN34	M170×3	193	220	26	16	7	171.5	206	0.7
AN36	M180×3	203	230	27	18	8	181.5	214	0.7
AN38	M190×3	214	240	28	18	8	191.5	224	0.7
AN40	M200×3	226	250	29	18	8	201.5	234	0.7

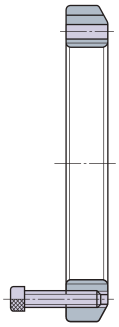
❶ Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Note : 1) Locknut series **AN** is used for adapter series **H (HE, HS)2**, **H (HE, HS)3**, **H (HE, HS)23** and **H (HE)31**.
2) The part number for hydraulic sleeve nuts has the suffix at the end. E.g. **AN40SP**

Hydraulic sleeve nuts





SP Type
with threaded
bolt hole



SPB Type
with bolt

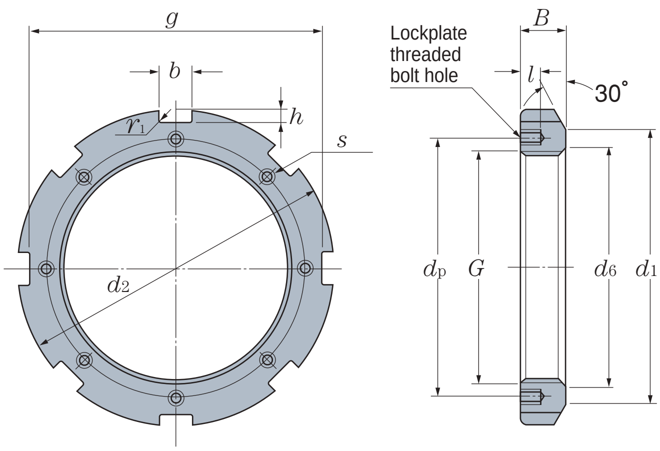
Dimensions mm				Mass kg (approx.)	Applicable parts	
SP, SPB Type					Lockwasher	Lockplate
R (Thread)	T_M	U	T_P			
—	—	—	—	2.03	AW30(X)	—
—	—	—	—	2.21	AW31(X)	—
—	—	—	—	2.59	AW32(X)	—
—	—	—	—	2.43	AW33(X)	—
—	—	—	—	2.80	AW34(X)	—
—	—	—	—	3.07	AW36(X)	—
—	—	—	—	3.39	AW38(X)	—
M10	218	12	217	3.69	AW40(X)	—

3) Protective plates applicable to hydraulic sleeve nuts are listed on P52.

Locknuts

Series
AN
(For adapte sleever, withdrawal sleeve and shaft)
AN··SP
AN··SPB
(Hydraulic withdrawal sleeve nuts)

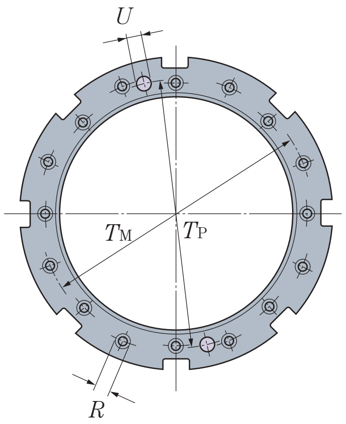
Nut with lockplate

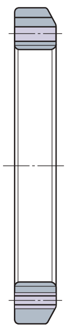


Part numbers	Thread ❶	Dimensions mm								Lockplate threaded bolt hole		
	G	d_1	d_2	B	b	h	d_6	g	r_1 max	l	s ❷	d_p
AN44	Tr220×4	250	280	32	20	10	222	260	0.8	15	M8	238
AN48	Tr240×4	270	300	34	20	10	242	280	0.8	15	M8	258
AN52	Tr260×4	300	330	36	24	12	262	306	0.8	18	M10	281
AN56	Tr280×4	320	350	38	24	12	282	326	0.8	18	M10	301
AN60	Tr300×4	340	380	40	24	12	302	356	0.8	18	M10	326
AN64	Tr320×5	360	400	42	24	12	322.5	376	0.8	18	M10	345
AN68	Tr340×5	400	440	55	28	15	342.5	410	1	21	M12	372
AN72	Tr360×5	420	460	58	28	15	362.5	430	1	21	M12	392
AN76	Tr380×5	450	490	60	32	18	382.5	454	1	21	M12	414
AN80	Tr400×5	470	520	62	32	18	402.5	484	1	27	M16	439
AN84	Tr420×5	490	540	70	32	18	422.5	504	1	27	M16	459
AN88	Tr440×5	510	560	70	36	20	442.5	520	1	27	M16	477
AN92	Tr460×5	540	580	75	36	20	462.5	540	1	27	M16	497
AN96	Tr480×5	560	620	75	36	20	482.5	580	1	27	M16	527
AN100	Tr500×5	580	630	80	40	23	502.5	584	1	27	M16	539
AN106	Tr530×6	610	670	80	40	23	533	624	1	38	M20	573
AN112	Tr560×6	650	710	85	45	25	563	660	1	38	M20	606

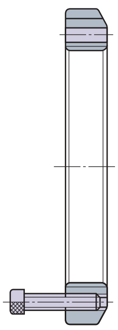
❶ Standard thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).
❷ Standard thread shapes and dimensions of threaded set screw holes are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Note : 1) Locknut series **AN** is used for adapter series **H (HE, HS)23**, **H (HE)31** and **H32**.

Hydraulic sleeve nuts





SP Type
with threaded
bolt hole



SPB Type
with bolt

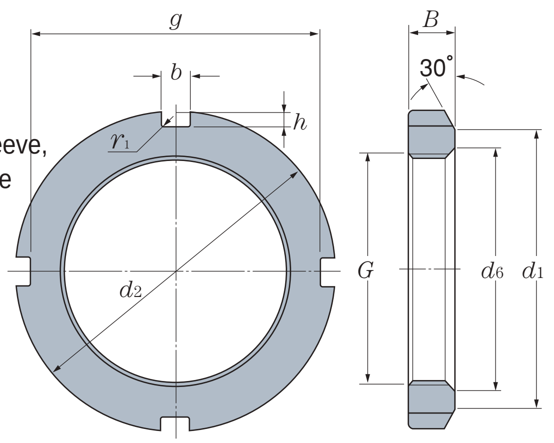
Dimensions mm				Mass kg (approx.)	Applicable parts	
SP, SPB Type					Lockwasher	Lockplate
R (Thread)	T_M	U	T_P			
M16	246	12	237	5.20	AW44(X)	AL44
M16	266	12	257	5.95	AW48(X)	AL44
M16	286	12	277	8.05	AW52(X)	AL52
M16	306	12	297	9.05	AW56(X)	AL52
M16	330	12	317	11.8	—	AL60
M16	350	12	337	13.1	—	AL64
M20	374	12	357	23.1	—	AL68
M20	394	12	377	25.1	—	AL68
M20	416	12	397	30.9	—	AL76
M20	436	12	417	36.9	—	AL80
M24	465	12	437	43.5	—	AL80
M24	485	12	457	45.3	—	AL88
M24	506	12	477	50.4	—	AL88
M24	526	12	497	62.2	—	AL96
M24	546	15	524	63.3	—	AL100
M24	576	15	554	74.6	—	AL106
M24	609	—	—	89.2	—	AL112

2) The part number for hydraulic sleeve nuts has the suffix at the end. E.g. **AN44SP**
3) Protective plates applicable to hydraulic sleeve nuts are listed on P52.

Locknuts

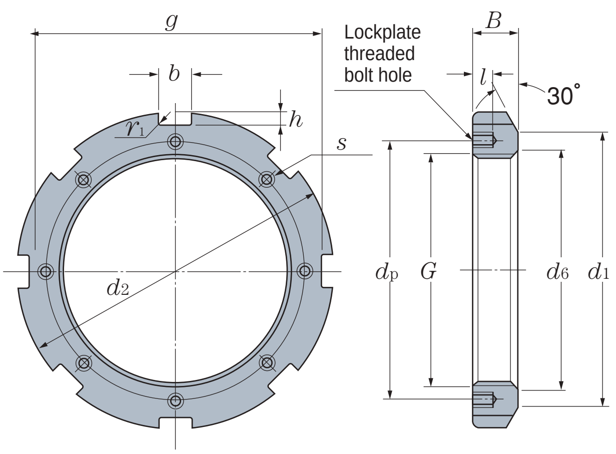
Series
ANL
(For adapter sleeve, withdrawal sleeve and shaft)
ANL··SP
ANL··SPB
(Hydraulic withdrawal sleeve nuts)

Nut with lockwasher



ANL24～ANL40

Nut with lockplate

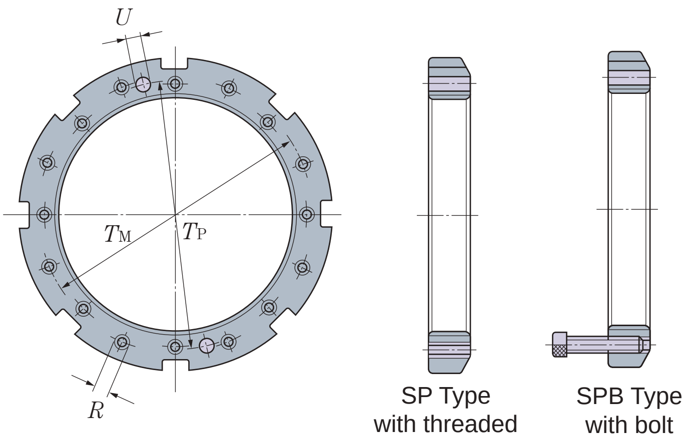


ANL44～ANL126

Part numbers	Thread ❶	Dimensions mm										
										Lockplate threaded bolt hole		
	G	d_1	d_2	B	b	h	d_6	g	r_1 max	l	s ❷	d_p
ANL24	M120×2	133	145	20	12	5	121	135	0.7	–	–	–
ANL26	M130×2	143	155	21	12	5	131	145	0.7	–	–	–
ANL28	M140×2	151	165	22	14	6	141	153	0.7	–	–	–
ANL30	M150×2	164	180	24	14	6	151	168	0.7	–	–	–
ANL32	M160×3	174	190	25	16	7	161.5	176	0.7	–	–	–
ANL34	M170×3	184	200	26	16	7	171.5	186	0.7	–	–	–
ANL36	M180×3	192	210	27	18	8	181.5	194	0.7	–	–	–
ANL38	M190×3	202	220	28	18	8	191.5	204	0.7	–	–	–
ANL40	M200×3	218	240	29	18	8	201.5	224	0.7	–	–	–
ANL44	Tr220×4	242	260	30	20	9	222	242	0.8	12	M6	229
ANL48	Tr240×4	270	290	34	20	10	242	270	0.8	15	M8	253
ANL52	Tr260×4	290	310	34	20	10	262	290	0.8	15	M8	273
ANL56	Tr280×4	310	330	38	24	10	282	310	0.8	15	M8	293
ANL60	Tr300×4	336	360	42	24	12	302	336	0.8	15	M8	316
ANL64	Tr320×5	356	380	42	24	12	322.5	356	0.8	15	M8	335
ANL68	Tr340×5	376	400	45	24	12	342.5	376	1	15	M8	355
ANL72	Tr360×5	394	420	45	28	13	362.5	394	1	15	M8	374
ANL76	Tr380×5	422	450	48	28	14	382.5	422	1	18	M10	398
ANL80	Tr400×5	442	470	52	28	14	402.5	442	1	18	M10	418
ANL84	Tr420×5	462	490	52	32	14	422.5	462	1	18	M10	438
ANL88	Tr440×5	490	520	60	32	15	442.5	490	1	21	M12	462
ANL92	Tr460×5	510	540	60	32	15	462.5	510	1	21	M12	482
ANL96	Tr480×5	530	560	60	36	15	482.5	530	1	21	M12	502
ANL100	Tr500×5	550	580	68	36	15	502.5	550	1	21	M12	522
ANL106	Tr530×6	590	630	68	40	20	533	590	1	28	M16	556
ANL112	Tr560×6	610	650	75	40	20	563	610	1	28	M16	581
ANL120	Tr600×6	660	700	75	40	20	603	660	1	28	M16	626
ANL126	Tr630×6	690	730	75	45	20	633	690	1	28	M16	656

❶ Standard thread shapes and dimensions of the part numbers **ANL24** to **ANL40** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers to **ANL44**～**ANL126** are as per JIS B 0216 (metric trapezoidal screw threads).
❷ Standard thread shapes and dimensions of threaded set screw holes are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).

Hydraulic sleeve nuts



SP Type with threaded bolt hole

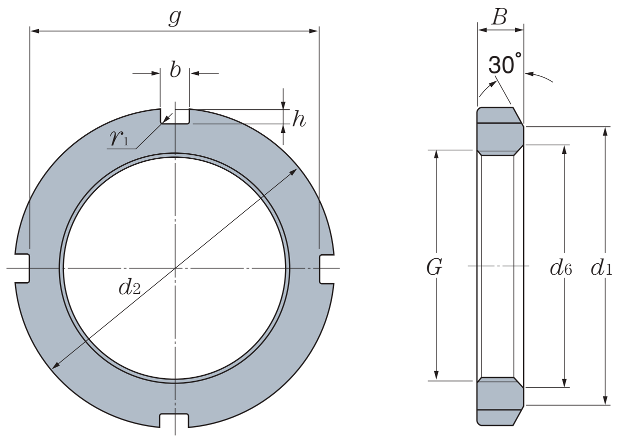
SPB Type with bolt

Dimensions mm				Mass kg (approx.)	Applicable parts	
SP, SPB Type					Lockwashers	Lockplate
R (Thread)	T_M	U	T_P			
—	—	—	—	0.780	AWL24(X)	—
—	—	—	—	0.880	AWL26(X)	—
—	—	—	—	0.990	AWL28(X)	—
—	—	—	—	1.38	AWL30(X)	—
—	—	—	—	1.56	AWL32(X)	—
—	—	—	—	1.72	AWL34(X)	—
—	—	—	—	1.95	AWL36(X)	—
—	—	—	—	2.08	AWL38(X)	—
—	—	—	—	2.98	AWL40(X)	—
M10	236	12	237	3.09	—	ALL44
M12	260	12	257	5.16	—	ALL48
M12	280	12	277	5.67	—	ALL48
M12	300	12	297	6.78	—	ALL56
M12	322	12	317	9.62	—	ALL60
M12	342	12	337	9.94	—	ALL64
M12	362	12	357	11.7	—	ALL64
M12	382	12	377	12.0	—	ALL72
M16	406	12	397	14.9	—	ALL76
M16	426	12	417	16.9	—	ALL76
M16	446	12	437	17.4	—	ALL84
M16	468	12	457	26.2	—	ALL88
M16	488	12	477	29.6	—	ALL88
M16	508	12	497	28.3	—	ALL96
M16	530	15	524	33.6	—	ALL96
M16	559	15	554	42.9	—	ALL106
M16	595	—	—	44.4	—	ALL112
M16	635	15	624	54.0	—	ALL106
M16	663	15	654	56.0	—	ALL126

Note : 1) Locknut series **ANL** is used for adapter series **H(HE)30**.
2) The part number for hydraulic sleeve nuts has the suffix at the end. E.g. **ANL44SP**
3) Protective plates applicable to hydraulic sleeve nuts are listed on P52.

Nuts

Series
HN



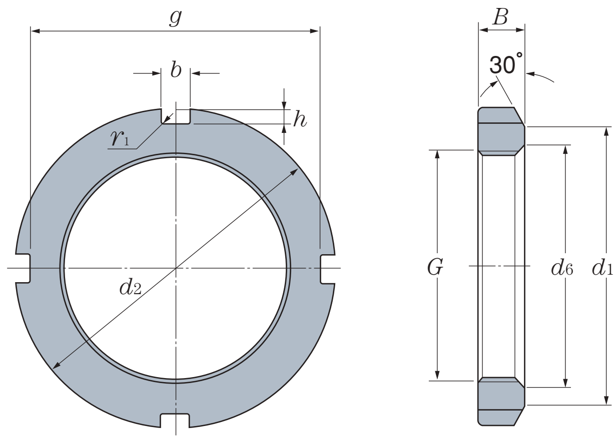
Part numbers	Thread ❶	Dimensions mm					Mass kg (approx.)	Dimensions mm (approx.)		
	G	d_1	d_2	B	b	h		d_6	g	r_1 max
HN42	Tr210×4	238	270	30	20	10	4.75	212	250	0.8
HN44	Tr220×4	250	280	32	20	10	5.35	222	260	0.8
HN46	Tr230×4	260	290	34	20	10	5.80	232	270	0.8
HN48	Tr240×4	270	300	34	20	10	6.20	242	280	0.8
HN50	Tr250×4	290	320	36	20	10	7.00	252	300	0.8
HN52	Tr260×4	300	330	36	24	12	8.55	262	306	0.8
HN54	Tr270×4	310	340	38	24	12	9.20	272	316	0.8
HN56	Tr280×4	320	350	38	24	12	10.0	282	326	0.8
HN58	Tr290×4	330	370	40	24	12	11.8	292	346	0.8
HN60	Tr300×4	340	380	40	24	12	12.0	302	356	0.8
HN62	Tr310×5	350	390	42	24	12	13.4	312.5	366	0.8
HN64	Tr320×5	360	400	42	24	12	13.5	322.5	376	0.8
HN66	Tr330×5	380	420	52	28	15	20.4	332.5	390	1
HN68	Tr340×5	400	440	55	28	15	24.5	342.5	410	1
HN70	Tr350×5	410	450	55	28	15	25.2	352.5	420	1
HN72	Tr360×5	420	460	58	28	15	27.5	362.5	430	1
HN74	Tr370×5	430	470	58	28	15	28.2	372.5	440	1
HN76	Tr380×5	450	490	60	32	18	33.5	382.5	454	1
HN80	Tr400×5	470	520	62	32	18	40.0	402.5	484	1
HN84	Tr420×5	490	540	70	32	18	46.9	422.5	504	1
HN88	Tr440×5	510	560	70	36	20	48.5	442.5	520	1
HN92	Tr460×5	540	580	75	36	20	55.0	462.5	540	1
HN96	Tr480×5	560	620	75	36	20	67.0	482.5	580	1
HN100	Tr500×5	580	630	80	40	23	69.0	502.5	584	1
HN102	Tr510×6	590	650	80	40	23	75.0	513	604	1
HN106	Tr530×6	610	670	80	40	23	78.0	533	624	1
HN110	Tr550×6	640	700	80	40	23	92.5	553	654	1
HN112	Tr560×6	650	710	85	45	25	85.6	563	660	1

❶ Standard thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).
Note : Part number **HN54** indicates that it does not meet JIS B 1554 standards.

Withdrawal sleeve nuts

Nuts

Series
HNL

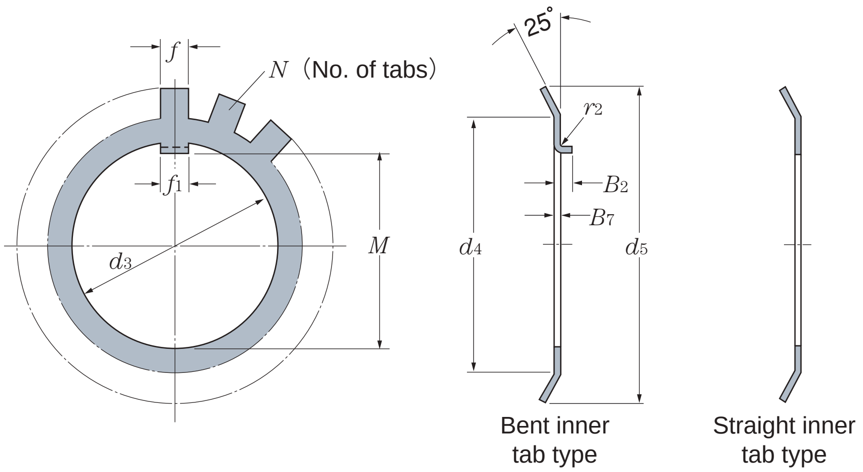


Part numbers	Thread ❶	Dimensions mm					Mass kg (approx.)	Dimensions mm (approx.)		
	G	d_1	d_2	B	b	h		d_6	g	r_1 max
HNL41	Tr205×4	232	250	30	18	8	3.43	207	234	0.8
HNL43	Tr215×4	242	260	30	20	9	3.72	217	242	0.8
HNL44	Tr220×4	242	260	30	20	9	3.09	222	242	0.8
HNL47	Tr235×4	262	280	34	20	9	4.60	237	262	0.8
HNL48	Tr240×4	270	290	34	20	10	5.16	242	270	0.8
HNL52	Tr260×4	290	310	34	20	10	5.80	262	290	0.8
HNL56	Tr280×4	310	330	38	24	10	6.72	282	310	0.8
HNL60	Tr300×4	336	360	42	24	12	9.60	302	336	0.8
HNL64	Tr320×5	356	380	42	24	12	10.3	322.5	356	1
HNL68	Tr340×5	376	400	45	24	12	11.7	342.5	376	1
HNL69	Tr345×5	384	410	45	28	13	11.5	347.5	384	1
HNL72	Tr360×5	394	420	45	28	13	12.1	362.5	394	1
HNL73	Tr365×5	404	430	48	28	13	14.2	367.5	404	1
HNL76	Tr380×5	422	450	48	28	14	16.0	382.5	422	1
HNL77	Tr385×5	422	450	48	28	14	15.0	387.5	422	1
HNL80	Tr400×5	442	470	52	28	14	18.5	402.5	442	1
HNL82	Tr410×5	452	480	52	32	14	19.0	412.5	452	1
HNL84	Tr420×5	462	490	52	32	14	19.4	422.5	462	1
HNL86	Tr430×5	472	500	52	32	14	19.8	432.5	472	1
HNL88	Tr440×5	490	520	60	32	15	27.0	442.5	490	1
HNL90	Tr450×5	490	520	60	32	15	23.8	452.5	490	1
HNL92	Tr460×5	510	540	60	32	15	28.0	462.5	510	1
HNL94	Tr470×5	510	540	60	32	15	25.0	472.5	510	1
HNL96	Tr480×5	530	560	60	36	15	29.5	482.5	530	1
HNL98	Tr490×5	550	580	60	36	15	34.0	492.5	550	1
HNL100	Tr500×5	550	580	68	36	15	35.0	502.5	550	1
HNL104	Tr520×6	570	600	68	36	15	37.0	523	570	1
HNL106	Tr530×6	590	630	68	40	20	47.0	533	590	1
HNL108	Tr540×6	590	630	68	40	20	43.5	543	590	1
HNL112	Tr560×6	610	650	75	40	20	48.3	563	610	1
HNL118	Tr590×6	650	690	75	40	20	57.0	593	650	1
HNL120	Tr600×6	660	700	75	40	20	53.8	603	660	1
HNL126	Tr630×6	690	730	75	45	20	60.6	633	690	1

❶ Standard thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).

Lockwashers

Series
AW



Part numbers		Dimensions mm								Mass	Dimensions mm		Applicable Locknut numbers
Bent inner tab type	Straight inner tab type	d_3	d_4	d_5	f_1	M	f	B_7	N	kg (approx.) 100 pieces	Bent inner tab type B_2	r_2	
AW00	**AW00X**	10	13.5	21	3	8.5	3	1	9	0.131	3	0.5	AN00
AW01	**AW01X**	12	17	25	3	10.5	3	1	11	0.192	3	0.5	AN01
AW02	**AW02X**	15	21	28	4	13.5	4	1	13	0.253	3.5	1	AN02
AW03	**AW03X**	17	24	32	4	15.5	4	1	13	0.313	3.5	1	AN03
AW04	**AW04X**	20	26	36	4	18.5	4	1	13	0.350	3.5	1	AN04
AW/22	**AW/22X**	22	28	38	4	20.5	4	1	13	0.394	3.5	1	AN/22
AW05	**AW05X**	25	32	42	5	23	5	1.25	13	0.640	3.75	1	AN05
AW/28	**AW/28X**	28	36	46	5	26	5	1.25	13	0.723	3.75	1	AN/28
AW06	**AW06X**	30	38	49	5	27.5	5	1.25	13	0.780	3.75	1	AN06
AW/32	**AW/32X**	32	40	52	5	29.5	5	1.25	13	0.839	3.75	1	AN/32
AW07	**AW07X**	35	44	57	6	32.5	5	1.25	15	1.04	3.75	1	AN07
AW08	**AW08X**	40	50	62	6	37.5	6	1.25	15	1.23	3.75	1	AN08
AW09	**AW09X**	45	56	69	6	42.5	6	1.25	17	1.52	3.75	1	AN09
AW10	**AW10X**	50	61	74	6	47.5	6	1.25	17	1.60	3.75	1	AN10
AW11	**AW11X**	55	67	81	8	52.5	7	1.5	17	1.96	5.5	1	AN11
AW12	**AW12X**	60	73	86	8	57.5	7	1.5	17	2.53	5.5	1.2	AN12
AW13	**AW13X**	65	79	92	8	62.5	7	1.5	19	2.90	5.5	1.2	AN13
AW14	**AW14X**	70	85	98	8	66.5	8	1.5	19	3.34	5.5	1.2	AN14
AW15	**AW15X**	75	90	104	8	71.5	8	1.5	19	3.56	5.5	1.2	AN15
AW16	**AW16X**	80	95	112	10	76.5	8	1.8	19	4.64	5.8	1.2	AN16
AW17	**AW17X**	85	102	119	10	81.5	8	1.8	19	5.24	5.8	1.2	AN17
AW18	**AW18X**	90	108	126	10	86.5	10	1.8	19	6.23	5.8	1.2	AN18
AW19	**AW19X**	95	113	133	10	91.5	10	1.8	19	6.70	5.8	1.2	AN19
AW20	**AW20X**	100	120	142	12	96.5	10	1.8	19	7.65	7.8	1.2	AN20
AW21	**AW21X**	105	126	145	12	100.5	12	1.8	19	8.26	7.8	1.2	AN21
AW22	**AW22X**	110	133	154	12	105.5	12	1.8	19	9.40	7.8	1.2	AN 22
AW23	**AW23X**	115	137	159	12	110.5	12	2	19	10.8	8	1.5	AN23
AW24	**AW24X**	120	138	164	14	115	12	2	19	10.5	8	1.5	AN24
AW25	**AW25X**	125	148	170	14	120	12	2	19	11.8	8	1.5	AN25
AW26	**AW26X**	130	149	175	14	125	12	2	19	11.3	8	1.5	AN26
AW27	**AW27X**	135	160	185	14	130	14	2	19	14.4	8	1.5	AN27
AW28	**AW28X**	140	160	192	16	135	14	2	19	14.2	10	1.5	AN28
AW29	**AW29X**	145	171	202	16	140	14	2	19	16.8	10	1.5	AN29

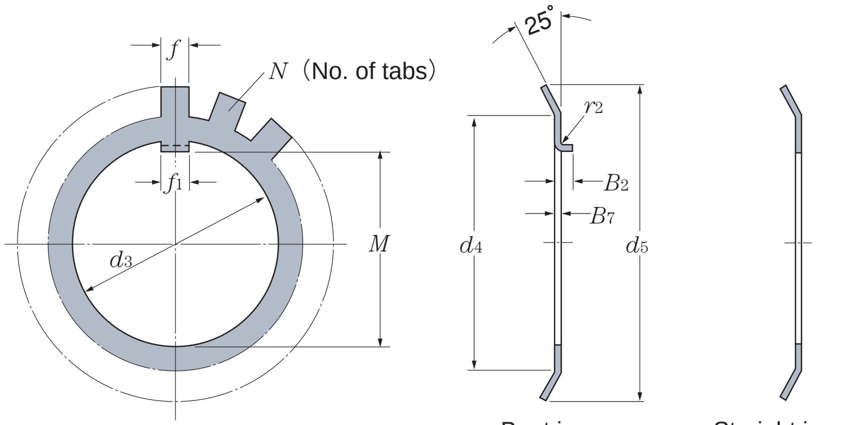
Note : 1) Narrow slit type adapter sleeves appended with the code suffix "**X**" after the **H (HE, HS)2** and **HH (HHE, HHS)23** part numbers use straight inner tab washers. Wide slit type adapter sleeves without the suffix code "**X**" after the adapter part number can use either bent inner tab washers istraight inner tab washers.

2) Bent inner tab type of the part number **AW00** and **AW01** indicate that they do not meet JIS B 1554 standards.

Part numbers		Dimensions mm								Mass kg (approx.)	Dimensions mm Bent inner tab type		Applicable Locknut numbers
Bent inner tab type	Straight inner tab type	d_3	d_4	d_5	f_1	M	f	B_7	N	100 pieces	B_2	r_2	
AW30	AW30X	150	171	205	16	145	14	2	19	15.5	10	1.5	AN30
AW31	AW31X	155	182	212	16	147.5	16	2.5	19	20.9	10.5	1.5	AN31
AW32	AW32X	160	182	217	18	154	16	2.5	19	22.2	10.5	1.5	AN32
AW33	AW33X	165	193	222	18	157.5	16	2.5	19	24.1	10.5	1.5	AN33
AW34	AW34X	170	193	232	18	164	16	2.5	19	24.7	10.5	1.5	AN34
AW36	AW36X	180	203	242	20	174	18	2.5	19	26.8	10.5	1.5	AN36
AW38	AW38X	190	214	252	20	184	18	2.5	19	27.8	10.5	1.5	AN38
AW40	AW40X	200	226	262	20	194	18	2.5	19	29.3	10.5	1.5	AN40
AW42	AW42X	210	238	282	24	204	20	3	19	43.2	13	1.5	AN42
AW44	AW44X	220	250	292	24	213	20	3	19	48.0	13	1.5	AN44
AW46	AW46X	230	260	310	24	223	20	3	19	50.0	13	1.5	AN46
AW48	AW48X	240	270	312	24	233	20	3	19	50.2	13	1.5	AN48
AW50	AW50X	250	290	332	24	243	20	3	19	59.1	13	1.5	AN50
AW52	AW52X	260	300	342	28	253	24	3	23	72.9	18	1.5	AN52
AW56	AW56X	280	320	362	28	273	24	3	23	75.9	18	1.5	AN56
AW60	AW60X	300	340	392	32	293	24	3	23	86.4	18	1.5	AN60
AW64	AW64X	320	360	420	32	311	24	4	23	127	19	2	AN64
AW68	AW68X	340	400	460	32	331	28	4	23	180	19	2	AN68
AW72	AW72X	360	420	480	32	351	28	4	23	185	19	2	AN72
AW76	AW76X	380	450	510	36	371	32	4	23	223	19	2	AN76
AW80	AW80X	400	470	540	36	391	32	4	23	244	19	2	AN80
AW84	AW84X	420	490	560	36	411	32	4	23	250	19	2	AN84
AW88	AW88X	440	510	580	40	431	36	4	23	269	19	2	AN88
AW92	AW92X	460	540	600	40	451	36	4	25	295	19	2	AN92
AW96	AW96X	480	560	640	40	471	36	4	25	335	19	2	AN96
AW100	AW100X	500	580	650	44	491	40	4	25	340	19	2	AN100

Lockwashers

Series
AWL



Bent inner tab type

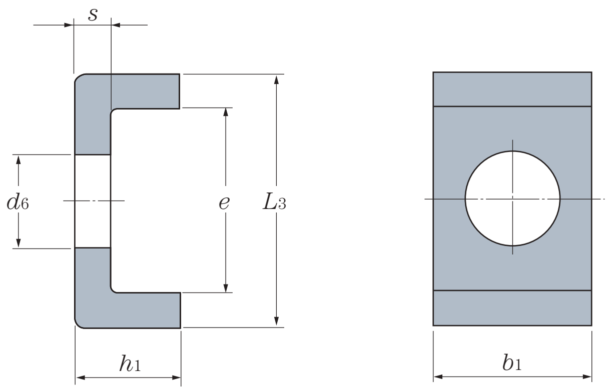
Straight inner tab type

Part numbers		Dimensions mm								Mass kg (approx.)	Dimensions mm		Applicable Locknut numbers
Bent inner tab type	Straight inner tab type	d_3	d_4	d_5	f_1	M	f	B_7	N	100 pieces	Bent inner tab type B_2	r_2	
AWL24	**AWL24X**	120	133	155	14	115	12	2	19	7.70	8	1.5	ANL24
AWL26	**AWL26X**	130	143	165	14	125	12	2	19	8.70	8	1.5	ANL26
AWL28	**AWL28X**	140	151	175	16	135	14	2	19	10.9	10	1.5	ANL28
AWL30	**AWL30X**	150	164	190	16	145	14	2	19	11.3	10	1.5	ANL30
AWL32	**AWL32X**	160	174	200	18	154	16	2.5	19	16.2	10.5	1.5	ANL32
AWL34	**AWL34X**	170	184	210	18	164	16	2.5	19	19.0	10.5	1.5	ANL34
AWL36	**AWL36X**	180	192	220	20	174	18	2.5	19	18.0	10.5	1.5	ANL36
AWL38	**AWL38X**	190	202	230	20	184	18	2.5	19	20.5	10.5	1.5	ANL38
AWL40	**AWL40X**	200	218	250	20	194	18	2.5	19	21.4	10.5	1.5	ANL40
AWL44	**AWL44X**	220	242	272	24	213	20	3	19	34.4	13	1.5	ANL44
AWL48	**AWL48X**	240	270	302	24	233	20	3	19	45.0	13	1.5	ANL48
AWL52	**AWL52X**	260	290	322	24	253	20	3	23	50.5	18	1.5	ANL52
AWL56	**AWL56X**	280	310	342	28	273	24	3	23	56.7	18	1.5	ANL56
AWL60	**AWL60X**	300	336	375	28	293	24	3	23	71.6	18	1.5	ANL60
AWL64	**AWL64X**	320	356	395	28	311	24	4	23	99.0	19	2	ANL64
AWL68	**AWL68X**	340	376	415	28	331	24	4	23	103	19	2	ANL68
AWL72	**AWL72X**	360	394	435	32	351	28	4	23	111	19	2	ANL72
AWL76	**AWL76X**	380	422	465	32	371	28	4	23	133	19	2	ANL76
AWL80	**AWL80X**	400	442	485	32	391	28	4	23	137	19	2	ANL80
AWL84	**AWL84X**	420	462	505	36	411	32	4	23	149	19	2	ANL84
AWL88	**AWL88X**	440	490	535	36	431	32	4	23	175	19	2	ANL88
AWL92	**AWL92X**	460	510	555	36	451	32	4	25	185	19	2	ANL92
AWL96	**AWL96X**	480	530	575	40	471	36	4	25	198	19	2	ANL96
AWL100	**AWL100X**	500	550	595	40	491	36	4	25	203	19	2	ANL100

Note : Narrow slit type adapter sleeves appended with the code suffix "**X**" after the **H30** and **H30(E)** numbers use straight inner tab washers.
Wide slit type adapter sleeves without the suffix "**X**" code after the adapter part number can use either bent inner tab washers or straight inner tab washers.

Lockplates

Series
AL
ALL



Part numbers	Dimensions mm								Mass kg (approx.) 100 pieces	Applicable Locknut numbers
	s	b_1	h_1	d_6	e	l ❶	G_2 ❷	L_3		
AL44	4	20	12	9	22.5	16	M8	30.5	2.60	AN44, AN48
AL52	4	24	12	12	25.5	20	M10	33.5	3.39	AN52, AN56
AL60	4	24	12	12	30.5	20	M10	38.5	3.79	AN60
AL64	5	24	15	12	31	20	M10	41	5.35	AN64
AL68	5	28	15	14	38	25	M12	48	6.65	AN68, AN72
AL76	5	32	15	14	40	25	M12	50	7.96	AN76
AL80	5	32	15	18	45	30	M16	55	8.20	AN80, AN84
AL88	5	36	15	18	43	30	M16	53	9.00	AN88, AN92
AL96	5	36	15	18	53	30	M16	63	10.4	AN96
AL100	5	40	15	18	45	30	M16	55	10.5	AN100
AL106	7	40	21	22	51	40	M20	65	15.3	AN106
AL112	7	45	21	22	54	40	M20	68	18.2	AN112

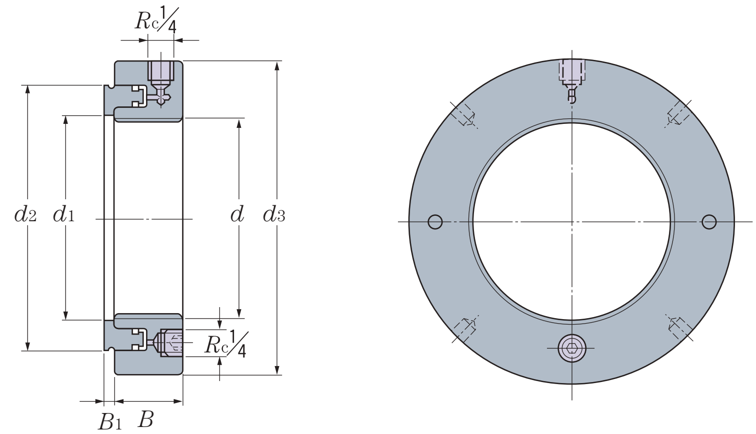
❶ l dimensions indicate reference dimensions for the length of fastening bolts of clasps.
❷ G_2 dimensions indicate reference dimensions for the thread of fastening bolts of clasps.
Note : This series uses series **H31**, **H32** and **H23** adapters.

Part numbers	Dimensions mm								Mass kg (approx.) 100 pieces	Applicable Locknut numbers
	s	b_1	h_1	d_6	e	l ❶	G_2 ❷	L_3		
ALL44	4	20	12	7	13.5	12	M6	21.5	2.12	ANL44
ALL48	4	20	12	9	17.5	16	M8	25.5	2.29	ANL48, ANL52
ALL56	4	24	12	9	17.5	16	M8	25.5	2.92	ANL56
ALL60	4	24	12	9	20.5	16	M8	28.5	3.16	ANL60
ALL64	5	24	15	9	21	16	M8	31	4.56	ANL64, ANL68
ALL72	5	28	15	9	20	16	M8	30	5.03	ANL72
ALL76	5	28	15	12	24	20	M10	34	5.28	ANL76, ANL80
ALL84	5	32	15	12	24	20	M10	34	6.11	ANL84
ALL88	5	32	15	14	28	25	M12	38	6.45	ANL88, ANL92
ALL96	5	36	15	14	28	25	M12	38	7.29	ANL96, ANL100
ALL106	7	40	21	18	34	30	M16	48	15.3	ANL106, ANL120
ALL112	7	40	21	18	29	30	M16	43	14.2	ANL112
ALL126	7	45	21	18	34	30	M16	48	17.4	ANL126

❶ l dimensions indicate reference dimensions for the length of fastening bolts of clasps.
❷ G_2 dimensions indicate reference dimensions for the thread of fastening bolts of clasps.
Note : This series uses series **H30** and **H39** adapters.

Hydraulic Nuts

Series
HPN



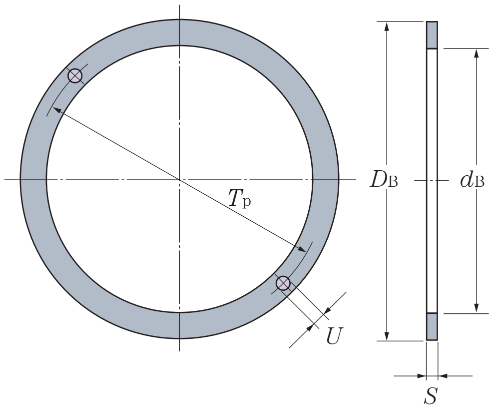
Part numbers	Dimensions mm						Plunger Travel Length max mm	Plunger Effective Area mm^2	Mass kg (approx.)
	Thread ❶ d	d_1	d_2	d_3	B	B_1			
HPN18	M90×2	90.5	127	156	38	5	5	4 700	4.00
HPN19	M95×2	95.5	133	162	38	5	5	4 900	4.30
HPN20	M100×2	100.5	138	166	38	6	5	5 100	4.40
HPN21	M105×2	105.5	143	172	38	6	5	5 300	4.65
HPN22	M110×2	110.5	149	178	38	6	5	5 600	4.95
HPN23	M115×2	115.5	154	182	38	6	5	5 800	5.00
HPN24	M120×2	120.5	159	188	38	6	5	6 000	5.25
HPN25	M125×2	125.5	164	192	38	6	5	6 200	5.35
HPN26	M130×2	130.5	170	198	38	6	5	6 400	5.65
HPN27	M135×2	135.5	175	204	38	6	5	6 600	5.90
HPN28	M140×2	140.5	180	208	38	7	5	6 800	6.00
HPN29	M145×2	145.5	186	214	39	7	5	7 300	6.50
HPN30	M150×2	150.5	191	220	39	7	5	7 500	6.60
HPN31	M155×3	155.5	198	226	39	7	5	8 100	6.95
HPN32	M160×3	160.5	204	232	40	7	6	8 600	7.60
HPN33	M165×3	165.5	209	238	40	7	6	8 900	7.90
HPN34	M170×3	170.5	215	244	41	7	6	9 400	8.40
HPN36	M180×3	180.5	227	256	41	7	6	10 300	9.15
HPN38	M190×3	191	239	270	42	8	7	11 500	10.5
HPN40	M200×3	201	251	282	43	8	8	12 500	11.5
HPN41	Tr205×4	207	256	288	43	8	8	12 800	12.0
HPN42	Tr210×4	212	262	294	44	8	9	13 400	12.5
HPN43	Tr215×4	217	267	300	44	8	9	13 700	13.0
HPN44	Tr220×4	222	273	306	44	8	9	14 400	13.5
HPN45	Tr225×4	227	280	312	45	8	9	15 200	14.5
HPN46	Tr230×4	232	285	318	45	8	9	15 500	14.5
HPN47	Tr235×4	237	291	326	46	8	10	16 200	16.0
HPN48	Tr240×4	242	296	330	46	9	10	16 500	16.0
HPN50	Tr250×4	252	307	342	46	9	10	17 600	17.5
HPN52	Tr260×4	262	319	356	47	9	11	18 800	19.0
HPN54	Tr270×4	272	330	368	48	9	12	19 800	20.5
HPN56	Tr280×4	282	341	380	49	9	12	21 100	22.0
HPN58	Tr290×4	292	353	390	49	9	13	22 400	22.5

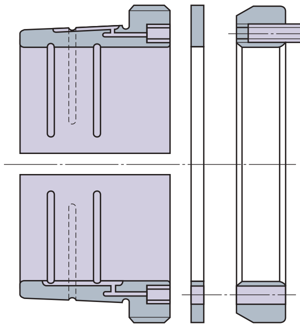
❶ Standard thread shapes and dimensions of the part numbers **HPN18** to **HPN40** are as per JIS B 0205-1 and JIS B 0205-4 (general purpose metric screw threads).
Standard thread shapes and dimensions of the part numbers **HPN41** to **HPN126** are as per JIS B 0216 (metric trapezoidal screw threads).

Part numbers	Dimensions mm						Plunger Travel Length max mm	Plunger Effective Area mm^2	Mass kg (approx.)
	Thread ❶ *d*	d_1	d_2	d_3	B	B_1			
HPN60	Tr300×4	302	364	404	51	10	14	23 600	25.5
HPN62	Tr310×5	312	375	416	52	10	14	24 900	27.0
HPN64	Tr320×5	322	387	428	53	10	14	26 300	29.5
HPN66	Tr330×5	332	397	438	53	10	14	27 000	30.0
HPN68	Tr340×5	342	408	450	54	10	14	28 400	31.5
HPN69	Tr345×5	347	414	456	54	10	14	29 400	32.5
HPN70	Tr350×5	352	420	464	56	10	14	29 900	35.0
HPN72	Tr360×5	362	431	472	56	10	15	31 300	35.5
HPN73	Tr365×5	367	436	482	57	11	15	31 700	38.5
HPN74	Tr370×5	372	442	486	57	11	16	32 800	39.0
HPN76	Tr380×5	382	452	498	58	11	16	33 500	40.5
HPN77	Tr385×5	387	459	504	58	11	16	34 700	41.0
HPN80	Tr400×5	402	475	522	60	11	17	36 700	45.5
HPN82	Tr410×5	412	486	534	61	11	17	38 300	48.0
HPN84	Tr420×5	422	498	546	61	11	17	40 000	50.0
HPN86	Tr430×5	432	508	556	62	11	17	40 800	52.5
HPN88	Tr440×5	442	519	566	62	12	17	42 500	54.0
HPN90	Tr450×5	452	530	580	64	12	17	44 100	57.5
HPN92	Tr460×5	462	541	590	64	12	17	45 100	60.0
HPN94	Tr470×5	472	552	602	65	12	18	46 900	62.0
HPN96	Tr480×5	482	563	612	65	12	19	48 600	63.0
HPN98	Tr490×5	492	573	624	66	12	19	49 500	66.0
HPN100	Tr500×5	502	585	636	67	12	19	51 500	70.0
HPN102	Tr510×6	512	596	648	68	12	20	53 300	74.0
HPN104	Tr520×6	522	606	658	68	13	20	54 300	75.0
HPN106	Tr530×6	532	617	670	69	13	21	56 200	79.0
HPN108	Tr540×6	542	629	682	69	13	21	58 200	81.0
HPN110	Tr550×6	552	639	693	70	13	21	59 200	84.0
HPN112	Tr560×6	562	650	704	71	13	22	61 200	88.0
HPN114	Tr570×6	572	661	716	72	13	23	63 200	91.0
HPN116	Tr580×6	582	671	726	72	13	23	64 200	94.0
HPN120	Tr600×6	602	693	748	73	13	23	67 300	100
HPN126	Tr630×6	632	726	782	74	14	23	72 900	110

Protective Plates

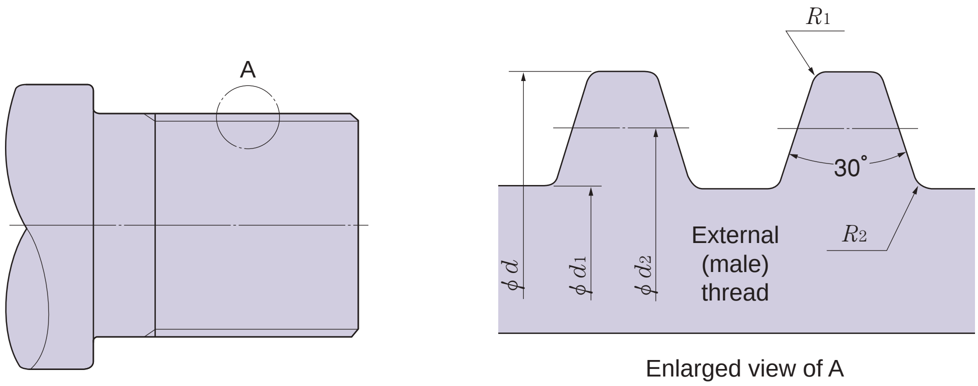
Series
ANP





Part numbers	Dimensions mm					Mass kg (approx.)	Applicable Locknut numbers	
	d_B	D_B	S	U	T_P		Series AN	Series ANL
ANP40	202	234	2	12	217	0.172	AN40SPB	—
ANP44	222	268	2.5	12	237	0.347	AN44SPB	ANL44SPB
ANP48	242	285	2.5	12	257	0.349	AN48SPB	ANL48SPB
ANP52	262	305	2.5	12	277	0.376	AN52SPB	ANL52SPB
ANP56	282	326	2.5	12	297	0.412	AN56SPB	ANL56SPB
ANP60	302	356	2.5	12	317	0.547	AN60SPB	ANL60SPB
ANP64	322	376	2.5	12	337	0.581	AN64SPB	ANL64SPB
ANP68	342	410	2.5	12	357	0.788	AN68SPB	ANL68SPB
ANP72	362	430	2.5	12	377	0.830	AN72SPB	ANL72SPB
ANP76	382	454	2.5	12	397	0.927	AN76SPB	ANL76SPB
ANP80	402	484	2.5	12	417	1.12	AN80SPB	ANL80SPB
ANP84	422	504	2.5	12	437	1.17	AN84SPB	ANL84SPB
ANP88	442	520	2.5	12	457	1.16	AN88SPB	ANL88SPB
ANP92	462	540	2.5	12	477	1.2	AN92SPB	ANL92SPB
ANP96	482	580	2.5	12	497	1.6	AN96SPB	ANL96SPB
ANP100	502	584	2.5	15	524	1.4	AN100SPB	ANL100SPB
ANP106	532	630	3	15	554	2.1	AN106SPB	ANL106SPB
ANP114	572	680	3	15	594	2.5	AN114SPB	ANL114SPB

Note : Applicable hydraulic sleeve nuts are listed on P36 to 43.



Enlarged view of A

Tr male thread allowable limit dimensions and rounding radii

Thread	Major Diameter d		Pitch Diameter d_2		Minor Diameter d_1		Rounded Peak Radius R_1	Rounded Valley Radius R_2
	Max	Min	Max	Min	Max	Min	Max	Max
Tr220×4	220.000	219.700	217.905	217.570	215.500	214.986	R0.125	R0.25
Tr240×4	240.000	239.700	237.905	237.570	235.500	234.986		
Tr260×4	260.000	259.700	257.905	257.570	255.500	254.986		
Tr280×4	280.000	279.700	277.905	277.570	275.500	274.986		
Tr300×4	300.000	299.700	297.905	297.570	295.500	294.986		
Tr320×5	320.000	319.665	317.394	317.019	314.500	313.925		
Tr340×5	340.000	339.665	337.394	337.019	334.500	333.925		
Tr360×5	360.000	359.665	357.394	356.994	354.500	353.894		
Tr380×5	380.000	379.665	377.394	376.994	374.500	373.894		
Tr400×5	400.000	399.665	397.394	396.994	394.500	393.894		
Tr410×5	410.000	409.665	407.394	406.994	404.500	403.894		
Tr420×5	420.000	419.665	417.394	416.994	414.500	413.894		
Tr430×5	430.000	429.665	427.394	426.994	424.500	423.894		
Tr440×5	440.000	439.665	437.394	436.994	434.500	433.894		
Tr450×5	450.000	449.665	447.394	446.994	444.500	443.894		
Tr460×5	460.000	459.665	457.394	456.994	454.500	453.894		
Tr470×5	470.000	469.665	467.394	466.994	464.500	463.894		
Tr480×5	480.000	479.665	477.394	476.994	474.500	473.894		
Tr500×5	500.000	499.665	497.394	496.994	494.500	493.894		
Tr530×5	530.000	529.625	526.882	526.457	523.000	522.351	R0.25	R0.5
Tr560×6	560.000	559.625	556.882	556.457	553.000	552.351		
Tr570×6	570.000	569.625	566.882	566.457	563.000	562.351		
Tr600×6	600.000	599.625	596.882	596.457	593.000	592.351		
Tr630×6	630.000	629.625	626.882	626.457	623.000	622.351		

- The values for the allowable limit dimensions above do not include thread shape errors or pitch errors (total cumulative errors). When manufacturing Tr threa the lower limit of the above allowable limit dimensions are to be used where possible for machining.

Note : These values were calculated with class 7e from JIS B 0217 (metric trapezoidal screw threads).

4. Handling

(1) Installation/removal of adapter sleeves using locknuts

Using adapters to mount bearings onto shafts makes installation and positioning easier, while maintaining the appropriate level of holding force needed. Incorrect installation methods may cause damage when running the bearings, so care is re during installation.

Withdrawal sleeves can be handled in the same way as adapters, however the following procedures mainly outline the handling method for adapters.

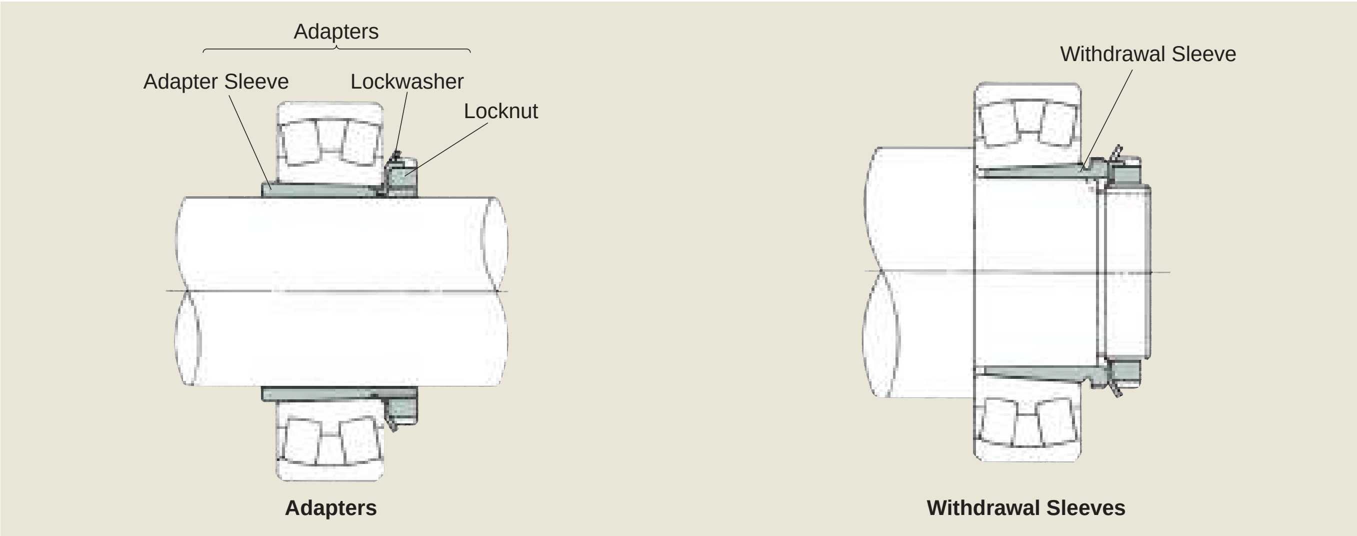


Fig. 1

1. Preparation

(1) Prepare the relevant tools and lubricants required for assembly work (see **Fig. 2**).

Fig. 2

(2) Verify the part number of the bearings and adapters being installed, and check that the adapter and dimensions are suitable for the shaft diameter.

(3) Clean the shafts that the adapters will be installed on.Check that the shaft diameter measurements are within the specified appropriate tolerance (see **Fig. 3**).

(4) Adapters have rust inhibitor applied to the surface. After removing the adapters from their packaging, wipe clean any oil using a clean cloth soaked in kerosene.

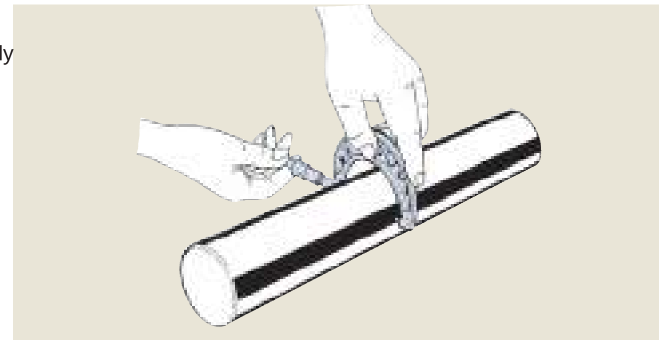


Fig. 3

(5) To prevent scoring and other damage caused by high surface pressures when fastening components, first apply lubricant containing molybdenum dioxide or extreme-pressure gear oil to the tapered surfaces of sleeves, threads, the side of nuts and other surfaces. Take care that no oil is applied between the shaft and adapter during this step.

If components are assembled immediately after cleaning and then fastened, the poor lubrication between the bearing and shaft contact surfaces as well as fastening threads may result in insufficient fastening caused by scoring on thread peaks before the specified level of fastening is achieved.

2. Installation

(1) When fitting the adapter to the shaft, use the appropriate wedge to open the split section of the adapter sleeve to make it easier to fit it to the shaft (see **Fig. 4**).

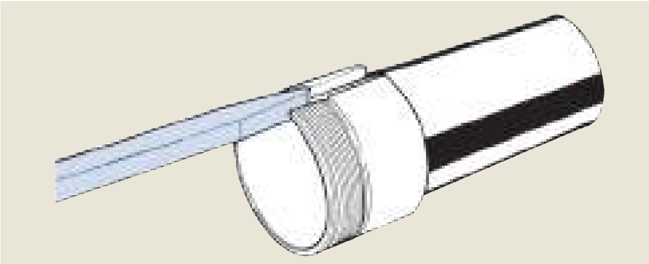


Fig. 4

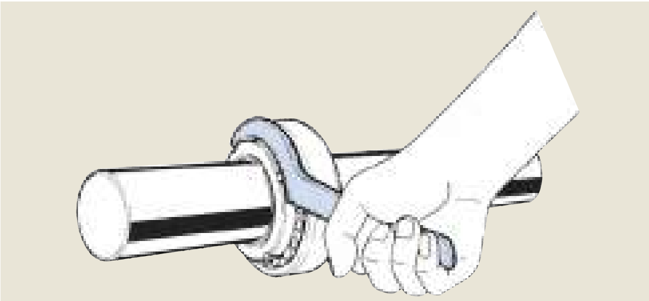


Fig. 5

(2) Using the hook spanner shown in **Fig. 5** makes it convenient to fasten the nut. If a hook spanner is not available, fasten the nut by aligning the end of a suitably sized rod with the notch in the nut and tapping with a hammer, as shown in **Fig 6**. Hitting it wildly may cause deformation of the notch in the nut or burrs to be formed, damaging the bearing.

Large nuts require a high fastening torque, and washers can be easily damaged when fastening nuts with washers still attached. Remove the washer first before fastening the nut. When using this method, remove the nut after the specified level of fastening has been achieved, fit the washer and fasten the nut again to its original position.

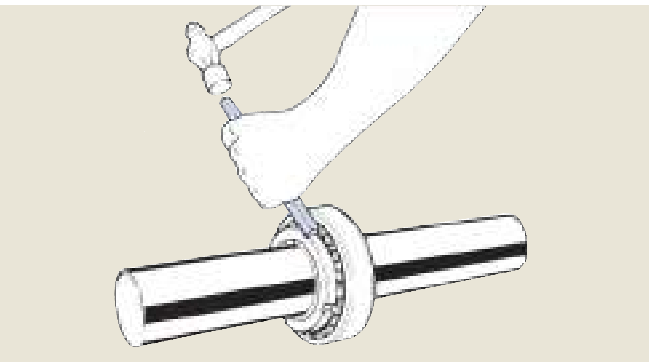


Fig. 6

(3) To check that the specified level of fastening has been achieved, measure how much the bearing radial internal clearance has changed before and after fastening (see **Fig. 7**), or measure the relative amount of axial movement between the adapter and bearing.

See the relevant "Ball and Roller Bearings Catalog" CAT. No. 2202 for details of these values.

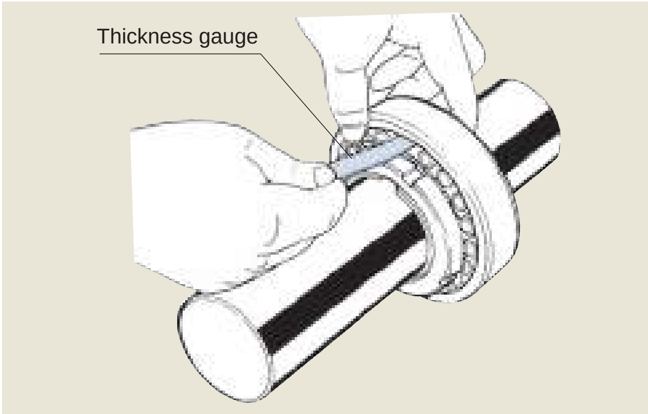
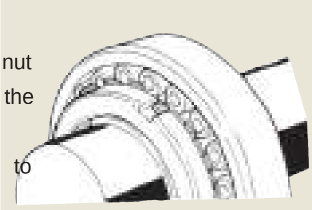


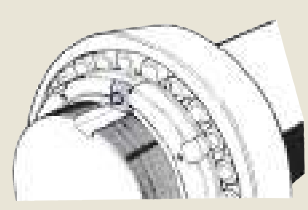
Fig. 7

(4) After fastening, always check that the specified level of fastening above has been achieved, and bend the washer securing tab into the notch in the nut (**Fig. 8**). For large nuts, use a clasp to secure the nut (see **Fig. 9**). When doing so, do not turn the nut backwards so that the tab is aligned with the notch.



Secured with washer tab

Fig. 8



Secured with clasp

Fig. 9

3. Removal

For adapters, first lift the washer tab that is bent into the notch in the nut, and use a hook spanner or rod and hammer to turn the nut to 3 times to loosen it. With the nut loosened, the bearing can be removed easily by aligning the rod against the side of the nut and pushing in the direction for removing the sleeve (see **Fig. 10**).

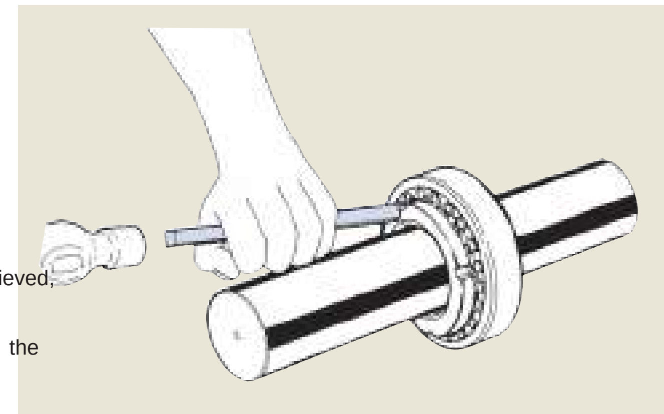


Fig. 10

(2) Installation/removal of bearings using hydraulic sleeves

Using the pressure from a hydraulic pump when installing tapered bore bearings makes it easy to install bearings without applying exc force. When using either a hydraulic adapter or hydraulic withdrawal sleeves, the eight fastening bolts are to be fastened with equal for Hydraulic adapters are to be handled in the same way as hydraulic withdrawal sleeves, however the following procedures mainly outlin handling method for hydraulic withdrawal sleeves.

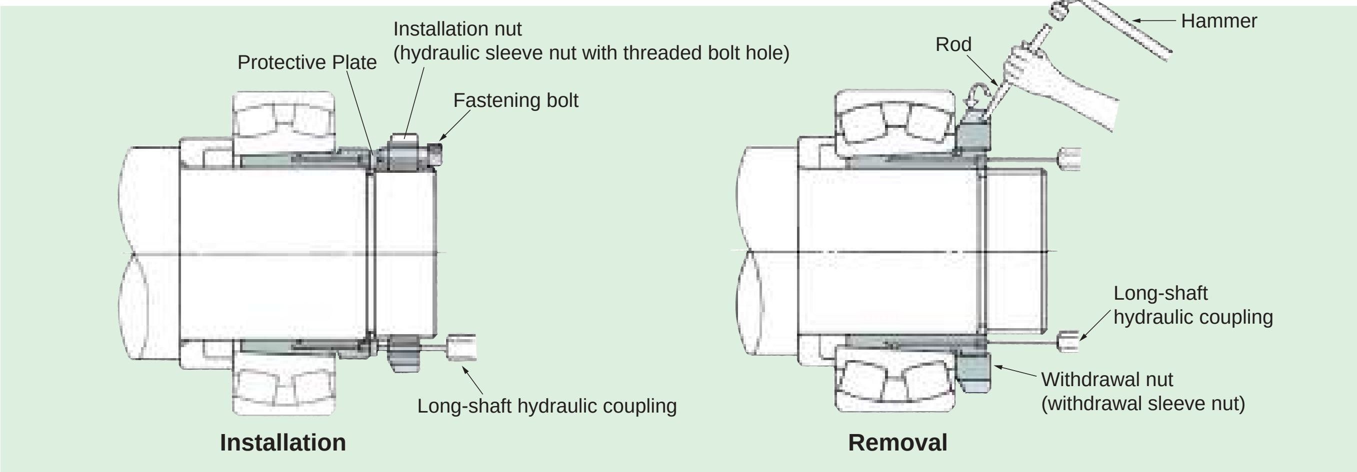


Fig. 11

1. Installation

(1) Preparation

In addition to the items shown in **Fig. 2** on P. 55, prepare a hydraulic pump, hydraulic sleeve nut, protective plate and hexagonal bolts (see **Fig. 12** and **13**).

Set the hydraulic pump to a pressure between 35 to 70 MPa (350 to 700 kgf/cm², 5000 to 10000 lbf/in²) to suit the specific application.

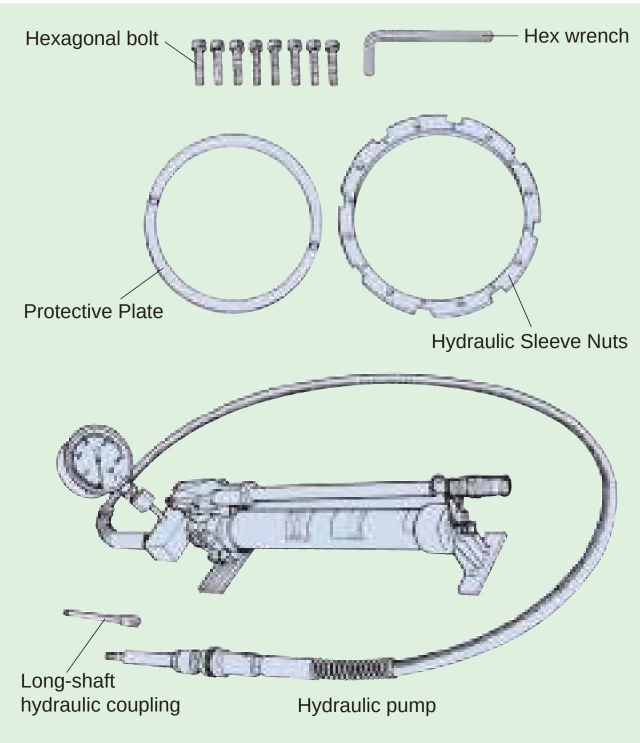


Fig. 12

(2) Install the bearing and hydraulic withdrawal sleeve (see **Fig. 13**).
Next, set protective plates that suit the shaft they are being mounted to, to both ends of the hydraulic withdrawal sleeve.

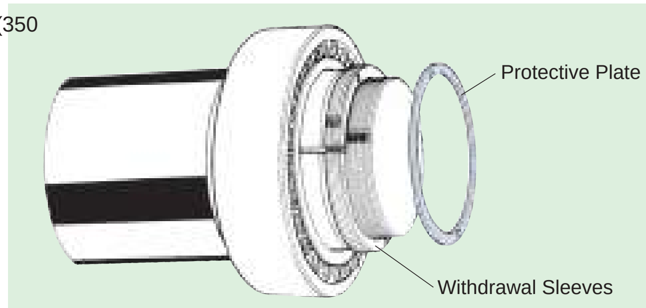


Fig. 13

(3) Prepare an installation nut that suits the shaft it is being mounted to. First assemble fastening bolts (×8) that have been applied with molybdenum dioxide to the installation nut (see **Fig. 14**).

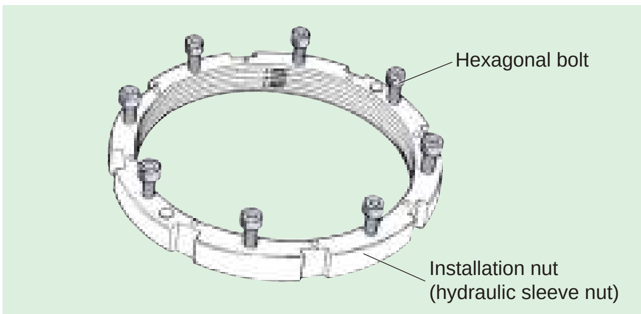


Fig. 14

(4) Check that the holes in the hydraulic withdrawal sleeve, protective plate and installation nut are aligned along the same shaft, and connect the hose from the long-shaft hydraulic coupling and hydraulic pump (see **Fig. 15**).

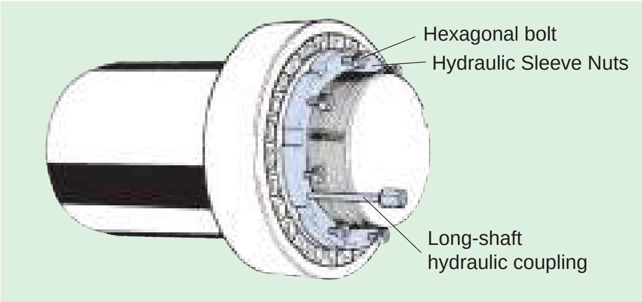


Fig. 15

(5) Increase the hydraulic pump pressure while tightening the fastening bolts with a spanner and measure the bearing radial internal clearance with a thickness gauge, and tighten the bolts evenly until reaching the specified mounted clearance (see **Fig. 16**).
Remove the nut and bolt, and secure with the specified washer or clasp.

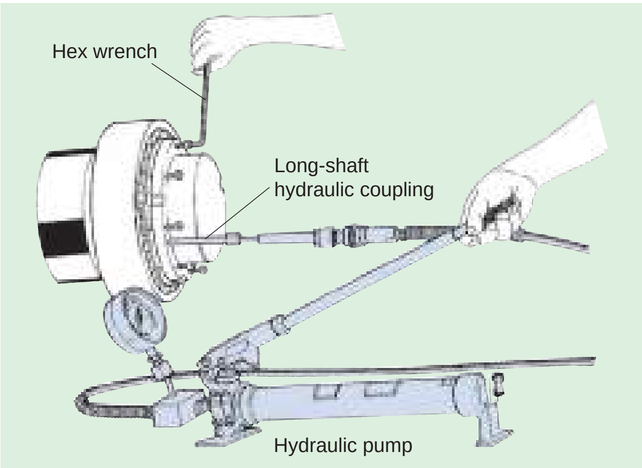


Fig. 16

2. Removal

(1) Preparation

Prepare a hydraulic pump, long-shaft hydraulic coupling, withdrawal nut, rod and hammer (see **Fig. 17**).

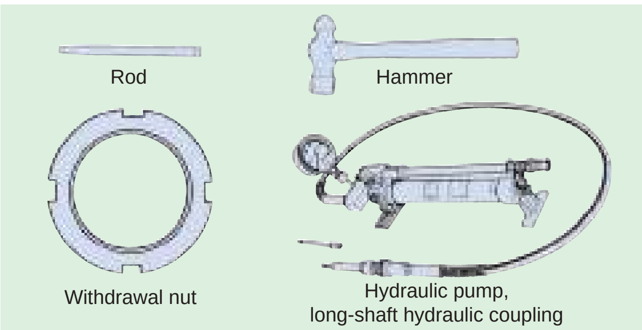


Fig. 17

(2) Prepare a withdrawal nut that suits the hydraulic withdrawal sleeve, and install it to the thread of the hydraulic withdrawal sleeve (see **Fig. 18**).

(3) Set the long-shaft hydraulic coupling to the lubrication port at the end of the hydraulic withdrawal sleeve (see **Fig. 19**).

(4) Connect the hose from the hydraulic pump to the long-shaft hydraulic coupling (see **Fig. 19**).

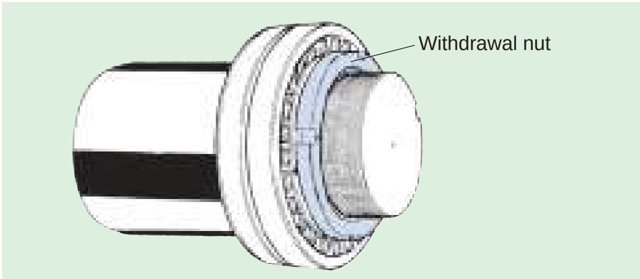


Fig. 18

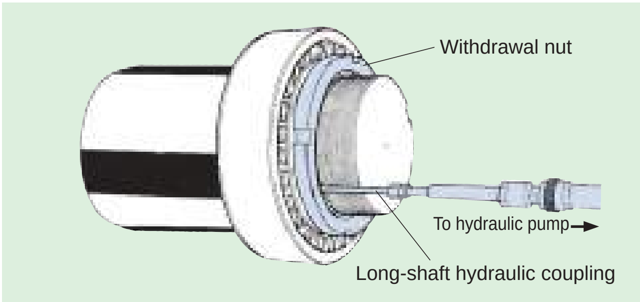


Fig. 19

(5) Turn the withdrawal nut using the pressure from the hydraulic pump, and remove the hydraulic withdrawal sleeve (see **Fig. 20**).

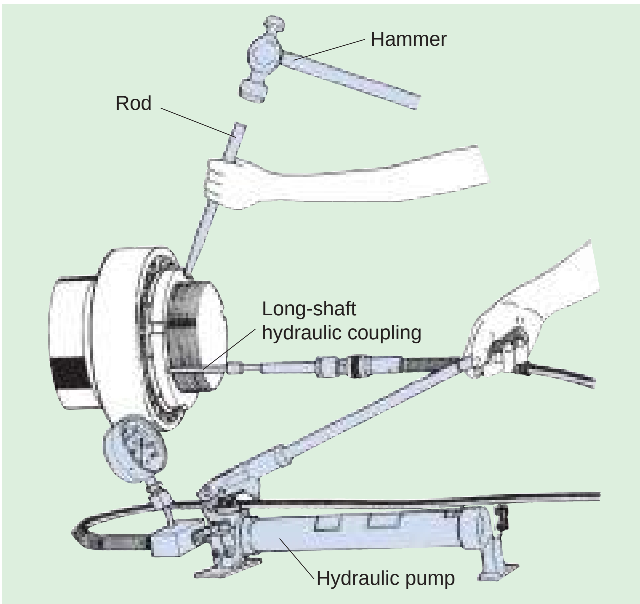


Fig. 20

Tap the four notches in the withdrawal nut using the rod and hammer while applying pressure from the hydraulic pump, and remove the hydraulic withdrawal sleeve.

Example of hydraulic sleeve usage

Bearing installation

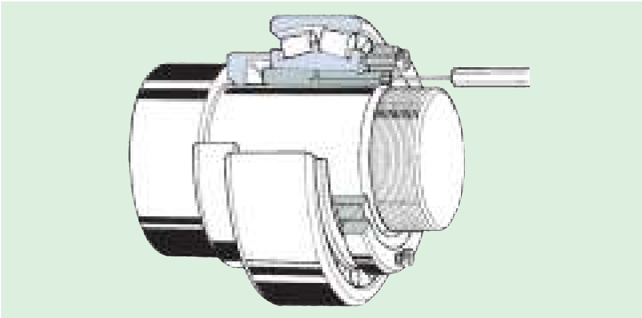


Fig. 21 Hydraulic adapter

Fasten the bolt of the hydraulic sleeve nut and install the bearing.

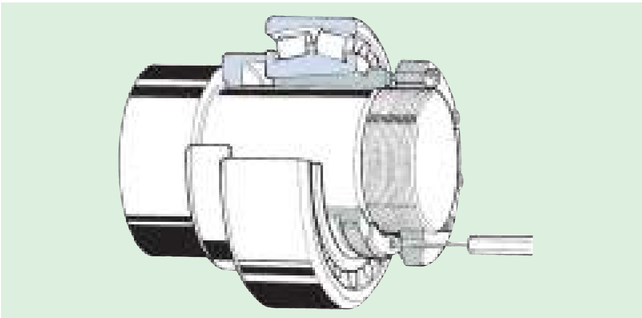


Fig. 22 Hydraulic withdrawal sleeve

Fasten the bolt of the hydraulic sleeve nut and install the bearing through the protective plate.

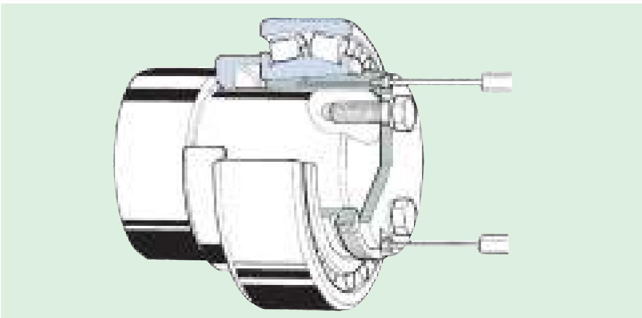


Fig. 23 Hydraulic withdrawal sleeve

Install the bearing through the end plate by fastening the bolt at the end of the shaft.

Bearing removal

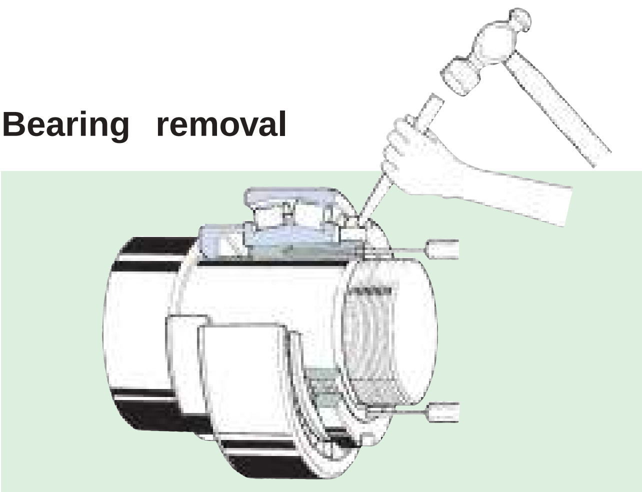


Fig. 24 Hydraulic withdrawal sleeve

Tap the withdrawal sleeve nut with a rod and hammer, and remove the bearing together with the withdrawal sleeve.

(3) Installation/removal of bearings using hydraulic nuts

Installing tapered bore bearings directly onto shafts or using adapters or withdrawal sleeves and removing them from shafts requires higl pressure forces and pulling forces. Using hydraulic nuts prevents excessive force from being applied that would damage shafts and bearin while applying large, equal forces for installation and removal work.

Adapter sleeves are to be handled in the same way as withdrawal sleeves, however the following procedures mainly outline the handlin method for withdrawal sleeves.

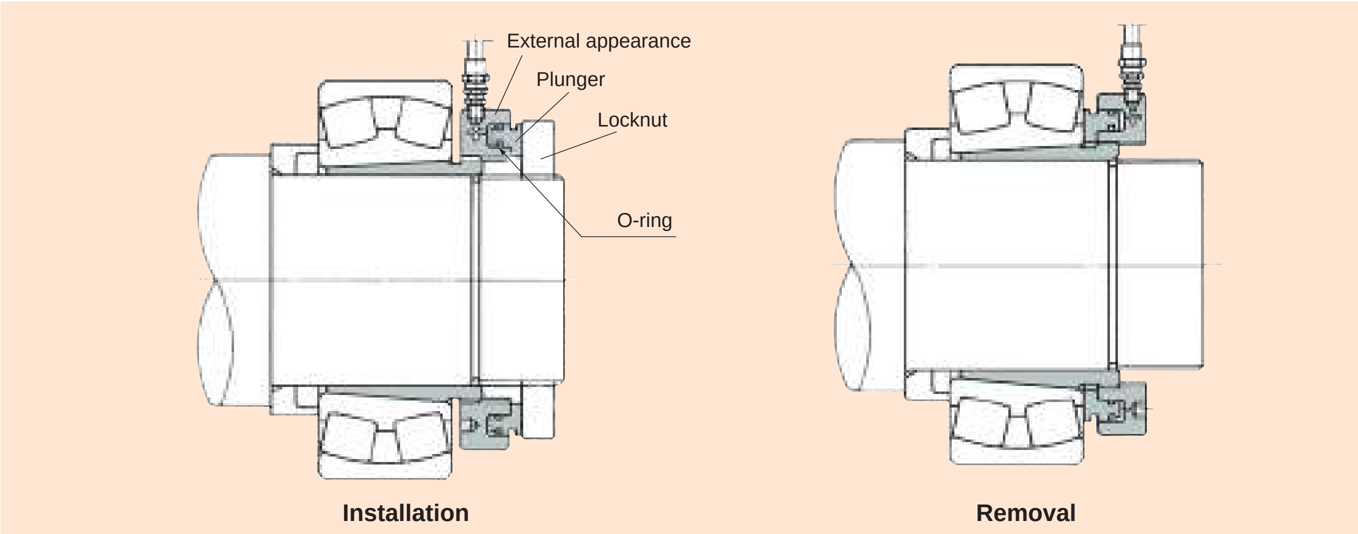


Fig. 25

1. Preparation

Prepare the relevant tools and hydraulic pumps required for assembly and removal work (see **Fig.** P. 55). Other precautions are the same as those listed under 1. Preparation on P. 55.

2. Confirmation

Check each boundary dimension of parts such as bearings, hydraulic nuts, locknuts and withdrawal sleeves (see **Fig. 26**, **27**, **28**).

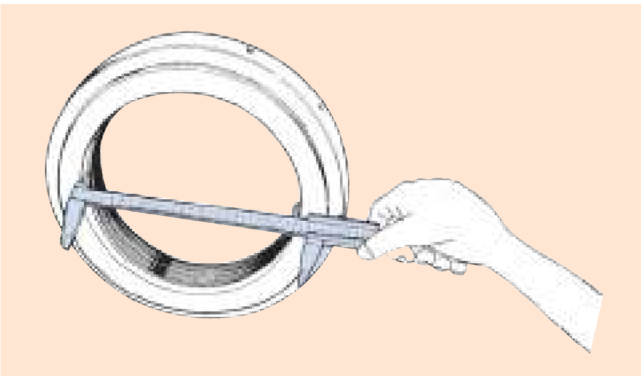


Fig. 26

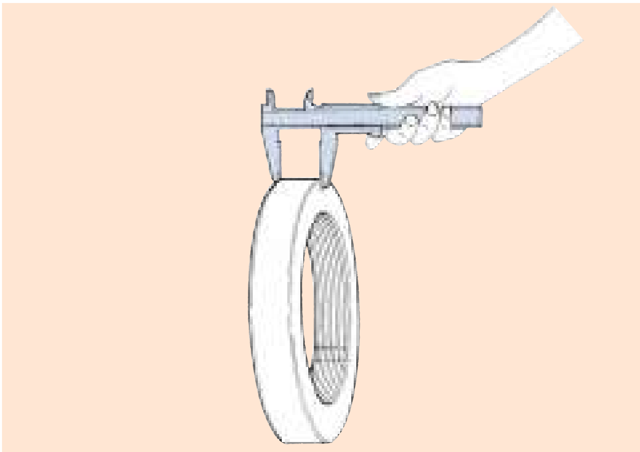


Fig. 27

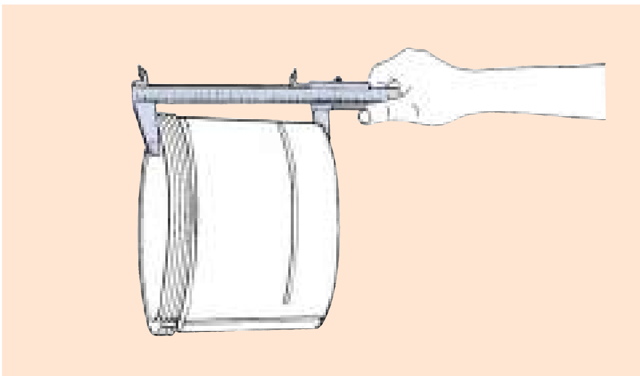


Fig. 28

3. Installation

(1) With the bearing moving free before installation (before fastening), measure the radial internal clearance with a thickness gauge (see **Fig. 29**). Measure the bearing clearance at three or more points around the bearing, and take the average value.

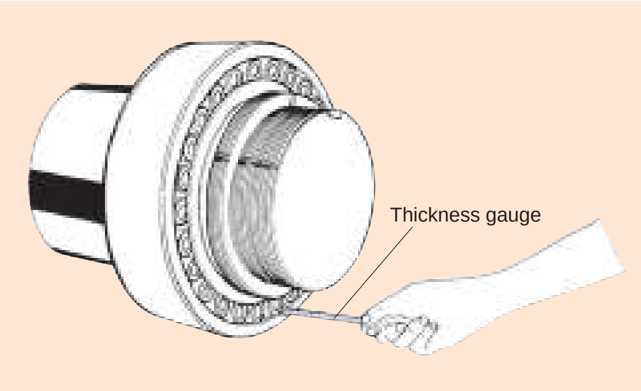


Fig. 29

(2) After installing the hydraulic nut, install a locknut that suits the installation shaft as shown in **Fig. 30**.

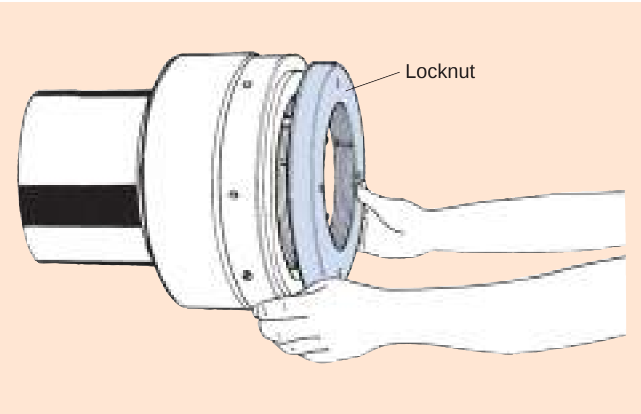


Fig. 30

(3) Connect the hose from the hydraulic pump to the hydraulic nut using a hydraulic coupling (see **Fig. 31**).

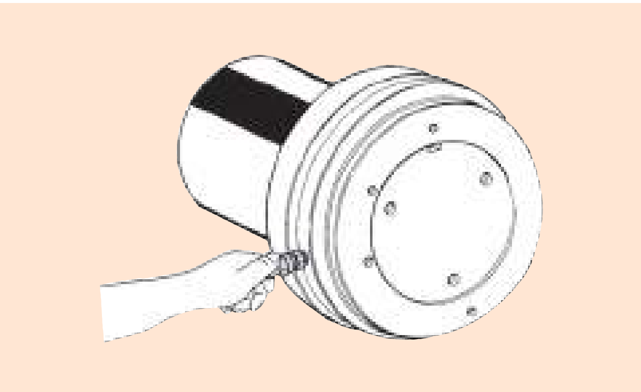


Fig. 31

(4) Measure the bearing radial internal clearance with a thickness gauge, and increase the hydraulic pump pressure until reaching the specified mounted clearance (see **Fig. 32**).

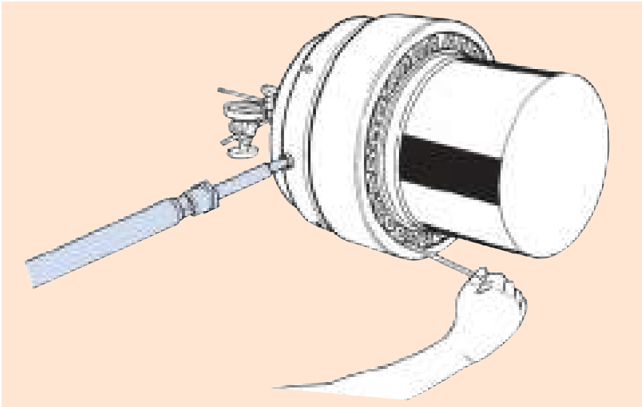


Fig. 32

(5) Remove the locknut and hydraulic nut, set a washer that suits the installation shaft, fasten the shaft nut and bend the washer tab into the notch in the nut to secure it. For large nuts, use a clasp to secure the nut (see **Fig. 33**).

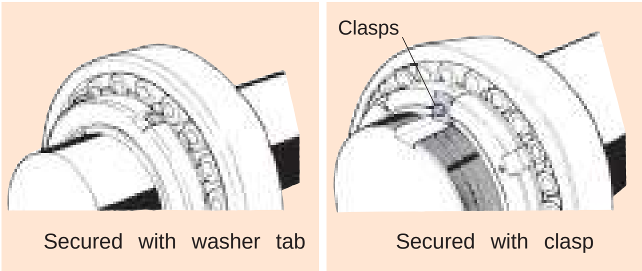


Fig. 33

4. Removal

Install a hydraulic nut to the thread of the withdrawal sleeve, and remove the withdrawal sleeve from the bearing using the hydraulic pump pressure (see **Fig. 34**). When doing so, install the bearing so that it makes contact with the plunger side of the hydraulic nut.

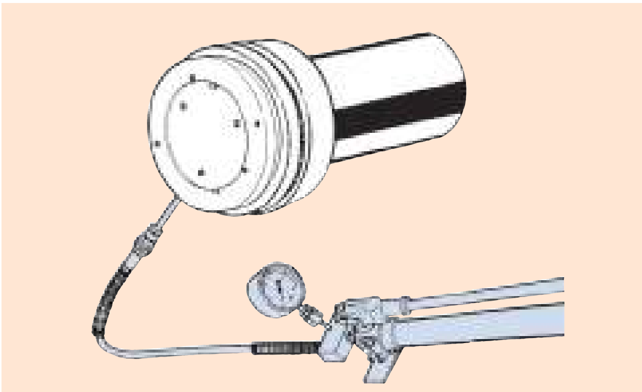


Fig. 34

Example of hydraulic nut usage

Bearing installation

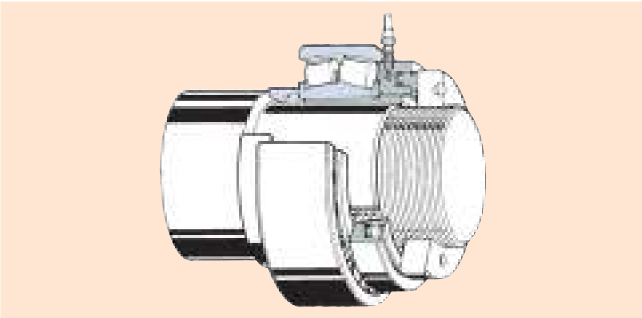


Fig. 35 Using a locknut

Screw the hydraulic nut onto the withdrawal sleeve, turn the locknut on the shaft thread until it makes contact with the plunger, and increase pressure to press the sleeve.

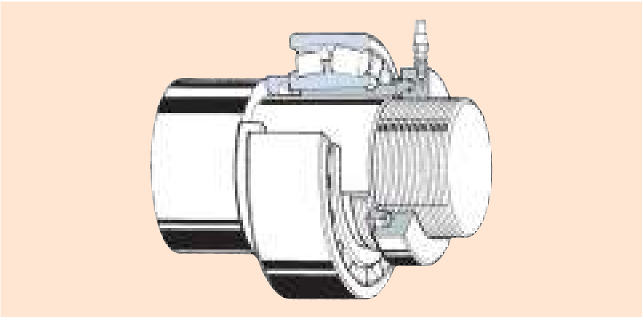


Fig. 36 Using the installation shaft thread

Turn the hydraulic nut on the shaft thread so that the plunger makes contact with the side of the withdrawal sleeve, and increase pressure to press the sleeve.

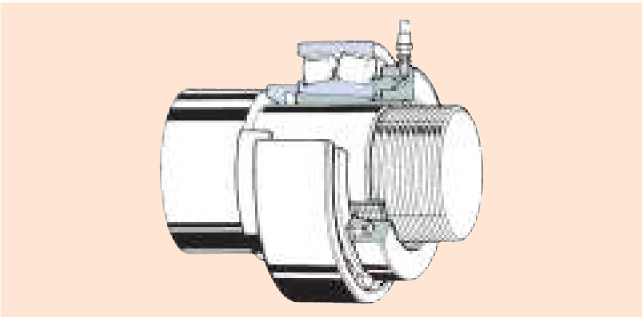


Fig. 37 Using the adapter sleeve thread

Turn the hydraulic nut on the adapter sleeve so that the plunger makes contact with the side of the bearing, and increase pressure to press the bearing.

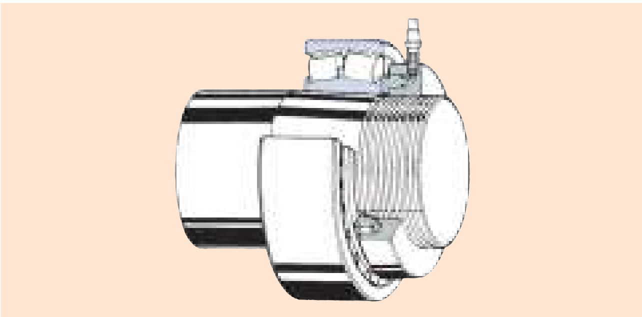


Fig. 38 Using the tapered bearing thread

Turn the hydraulic nut on the shaft thread so that the plunger makes contact with the side of the bearing, and increase pressure to press the bearing.

Bearing removal

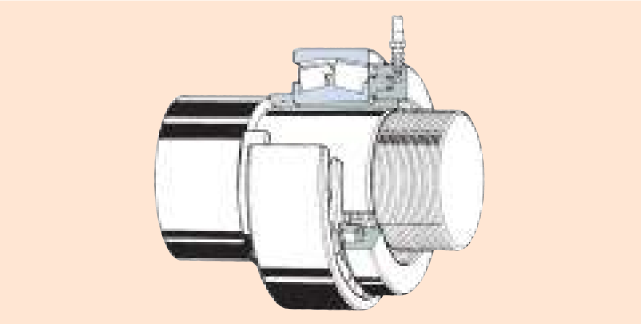


Fig. 39 Using the withdrawal sleeve thread

Turn the hydraulic nut on the withdrawal sleeve so that the plunger makes contact with the side of the bearing, and increase pressure to pull out the withdrawal sleeve.

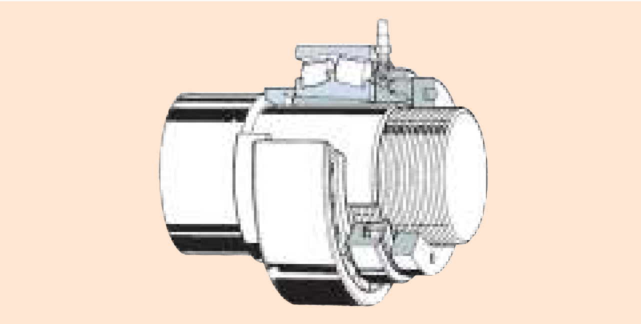


Fig. 40 Using a locknut

Install the hydraulic nut to the adapter sleeve (maintain clearance between the bearing and the side of the hydraulic nut), turn the locknut until it makes contact with the locknut, and increase pressure to press the sleeve..

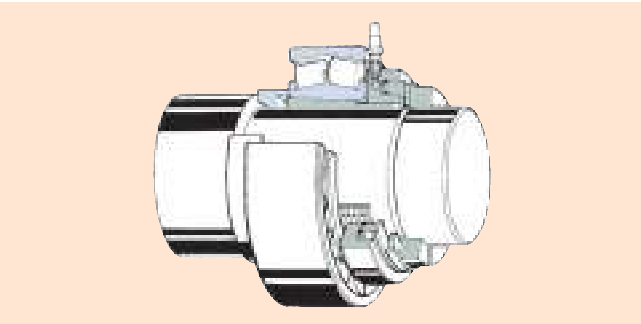


Fig. 41 Using a stop ring

Turn the hydraulic nut on the adapter sleeve (maintain clearance between the bearing and the side of the hydraulic nut), and secure the stop ring with the shaft groove. Increase pressure to press the sleeve through the stop ring.

For New Technology Network

NTN corporation

Large Size, Long Operating Life Bearing - EA type

CAT. No. 3024/E

NTN Large Size, Long Life Bearings - EA type

A newly developed special heat treatment allows these bearings to ensure longer operating life under severe operating conditions!!

EA bearings have a particularly strong advantage by providing longer operating life due to their improved crack fatigue strength, wear strength and peeling resistance characteristics, especially when the lubricant is contaminated and also when the lubricant is clean. Accordingly, these bearings can be used at steel rolling mills and casting facilities where poor lubrication, vibrations and impact loads often exist. The EA bearings provide advantages due to their compact design, longer operating life, and longer intervals between maintenance and inspections. They can be used also for other applications with heavy loads and severe lubricating conditions such as construction and industrial machines.

1 Performance

(Operating life and strength comparison of EA bearings against standard carburized bearings)

(1) Operating life using lubricant mixed with foreign matter is: More than 5 times.
(2) Operating life using clean lubricant is: More than 2 times.
(3) Peeling strength: 3 times. (Rate of incidence is 1/3.)
(4) Wear strength: 2 times. (Wear rate is 1/2.)
(5) Fret strength: 1.3 times.(Wear rate is about 80%.)
(6) Operating life when fitting stress is high is: 3 times.
(7) Operating life against crack fatigue is: 1.5 times.

2 EA bearings

The analysis of bearing damage over many years confirms that most damages to large size bearings are caused by flaking, which starts from indentations made by foreign particles, from peeling caused by insufficient lubrication, from smearing and from cracks originating from those spots on the surface.

EA bearings are produced by a special heat treating process of carburized steel. This process is especially used for larger size bearings. The heat treatment combines carburization and nitriding. This process is an important achievement which strengthens the surface layer and provides a longer operating life when the damage originates on the surface. (Refer to **Fig.1**) The special heat treatment is applied to tapered roller bearings, cylindrical roller bearings and self-aligning spherical roller bearings. Consult **NTN** Corporation for available bearings. Large bearings are identified by the prefix EA. Small size tapered roller bearings use the prefix ETA.

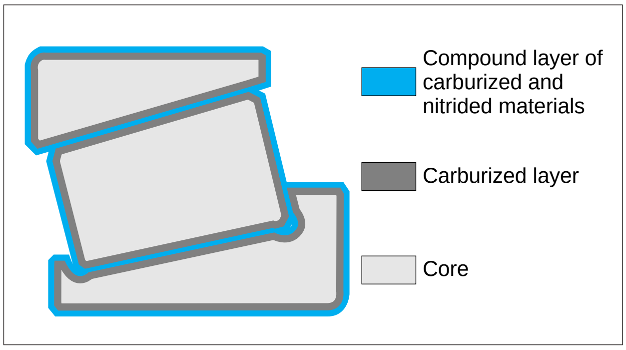


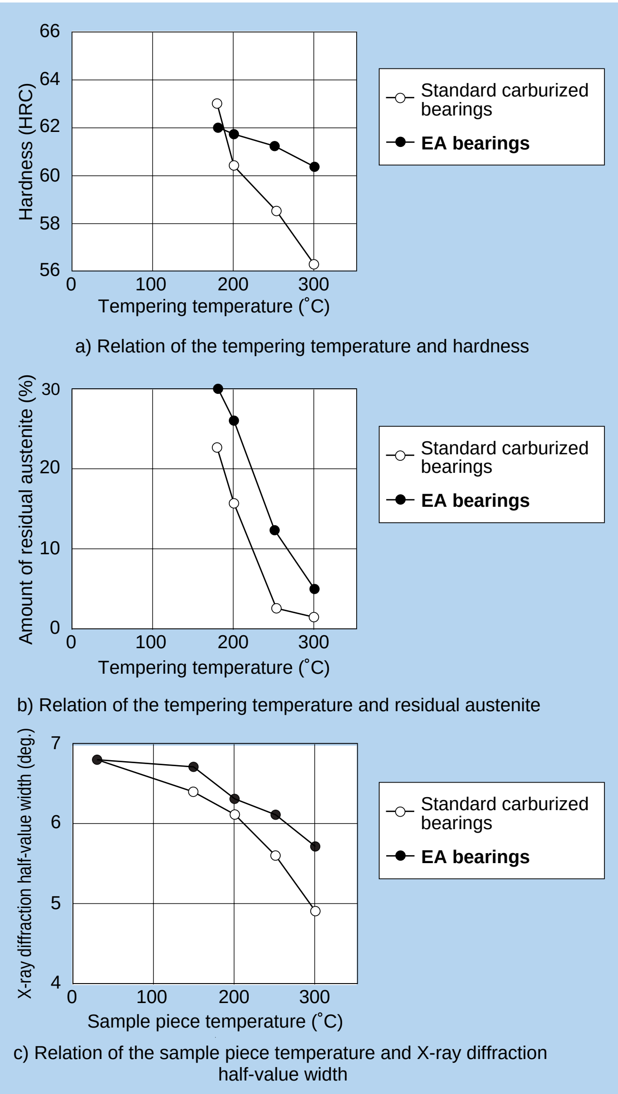
Fig. 1

3 Long Operating Life Theory

EA bearings are designed to form the dispersion of proper amounts of residual austenite and carbides in the surface layer through the special heat treating process. This also improves the thermal stability of the structure. Heat is usually generated on the raceway surface due to rolling friction and sheering stress. For standard bearings this may often change the characteristics of the material (i.e. its sheering stress, hardness and microstructure) and cracks may occur due to re-tempering and fatigue. Consequently, the peculiar characteristics of the EA bearing, namely the temper resistance which will not change the material quality due to tempering, and the surface toughness which will resist cracks and elongation, are effective against the types of damage which start from points on the surface. Adequate amounts of residual austenite, obtained by standard carburization, prevent cracks and their growth when through the manufacturing operations the bearing material strengthens and the surface layer becomes tougher, but this material on the surface is unstable when heated. Because of this fact, compounding nitrogen under suitable conditions and by permeating nitrogen, the residual austenite and martensite matrix of EA bearings is heat stabilized. This maintains the material quality while extracting the appropriate amount of carbide to increase the fatigue strength without lowering the crack strength.

Fig.2 shows the change of hardness of the standard carburized bearing and the carburized EA bearing by tempering, the change of residual austenite by tempering and the relation of matrix strength at high temperature measured by X-ray diffraction half-value width. Compared with the standard process, the special heat treatment provides high resistance to re-tempering and stability of residual austenite.

Fig.3 shows the change of the material quality on the bearing race surface when a lubricant mixed with foreign matter is used in the rolling fatigue test. The EA bearings show a longer operating life since their X-ray diffraction half value width (martensite hardness) and the residual austenite on the surface are resistant to change.



a) Relation of the tempering temperature and hardness

b) Relation of the tempering temperature and residual austenite

c) Relation of the sample piece temperature and X-ray diffraction half-value width

Fig.2 Material stability comparison for standard carburized bearings with EA bearings

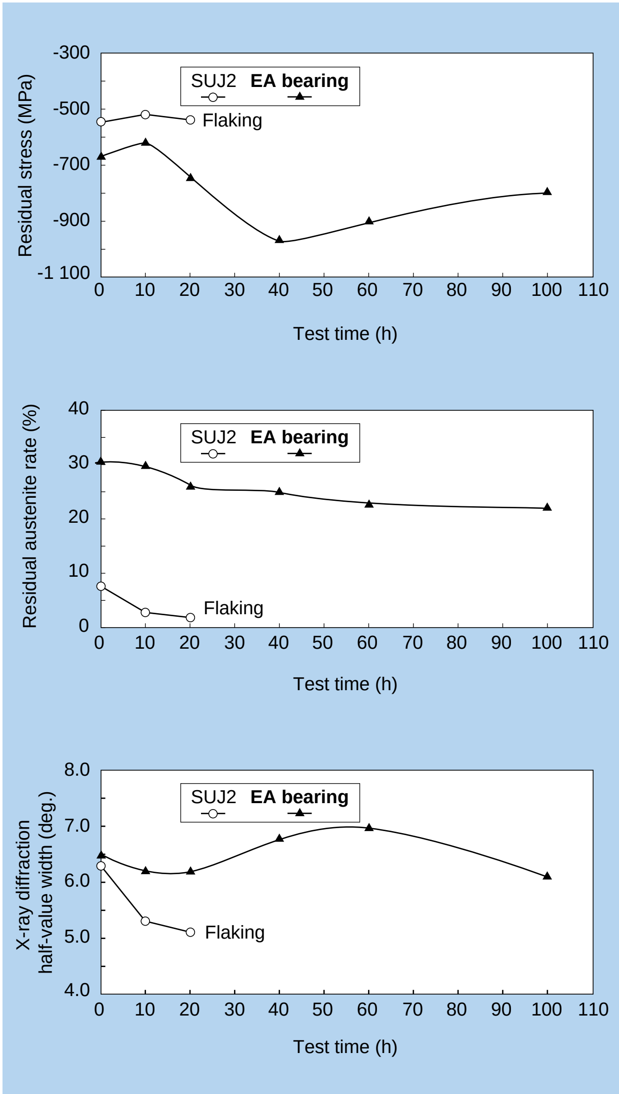


Fig.3 Material quality change on the surface when lubricant mixed with foreign material is used in the rolling fatigue test

4 Various Strength Characteristics

(1) Operating life when lubricant mixed with foreign matter is used.

Fig.4,5 show the durability results of comparison tests with small tapered roller bearings when lubricant mixed with foreign matter is used.
EA bearings display a life span of more than 5 times compared to standard carburized bearings regardless of test conditions.

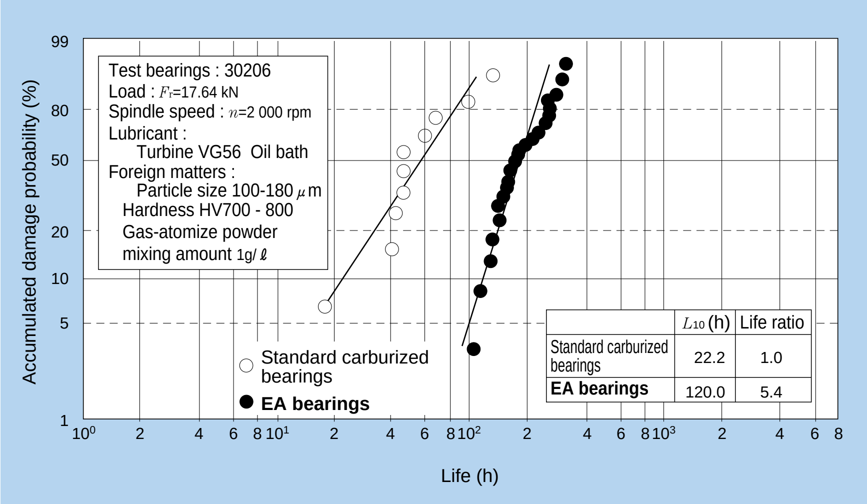


Fig.4 (Test conditions #1) Operating life results when lubricant mixed with foreign matter is used.

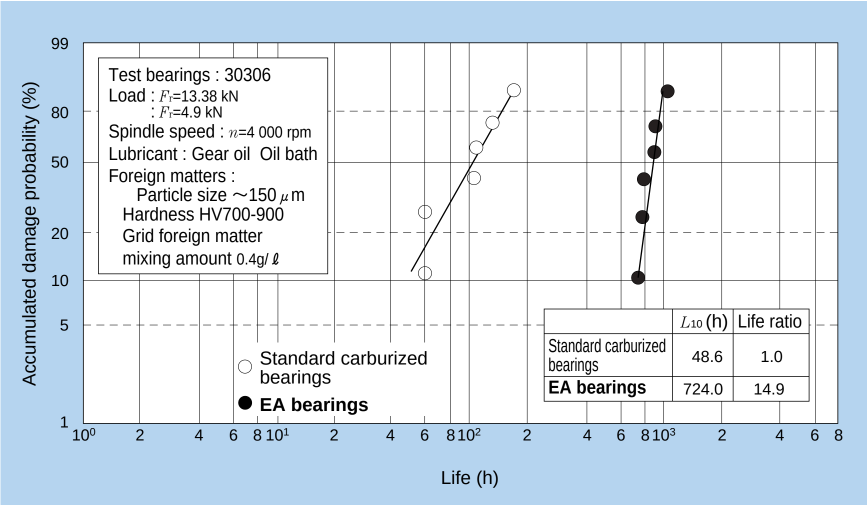


Fig.5 (Test conditions #2) Operating life results when lubricant mixed with foreign matter is used.

(2) Operating life when clean lubricant is used.

To compare the rolling fatigue strength under severe contact stress conditions, the operating life test between the standard carburized bearings and EA bearings was performed. **Fig.6** shows the result. The tests show that the EA bearings have a longer operating life than standard carburized bearings.

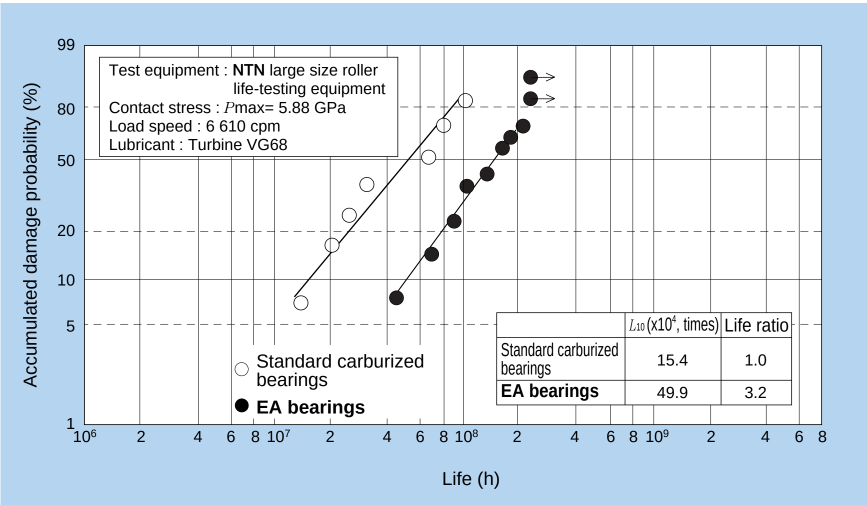


Fig.6 Operating life test results under severe stress condition with clean lubricant.

(3) Peeling Strength

Peeling damage occurs when lubrication film formation on rolling elements is insufficient and metal to metal contact takes place. It often occurs due to slippage and due to deterioration of the lubricating oil when infiltration of a sludge, water and foreign matter exists. **Fig.7** shows the strength comparison in relation to the damage. EA bearings have an incidence rate of about 1/3 compared with standard carburized bearings.

(4) Wear Resistant Strength

The sliding contact areas such as roller bearing ribs are subject to metal to metal abrasive wear in harsh lubricating conditions. The wear resistant strength has been measured using the **NTN** wear test unit. As indicated in **fig.8**, the wear trace depth of the special heat treated EA bearing has been roughly halved compared to that of the standard carburized bearings. Also as **fig.9** indicates, the EA bearing has superior fretting wear resistant characteristics.

(5) Crack Fatigue Strength

Cracking causes the destruction of the bearing. Under very severe operating conditions it is possible that this type of damage may occur. As shown in **Table 1** and **2**, EA bearings have a longer operating life than the standard carburized bearings when the results from rotation crack fatigue strength tests as well as the rolling crack fatigue strength tests with heavy press fits are compared.

Table 1 Ring test results for rotation crack fatigue strength

Bearing	L_{10}(h)×10^4 times	L_{10} ratio
Standard carburized bearings	6 670	1.0
EA bearings	9 020	1.4

Test conditions

Test unit :**NTN** Ring rotation crack fatigue test unit
Load :9.8kN
Load speed :8 000 cpm

Table 2 Test results for rolling crack fatigue strength with heavy ring press fit

Bearing	L_{10}(h)×10^4 times	L_{10} ratio
Standard carburized bearings	2 030	1.0
EA bearings	6 240	3.1

Test conditions

Test unit :**NTN** line contact type rolling life test unit
Fitting stress :425 MPa on raceways
Load :4.9 kN
Load speed :6 120 cpm

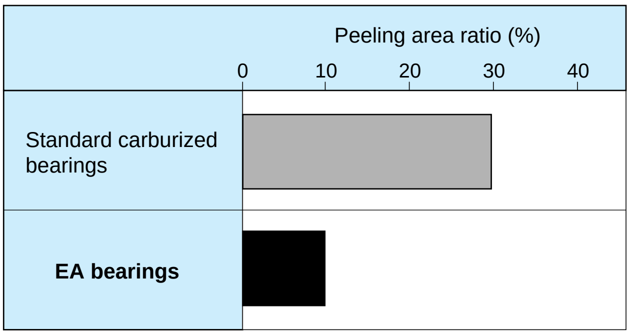


Fig.7 Results of surface strength using peeling strength test

Test conditions
Contact stress :P_{max}=3 GPa
Spindle speed :1 000 rpm
Lubricant :Turbine VG68
Total rotations :5x10^6 times

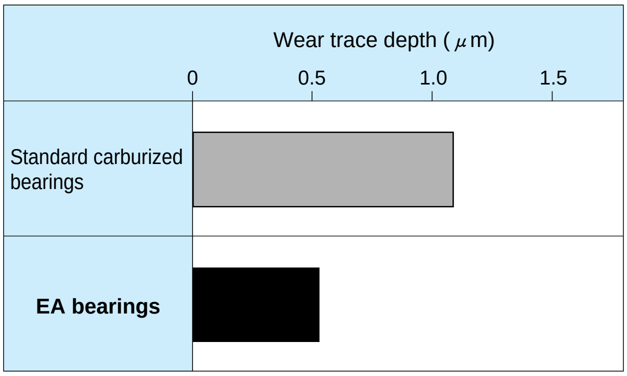


Fig.8 Results of wear test using NTN test unit

Test conditions
Contact stress :210 MPa P_{max}=210 MPa
Spindle speed :2 000 rpm
Lubricant :Turbine VG68
Test time :10 min.

Fig.9 Results of fretting wear test

Test conditions
Contact stress :2.5 GPa
Amplitude :0.48 mm
Number of vibrations :30 Hz
Lubricant :Turbine VG68
Test time :8 hours

NTN®

NTN Bearings for Wind Turbines

風力発電装置用軸受

CAT. No. 8405-Ⅱ/JE

Wind Power – Our Energy

Solutions for the next generation of wind turbines

Wind turbine technology continues to demand increased efficiency, reliability and longer service life of equipment. Innovative bearing designs from **NTN** are instrumental in these improvements and in spreading the use of wind technology for electrical power generation. Our products are built with three concepts in mind: harmony with the natural environment, improved energy conservation and contribution to international society.

風力発電技術には、効率、信頼性、耐用年数への限りない進化が求められています。「自然環境との調和」、「エネルギー資源の保護」、「国際社会への貢献」を目指す**NTN**の軸受は、これらの要求と風力発電の普及に貢献しています。

風力発電 — 私達のエネルギー

次世代風力発電装置への提案

Rotor Mainshaft Bearings

Meeting demanding requirements with a proven track record and reliability

主軸受

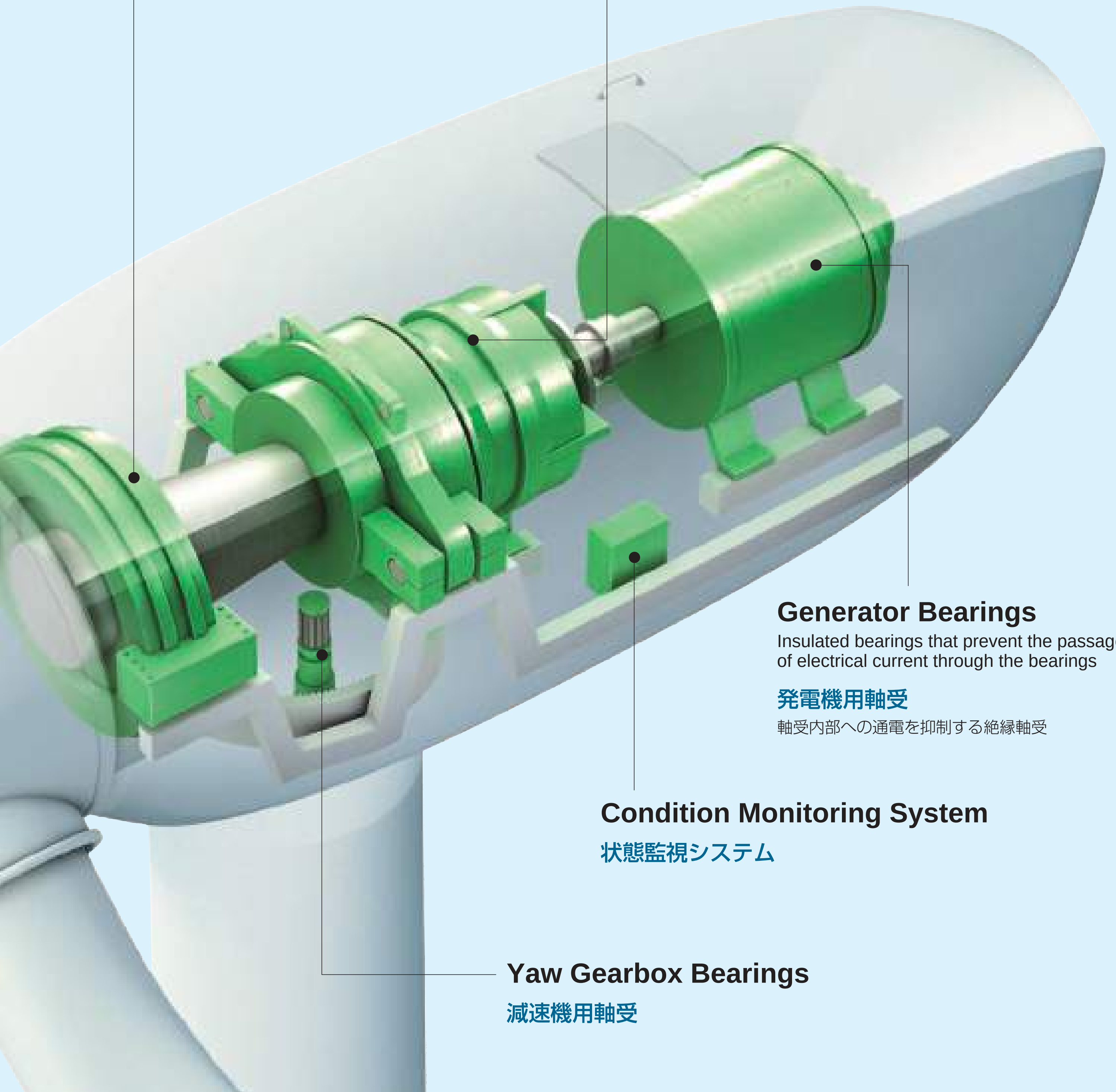
豊富な実績と確かな信頼性で多様なニーズに対応

Gearbox Bearings

Life-extending technologies to handle even the most severe application conditions

増速機用軸受

過酷な使用条件にも対応する長寿命化技術



Generator Bearings

Insulated bearings that prevent the passage of electrical current through the bearings

発電機用軸受

軸受内部への通電を抑制する絶縁軸受

Condition Monitoring System

状態監視システム

Yaw Gearbox Bearings

減速機用軸受

Rotor Mainshaft Bearings 主軸受

Meeting demanding requirements with a proven track record and reliability

豊富な実績と確かな信頼性で多様なニーズに対応

Various types of bearings are used for the rotor mainshaft.
NTN provides bearings with high reliability and long service lives based on the application conditions.
Additionally **NTN** is capable of providing large-bore bearings for offshore wind turbines with capacities greater than 5 MW.

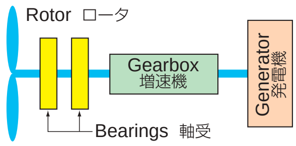
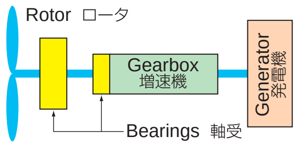
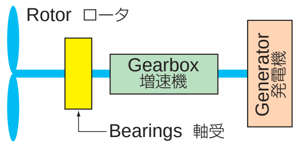
主軸受には様々な軸受形式が採用されます。
NTNは、使用条件に応じて信頼性の高い長寿命な軸受を提供します。
また、5MW以上の洋上風力発電装置用大形軸受も対応可能です。

Spherical roller bearings
自動調心ころ軸受

Cylindrical roller bearings
円筒ころ軸受

Double-row tapered roller bearings
複列円すいころ軸受

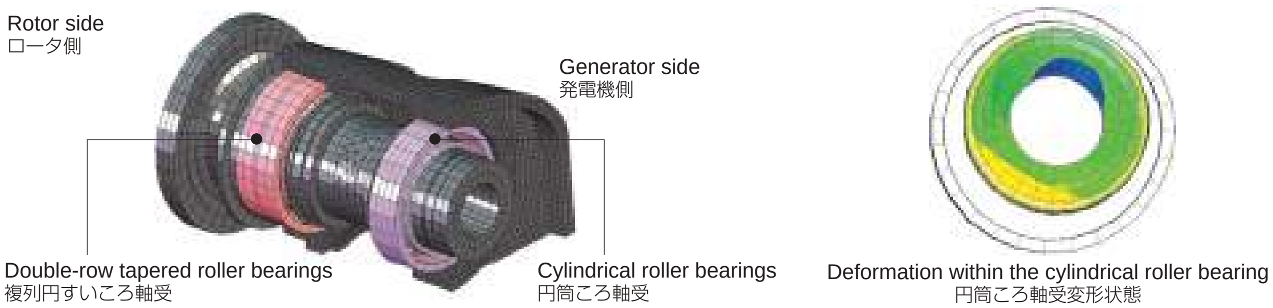
Typical Mainshaft bearing arrangements 主な主軸受配列

Turbine Layout 配列			
Rotor side bearings ロータ側軸受	Spherical roller bearings 自動調心ころ軸受 Cylindrical roller bearings 円筒ころ軸受	Spherical roller bearings 自動調心ころ軸受	Double-row tapered roller bearings 複列円すいころ軸受
Generator side bearings 発電機側軸受	Spherical roller bearings 自動調心ころ軸受 Double-row tapered roller bearings 複列円すいころ軸受	(Cylindrical roller bearings) （円筒ころ軸受）	

Representative rotor shaft bearing analysis 主軸受解析例

Using structural analysis of the bearings, housing, frame, and other components of the turbine, **NTN** can design highly reliable bearing internal geometry, which accounts for component deformation.

軸受や軸箱、架台などの軸受周辺部品を含めた構造解析により、変形を考慮した信頼性の高い軸受内部設計を実現。



Representative rotor shaft bearing analysis
主軸受解析例

Gearbox Bearings

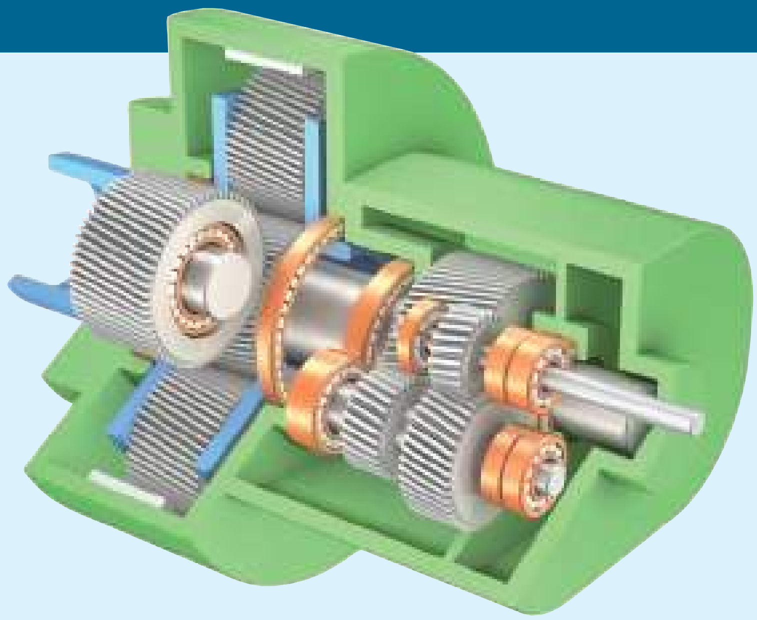
Life-extending technologies to handle even the most severe application conditions

増速機用軸受

過酷な使用条件にも対応する長寿命化技術

Required bearing attributes differ depending on their position within the gearbox.

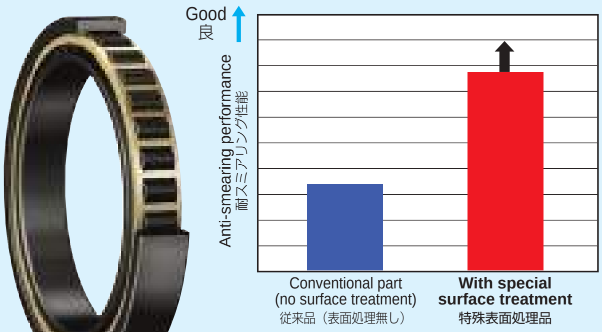
増速機に使用される軸受は、部位によって要求される機能が異なります。



Special surface treatment
特殊表面処理

By using a special surface treatment on the inner and outer raceways, and rolling elements, oil film formation is improved and surface damage (i.e. smearing) is prevented. As shown in the graph below, anti-smearing performance is improved compared to that of a conventional part.

内外輪および転動体への特殊な表面処理により、油膜形成能力が向上して表面損傷（スミアリング損傷）を防ぎます。以下のグラフに示すように、従来品に比べて耐スミアリング性能が向上します。

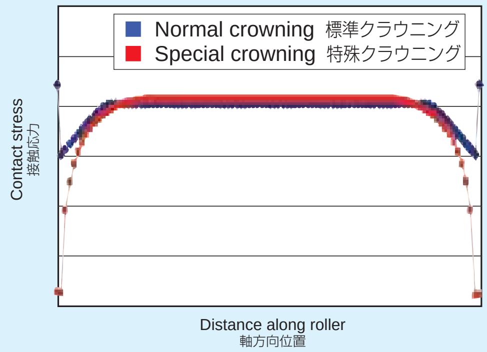


Smearing test results
スミアリング試験結果

Special roller crowning
転動体特殊クラウニング

Increased lifespan is sought by using a special crowing profile on the rolling elements to reduce edge stresses in the application.

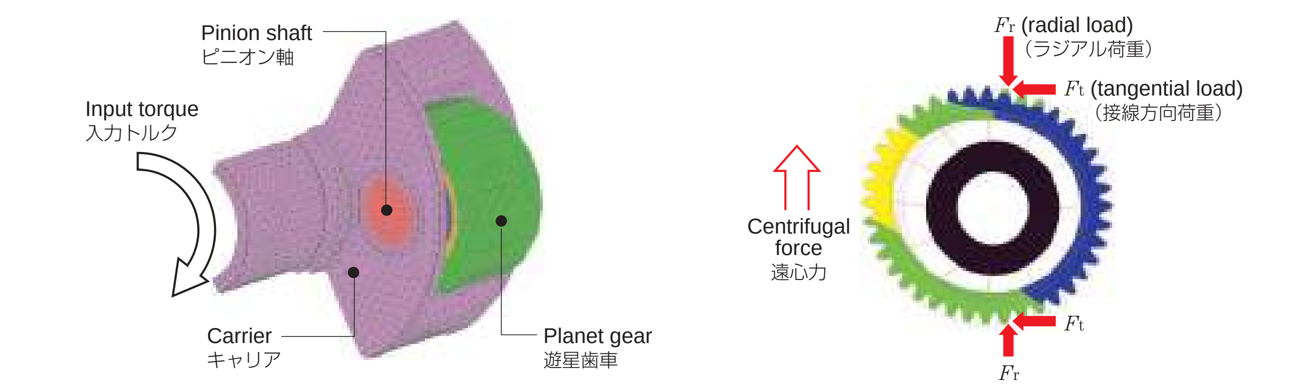
転動体に特殊クラウニングを施し、エッジ応力の低減により長寿命化を図ります。



Representative analysis of a bearing, including gearbox components
増速機部品を含む軸受の解析例

By analyzing the structure around the bearings (carriers, gears, etc.) **NTN** is able to optimize the internal design of the bearing to produce high reliability in cases where deformation is present.

キャリア、歯車などの軸受周辺部品を合わせた解析により、変形を考慮した信頼性の高い軸受内部設計を実現。



Generator Bearings

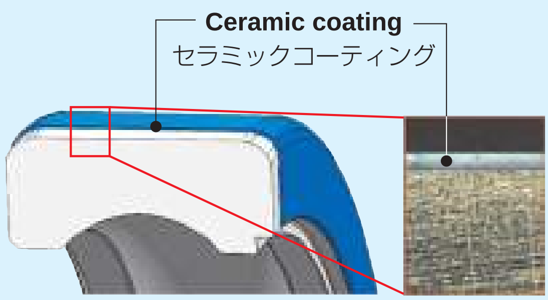
発電機用軸受

Insulated bearings for preventing the passage of electrical current through the bearings

軸受内部への通電を抑制する絶縁軸受

- A ceramic coating on the outer surface of the bearing creates an insulating layer and prevents electrical corrosion. (Insulating value when 500 V DC: 100 MΩ or more; electrical breakdown power: 3 kV or more)
- Bearing dimensions and tolerances are identical to standard product (without insulation), allowing for easy substitution.
  ※Standard products are also available upon request.

- 軸受外輪表面のセラミックコーティングにより、高い絶縁性能を実現し、電食を防止します。
  (DC500V時の絶縁性能：100MΩ以上、絶縁破壊電圧：3KV以上)
- 軸受寸法、寸法精度は標準軸受（非絶縁仕様）と同一であり、互換性を有しています。
  ※ご要望により標準軸受の製作も可能です。



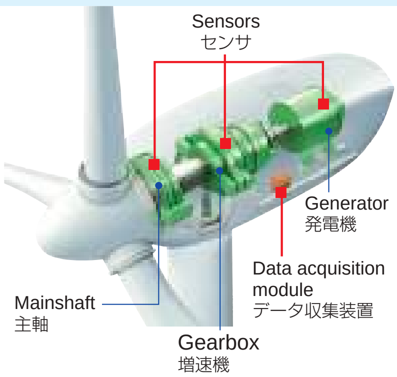
Condition Monitoring System for Wind Turbines "Wind Doctor™"

風力発電装置用状態監視システム "Wind Doctor™"

RENEWABLES CERTIFICATION DNV·GL Certificate no. TC-GL-IV-1-01745-0

Wind Doctor™, an **NTN** condition monitoring system (CMS) for wind turbines, enables remote monitoring of the in-situ bearing status for early failure detection of the bearings. Utilizing diagnosis reports from **NTN** by signing the monitoring service contract, it will contribute to reduction of the maintenance cost as well as improving the availability factor of the turbines, through preventing secondary damage, advance preparation of the parts, and avoiding unexpected maintenance work.

NTNの風力発電装置用状態監視システム「Wind Doctor™」を搭載することで、軸受運転状況の遠隔監視と早期の故障検知が可能です。モニタリングサービス契約により提供される診断分析情報により、損傷の拡大防止や交換部品の事前手配、計画的な補修が行えるため、メンテナンス費用の低減だけでなく稼働率の向上にも寄与します。



LAN, Mobile telephone line etc.
LAN、携帯電話回線など

[Wind turbine]
【風力発電装置】
- Vibration sensor
  振動センサ
- Rotation sensor
  回転センサ

[Data acquisition module]
【データ収集装置】
- FFT analysis
  FFT分析
- Various types of signal processing including envelope processing
  エンベロープ処理などの各種信号処理

[User computer]
【ユーザPC】
- Vibration and trend graph display
  振動データのトレンドグラフ表示

For New Technology Network

NTN®

NTN corporation

Long-Life AS Series TAB/ETA Bearings

CAT. No. 3025／E

NTN Long-Life AS Series TAB/ETA Bearings

Our long-life TAB and ETA bearings are able to withstand harsh environments and load conditions.

TAB bearings

ETA bearings

Our TAB and ETA bearings were developed using new materials and a special heat treatment in order to satisfy the recent demand for longer life and more compact equipment. These bearings even last longer than the TMB (deep groove ball bearings) and ET (tapered roller bearings) bearings of our preceding long-life series. They offer excellent cost performance by enhancing equipment reliability. Don't take our word for it. See for yourself!

Applications

Ideal for applications that demand long life and compactness, such as automobile transmissions and differential pinions.

Advantages

Our TAB and ETA bearings offer better reliability, smaller size and lower cost. They also offer long life for lubrication containing hard foreign matter.

1 Features

● **Able to withstand lubrication containing hard foreign matter.**

Automobile transmission bearings are often damaged by foreign matter in the lubrication. Our TAB/ETA bearings are designed to last longer under such conditions. Our TAB bearings last five times longer than the standard type, and twice as long as our TMB Series. Our ETA bearings last nine times as long as the standard, and five times longer than our ET Series.

● **Resists peeling.**

Peeling damage is caused when lubrication conditions deteriorate during use. Our TAB/ETA bearings are designed to stretch life as long as possible by being more resistant to peeling. Our TAB bearings offer five times longer peeling life than the standard type, and our ETA bearings offer eight times longer peeling life.

2 Long-Life Mechanism

Because most bearing damage occurs on the raceway surface, **NTN** has enhanced the surface layer structure through a special heat treatment and selection of materials that have a persevering structure that does not give up surface hardness. Also, **NTN** has optimized the crowning of the tapered roller elements.

These measures inhibit formation of hairline cracks that serve as the starting point for peeling and various other types of damage, and provide merits such as long life.

2.1 Crack Resistance and Stress Relaxing Effect

Softer than martensite parent phase, *retained austenite* relaxes the stress concentration in the impression area caused by contaminated lubrication material inhibiting formation of cracks.

As shown in **Fig. 1**, residual stress shifts toward the pulling side for extreme surface layers of the impression portion in all cases, and through-hardened steel having undergone standard heat treatment produces residual tensile stress. If you compare items having special heat treatment and those having standard heat treatment, there is less harmful shift of stress to the pulling side for those having undergone special heat treatment. Special heat treatment is recognized as having a stress relaxing effect.

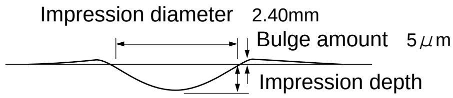
2.2 Reason for Long Life

For our ETA bearings, we use a moderate amount of dispersed carbides and retained austenite for the surface structure produced by the previously mentioned special heat treatment, and the structure is specially designed for thermal stability.

The raceway surface is usually affected by shear stress and heat generated by rolling, thus changing the material (residual stress, hardness, micro-structure) by tempering and fatigue, tending to produce fatigue cracks. Therefore, characteristics which prevent material from changing due to tempering (tempering resistance), and properties whereby material tends to stretch rather than crack (toughness) are effective for surface starting point type damage. Usually obtained by carbonizing, retained austenite inhibits formation and development of cracks. Because it is work-hardened (strength is enhanced), a tough material can be obtained by adding moderately, but is unstable towards heat. If combined with nitrogen under the proper conditions, penetration by nitrogen makes retained austenite and martensite parent phase (matrix) stable towards heat. Along with using material that is resistant to change, by depositing the proper amount of carbides, fatigue strength can be enhanced without losing cracking strength.

Table 1 Comparison of Impression Shape for Various Materials

Material		Surface hardness [HRC]	Retained austenite amount [%]	Impression diameter [mm]	Impression depth [μm]	Bulge amount [μm]
Through-hardened steel	Standard bearing	62.0	10	2.40	80	5
	TAB bearing	62.0	28	2.45	83	4
Carbonized steel	Standard bearing	61.0	25	2.80	102.5	1
	ETA bearing	62.5	29	2.63	97.5	1
Impression shape example		(Through-hardened steel standard bearing)				



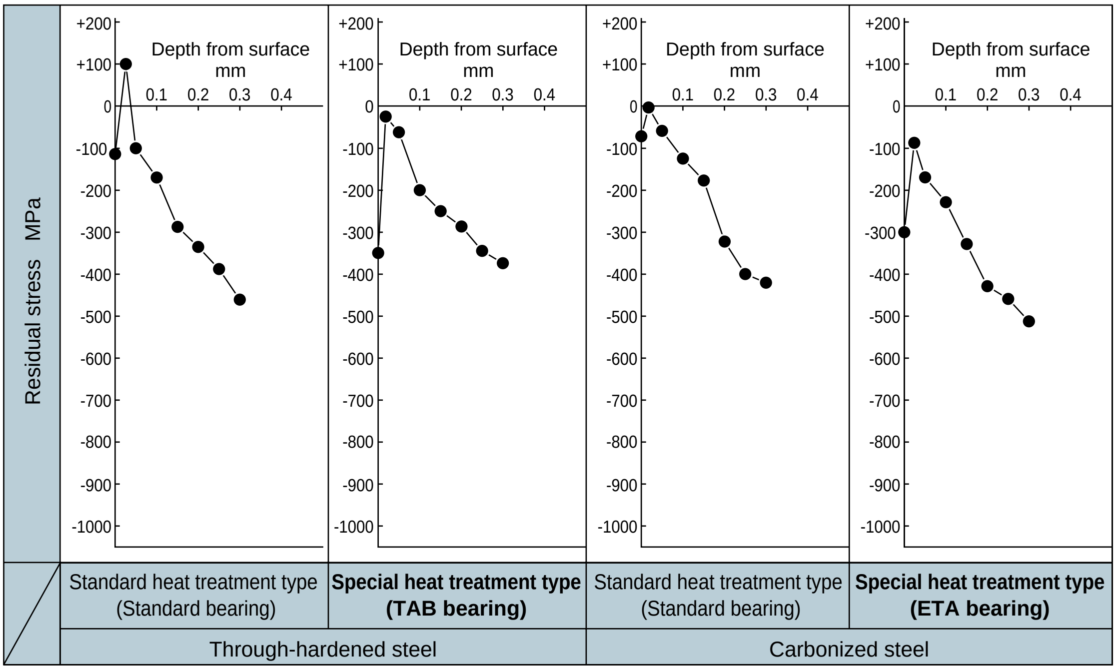


Fig. 1 Residual Stress in Impression

3 Applicable Bearing Size

● Deep groove ball bearings	● Tapered roller bearings
TAB 000～TAB 020 TAB 200～TAB 217 TAB 300～TAB 311	ETA bearings are applied for outer diameters less than 145 mm

Contact **NTN** for information concerning model numbers.

4 Life Test

Results of the life test are as given below. The data given here concerns standard and TAB/ETA bearings. Disparity however results in figures that depend on the type of foreign matter when foreign matter is mixed in with the lubrication oil. This data is provided for your reference.

4.1 Test Bearings and Test Conditions

Test bearings are given in **Table 2**, and test conditions in **Table 3** and **4**.

Table 2 Test Bearings

Bearing	Main dimensions mm	Basic dynamic load rating C_r kN	Basic static load rating C_{or}
Standard 6206	φ30×φ62×16	19.5	11.3
TAB206	↑	↑	↑
Standard 30206	φ30×φ62×17.25	43.5	48.0
ETA30206	↑	↑	↑

Table 3 Test Bearings (6206, TAB6206)

	Ordinary lubrication oil	Foreign matter mixed in with lubrication oil (reference)
Radial load kN	12.25	6.9
Number of revolutions rpm	2 000	2 000
Lubrication oil	Turbine 56	Turbine 56 + **NTN** standard foreign matter
Lubrication method	Circulating lubrication	Fueling

Table 4 Test Bearings (30206, ETA30206)

	Ordinary lubrication oil	Foreign matter mixed in with lubrication oil (reference)
Radial load kN	17.64	17.64
Number of revolutions rpm	2 000	2 000
Lubrication oil	Turbine 56	Turbine 56 + **NTN** standard foreign matter
Lubrication method	Circulating lubrication	Fueling

4.2 Life Data

Foreign matter mixed in with lubrication oil (reference)
Figures 2 and **3** show the test results with **NTN** standard foreign matter mixed in with lubrication oil. With L_{10} life, TAB bearings last more than five times longer than standard bearings, and ETA bearings last more than nine times longer.

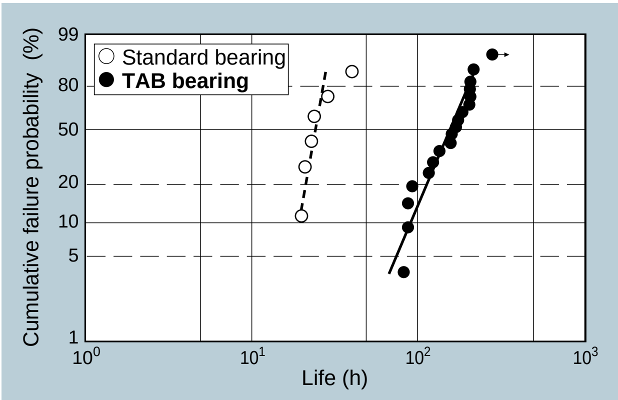


Fig. 2 Comparison of life of TAB ball bearing and standard bearing (with foreign matter)

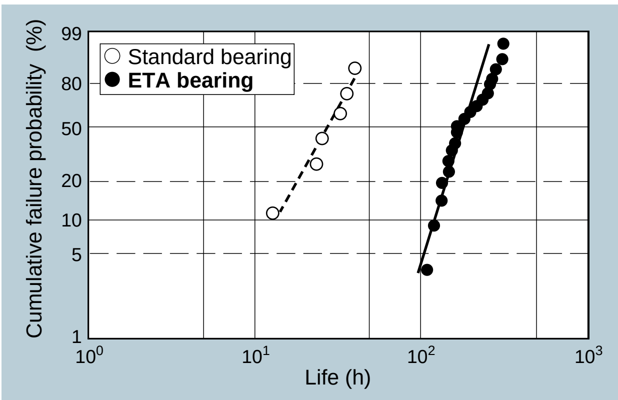


Fig. 3 Comparison of life of ETA tapered roller bearing and standard bearing (with foreign matter)

For New Technology Network

NTN®

NTN corporation

Bearings for Special Environments

Ultra Final Series

CAT. No. 3023-Ⅲ／E

NTN
Bearings for Special Environments

NTN responds to emerging market needs
with unique technologies for extreme environments.

C O N T E N T S

Recent advances in the process technologies employed in semiconductor fabrication and other industrial sectors have raised expectations for the bearings used in vacuum environments. Today, such bearings are required to be cleaner, more durable and more resistant to corrosion. In response, **NTN** Corporation has developed a bearing technology that employs solid lubricant for ultra-high vacuum environments.
Moreover, **NTN** has continued to expand its product line with bearings designed for corrosive environments. These innovations round out a product line that already features vacuum bearings and ultra-clean bearings designed to accommodate today's increasingly complex production environments.

1. Selecting Bearings for Extreme Environments

The operating environments of today's advanced industries — as typified by the semiconductor fabrication industry — are complex and entail a variety of factors. To simplify the selection of the optimal bearings for complex environments, please refer to **Figure 1**. It illustrates schematically three such environments — vacuum, clean and corrosive — as well as the complex interrelation among these environments. This diagram lists the typical equipment and facilities found in each environment as well as the applicable bearings.

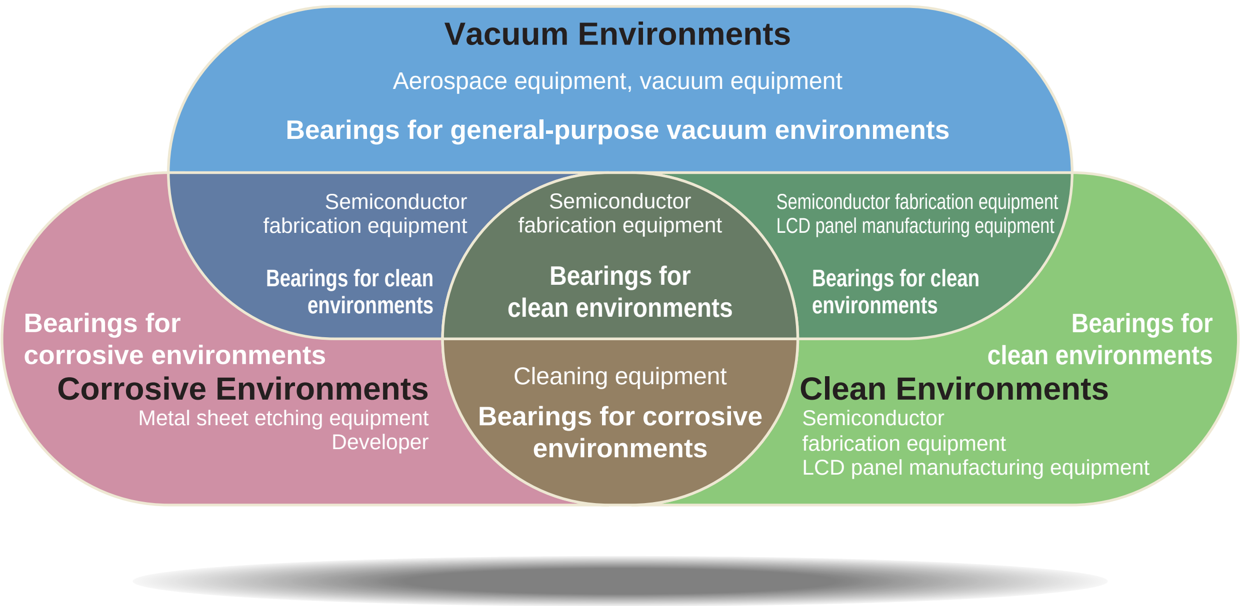


Fig. 1

2. Classifications and Standard Specifications of Bearings for Special Environments

Table 1 summarizes the standard specifications of bearings for special environments.
For custom specifications, please contact **NTN** Engineering.

Table 1. Bearings for Special Environments: Classifications and Standard Specifications

Classification	Operating Environment					Bearing Specification	
	Temperature	Atmosphere	Vacuum	Corrosives	Magnetic field	Inner Ring/Outer Ring	Ball
Vacuum environments	～150˚C	○	○			Martensite stainless steel + MoS_2 coating	Martensite stainless steel + MoS_2 coating
	～300˚C		○			Martensite stainless steel + Pb coating	Martensite stainless steel + Pb coating
	～400˚C		○			Martensite stainless steel	Martensite stainless steel + Ag coating
Clean environments	～ 70˚C	○				Martensite stainless steel	Martensite stainless steel
	～200˚C	○	○				
	～260˚C	○	○			Martensite stainless steel + special PTFE coating	Martensite stainless steel + special PTFE coating
	～300˚C	○	○				Martensite stainless steel + special PTFE coating + special balls
Contaminant-free environments	～ 80˚C	○				Bearing steel or martensite stainless steel	Bearing steel or martensite stainless steel
	～100˚C	○					
	～120˚C	○					
Corrosive environments	～120˚C	○		○		Bearing steel + corrosion resistant coating	Bearing steel
		○		○		Martensite stainless steel	Martensite stainless steel
	～150˚C	○	○	○	○	Ceramic	Ceramic
		○	○	○		Precipitation-hardened stainless steel	
		○		○	○	PPS resin	Ceramic or glass
High temperatures	～500˚C	○				High-speed tool steel	Ceramic
	～800˚C	○				Ceramic	
Cryogenic environments	-273˚C～	○				Martensite stainless steel + special PTFE coating	Martensite stainless steel + special PTFE coating
Non-magnetic environments	～150˚C	○			○	Non-magnetic steel	Ceramic
						Ceramic	
Anti-radioactivity	～120˚C	○				Bearing steel	Bearing steel
Electrically conductive	～120˚C	○				Bearing steel	Bearing steel
	～200˚C	○				Heat-resistant treatment + bearing steel	
Electrically insulated	～120˚C	○				Ceramic	Ceramic
		○				Bearing steel	
		○				Ceramic coating (outer ring)	Bearing steel
		○				PPS resin coating (outer ring)	

Bearing Specifications		Bearing No.	Technical Data Page Ref.
Cage	Grease		
PTFE resin	——	MM－. . . T3	P5, P6
Leaded copper alloy		MN－. . . L9	
Austenite stainless steel		5MG－. . .	
Austenite stainless steel	Low out particle grease	SSN. . . /L635QMP	P8, P9
	Low out particle grease in vacuum environments	SEB. . . . /LX23Q..	P8
Austenite stainless steel + special PTFE coating	——	MT2－SEB. . .	P5, P7, P8, P9 P10
Austenite stainless steel + special PTFE coating		MT2－5PT－SEB. . .	P9
Cold rolled steel plate or austenite stainless steel	General-purpose with solid grease	. . . . /LP03	
	Food-grade with solid grease	. . . . /LP06	
	High-temperature with solid grease	. . . . /LP05	
Cold rolled steel plate	Grease	MXn－. . .	
Austenite stainless steel		F－. . .	
PTFE resin or austenite stainless steel	——	S－. . . 5S－2Fn	
PTFE resin		5S－2N－. . .	P11
——	——	2H－5S－. . .	
		S－. . .	
PTFE resin	——	MT2－F－. . . T3	
PTFE resin	Grease	5S－2Fn－. . .	
		S－. . .	
Cold rolled steel plate	Radioactivity-resistant grease		
Cold rolled steel plate	Electrically conductive grease (EP-2)	. . . /L646	P11
	Electrically conductive fluorine grease (EF-2)	TS3－. . . /LY06	
Cold rolled steel plate	Grease	S－. . .	
		5S－. . .	
		7MC－. . .	
		7MP－. . .	

3. Performance and Technical Data of Various Bearings

3.1 Vacuum bearings

Table 2 Performance of Vacuum Bearings

◎: Excellent ○: Good △: Fair ×: Not recommended

Bearing type	Allowable vacuum range Pa	Allowable temperature range °C	Load-carrying capacity	Low-torque performance	Out Particle	Outgassing	Electrical conductivity
MoS_2-coated bearings	10^{-5}～1	～+150	△	◎	○	○	×
Pb-coated bearings	～10^{-5}	～+300	○	◎	○	◎	○
Ag-coated bearings	～10^{-5}	～+400	△	○	○	◎	○
Bearings with vacuum grease (optional)	10^{-5}(vapor pressure) to atmospheric	～+200	◎	×	×	×	×

Note: Ratings represent relative performance among vacuum bearings.

Test Data

Results of durability evaluation.

Figures 2 through **6** provide sample evaluations of coating-dependent durability.

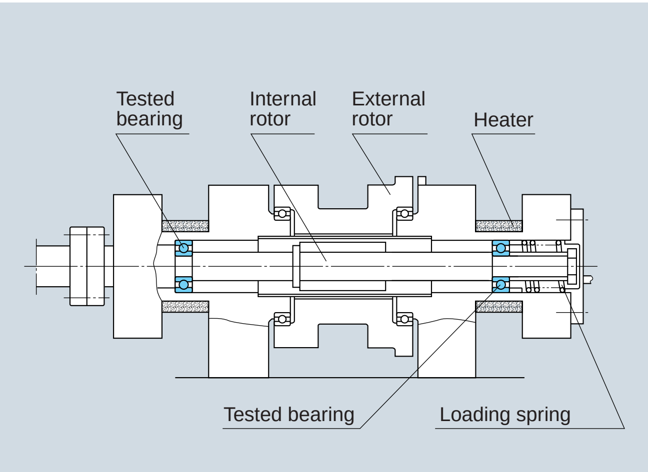


Fig. 2 Durability tester for high-vacuum bearing

● Test conditions

Bearing : Deep groove ball bearings, φ8×φ22×7 (Open type)
Axial load : 10N, 30N, 50N
Speed : 2 500min^{-1}
Degree of vacuum : Around 10^{-5} Pa
Temperature : Room temperature
Evaluation criterion : Bearing life is regarded as having expired when the bearing friction torque with two bearings reaches 10^{-2} N・m.

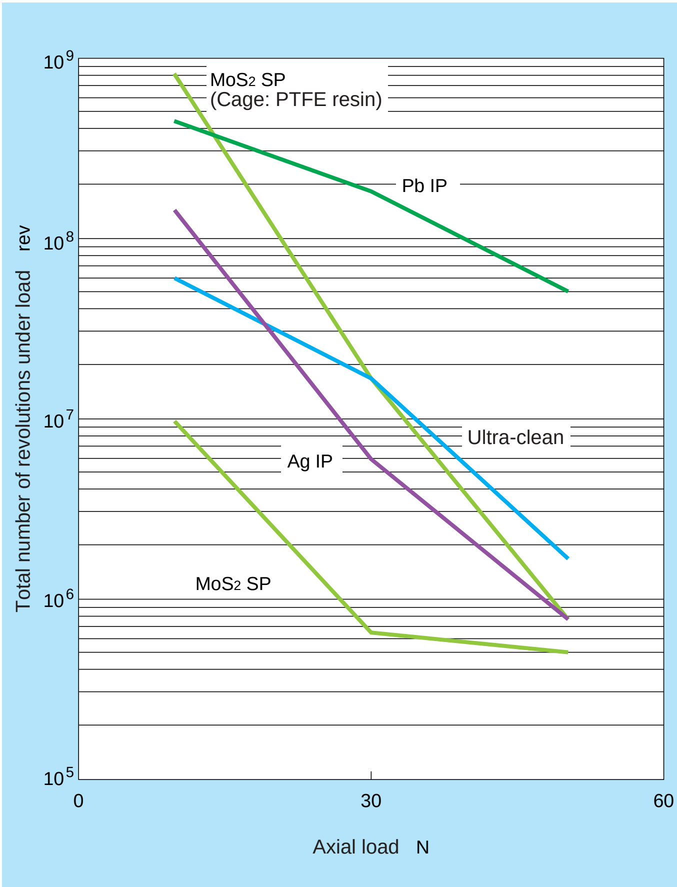


Fig. 3 Load vs. durability in a vacuum

● Test conditions

Bearing	: Angular contact ball bearings, φ10×φ22×7 (Full complement type)
Axial load	: 10N
Speed	: 2 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

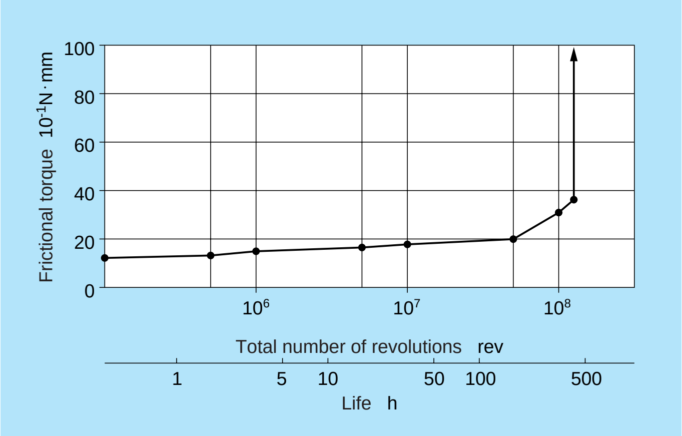


Fig. 4 Evaluation of durability of Ag IP bearing

● Test conditions

Bearing	: Angular contact ball bearings, φ10×φ22×7 (Cage: Leaded copper alloy))
Axial load	: 10N
Speed	: 7 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

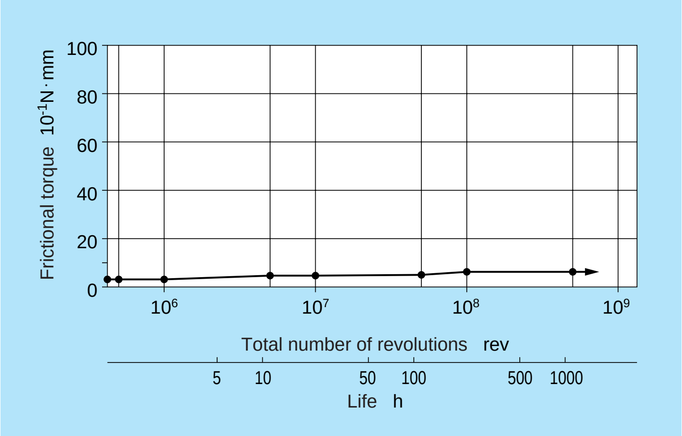


Fig. 5 Evaluation of durability of Pb IP bearing

● Test conditions

Bearing	: Angular contact ball bearings, φ10×φ22×7 (Cage: PTFE resin)
Axial load	: 10N
Speed	: 7 500min^{-1}
Degree of vacuum	: Around 10^{-5} Pa
Temperature	: Room temperature

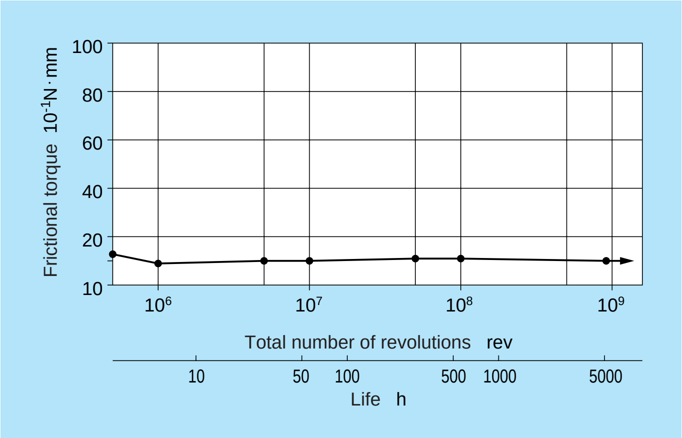


Fig. 6 Evaluation of durability of MoS_2 SP bearing

3.2 Bearings for clean environments

Table 3 Performance of Bearings for Clean Environments

◎ : Excellent ○ : Good △ : Fair × : Not recommended

Bearing type	Allowable vacuum range Pa	Allowable temperature range °C	Load-carrying capacity	Low-torque performance	Out Particle	Outgassing	Corrosion resistance	Maximum d_n value
Bearings with low out particle grease	Atmospheric	＋ 70	◎	△	△	—1)	△	20×10^4
Bearings with low out particle grease for vacuum environment	10^{-5} to atmospheric	～＋200	◎	×	△	△	△	20×10^4
Ultra-clean bearings	10^{-5} to atmospheric	～＋260	△	◎	◎	◎	△	1×10^4
Long life ultra-clean bearings	10^{-6} to atmospheric	～＋300	△	◎	○	◎	△	1×10^4

Note: Ratings represent relative performance among bearings designed for clean environments.
1) Excluded from evaluation because this type of bearing is used under atmospheric pressure.

Test Data

3.2.1 Evaluation of out particle characteristics

Figures 7 through **13** provide evaluations of the tendency to out particles.

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N
Speed : $50min^{-1}$
Minimum particle size measured : 0.3 µm
Temperature : Room temperature

● Test results

· Generation of airborne particles is indicated as the number of particles present in one cubic foot of collected air (number of particles/cf).
· **NTN**'s ultra-clean bearings generate a very low particle count (equivalent to Class 10).

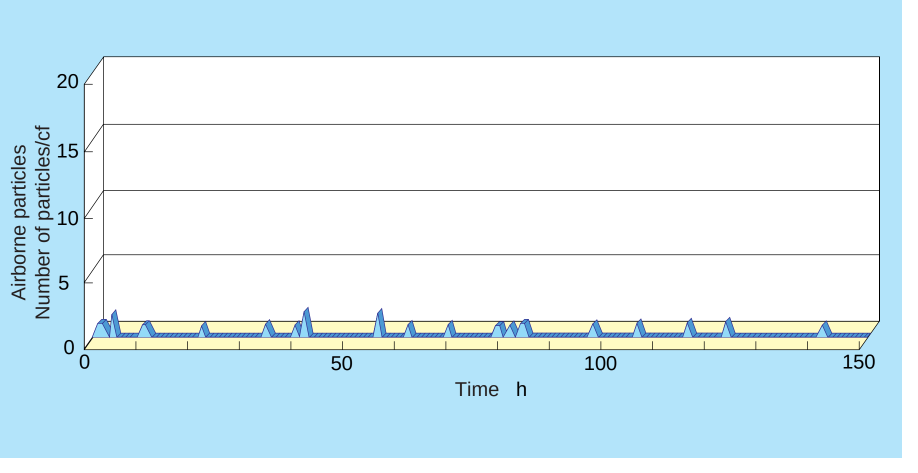


Fig. 7 Measurement of out particle by ultra-clean bearing (at atmospheric pressure)

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N (50N)
Speed : $50min^{-1}$
Degree of vacuum : Around 10^{-5} Pa
Minimum particle size measured : 0.38 µm
Temperature : Room temperature (20°C)

● Test results

· The out particle characteristics of ultra-clean bearings are not significantly altered by load or temperature. This type of bearing exhibits low out particle over a wider range of conditions.

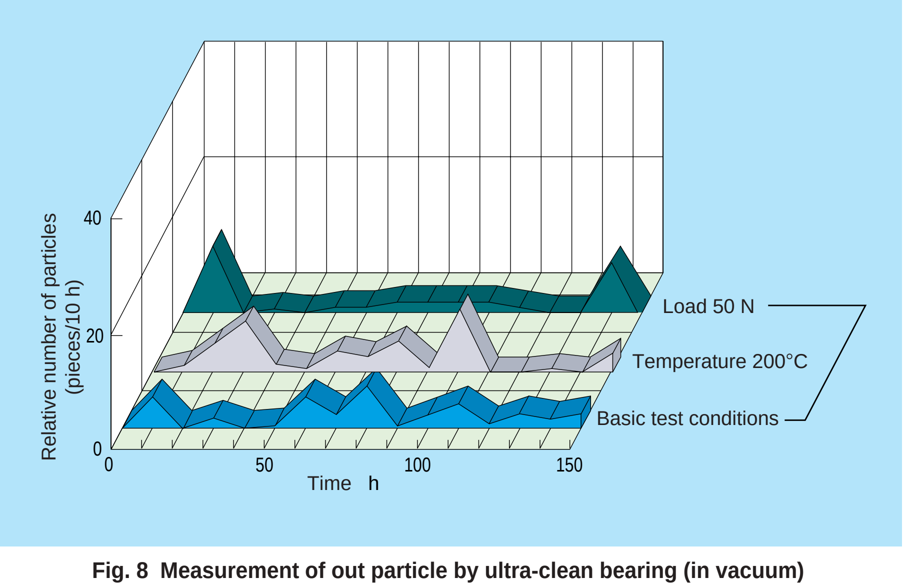


Fig. 8 Measurement of out particle by ultra-clean bearing (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N
Speed : 50min^{-1}
Minimum particle size measured : 0.38 μm
Degree of vacuum : Around 10^{-5} Pa

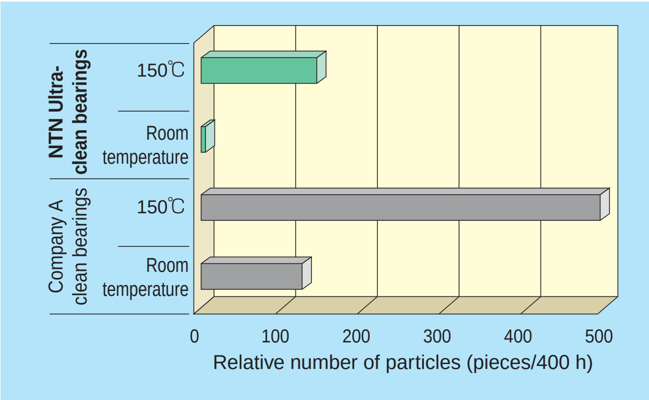


Fig. 9 Measurement of out particle by ultra-clean bearing (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N
Minimum particle size measured : 0.1 μm
Temperature : Room temperature

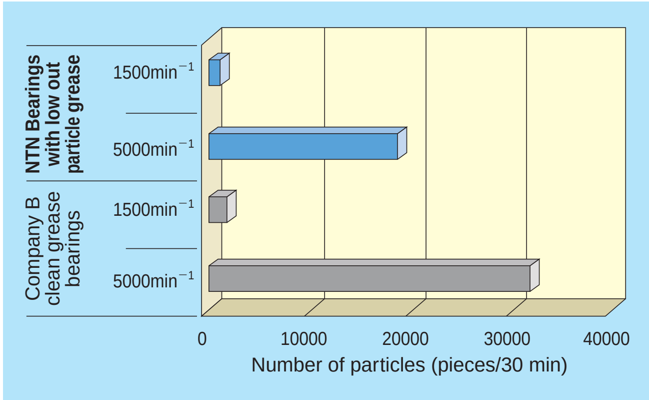


Fig. 10 Measurement of out particles by bearing with low out particle grease (at atmospheric pressure)

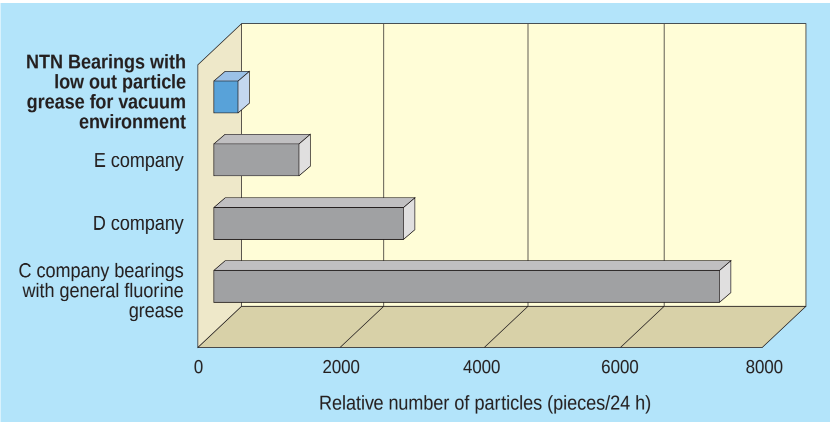


Fig. 11 Measurement of out particles by bearing prelubricated with low out particle vacuum grease (in vacuum)

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 30N
Speed : 200min^{-1}
Minimum particle size measured : 0.2 μm
Degree of vacuum : Around 10^{-5} Pa

● Test conditions

Bearing : Deep groove ball bearings φ10×φ26×8
Axial load : 15N
Minimum particle size generated : 0.1 μm
Temperature : Room temperature (at atmospheric pressure)

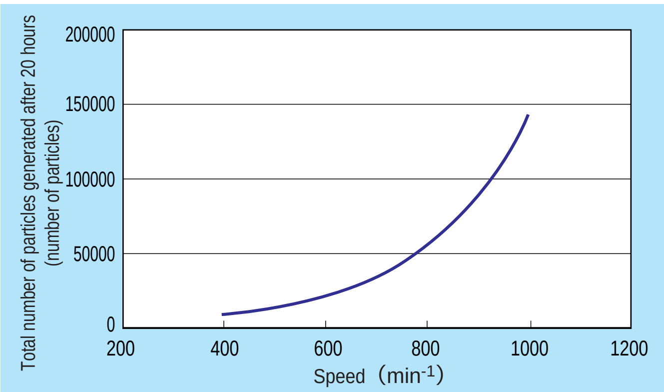


Fig. 12 Relation between bearing speed and number of out particles (bearing with low out particle grease)

● Test conditions

Bearing : Deep groove ball bearings φ10×φ26×8
Speed : 400min^{-1}
Minimum particle size generated : 0.1 μm
Temperature : Room temperature (at atmospheric pressure)

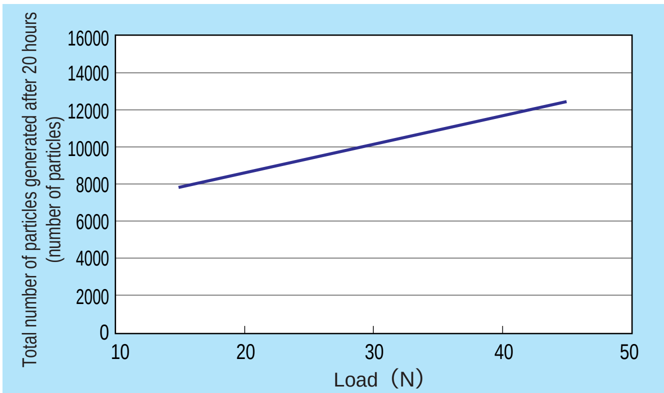


Fig. 13 Relation between axial load and number of out particles (bearing with low out particle grease)

3.2.2 Results of durability evaluation

Figures 14 through **16** provide evaluations of bearing durability.

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N
Speed : 360min^{-1}
Degree of vacuum : Around 10^{-5} Pa
Temperature : Room temperature

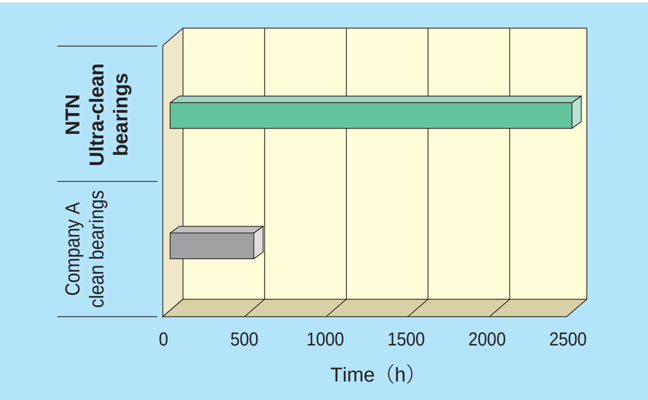


Fig. 14 Evaluation of durability of ultra-clean bearing

● Test conditions

Bearing : Deep groove ball bearings φ20×φ47×14
Axial load : 67N
Radial load : 67N
Speed : 10000min^{-1}
Temperature : 100˚C

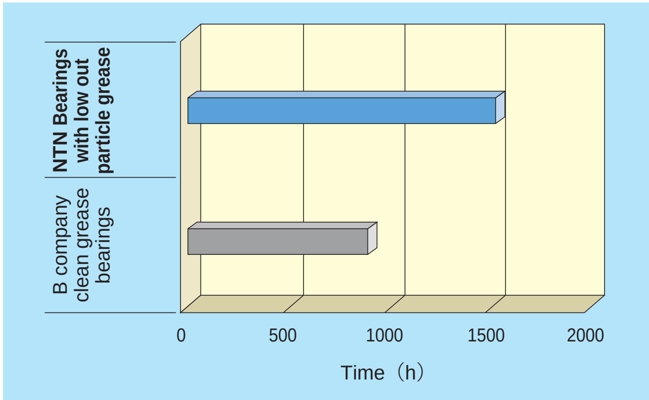


Fig. 16 Evaluation of durability of bearing with low out particle grease

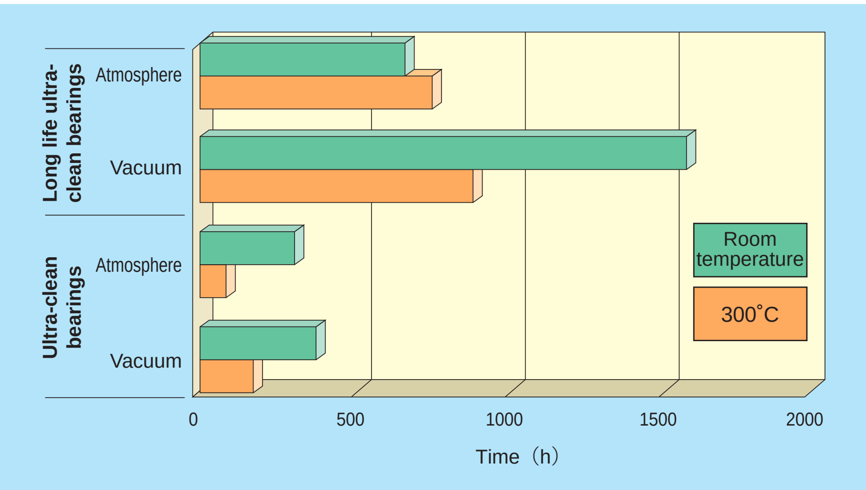


Fig. 15 Evaluation of durability of long-life ultra-clean bearing

● Test conditions

Bearing : Deep groove ball bearings φ8×φ22×7
Axial load : 10N
Speed : 2500min^{-1}
Atmospheric pressure/vacuum (around 10^{-5} Pa)

3.2.3 Evaluations of outgassing characteristics

Figures 17 and **18** provide evaluations of outgassing characteristics.

● Test conditions

Bearing : Ultra-clean bearing 6 mm dia.×19 mm dia.×6
: Bearing with vacuum grease 6 mm dia.×19 mm dia.×6
: Untreated bearing (PTFE cage) 9.5 mm dia.×22 mm dia.×7.1

Degree of vacuum : Around 10^{-5} Pa

Temperature : Room temperature, 200˚C

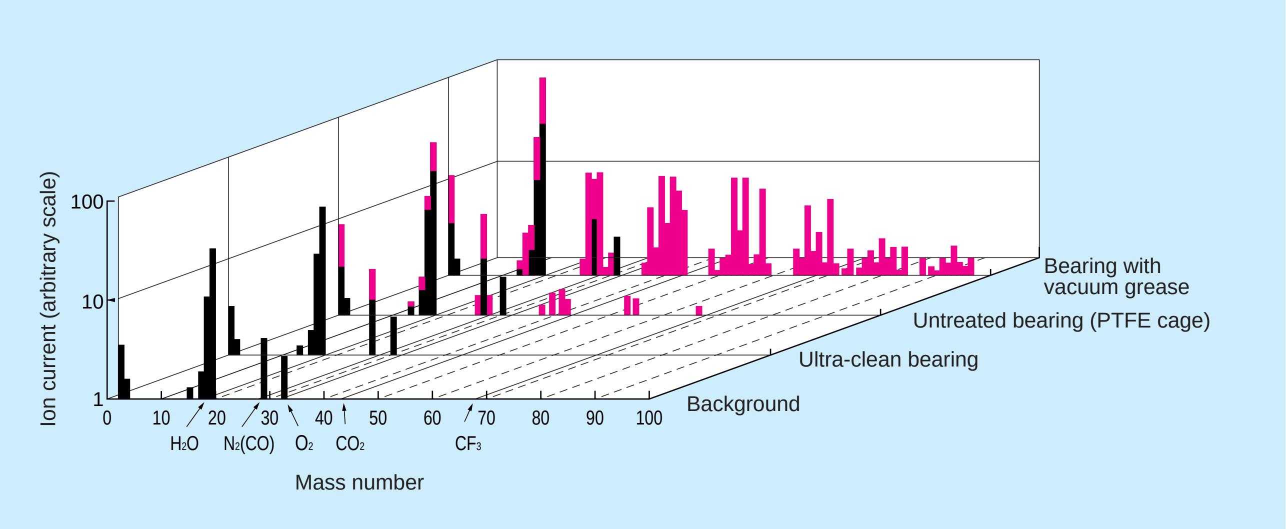


Fig. 17 Example of gasses released immediately after installation of bearing (at room temperature)

- Components that increased after bearing installation are indicated in red, relative to the background measurement of the test equipment.
- The diagram shows that H_2O, N_2 (CO), O_2 and the like are present as background components.
- The ultra-clean bearing exhibited some increase in N_2 (CO) outgassing, but did not show increased outgassing of other components. Additionally, while running, it did not exhibit any increase in outgassing. The **NTN** ultra-clean bearing always exhibits low outgassing.

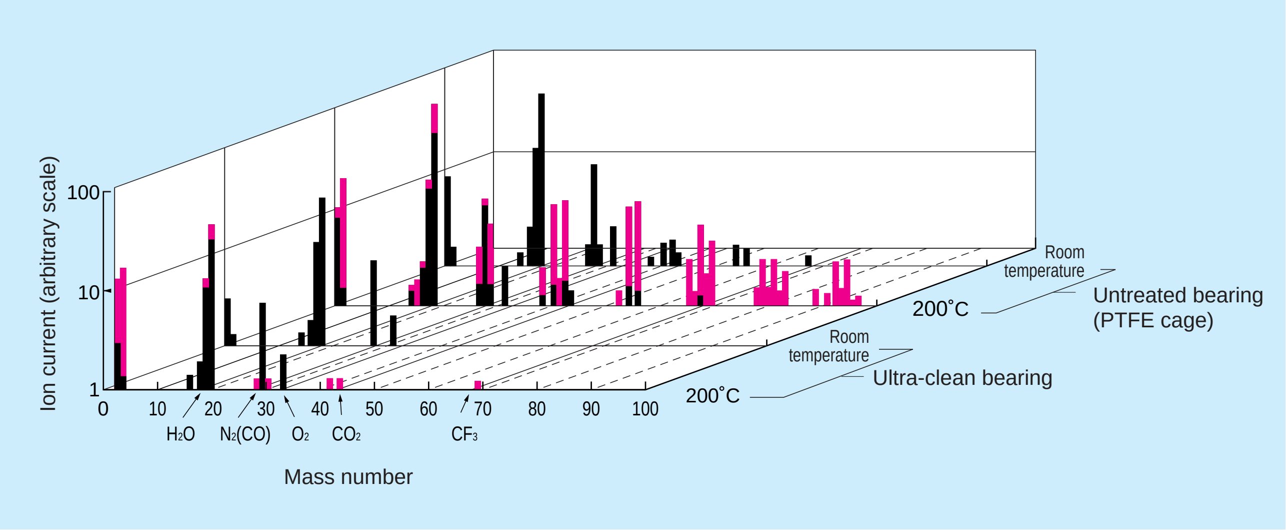


Fig. 18 Comparison of outgassing at room temperature and high temperature

- Components that increased as a result of the temperature increase from room temperature to 200˚C are indicated in red.
- At 200˚C, the amount of gasses released by the ultra-clean bearing somewhat exceed the amount released at room temperature. However, the amount remained small, indicating the low outgassing characteristic of the ultra-clean bearing even in high-temperature applications.

3.3 Bearings for corrosive environments

Table 4 Performance of Bearings for Corrosive Environments

	Applicable temperature range ˚C	Load-carrying capability
PPS resin rolling bearing	Room temperature to 150˚C	Yes

Table 5 Corrosion resistance of bearings for corrosive environments

○ : Good △ : Fair × : Not recommended

	Inner ring & outer ring	Cage			Rolling elements	
	PPS resin	Polyimide resin (optional)	Polyamide resin (optional)	PTFE resin	Ceramic	Glass
10% hydrochloric acid	○	○	×	○	○	△
35% sulfuric acid	○	○	×	○	○	○
35% nitric acid	○	○	×	○	○	○
10% acetic acid	○	△	×	○	○	○
10% potassium hydroxide	○	△	○	○	○	×
10% sodium hydroxide	○	△	○	○	○	×
30% aqueous ammonia	○	△	×	○	○	○

3.4 Electrically conductive bearings

● Test conditions

Bearing : Deep groove ball bearings φ30×φ42×7
Speed : $150min^{-1}$
Speed : 50N
Temperature : Room temperature

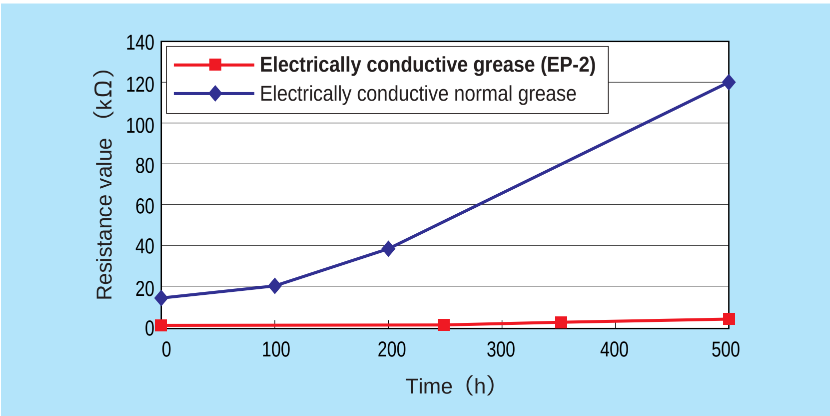


Fig. 19 Durability with electrically conductive grease (EP-2)

4. Material Characteristics

Table 6 Comparison of Characteristics of Ceramic (Si_3N_4) and Bearing Steel (SUJ2)

Characteristics		Ceramic (Si_3N_4)	Bearing Steel (SUJ2)
Hardness	HV	1500	750
Density	g/cm^3	3.2	7.8
Young's modulus	GPa	310	210
Poisson's ratio		0.26	0.3
Coefficient of thermal expansion	$\times 10^{-6}/˚C$	3.0	12.5
Thermal conductivity	W/m·k	29	46
Magnetism		Non-magnetic	Ferromagnetic
Corrosion resistance		Good	Poor
Electrical conductivity		Insulator	Conductor

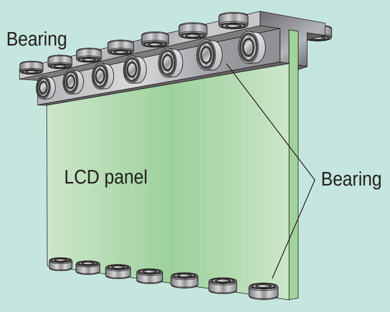
5. Applications

Table 7 summarizes typical applications of **NTN** bearings designed for extreme environments.

Table 7 Typical Applications of Bearings for Extreme Environments

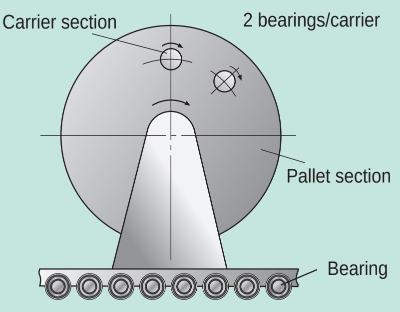
Equipment	Machine/Device	Application	For Vacuum Environments				For Clean Environments				For Corrosive Environments
			Vacuum grease	Ag coating	Pb coating	MoS_2 coating	Ultra-clean	Long-life ultra-clean	Low out particle grease	Low out particle vacuum grease	PPS resin
Aerospace	Manipulators	Actuators	○			○					
	Geosynchronous satellites	Control mechanisms				○					
	Artificial satellites	Antenna deployment mechanisms				○					
Vacuum	Vacuum pumps	Main shafts	○								
	Stepper motors for vacuum environments	Main shafts			○	○	○				
Semiconductor fabrication	Electron beam drawing equipment	Guide rollers					○				
	CVD systems	Transfer mechanisms					○	○		○	
	Sputtering systems	Transfer mechanisms					○	○		○	
	Evaporation systems	Rotary mechanisms		○			○			○	
	Etching systems	Transfer mechanisms					○			○	
	Transfer equipment for clean rooms	Transfer mechanisms					○		○	○	
	Cleaning equipment	Rotating shafts									○
LCD panel manufacturing	Ion implanters	Valve actuator mechanisms								○	
Hard disk manufacturing	Sputtering systems	Transfer/rotary mechanisms					○	○		○	
Electronic device manufacturing	Evaporation systems	Rotary mechanisms		○			○			○	
	Sputtering systems	Transfer mechanisms					○	○		○	
General industrial machinery	Film developers	Guide rollers									○

Transfer equipment of LCD panel



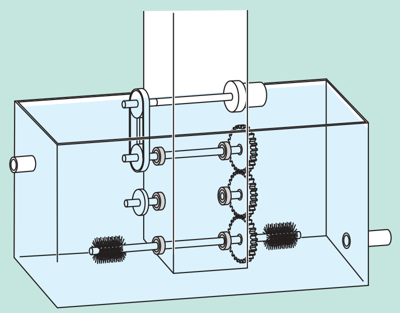
● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : Special PTFE coating
Material : Inner ring, outer ring, balls →Martensite stainless steel

Transfer equipment of HD substrate



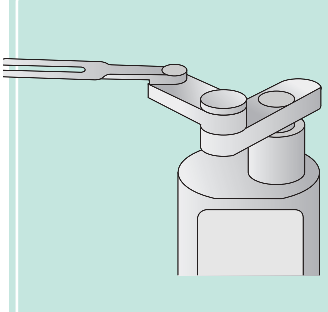
● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : Special PTFE coating + special balls
Material : Inner ring, outer ring, balls →Martensite stainless steel

Cleaning equipment within semiconductor fabrication equipment



● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : PTFE resin
Material : Inner ring, outer ring→PPS resin
Balls→Ceramic
Cage→PTFE resin

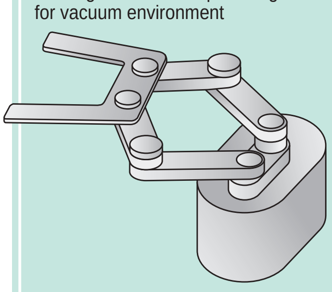
Transfer robot



● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : Low out particle grease
Material : Inner ring, outer ring, balls →Martensite stainless steel

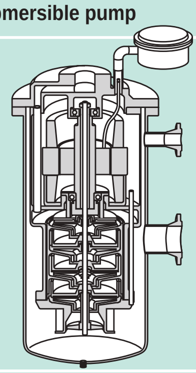
LCD transfer robot

Bearings with low out particle grease for vacuum environment



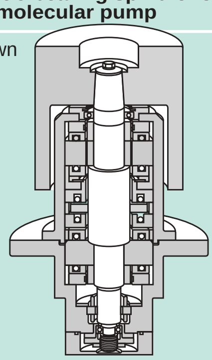
● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : Low out particle vacuuum grease
Material : Inner ring, outer ring, balls →Martensite stainless steel

Submersible pump



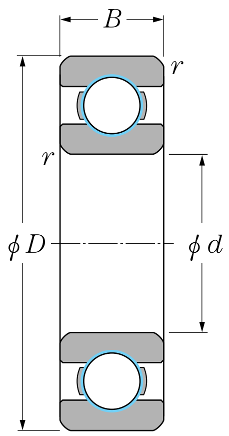
● **Bearing Specifications**
Type : Deep groove ball bearing
Lubrication : PTFE resin + special PTFE coating
Material : Inner ring, outer ring, balls →Martensite stainless steel
Cage→PTFE resin

Magnetic bearing spindle for turbo molecular pump

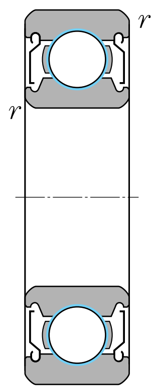


● **Bearing Specifications**
Type : Deep groove ball bearing or angular contact ball bearing
Lubrication : Pb or MoS_2
Material : Inner ring, outer ring, balls →Martensite stainless steel
Cage→Leaded copper alloy

6.1 Vacuum bearings



Open type 2)



Shielded type

Boundary dimensions (mm)				Bearing numbers	
d	D	B	$r_{s\,min}$ 1)	Ag coating	MoS_2 coating
4	13	5	0.2	5MG-SEB24J1ZZ1C3/0G	MM-SEB24J1ZZ1C3/0G
5	13	4	0.2	5MG-SEB95AJ1ZZ1C3/0G	MM-SEB95AJ1ZZ1C3/0G
	16	5	0.3	5MG-SEB25J1ZZ1C3/0G	MM-SEB25J1ZZ1C3/0G
6	15	5	0.2	5MG-SEB96J1ZZ1C3/0G	MM-SEB96J1ZZ1C3/0G
	17	6	0.3	5MG-SEB06J1ZZ1C3/0G	MM-SEB06J1ZZ1C3/0G
	19	6	0.3	5MG-SEB26J1ZZ1C3/0G	MM-SEB26J1ZZ1C3/0G
7	19	6	0.3	5MG-SEB07J1ZZ1C3/0G	MM-SEB07J1ZZ1C3/0G
8	19	6	0.3	5MG-SEB98J1ZZ1C3/0G	MM-SEB98J1ZZ1C3/0G
	22	7	0.3	5MG-SEB08J1ZZ1C3/0G	MM-SEB08J1ZZ1C3/0G
10	22	6	0.3	5MG-SEB900J1ZZ1C3/0G	MM-SEB900J1ZZ1C3/0G
	26	8	0.3	5MG-SEB000J1ZZ1C3/0G	MM-SEB000J1ZZ1C3/0G
	35	11	0.6	5MG-SEB300J1ZZ1C3/0G	MM-SEB300J1ZZ1C3/0G
12	24	6	0.3	5MG-SEB901J1ZZ1C3/0G	MM-SEB901J1ZZ1C3/0G
	28	8	0.3	5MG-SEB001J1ZZ1C3/0G	MM-SEB001J1ZZ1C3/0G
	32	10	0.6	5MG-SEB201J1ZZ1C3/0G	MM-SEB201J1ZZ1C3/0G
15	32	9	0.3	5MG-SEB002J1ZZ1C3/0G	MM-SEB002J1ZZ1C3/0G
	35	11	0.6	5MG-SEB202J1ZZ1C3/0G	MM-SEB202J1ZZ1C3/0G
17	30	7	0.3	5MG-SEB903JRIXZZ1C3/0G	MM-SEB903JRIXZZ1C3/0G
	35	10	0.3	5MG-SEB003J1ZZ1C3/0G	MM-SEB003J1ZZ1C3/0G
20	37	9	0.3	5MG-SEB904J1ZZ1C3/0G	MM-SEB904J1ZZ1C3/0G
	42	12	0.6	5MG-SEB004J1ZZ1C3/0G	MM-SEB004J1ZZ1C3/0G
25	42	9	0.3	5MG-SEB905J1ZZ1C3/0G	MM-SEB905J1ZZ1C3/0G
	47	12	0.6	5MG-SEB005J1ZZ1C3/0G	MM-SEB005J1ZZ1C3/0G
30	47	9	0.3	5MG-SEB906J1ZZ1C3/0G	—
	55	13	1	5MG-SEB006J1ZZ1C3/0G	MM-SEB006J1ZZ1C3/0G

1) Minimum allowable chamfer dimension r.
2) Seal grooves may be provided in some cases.

<Example part No:> 5 MG − SEB08 J1 C3

5 → Parts code with solid lubricant film

Parts	Code
Inner ring, Outer ring, Balls	No code
Inner ring, Outer ring	2
Balls	5

MG → Code for solid lubricant

- Molybdenum disulfide ··· MM (MoS_2-coated bearing)
- Silver ··· MG (Ag-coated bearing)
- Lead ··· MN (Pb-coated bearing)

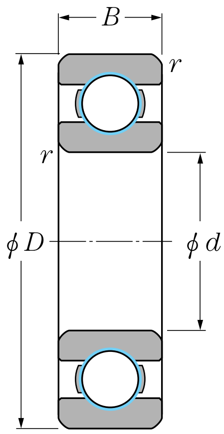
SEB08 → Basic No.

J1 → Cage code

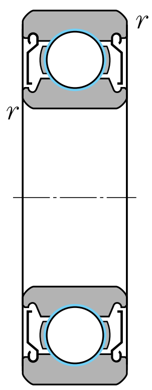
- Austenite stainless steel ··· J1
- PTFE resin ··· T3
- Leaded copper alloy ··· L9

C3 → Internal clearance code (C3 clearance)

6.2 Ultra-clean bearings



Open type 2)



Shielded type

Boundary dimensions (mm)				Bearing numbers	Allowable radial load 3)		Basic load ratings	
d	D	B	$r_{s\,min}$ 1)		N	kgf	dynamic 5) (N)	static (N)
4	8	2	0.08	**MT2-F-BC4-8C3** 4)	1	0.10	305	140
	9	2.5	0.1	**MT2-F-684AX50C3** 4)	1.6	0.16	490	224
	10	3	0.16	**MT2-F-BC4-10C3** 4)	1.6	0.16	500	235
	12	4	0.2	**MT2-F-604ZZ1C3/0G** 4)	2.5	0.26	745	360
	13	5	0.2	**MT2-SEB24J1ZZ1C3/0G**	3.4	0.35	1 010	490
5	10	3	0.15	**MT2-F-BC5-10C3** 4)	1.7	0.17	550	276
	13	4	0.2	**MT2-SEB95AJ1ZZ1C3/0G**	2.6	0.27	830	430
	14	5	0.2	**MT2-F-605ZZ1C3/0G** 4)	3.5	0.36	1 020	505
	16	5	0.3	**MT2-SEB25J1ZZ1C3/0G**	4	0.41	1 350	680
6	12	3	0.15	**MT2-F-BC6-12C3** 4)	1.8	0.18	640	365
	15	5	0.2	**MT2-SEB96J1ZZ1C3/0G**	3.7	0.38	1 040	530
	17	6	0.3	**MT2-SEB06J1ZZ1C3/0G**	6.1	0.62	1 690	865
	19	6	0.3	**MT2-SEB26J1ZZ1C3/0G**	13.1	1.34	1 800	885
7	17	5	0.3	**MT2-SEB97J1ZZ1C3/0G**	3.9	0.40	1 240	715
	19	6	0.3	**MT2-SEB07J1ZZ1C3/0G**	10.4	1.06	1 720	910
	22	7	0.3	**MT2-SEB27J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
8	19	6	0.3	**MT2-SEB98J1ZZ1C3/0G**	5.3	0.54	1 530	865
	22	7	0.3	**MT2-SEB08J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
	24	8	0.3	**MT2-SEB28J1ZZ1C3/0G**	24.8	2.53	3 050	1 590
9.525	22.225	7.142	0.3	**MT2-F-R6J1ZZ1C3/0G** 4)	16.5	1.68	2 560	1 400
10	22	6	0.3	**MT2-SEB900J1ZZ1C3/0G**	13.4	1.37	2 070	1 270
	26	8	0.3	**MT2-SEB000J1ZZ1C3/0G**	24	2.45	3 500	1 960
	30	9	0.5	**MT2-SEB200J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	35	11	0.6	**MT2-SEB300J1ZZ1C3/0G**	55.6	5.67	6 300	3 500
12	24	6	0.3	**MT2-SEB901J1ZZ1C3/0G**	14.1	1.44	2 220	1 460
	28	8	0.3	**MT2-SEB001J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	32	10	0.6	**MT2-SEB201J1ZZ1C3/0G**	37.4	3.82	4 700	2 750
15	28	7	0.3	**MT2-SEB902J1ZZ1C3/0G**	17.8	1.82	2 810	2 000
	32	9	0.3	**MT2-SEB002J1ZZ1C3/0G**	31.2	3.18	4 300	2 830
	35	11	0.6	**MT2-SEB202J1ZZ1C3/0G**	48.8	4.98	5 950	3 600
17	30	7	0.3	**MT2-SEB903JR1XZZ1C3/0G**	24.8	2.53	3 600	2 580
	35	10	0.3	**MT2-SEB003J1ZZ1C3/0G**	37.1	3.79	5 250	3 350
	40	12	0.6	**MT2-SEB203J1ZZ1C3/0G**	62.2	6.35	7 400	4 600
20	37	9	0.3	**MT2-SEB904J1ZZ1C3/0G**	36.3	3.70	4 900	3 700
	42	12	0.6	**MT2-SEB004J1ZZ1C3/0G**	48	4.90	7 200	5 050
	47	14	1.0	**MT2-SEB204J1ZZ1C3/0G**	77.1	7.87	9 900	6 650
25	42	9	0.3	**MT2-SEB905J1ZZ1C3/0G**	48	4.90	5 400	4 550
	47	12	0.6	**MT2-SEB005J1ZZ1C3/0G**	63.2	6.45	7 750	5 850
	52	15	1.0	**MT2-SEB205J1ZZ1C3/0G**	99	10.10	10 800	7 850
30	47	9	0.3	**MT2-SEB906J1ZZ1C3/0G**	51.5	5.25	5 550	5 000
	55	13	1.0	**MT2-SEB006J1ZZ1C3/0G**	103.5	10.56	10 200	8 300
	62	16	1.0	**MT2-SEB206J1ZZ1C3/0G**	129.4	13.20	15 000	11 300

1) Minimum allowable chamfer dimension r.
2) Seal grooves may be provided in some cases.
3) Allowable radial load is the maximum allowable load with only a radial load applied.
4) Maximum allowable temperature is 120˚C (260˚C for others).
5) The basic dynamic load rating is the value for stainless steel bearings.

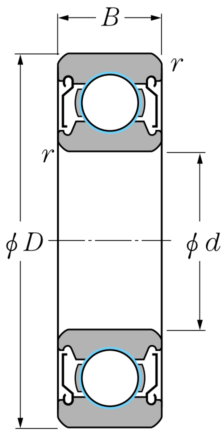
The lead time for products in this table is two weeks.

Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

<Example part No:> **MT2 – SEB08 J1 ZZ1 C3 / 0G**

- Grease lubricant code
  - Solid lubricant···0G
  - Low out particlae grease···L635
  - Low out particlae fluorine grease·························LX23
- Internal clearance code (C3 clearance)
- Shield code : Austenite stainless steel···ZZ1
  : No shield···No code
- Cage code: Austenite stainless steel···J1
- Basic No.
- Solid lubricant code : Special PTFE···MT2 (ultra-clean bearing)
  ···MT2-5PT (long life ultra-clean bearing)
  Grease lubrication···No suffix (indicated at end of part part No.)

6.3 Long life ultra-clean bearings



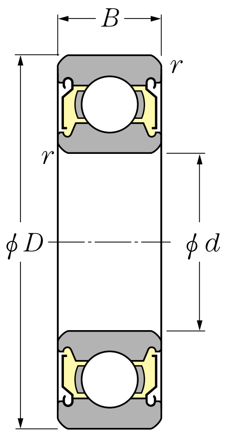
Shielded type

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	Bearing numbers	Allowable radial load 2) N	kgf	Basic load ratings dynamic3) (N)	static (N)
6	19	6	0.3	**MT2-5PT-SEB26J1ZZ1C3/0G**	13.1	1.34	1 800	885
7	22	7	0.3	**MT2-5PT-SEB27J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
8	22	7	0.3	**MT2-5PT-SEB08J1ZZ1C3/0G**	16.9	1.72	2 570	1 400
	24	8	0.3	**MT2-5PT-SEB28J1ZZ1C3/0G**	24.8	2.53	3 050	1 590
10	26	8	0.3	**MT2-5PT-SEB000J1ZZ1C3/0G**	24.0	2.45	3 500	1 960
	30	9	0.6	**MT2-5PT-SEB200J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	35	11	0.6	**MT2-5PT-SEB300J1ZZ1C3/0G**	55.6	5.67	6 300	3 500
12	28	8	0.3	**MT2-5PT-SEB001J1ZZ1C3/0G**	27.8	2.84	3 950	2 390
	32	10	0.6	**MT2-5PT-SEB201J1ZZ1C3/0G**	37.4	3.82	4 700	2 750
15	28	7	0.3	**MT2-5PT-SEB902J1ZZ1C3/0G**	17.3	1.77	2 810	2 000
	32	9	0.3	**MT2-5PT-SEB002J1ZZ1C3/0G**	31.2	3.18	4 300	2 830
	35	11	0.6	**MT2-5PT-SEB202J1ZZ1C3/0G**	48.8	4.98	5 950	3 600
17	30	7	0.3	**MT2-5PT-SEB903JR1XZZ1C3/0G**	22.4	2.29	3 600	2 580
	35	10	0.3	**MT2-5PT-SEB003J1ZZ1C3/0G**	37.1	3.79	5 250	3 350
	40	12	0.6	**MT2-5PT-SEB203J1ZZ1C3/0G**	62.2	6.35	7 400	4 600
20	37	9	0.3	**MT2-5PT-SEB904J1ZZ1C3/0G**	31.9	3.26	4 900	3 700
	42	12	0.6	**MT2-5PT-SEB004J1ZZ1C3/0G**	48.0	4.90	7 200	5 050
	47	14	1.0	**MT2-5PT-SEB204J1ZZ1C3/0G**	77.1	7.87	9 900	6 650
25	42	9	0.3	**MT2-5PT-SEB905J1ZZ1C3/0G**	42.6	4.35	5 400	4 550
	47	12	0.6	**MT2-5PT-SEB005J1ZZ1C3/0G**	54.0	5.51	7 750	5 850
	52	15	1.0	**MT2-5PT-SEB205J1ZZ1C3/0G**	99.0	10.01	10 800	7 850
30	47	9	0.3	**MT2-5PT-SEB906J1ZZ1C3/0G**	46.6	4.75	5 550	5 000
	55	13	1.0	**MT2-5PT-SEB006J1ZZ1C3/0G**	90.2	9.20	10 200	8 300

1) Minimum allowable chamfer dimension.
2) Allowable radial load is the maximum allowable load with only a radial load applied.
3) The basic dynamic load rating is the value for stainless steel bearings.
4) Maximum allowable temperature is 300˚C.

The lead time for products in this table is two weeks.
Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

6.4 Bearings with low out particle grease



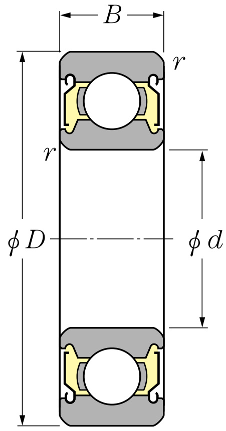
Shielded type

Boundary dimensions (mm)				Bearing numbers	Basic load ratings dynamic[2] (N)	static (N)
d	D	B	$r_{s\,min}$[1]			
4	12	4	0.2	**F-604ZZ1C3/L635QMP**	745	360
	13	5	0.2	**SEB24J1ZZ1C3/L635QMP**	1 010	490
5	13	4	0.2	**SEB95AJ1ZZ1C3/L635QMP**	830	430
	14	5	0.2	**F-605ZZ1C3/L635QMP**	1 020	505
	16	5	0.3	**SEB25J1ZZ1C3/L635QMP**	1 350	680
6	12	4	0.15	**F-WBC6-12ZZ1C3/L635QMP**	640	365
	15	5	0.2	**SEB96J1ZZ1C3/L635QMP**	1 040	530
	17	6	0.3	**SEB06J1ZZ1C3/L635QMP**	1 690	865
	19	6	0.3	**SEB26J1ZZ1C3/L635QMP**	1 800	885
7	17	5	0.3	**SEB97J1ZZ1C3/L635QMP**	1 240	715
	19	6	0.3	**SEB07J1ZZ1C3/L635QMP**	1 720	910
	22	7	0.3	**SEB27J1ZZ1C3/L635QMP**	2 570	1 400
8	19	6	0.3	**SEB98J1ZZ1C3/L635QMP**	1 530	865
	22	7	0.3	**SEB08J1ZZ1C3/L635QMP**	2 570	1 400
	24	8	0.3	**SEB28J1ZZ1C3/L635QMP**	3 050	1 590
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/L635QMP**	2 560	1 400
10	19	5	0.3	**SSN800ZZ1/L635QMP**	1 630	985
	22	6	0.3	**SSN900ZZ1/L635QMP**	2 070	1 270
	26	8	0.3	**SSN000ZZ1/L635QMP**	3 500	1 960
	30	9	0.5	**SSN200ZZ1/L635QMP**	3 950	2 390
	35	11	0.6	**SEB300J1ZZ1C3/L635QMP**	6 300	3 500
12	24	6	0.3	**SSN901ZZ1/L635QMP**	2 220	1 460
	28	8	0.3	**SSN001ZZ1/L635QMP**	3 950	2 390
	32	10	0.6	**SSN201ZZ1/L635QMP**	5 250	3 050
15	24	5	0.3	**SSN802ZZ1/L635QMP**	1 600	1 260
	28	7	0.3	**SSN902ZZ1/L635QMP**	3 350	2 260
	32	9	0.3	**SSN002ZZ1/L635QMP**	4 300	2 830
	35	11	0.6	**SSN202ZZ1/L635QMP**	5 850	3 750
17	30	7	0.3	**SSN903ZZ1/L635QMP**	3 550	2 560
	35	10	0.3	**SSN003ZZ1/L635QMP**	4 600	3 250
	40	12	0.6	**SSN203ZZ1/L635QMP**	7 350	4 800
20	37	9	0.3	**SSN904ZZ1/L635QMP**	4 900	3 700
	42	12	0.6	**SSN004ZZ1/L635QMP**	7 200	5 050
	47	14	1.0	**SSN204ZZ1/L635QMP**	9 900	6 650
25	42	9	0.3	**SSN905ZZ1/L635QMP**	5 400	4 550
	47	12	0.6	**SSN005ZZ1/L635QMP**	7 750	5 850
	52	15	1.0	**SSN205ZZ1/L635QMP**	10 800	7 850
30	47	9	0.3	**SSN906ZZ1/L635QMP**	5 550	5 000
	55	13	1.0	**SSN006ZZ1/L635QMP**	10 200	8 250
	62	16	1.0	**SSN206ZZ1/L635QMP**	15 000	11 300
35	72	17	1.1	**SSN207ZZ1/L635QMP**	19 800	15 400

1) Minimum allowable chamfer dimension.
2) The basic dynamic load rating is the value for stainless steel bearings.
3) Maximum allowable temperature is 70˚C.

The lead time for products in this table is two weeks.
Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

6.5 Bearings with low out particle grease for vacuum environment



Shielded type

Boundary dimensions (mm)				Bearing numbers	Basic load ratings dynamic[2] (N)	static (N)
d	D	B	$r_{s\,min}$ [1]			
4	12	4	0.2	**F-604ZZ1C3/LX23Q8** [2]	745	360
	13	5	0.2	**SEB24J1ZZ1C3/LX23Q12**	1 010	490
5	13	4	0.2	**SEB95AJ1ZZ1C3/LX23Q20**	830	430
	14	5	0.2	**F-605ZZ1C3/LX23Q8** [2]	1 020	505
	16	5	0.3	**SEB25J1ZZ1C3/LX23Q24**	1 350	680
6	12	4	0.15	**F-WBC6-12ZZ1C3/LX23Q7** [2]	640	365
	15	5	0.2	**SEB96J1ZZ1C3/LX23Q30**	1 040	530
	17	6	0.3	**SEB06J1ZZ1C3/LX23Q15**	1 690	865
	19	6	0.3	**SEB26J1ZZ1C3/LX23Q31**	1 800	885
7	17	5	0.3	**SEB97J1ZZ1C3/LX23Q6**	1 240	715
	19	6	0.3	**SEB07J1ZZ1C3/LX23Q24**	1 720	910
	22	7	0.3	**SEB27J1ZZ1C3/LX23Q19**	2 570	1 400
8	19	6	0.3	**SEB98J1ZZ1C3/LX23Q22**	1 530	865
	22	7	0.3	**SEB08J1ZZ1C3/LX23Q109**	2 570	1 400
	24	8	0.3	**SEB28J1ZZ1C3/LX23Q5**	3 050	1 590
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/LX23Q18** [2]	2 560	1 400
10	22	6	0.3	**SEB900J1ZZ1C3/LX23Q19**	2 070	1 270
	26	8	0.3	**SEB000J1ZZ1C3/LX23Q67**	3 500	1 960
	30	9	0.6	**SEB200J1ZZ1C3/LX23Q39**	3 950	2 390
	35	11	0.6	**SEB300J1ZZ1C3/LX23Q13**	6 300	3 500
12	24	6	0.3	**SEB901J1ZZ1C3/LX23Q14**	2 220	1 460
	28	8	0.3	**SEB001J1ZZ1C3/LX23Q48**	3 950	2 390
	32	10	0.6	**SEB201J1ZZ1C3/LX23Q59**	4 700	2 750
15	28	7	0.3	**SEB902J1ZZ1C3/LX23Q14**	2 810	2 000
	32	9	0.3	**SEB002J1ZZ1C3/LX23Q33**	4 300	2 830
	35	11	0.6	**SEB202J1ZZ1C3/LX23Q100**	5 950	3 600
17	30	7	0.3	**SEB903JR1XZZ1C3/LX23Q10**	3 600	2 580
	35	10	0.3	**SEB003J1ZZ1C3/LX23Q34**	5 250	3 350
	40	12	0.6	**SEB203J1ZZ1C3/LX23Q91**	7 400	4 600
20	37	9	0.3	**SEB904J1ZZ1C3/LX23Q17**	4 900	3 700
	42	12	0.6	**SEB004J1ZZ1C3/LX23Q41**	7 200	5 050
	47	14	1.0	**SEB204J1ZZ1C3/LX23Q50**	9 900	6 650
25	42	9	0.3	**SEB905J1ZZ1C3/LX23Q18**	5 400	4 550
	47	12	0.6	**SEB005J1ZZ1C3/LX23Q46**	7 750	5 850
	52	15	1.0	**SEB205J1ZZ1C3/LX23Q63**	10 800	7 850
30	47	9	0.3	**SEB906J1ZZ1C3/LX23Q12**	5 550	5 000
	55	13	1.0	**SEB006J1ZZ1C3/LX23Q35**	10 200	8 300
	62	16	1.0	**SEB206J1ZZ1C3/LX23Q65**	15 000	11 300

1) Minimum allowable chamfer dimension.
2) Maximum allowable temperature is 120˚C (200˚C for others).
3) The basic dynamic load rating is the value for stainless steel bearings.

The lead time for products in this table is two weeks.

Note: **NTN** continue to expand our product line. For information on bearings not included in this table, contact **NTN** Engineering.

Handling Precautions

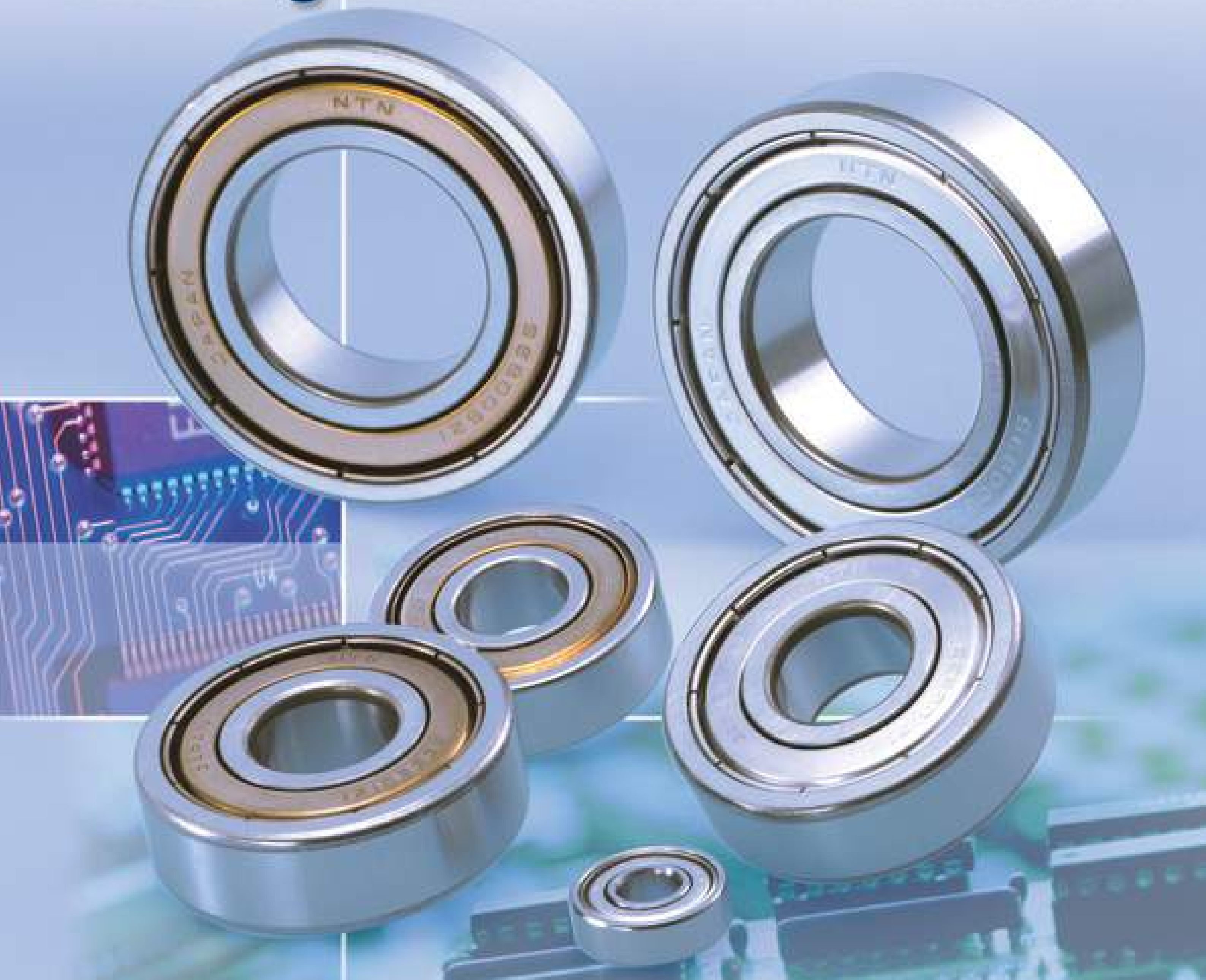
(1) Bearing components have been thoroughly degreased. Do not touch any bearing component with bare hands. Doing so may cause rusting of the bearing. Always wear clean, lint-free gloves when installing a bearing.
(2) Do not rinse a bearing with an organic solvent. Doing so may lead to lubricant leakage or damage to the lubricant film.
(3) Do not unpack a vacuum-packed or heat-packed bearing until immediately before installation. Otherwise, the bearing may rust or become contaminated with dust. If the bearing will not be used for an extended period, store it in a dry, closed container such as a desiccator.

For New Technology Network

NTN®

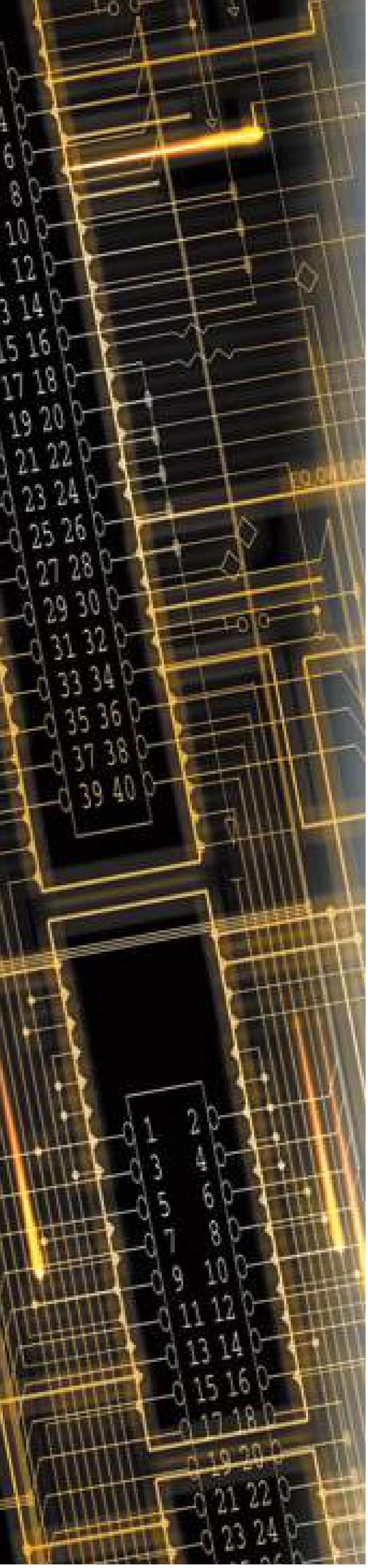
Lower particle generation for liquid crystal and semiconductor manufacturing equipment

Ultra Final Series
Bearings for Clean Environment



Ultra Final Series bearings for clean environment with enhanced durability and lower particle generation at high temperatures, clean rooms and vacuums

CAT. No. 3028-Ⅱ/E



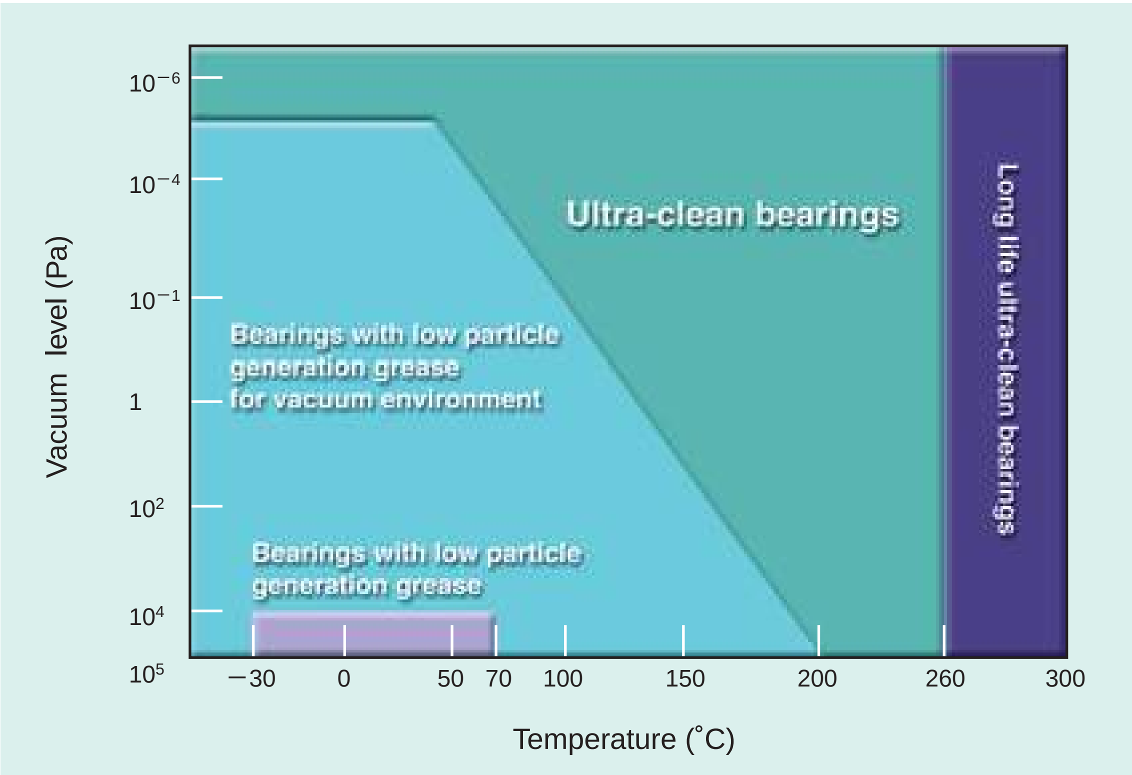
NTN bearings for clean environments

CONTENTS

NTN bearings for clean environments

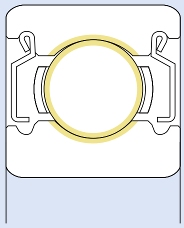
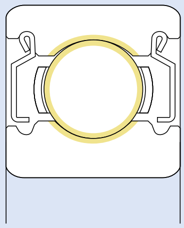
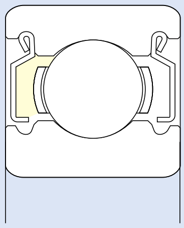
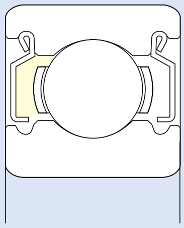
Ultra Final Series bearings for clean environments are bearings that produce minimal dust for vacuum equipment, transfer equipment, and equipment for manufacturing semiconductors, liquid crystal and electronic components.

Range of NTN bearings for clean environment



1. Standard specifications of bearings for clean environments

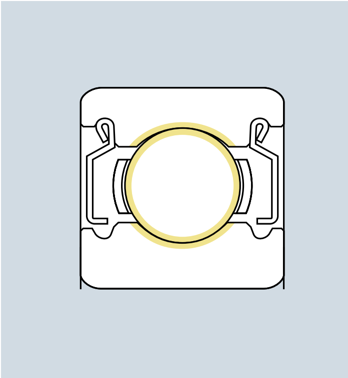
The standard specifications of bearings for clean environments are as follows.
For more details, contact **NTN** Engineering.

Classification of bearings	Appearance	Lubricant	Configuration
Ultra-clean bearings		Special PTFE	 Raceway groove and rolling elements
Long life Ultra-clean bearings		Special PTFE + Special ball	 Raceway groove and rolling elements
Bearings with low particle generation grease		**NTN** low particle generation grease	
Bearings with low particle generation grease for vacuum environment		Fluorine grease	

<table>
<tr><th colspan="4">Materials</th><th rowspan="2">Page of bearing dimension table</th></tr>
<tr><th>Inner and outer rings</th><th>Rolling elements</th><th>Cage</th><th>Shield</th></tr>
<tr><td rowspan="4">Martensite stainless steel</td><td>Martensite stainless steel</td><td rowspan="4">Austenite stainless steel</td><td rowspan="4">Austenite stainless steel</td><td>Page 8</td></tr>
<tr><td>Martensite stainless steel + Special ball</td><td>Page 9</td></tr>
<tr><td rowspan="2">Martensite stainless steel</td><td>Page 10</td></tr>
<tr><td>Page 11</td></tr>
</table>

2. Ultra-clean bearings (vacuum / high temperature)

● Appearance and configuration

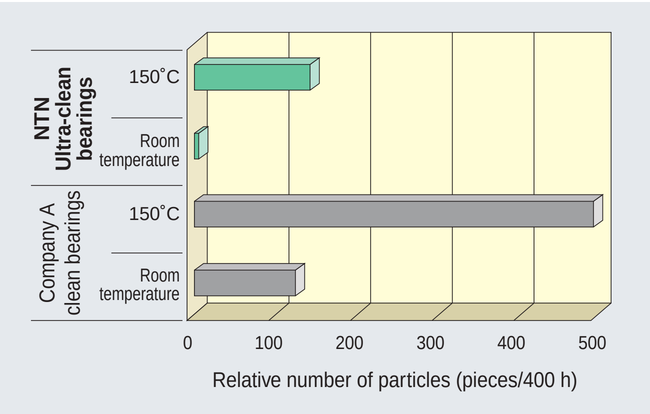


● Standard specifications

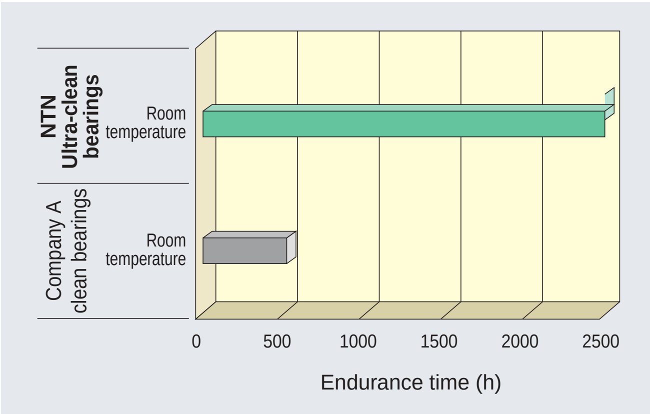
Inner and outer rings	: Martensite stainless steel
Rolling elements	: Martensite stainless steel
Cage	: Austenite stainless steel
Lubricant	: Special PTFE
Shield	: Austenite stainless steel

● Characteristics of particle generation and durability

1) Part No. : 608
2) Axial load : 10N
3) Rotational speed : 50min^{-1}
4) Vacuum level : 10^{-5}Pa



1) Part No. : 608
2) Axial load : 10N
3) Rotational speed : 360min^{-1}
4) Vacuum level : 10^{-5}Pa



● Features

1. Low particle generation, corrosion resistance.
2. Low torque.
3. Can be used in high temperature and high vacuum conditions.
4. Long life.

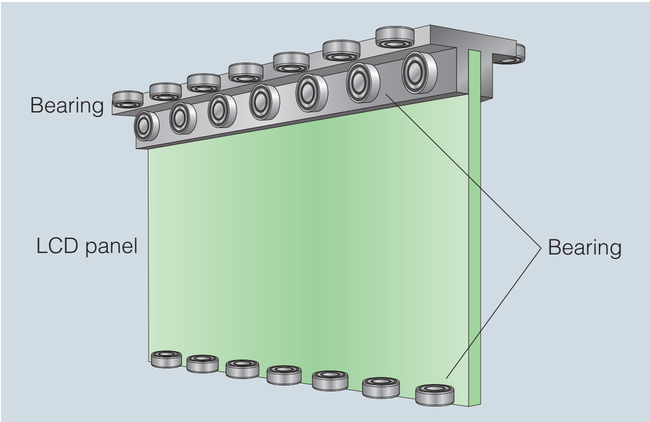
● Ex.) part No.

MT2－SEB08J1ZZ1C3／0G

● Operating temperature

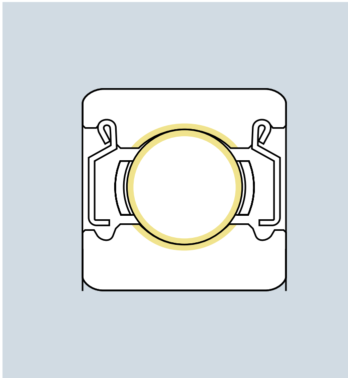
～ 260˚C

● Application example: Transfer equipment of LCD panel



3. Long life ultra-clean bearings (vacuum / high temperature)

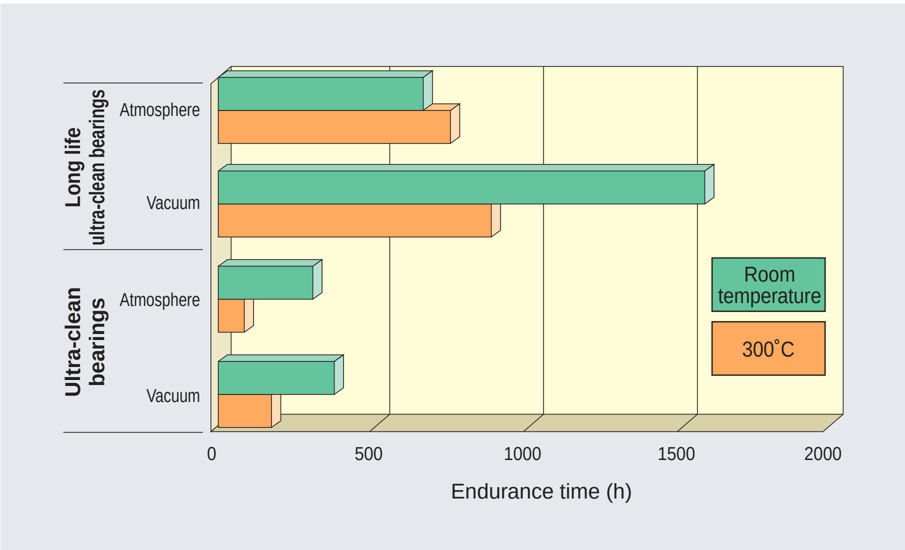
● Appearance and configuration



● Standard specifications

Inner and outer rings	: Martensite stainless steel
Rolling elements	: Martensite stainless steel
Cage	: Austenite stainless steel
Lubricant	: Special PTFE and special ball
Shield	: Austenite stainless steel

● Durability



1) Part No. : 608
2) Axial load : 10N
3) Rotational speed : 2500min^{-1}
4) Atmosphere/vacuum (10^{-4}Pa)

● Features

1. Low particle generation, corrosion resistance.
2. Low torque.
3. Longer life than ultra-clean bearing.

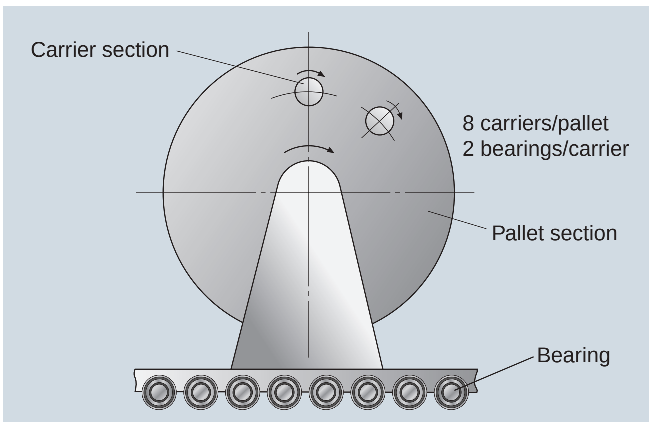
● Ex.) part No.

MT2－5PT－SEB08J1ZZ1C3／0G

● Operating temperature

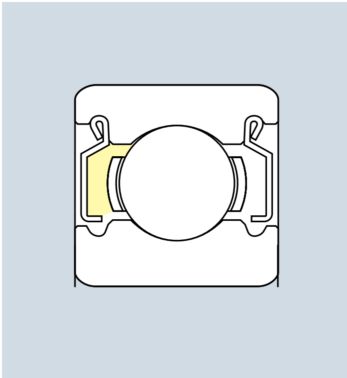
～300˚C

● Application example: Transfer equipment of HD substrate



4. Bearings with low particle generation grease (atmosphere / room temperature)

● Appearance and configuration

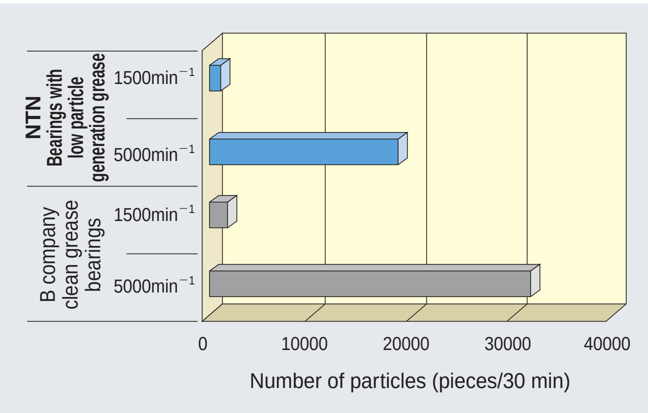


● Standard specifications

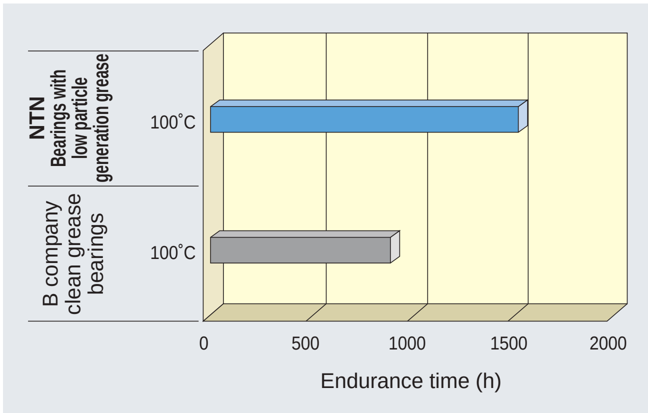
Inner and outer rings	: Martensite stainless steel
Rolling elements	: Martensite stainless steel
Cage	: Austenite stainless steel
Lubricant	: **NTN** low dusting grease ZD-1 (L635)
Shield	: Austenite stainless steel

● Characteristics of particle generation and durability

1）Part No. : 608
2）Axial load : 10N
3）Temperature : Room temperature



1）Part No. : 6204
2）Axial load : 67N
3）Rotational speed : 10000min^{-1}



● Features

1. Low particle generation, corrosion resistance.
2. Low torque.
3. Long life.

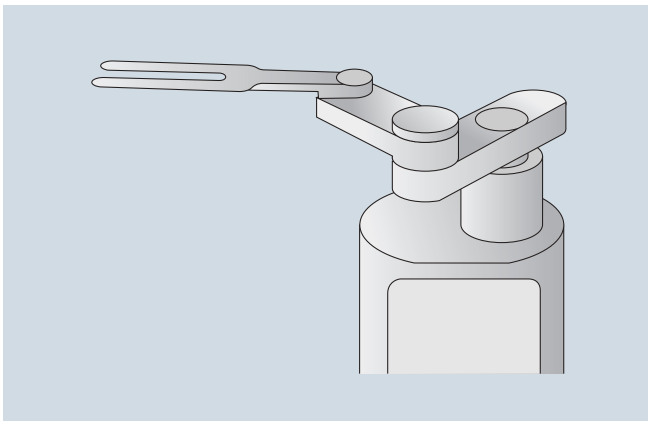
● Ex.) part No.

SEB08J1ZZ1C3／L635QMP

● Operating temperature

～70˚C

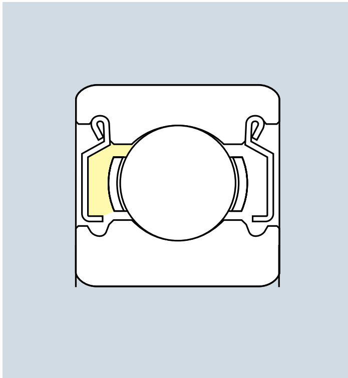
● Application example: Transfer robot



Cam follower and bearing unit with low particle generation grease are available.

5. Bearings with low particle generation grease for vacuum environment (vacuum / high temperature)

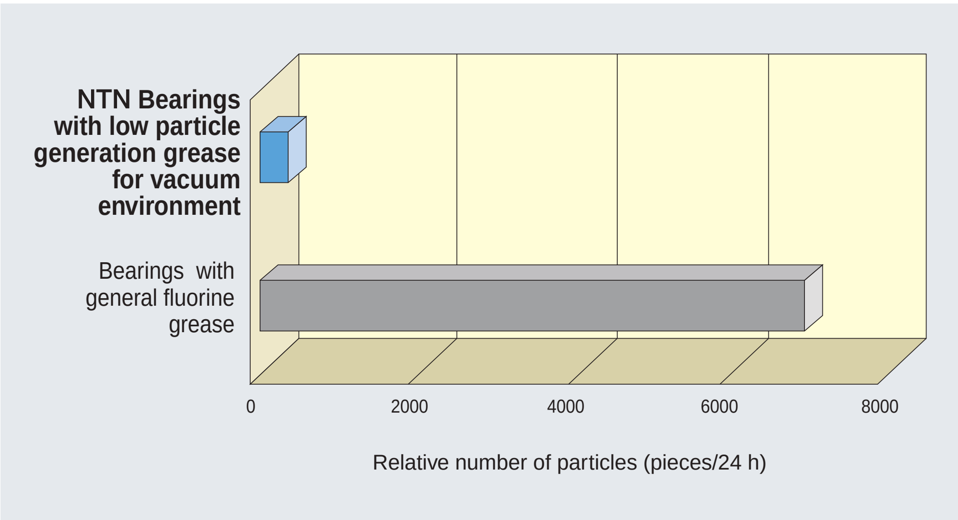
● Appearance and configuration



● Standard specifications

Inner and outer rings	: Martensite stainless steel
Rolling elements	: Martensite stainless steel
Cage	: Austenite stainless steel
Lubricant	: Low particle generation grease for vacuum environment (LX23)
Shield	: Austenite stainless steel

● Dusting characteristics of particle generation



1) Part No. : 608
2) Axial load : 29.4N
3) Rotational speed : 200min^{-1}
4) Vacuum level : 10^{-5}Pa

● Features

1. Low particle generation, corrosion resistance.
2. Can be used in high temperature and high vacuum conditions.
3. Long life.

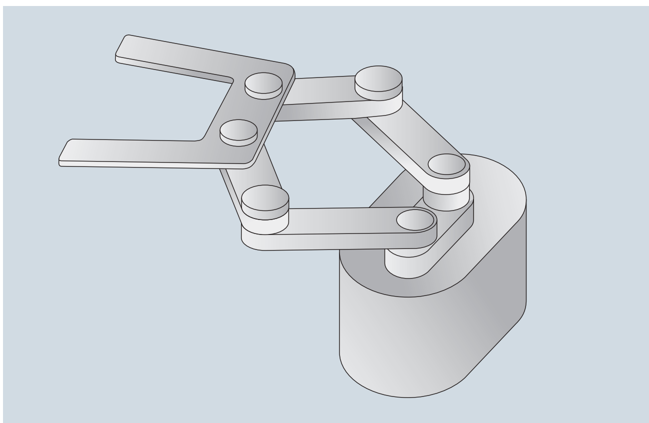
● Ex.) part No.

SEB08J1ZZ1C3／LX23Q109

● Operating temperature

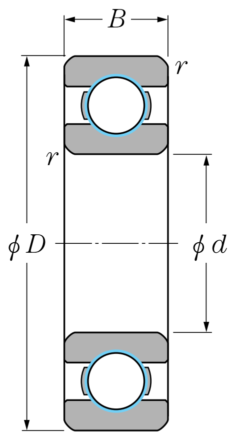
～200˚C

● Application example: LCD transfer robot

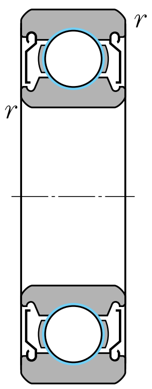


Cam follower and bearing unit with low particle generation grease for vacuum environment are available.

6. 1 Ultra-clean bearings



Open type 2)



Shielded type

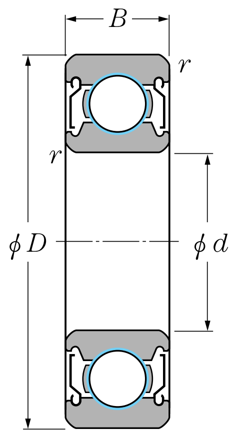
Main dimensions (mm)				Part No.	Allowable radial load 3)	
d	D	B	$r_{s\,min}$ 1)		N	kgf
4	8	2	0.08	**MT2-F-BC4-8C3** 4)	1	0.10
	9	2.5	0.1	**MT2-F-684AX50C3** 4)	1.6	0.16
	10	3	0.16	**MT2-F-BC4-10C3** 4)	1.6	0.16
	12	4	0.2	**MT2-F-604ZZ1C3** 4)	2.5	0.26
	13	5	0.2	**MT2-SEB24J1ZZ1C3/0G**	3.4	0.35
5	10	3	0.15	**MT2-F-BC5-10C3** 4)	1.7	0.17
	13	4	0.2	**MT2-SEB95AJ1ZZ1C3/0G**	2.6	0.27
	14	5	0.2	**MT2-F-605ZZ1C3/0G**	3.5	0.36
	16	5	0.3	**MT2-SEB25J1ZZ1C3/0G**	4	0.41
6	12	3	0.15	**MT2-F-BC6-12C3** 4)	1.8	0.18
	15	5	0.2	**MT2-SEB96J1ZZ1C3/0G**	3.7	0.38
	17	6	0.3	**MT2-SEB06J1ZZ1C3/0G**	6.1	0.62
	19	6	0.3	**MT2-SEB26J1ZZ1C3/0G**	13.1	1.34
7	17	5	0.3	**MT2-SEB97J1ZZ1C3/0G**	3.9	0.40
	19	6	0.3	**MT2-SEB07J1ZZ1C3/0G**	10.4	1.06
	22	7	0.3	**MT2-SEB27J1ZZ1C3/0G**	16.9	1.72
8	19	6	0.3	**MT2-SEB98J1ZZ1C3/0G**	5.3	0.54
	22	7	0.3	**MT2-SEB08J1ZZ1C3/0G**	16.9	1.72
	24	8	0.3	**MT2-SEB28J1ZZ1C3/0G**	24.8	2.53
9.525	22.225	7.142	0.3	**MT2-F-R6J1ZZ1C3/0G** 4)	16.5	1.68
10	22	6	0.3	**MT2-SEB900J1ZZ1C3/0G**	13.4	1.37
	26	8	0.3	**MT2-SEB000J1ZZ1C3/0G**	24	2.45
	30	9	0.5	**MT2-SEB200J1ZZ1C3/0G**	27.8	2.84
	35	11	0.6	**MT2-SEB300J1ZZ1C3/0G**	55.6	5.67
12	24	6	0.3	**MT2-SEB901J1ZZ1C3/0G**	14.1	1.44
	28	8	0.3	**MT2-SEB001J1ZZ1C3/0G**	27.8	2.84
	32	10	0.6	**MT2-SEB201J1ZZ1C3/0G**	37.4	3.82
15	28	7	0.3	**MT2-SEB902J1ZZ1C3/0G**	17.8	1.82
	32	9	0.3	**MT2-SEB002J1ZZ1C3/0G**	31.2	3.18
	35	11	0.6	**MT2-SEB202J1ZZ1C3/0G**	48.8	4.98
17	30	7	0.3	**MT2-SEB903JR1XZZ1C3/0G**	24.8	2.53
	35	10	0.3	**MT2-SEB003J1ZZ1C3/0G**	37.1	3.79
	40	12	0.5	**MT2-SEB203J1ZZ1C3/0G**	62.2	6.35
20	37	9	0.3	**MT2-SEB904J1ZZ1C3/0G**	36.3	3.70
	42	12	0.6	**MT2-SEB004J1ZZ1C3/0G**	48	4.90
	47	14	0.5	**MT2-SEB204J1ZZ1C3/0G**	77.1	7.87
25	42	9	0.3	**MT2-SEB905J1ZZ1C3/0G**	48	4.90
	47	12	0.6	**MT2-SEB005J1ZZ1C3/0G**	63.2	6.45
	52	15	0.5	**MT2-SEB205J1ZZ1C3/0G**	99	10.10
30	47	9	0.3	**MT2-SEB906J1ZZ1C3/0G**	51.5	5.25
	55	13	1	**MT2-SEB006J1ZZ1C3/0G**	103.5	10.56
	62	16	0.5	**MT2-SEB206J1ZZ1C3/0G**	129.4	13.20

1) Minimum allowable chamfer dimension.
2) Groove may be provided for seal in some cases.
3) Allowable radial load is the maximum load when radial load is applied.
4) Allowable temperature for this bearing is 120˚C. For others, 260˚C.

〈Example part No:〉 **MT2 − SEB08 J1 ZZ1 C3 ／ 0G**

- 0G → Grease lubricant code
  Solid lubricant···OG
  Low particle generation grease···L635
  Low particle generation fluorine grease ···LX23
- C3 → Internal clearance code (C3 clearance)
- ZZ1 → Shield code: Austenite stainless steel···ZZ1
  : No shield··· No code
- J1 → Cage code: Austenite stainless steel: J1
- SEB08 → Basic No.
- MT2 → Solid lubricant code: Special PTFE ···MT2 (ultra-clean bearing)
  ···MT2-5PT (long life ultra-clean bearing)
  Grease lubrication···No suffix (indicated at end of part part No.)

6. 2 Long life ultra-clean bearings



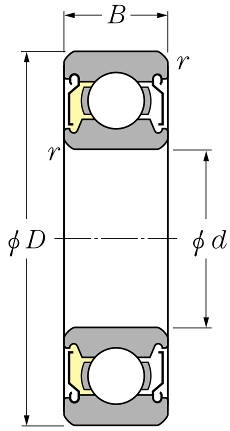
Shielded type

Main dimensions (mm)				Part No.	Allowable radial load 2)		Basic load ratings	
d	D	B	$r_{s\,min}$ 1)		N	kgf	dynamic (N)	static (N)
6	19	6	0.3	**MT2-5PT-SEB26J1ZZ1C3/0G**	13.1	1.34	2 340	885
7	22	7	0.3	**MT2-5PT-SEB27J1ZZ1C3/0G**	16.9	1.72	3 350	1 400
8	22	7	0.3	**MT2-5PT-SEB08J1ZZ1C3/0G**	16.9	1.72	3 350	1 400
	24	8	0.3	**MT2-5PT-SEB28J1ZZ1C3/0G**	24.8	2.53	4 000	1 590
10	26	8	0.3	**MT2-5PT-SEB000J1ZZ1C3/0G**	24.0	2.45	4 550	1 960
	30	9	0.6	**MT2-5PT-SEB200J1ZZ1C3/0G**	27.8	2.84	5 100	2 390
	35	11	0.6	**MT2-5PT-SEB300J1ZZ1C3/0G**	55.6	5.67	8 200	3 500
12	28	8	0.3	**MT2-5PT-SEB001J1ZZ1C3/0G**	27.8	2.84	5 100	2 390
	32	10	0.6	**MT2-5PT-SEB201J1ZZ1C3/0G**	37.4	3.82	6 100	2 750
15	28	7	0.3	**MT2-5PT-SEB902J1ZZ1C3/0G**	17.3	1.77	3 650	2 000
	32	9	0.3	**MT2-5PT-SEB002J1ZZ1C3/0G**	31.2	3.18	5 600	2 830
	35	11	0.6	**MT2-5PT-SEB202J1ZZ1C3/0G**	48.8	4.98	7 750	3 600
17	30	7	0.3	**MT2-5PT-SEB903JR1XZZ1C3/0G**	22.4	2.29	4 650	2 580
	35	10	0.3	**MT2-5PT-SEB003J1ZZ1C3/0G**	37.1	3.79	6 800	3 350
	40	12	0.6	**MT2-5PT-SEB203J1ZZ1C3/0G**	62.2	6.35	9 600	4 600
20	37	9	0.3	**MT2-5PT-SEB904J1ZZ1C3/0G**	31.9	3.26	6 400	3 700
	42	12	0.6	**MT2-5PT-SEB004J1ZZ1C3/0G**	48.0	4.90	9 400	5 050
	47	14	1.0	**MT2-5PT-SEB204J1ZZ1C3/0G**	77.1	7.87	12 800	6 650
25	42	9	0.3	**MT2-5PT-SEB905J1ZZ1C3/0G**	42.6	4.35	7 050	4 550
	47	12	0.6	**MT2-5PT-SEB005J1ZZ1C3/0G**	54.0	5.51	10 100	5 850
	52	15	1.0	**MT2-5PT-SEB205J1ZZ1C3/0G**	99.0	10.01	14 000	7 850
30	47	9	0.3	**MT2-5PT-SEB906J1ZZ1C3/0G**	46.6	4.75	7 250	5 000
	55	13	1.0	**MT2-5PT-SEB006J1ZZ1C3/0G**	90.2	9.20	13 200	8 300

1) Minimum allowable chamfer dimension.

2) Allowable radial load is the maximum load when radial load is applied.

6. 3 Bearings with low particle generation grease

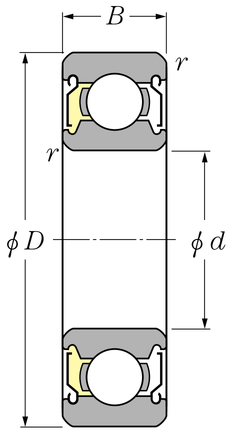


Shielded type

Main dimensions (mm)				Part No.
d	*D*	*B*	$r_{s\ min}$ [1)]	
4	12	4	0.2	**F-604ZZ1C3/L635QMP**
	13	5	0.2	**SEB24J1ZZ1C3/L635QMP**
5	13	4	0.2	**SEB95AJ1ZZ1C3/L635QMP**
	14	5	0.2	**F-605ZZ1C3/L635QMP**
	16	5	0.3	**SEB25J1ZZ1C3/L635QMP**
6	12	4	0.15	**F-WBC6-12ZZ1C3/L635QMP**
	15	5	0.2	**SEB96J1ZZ1C3/L635QMP**
	17	6	0.3	**SEB06J1ZZ1C3/L635QMP**
	19	6	0.3	**SEB26J1ZZ1C3/L635QMP**
7	17	5	0.3	**SEB97J1ZZ1C3/L635QMP**
	19	6	0.3	**SEB07J1ZZ1C3/L635QMP**
	22	7	0.3	**SEB27J1ZZ1C3/L635QMP**
8	19	6	0.3	**SEB98J1ZZ1C3/L635QMP**
	22	7	0.3	**SEB08J1ZZ1C3/L635QMP**
	24	8	0.3	**SEB28aJ1ZZ1C3/L635QMP**
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/L635QMP**
10	22	6	0.3	**SEB900J1ZZ1C3/L635QMP**
	26	8	0.3	**SEB000J1ZZ1C3/L635QMP**
	30	9	0.5	**SEB200J1ZZ1C3/L635QMP**
	35	11	0.6	**SEB300J1ZZ1C3/L635QMP**
12	24	6	0.3	**SEB901J1ZZ1C3/L635QMP**
	28	8	0.3	**SEB001J1ZZ1C3/L635QMP**
	32	10	0.6	**SEB201J1ZZ1C3/L635QMP**
15	28	7	0.3	**SEB902J1ZZ1C3/L635QMP**
	32	9	0.3	**SEB002J1ZZ1C3/L635QMP**
	35	11	0.6	**SEB202J1ZZ1C3/L635QMP**
17	30	7	0.3	**SEB903JR1XZZ1C3/L635QMP**
	35	10	0.3	**SEB003J1ZZ1C3/L635QMP**
	40	12	0.5	**SEB203J1ZZ1C3/L635QMP**
20	37	9	0.3	**SEB904J1ZZ1C3/L635QMP**
	42	12	0.6	**SEB004J1ZZ1C3/L635QMP**
	47	14	0.5	**SEB204J1ZZ1C3/L635QMP**
25	42	9	0.3	**SEB905J1ZZ1C3/L635QMP**
	47	12	0.6	**SEB005J1ZZ1C3/L635QMP**
	52	15	0.5	**SEB205J1ZZ1C3/L635QMP**
30	47	9	0.3	**SEB906J1ZZ1C3/L635QMP**
	55	13	1	**SEB006J1ZZ1C3/L635QMP**
	62	16	0.5	aT**SEB206J1ZZ1C3/L635QMP**

1) Minimum allowable chamfer dimension.

6. 4 Bearings with low particle generation grease for vacuum environment



Shielded type

Main dimensions (mm)				Part No.
d	D	B	$r_{s\ min}$ 1)	
4	12 13	4 5	0.2 0.2	**F-604ZZ1C3/LX23Q8** 2) **SEB24J1ZZ1C3/LX23Q12**
5	13 14 16	4 5 5	0.2 0.2 0.3	**SEB95AJ1ZZ1C3/LX23Q20** **F-605ZZ1C3/LX23Q8** 2) **SEB25J1ZZ1C3/LX23Q24**
6	12 15 17 19	4 5 6 6	0.15 0.2 0.3 0.3	**F-WBC6-12ZZ1C3/LX23Q7** 2) **SEB96J1ZZ1C3/LX23Q30** **SEB06J1ZZ1C3/LX23Q15** **SEB26J1ZZ1C3/LX23Q31**
7	17 19 22	5 6 7	0.3 0.3 0.3	**SEB97J1ZZ1C3/LX23Q6** **SEB07J1ZZ1C3/LX23Q24** **SEB27J1ZZ1C3/LX23Q19**
8	19 22 24	6 7 8	0.3 0.3 0.3	**SEB98J1ZZ1C3/LX23Q22** **SEB08J1ZZ1C3/LX23Q109** **SEB28J1ZZ1C3/LX23Q5**
9.525	22.225	7.142	0.3	**F-R6J1ZZ1C3/LX23Q18** 2)
10	22 26 30 35	6 8 9 11	0.3 0.3 0.5 0.6	**SEB900J1ZZ1C3/LX23Q19** **SEB000J1ZZ1C3/LX23Q67** **SEB200J1ZZ1C3/LX23Q38** **SEB300J1ZZ1C3/LX23Q13**
12	24 28 32	6 8 10	0.3 0.3 0.6	**SEB901J1ZZ1C3/LX23Q14** **SEB001J1ZZ1C3/LX23Q48** **SEB201J1ZZ1C3/LX23Q59**
15	28 32 35	7 9 11	0.3 0.3 0.6	**SEB902J1ZZ1C3/LX23Q14** **SEB002J1ZZ1C3/LX23Q33** **SEB202J1ZZ1C3/LX23Q100**
17	30 35 40	7 10 12	0.3 0.3 0.5	**SEB903JR1XZZ1C3/LX23Q10** **SEB003J1ZZ1C3/LX23Q34** **SEB203J1ZZ1C3/LX23Q91**
20	37 42 47	9 12 14	0.3 0.6 0.5	**SEB904J1ZZ1C3/LX23Q17** **SEB004J1ZZ1C3/LX23Q41** **SEB204J1ZZ1C3/LX23Q50**
25	42 47 52	9 12 15	0.3 0.6 0.5	**SEB905J1ZZ1C3/LX23Q18** **SEB005J1ZZ1C3/LX23Q46** **SEB205J1ZZ1C3/LX23Q63**
30	47 55 62	9 13 16	0.3 1 0.5	**SEB906J1ZZ1C3/LX23Q12** **SEB006J1ZZ1C3/LX23Q35** **SEB206J1ZZ1C3/LX23Q65**

1) Minimum allowable chamfer dimension.
2)Allowable temperature for this bearing is 120˚C. For others, 200˚C.

7. Introduction bearings for special environments

7. 1 Cam followers

CAT. NO. 3604

Features

- **NTN** offers a rich assortment of stainless steel cam followers that use low dusting grease or solid grease to maintain a clean environment.

7. 3 Ball screws

CAT. NO. 6002

Features

- All parts are made of stainless steel except the dust seal.
- Ball screws are vacuum grease sealed or provided with RAYDENT depending on working environment and conditions.
- Low dusting; can be used in both atmosphere and vacuums.

7. 5 Plastic rolling bearings

CAT. NO. 3023

Features

- Equipped with self-lubricating, corrosion-resistant plastic raceways and glass or ceramic balls.
- Doesn't require lubrication; offers lower torque than sliding bearings.
- Low dusting.

7. 2 Bearing units /Stainless steel series

CAT. NO. 3903/E

Features

- Housing and inner/outer rings are made of stainless steel. Maintain a clean environment by using low particle generation grease or bearings with solid grease.

7. 4 Miniature sliding screws with plastic nut

CAT. NO. 5112/E

Features

- Combination of nuts made of BEAREE AS5000 and screws made of stainless steel (SUS304) provides resistance to various environments, like corrosion and high temperature etc.
- Less noise than stainless steel ball screws.

NTN®

Bearings with solid grease

Patent pending

CAT. NO. 3022-Ⅷ/E

NTN
BEARINGS with SOLID GREASE

Bearings with general-purpose solid grease

Bearings with food-grade solid grease

Overview

"Solid grease" is a lubricant essentially composed of lubricating grease and ultra-high polymer polyethylene. Solid grease has the same viscosity as ordinary grease at normal temperature, but as a result of a special heat treatment process, this grease solidifies retaining a large proportion of the lubricant in it. Thanks to this solidification, the grease does not easily leak from the bearing, even when the bearing is subjected to strong vibrations or centrifugal force, helping to extend bearing life.

Bearings with solid grease are available in two types: the spot-pack type in which solid grease is injected into the retainer, and the full-pack type in which all empty space around the rolling elements is filled with solid grease.
Spot-pack solid grease is standard for deep groove ball bearings, small diameter ball bearings, and bearing units. Full-pack solid grease is standard for self-aligning ball bearings, self-aligning roller bearings, and needle roller bearings.

Table 1 Major components in solid greases

Solid grease (code)	Resin	Lubricant
General-purpose solid grease (LP03)	Ultra-high polymer polyethylene ❶	Li-mineral oil grease
Food-grade solid grease (LP09)	Ultra-high polymer polyethylene ❶	Urea-synthetic oil grease ❷

❶ Conforms to FDA standard.
❷ Conforms to H-1 standard of NSF.

●Solid grease filling options

Deep groove ball bearings (spot-pack)

Bearing units (spot-pack)

Spherical roller bearings (full-pack)

Needle roller bearings (full-pack)

Features

1. Reduced lubricant leakage

Because the base oil is retained in a solid mixture, it is less likely to leak out of the bearing. During operation, temperature rise and/or centrifugal force will cause a gradual release of the base oil into the raceway groove. Eliminating grease leakage from the bearing ensures a consistent supply of lubricant and prevents contamination of the surrounding environment.

2. Superior lubrication

Bearings with solid grease resist grease leakage prolonging bearing life in applications where high centrifugal force or vibration are present. The solid lubricant does not emulsify when exposed to water also extending both grease and bearing life.

3. Low torque characteristics

The running torque of spot-pack bearings with solid grease is lower than that of bearings using standard lubricants. With conventional greases, a shearing resistance is created as the grease is channeled out of the raceway groove. Spot-pack bearings with solid grease do not experience shear resistance resulting in a lower running torque.

4. Sealing effect

Though solid grease protects a bearing against ingress of foreign matters (water, dust, etc.), it is not a sufficient means as a sealing device. Therefore, for applications that need reliable sealing performance, we recommend the use of contact type rubber seals (deep groove ball bearings, bearing units) or other seals (other bearing types).

1 Availability

1. Bearings with general-purpose solid grease (LP03)

Table 2 (○:standard △:special ×:not available)

Bearing	Type		Bearing size Bearing out. dia.
	Spot-pack	Full-pack	
Deep groove ball bearings	○❶	△	Up to 350 mm dia.
Miniature bearings Small dia. ball bearings	○❶	×	Inside diameter from 6 to 9 mm
Self-aligning ball bearings	×	○❶	Up to 250 mm dia.
Spherical roller bearings	×	○❶	Up to 250 mm dia.
Bearing units	○❶	△	Up to 300 mm dia.
Needle roller bearings	×	○❷	Note ❷

❶ Deep groove ball bearings with spot-pack configuration and ZZ shields are standard. Certain types and sizes of standard bearings listed in the table above are not available with solid grease. For further information, consult **NTN** Engineering by specifying the intended bearing type and size.
❷ Available bearing size for needle roller bearings varies depending on bearing type. For further information, contact **NTN** Engineering.
Note: The bearing components are not composed of a corrosion-proof material.

2. Spot-pack configuration for bearings with food-grade solid grease (LP09)

F-UC204D1 to F-UC210D1
(Bearing units-stainless steel series)
Stainless steel deep groove ball bearings ❶ (bearing outside diameter 250 mm or less)

2 Allowable Temperature Range

The maximum operating temperature on the outer ring of bearings with solid grease must fall within the ranges in **Table 3** below.
The bearings with solid grease may be assembled by "shrink fit" technique. However, be absolutely sure that that the maximum heating temperature does not exceed 100˚C, the heating time is shorter than 2 hours, and the bearing does not turn during the shrink fit process.

Table 3

	Bearings with general-purpose solid grease (LP03)	Bearings with food-grade solid grease (LP09)
Allowable temperature range	-20˚C~80˚C (Long-time operation: 60˚C or less)	-10˚C~100˚C (Long-time operation: 80˚C or less)

3 Allowable Speed

Table 4 Allowable speed for bearings with solid grease

Bearing type	Load type	Allowable speed (d_n value) ❶		
		general-purpose		food-grade
		Spot-pack	Full-pack	Spot-pack
Deep groove ball bearings	Radial load	20×10^4	5×10^4	10×10^4 ❸
Miniature bearings Small dia. ball bearings	Radial load	20×10^4	—	—
Self-aligning ball bearings	Radial load	—	3×10^4	—
Spherical roller bearings	Radial load	—	3×10^4	—
	Axial load/radial load≦0.3	—	2×10^4	—
Bearing units	Radial load	12×10^4	3×10^4	10×10^4
Needle roller bearings	Radial load	—	3×10^4 ❷	—

❶ d_n value: (d = bearing bore dia. [mm])×(n = service speed [min^{-1}])
❷ $F_w.n$ value: (F_w = roller set bore dia. [mm])×(n = service speed [min^{-1}])
❸ If intending a speed exceeding an allowable speed, consult **NTN** Engineering.

4 Minimum Required Load

A minimum radial load is required to prevent skidding of the rolling elements when using full-pack solid grease. The minimum load required is approximately 1% of the bearing dynamic load rating.
Please consult **NTN** for further details.

5
Performance test data

(1) Lubricant Leakage Test

Non shielded/sealed test bearings (spot-pack) were subjected to a centrifugal acceleration of 3,000 G (5,000 min^{-1}) for a period of four hours. Lubricant leakage from the **NTN** bearings with solid grease was approximately 2.0% by weight for the horizontally mounted condition, and approximately 5.0% by weight for the vertically mounted condition.
(Standard grease filled bearings using contact (LU) and non-contact (LB) seals were also subjected to the above test. Within ten minutes after starting the test, centrifugal force caused the seals to become displaced allowing the grease to expel.)

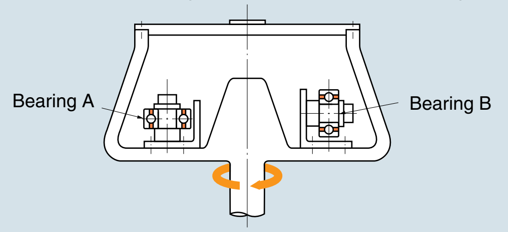


Fig. 1 Lubricant leakage test method

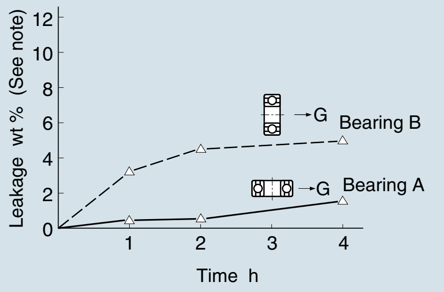


Fig. 2 Lubricant leakage test results

Note) Leakage: weight ratio of leaked lubricant compared to the amount (100%) of **NTN** Solid grease filled

Table 5 Lubricant leakage test conditions

	Bearing A	Bearing B
Test pieces	6201(Solid grease, spot-pack, open) 6201LLU(lithium mineral oil grease, contact type rubber seal) 6201LLB(lithium mineral oil grease, non-contact type rubber seal)	
Centrifugal acceleration	3,000 G (5,000 min^{-1})	
Bearing speed	Static	
Bearing fixing	The centrifugal force acts in the radial loading direction of the bearing.	The centrifugal force acts in the axial loading direction of the bearing.
Test time	4 hours : The bearings were weighed every hour and lubricant leakage (weight ratio) was determined.	

(2) Rotating Torque Test

When tested, the required rotating torque level for **NTN** bearings with solid grease utilizing the spot-pack configuration was found to be less than bearings using lithium-diester grease (an acknowledged low torque grease). However, the full-pack configuration exhibited running torque levels greater than those of standard bearings.

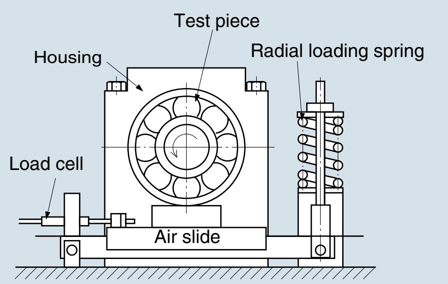


Fig. 3 Torque tester

Table 6 Torque testing conditions

	Testing conditions
Test piece	6204ZZ
Test grease	LP03 and Li greases (30% fill relative to the bearing space capacity, other than for LP03 full-pack configuration)
Bearing load	Radial load; 39 N {4 kgf}
Bearing speed	1,800, 3,600, 7,200 min^{-1}
Measuring method	Measured after rotating torque was stabilized

Table 7 Torque test results

unit $\times 10^{-4}$Nm

Speed (min^{-1})		1800	3600	7200
Li-mineral oil grease		230	385	550
Li-polyol-ester-grease		145	265	383
Li-diester grease		90	315	403
Solid grease	Spot-pack	63	113	190
	Full-pack	340	—	—

(3) Salt Water Test

A salt water endurance test was performed to compare the performance of bearings with solid grease to that of bearings using a conventional lubricant (lithium-mineral oil based grease). As noted in **Table 9**, **NTN** bearings with solid grease were found to out perform standard bearings although some surface deterioration had been detected.

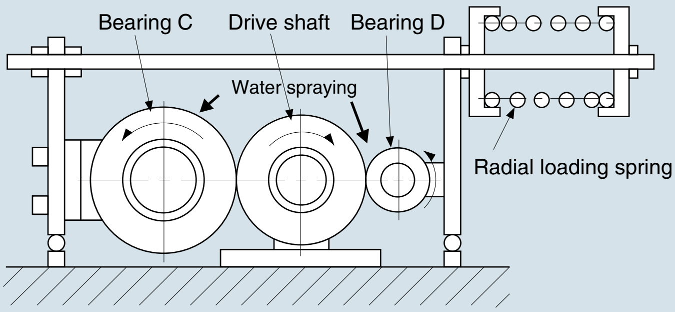


Fig. 4 Salt water testing equipment

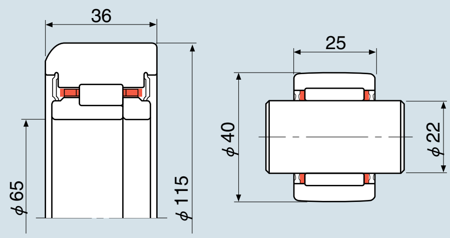


Fig. 5 Test pieces

Table 8 Salt water testing conditions

	Bearing C	Bearing D
Bearing load	157 N {16 kgf}	
Bearing speed	50 min^{-1} (outer ring)	144 min^{-1} (outer ring)
Volume of sprayed water	9 lit./min.	
Salt concentration	5.0% wt.	
Operating cycle	Total running time 500 h. (5 hour run+5 hour break)×62 cycles	

Table 9 Salt water test results

	Solid grease		Li-mineral oil grease	
	Brg. C	Brg. D	Brg. C	Brg. D
Rotating condition (ease of hand rotation)	△	△	×	×
Amount of lubricant remaining	○	○	×	×
Lubricant deterioration	△	△	×	×
Water invasion resistance	○	○	×	×

Test results= ○: good △: fair (some deterioration detected) ×: poor

6 Stainless steel series prelubricated deep groove ball bearings

1. Product overview

(1) Having an inner ring, outer ring, and retainer each made of a stainless steel, this unique series of contact seal type deep groove ball bearings have a spot-pack configuration with solid grease (LP03).

(2) Bearing accuracy
The dimensional accuracy and running accuracy of this series of bearings are equivalent to JIS class 0 bearings.

(3) Radial internal clearance
The permissible radial internal clearances of this bearing series are summarized in the table below. Note that the values in this table differ from those specified in the JIS (Japanese Industrial Standard) standard.

Unit: μm

Nominal bore diameter mm		Radial internal clearance	
over	incl.	min	max
—	10	6	17
10	18	6	20
18	30	8	22

(4) The indications on the inner and outer rings are as listed below.

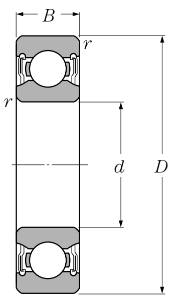
● SSN 0 series

Designation	Indication	
	Inner ring	Outer ring
SSN000LL	SS	SS
SSN001LL	SS	SS
SSN002LL	SS	SS
SSN003LL	SS	SMT, SS6003, JAPAN
SSN004LL	SS	SMT, SS6004, JAPAN
SSN005LL	SS	SMT, SS6005, JAPAN
SSN006LL	SS	SMT, SS6006, JAPAN

● SSN 2 series

Designation	Indication	
	Inner ring	Outer ring
SSN200LL	SS	SMT, SS6200, JAPAN
SSN201LL	SS	SMT, SS6201, JAPAN
SSN202LL	SS	SMT, SS6202, JAPAN
SSN203LL	SS	SMT, SS6203, JAPAN
SSN204LL	SS	SMT, SS6204, JAPAN
SSN205LL	SS	SMT, SS6205, JAPAN
SSN206LL	SMT, 6206RS, JAPAN	SS

2. Dimension table



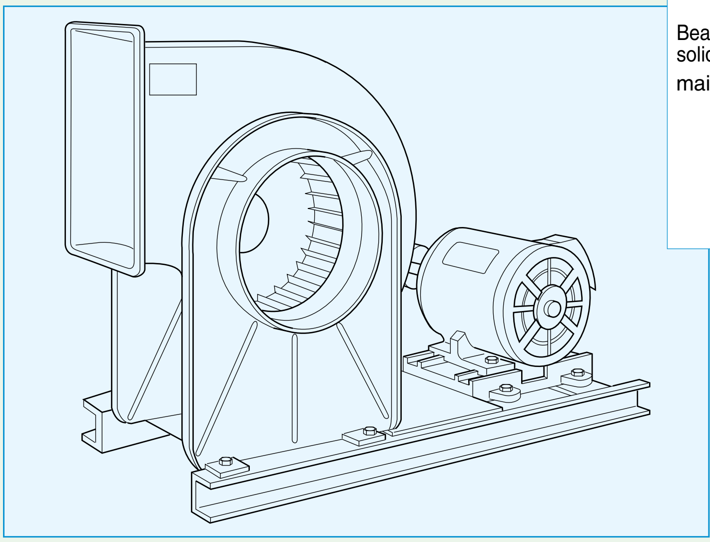
Contact seal type

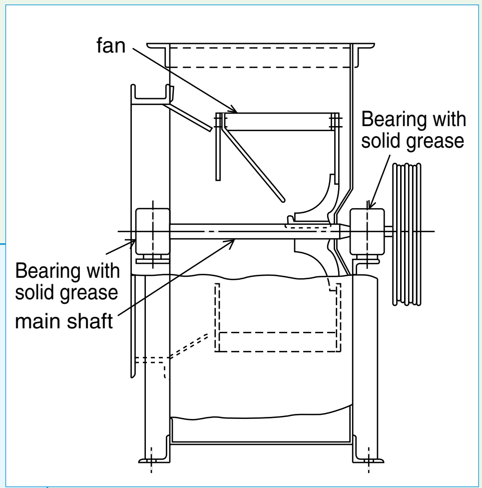
Boundary dimensions mm				Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Bearing number	Optional❷ (Basic number)
d	D	B	$r_{s\,min}$❶	C_r	C_{0r}	C_r	C_{0r}		
10	26	8	0.3	3.5	1.96	360	200	**SSN000LL/LP03**	6000
	30	9	0.6	3.95	2.39	400	244	**SSN200LL/LP03**	6200
12	28	8	0.3	3.95	2.39	400	244	**SSN001LL/LP03**	6001
	32	10	0.6	5.25	3.05	535	310	**SSN201LL/LP03**	6201
15	32	9	0.3	4.30	2.86	440	291	**SSN002LL/LP03**	6002
	35	11	0.6	5.85	3.75	600	380	**SSN202LL/LP03**	6202
17	35	10	0.3	4.60	3.25	470	330	**SSN003LL/LP03**	6003
	40	12	0.6	7.35	4.80	750	490	**SSN203LL/LP03**	6203
20	42	12	0.6	7.20	5.05	735	515	**SSN004LL/LP03**	6004
	47	14	1	9.90	6.65	1 010	680	**SSN204LL/LP03**	6204
25	47	12	0.6	7.75	5.85	790	595	**SSN005LL/LP03**	6005
	52	15	1	10.8	7.85	1 100	800	**SSN205LL/LP03**	6205
30	55	13	1	10.2	8.25	1 040	845	**SSN006LL/LP03**	6006
	62	16	1	15.0	11.3	1 530	1 150	**SSN206LL/LP03**	6206

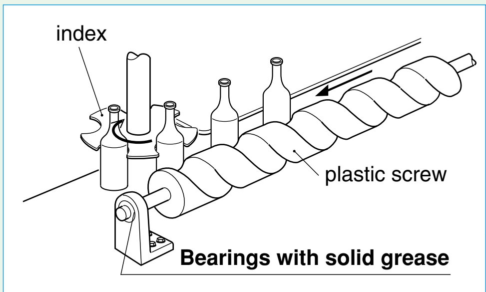
❶ Smallest allowable dimension for chamfer dimension r.
❷ The dimensions with listed basic numbers are identical to the boundary dimensions in JIS B 1512.

Fan blower support bearing

Lubricant suction prevention

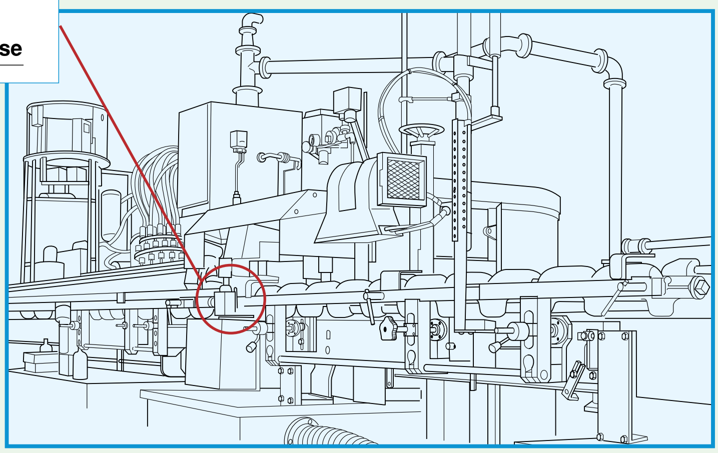






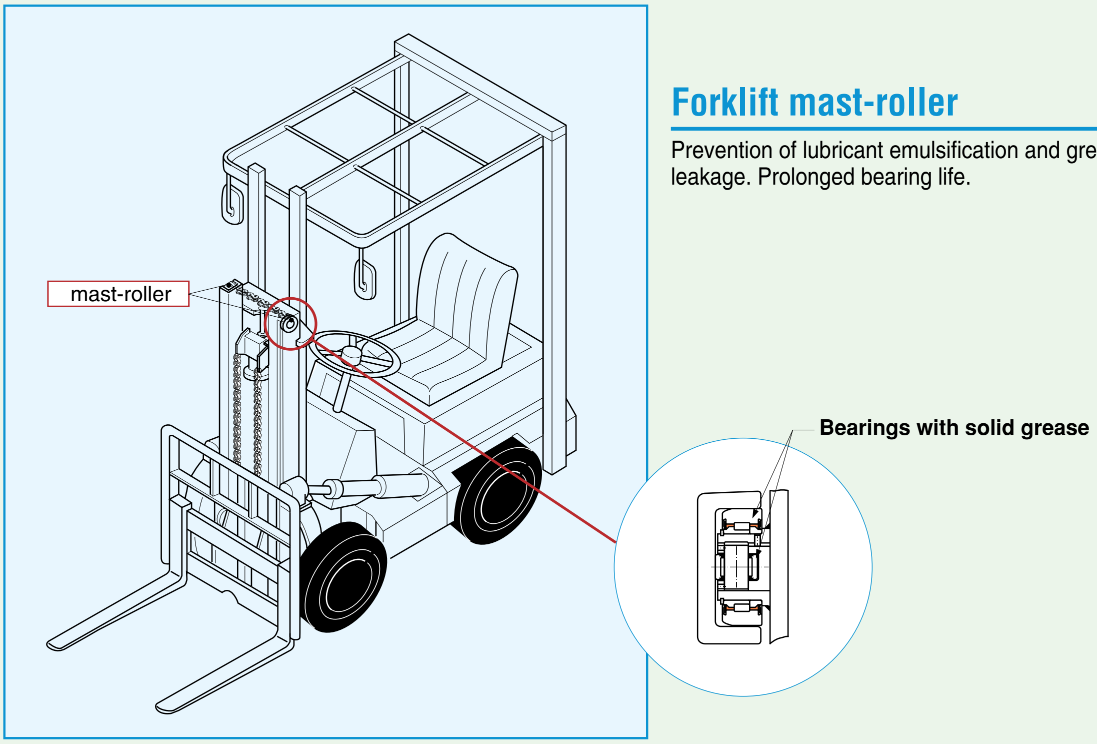
Support bearings for bottle feeder of filler on bottling line

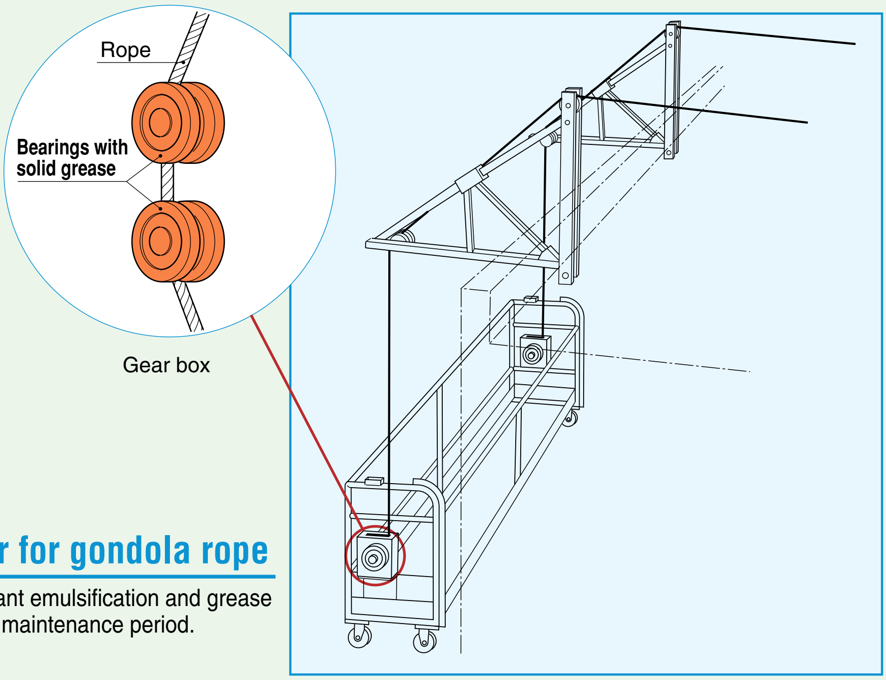
Prevention of lubricant leakage and product contamination



Forklift mast-roller

Prevention of lubricant emulsification and grease leakage. Prolonged bearing life.

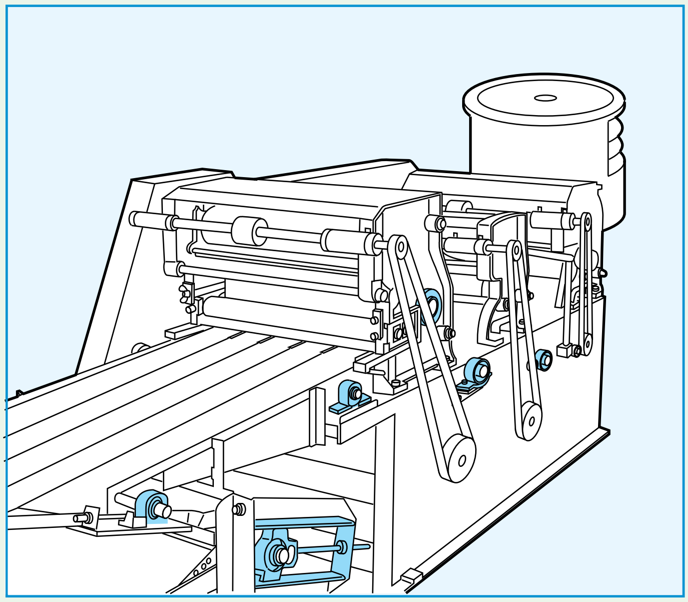




Guide roller for gondola rope

Prevention of lubricant emulsification and grease leakage. Prolonged maintenance period.

Noodle-making machine



Automatic wonton skin making lines

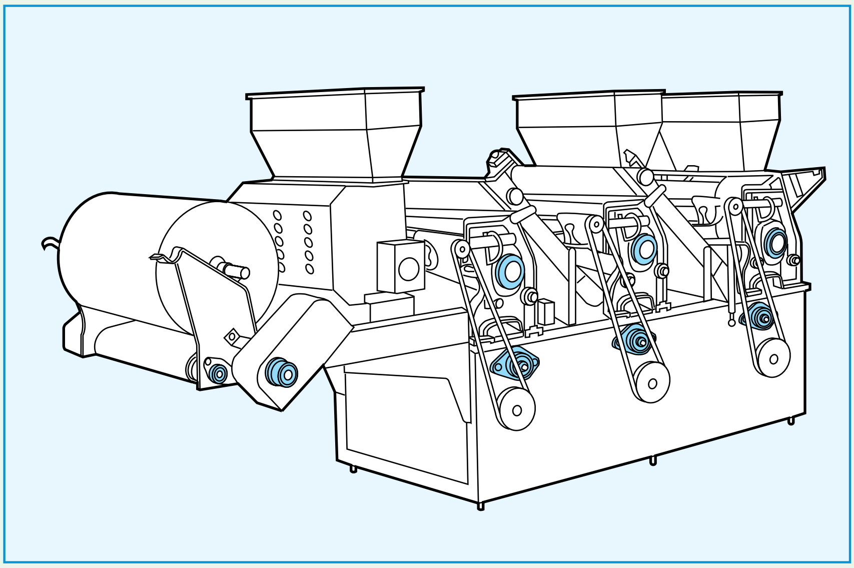


Table 10 Typical applications

Machines	Required characteristics
Cranes, sheaves, conveyors, steel mill rollers, amusement machines, etc.	Bearings with long lubricant life
Fork lift truck mast rollers, conveyors, etc.	Improved dust and water-proofing capability
Wire stranding machines etc.	Prevention of lubricant leakage (i.e. applications where the bearing is required to rotate about an axis other than its own).
Printing presses, office equipment, textile machines, food processing machines, etc.	Prevention of leaked lubricant (clean work environment)
Testing equipment, film stretching machines, etc.	Low torque

CAUTIONS: Avoid use in presence of splashing organic solvent (acetone, benzene, kerosene, etc.)

For New Technology Network

NTN®

Integrated Rotation Sensor Bearings

CAT. No. 3032/E

NTN Integrated Rotation Sensor Bearings

1. This is an integrated product combining a bearing with a rotation sensor that detects the speed and direction of rotation.

2. With a wide variety of models and advanced functions available, these bearings will make your machines more compact and also help in improving their reliability.

In recent years, industrial machines have been using electrical controls that make the machines simpler, allow unmanned operation, and reduce the environment load. In view of this background, many sensors necessary for electrical control are being used, and there is an increased need for bearings with sensors because they simplify installation of sensors and help in making the machines more compact. Therefore, NTN has combined its superior bearing technology and sensor technology to create a series of bearings with rotation sensors.

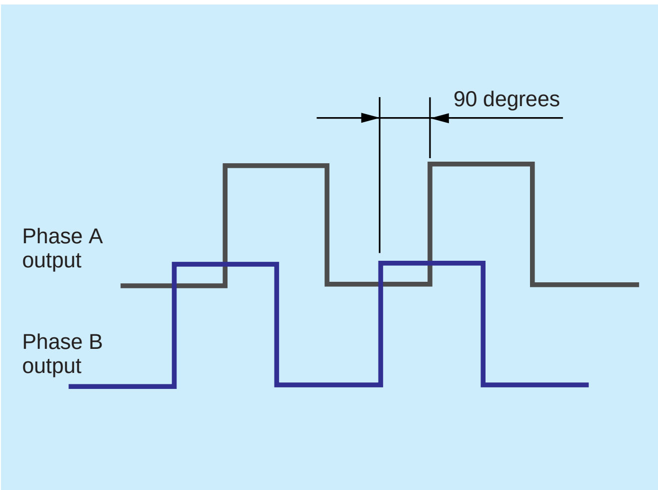
1 Construction and Principles

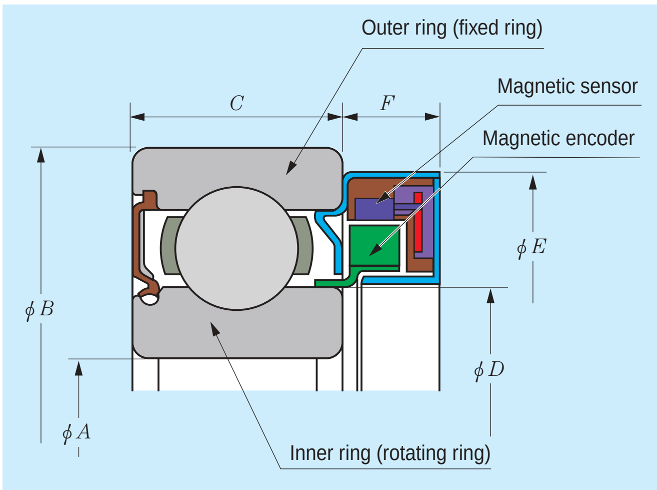
The rotation sensor is made up of a magnetic encoder (a multiple pole magnet) and a magnetic sensor.

The magnetic encoder is fixed to the inner ring (the rotating ring) of the bearing and the magnetic sensor is fixed to the outer ring (the fixed ring).

With the rotation of the shaft (and the inner ring), when the magnetic encoder passes near the magnetic sensor, the magnetic sensor senses changes in the magnetic pole (N pole and S pole) of the magnetic encoder that is opposite to it and outputs a corresponding electrical signal (with a rectangular waveform).

Through numerical processing of these output signals, the rotational speed can be calculated. In addition, because the phase A output and phase B output signals have a mutual electrical phase shift of 90 degrees, the direction of rotation can also be detected.





2 Applications

AC servo motors, DC servo motors, hydraulic motors, etc.

The adoption of **NTN** integrated rotation sensor bearings allows detection of the rotational speeds and rotational directions of motors. There is no need to add an encoder outside the motor, which allows the motor to be more compact.

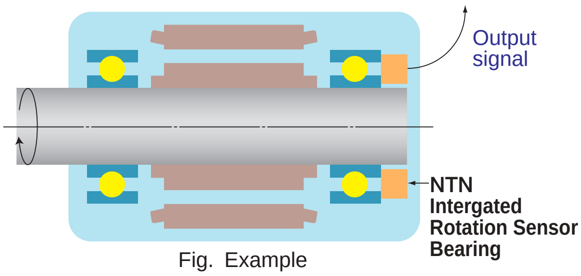


Fig. Example

3 Specifications

Bearing model number	6202	6204	6206	6208	6209
Bearing tolerance class	JIS：Grade 0 ISO：NORMAL				
Bearing inner diameter (mm) :ϕA	15	20	30	40	45
Bearing outer diameter (mm) :ϕB	35	47	62	80	85
Bearing width (mm): : C	11	14	16	18	19
Sensor unit inner diameter (mm) :ϕD	18	29.5	40.6	53	57.3
Sensor unit outer diameter (mm) :ϕE	32	46.6	58	75	77
Sensor unit width (mm) : F	7.5	7.5	7.5	7.5	7.5
Basic dynamic load ratings (kN)	7.75	12.8	19.5	29.1	32.5
Basic static load ratings (kN)	3.6	6.65	11.3	17.8	20.4
Allowed axial load (static) (kN)	1.48	3.08	5.81	11	9.59
Radial internal clearance: C3 (mm)	0.011〜0.025	0.013〜0.028	0.013〜0.028	0.015〜0.033	0.018〜0.036
Lubrication	Grease (Multemp SRL)				
Seal type	LU (Contact seal NBR)				
Input voltage (+Vcc DC)	5〜24				
Number of output pulses	32	48	64	80	80
Number of signal phases	Two phases (phase A and phase B)				
Sensor output accuracy (See the section on "Calculation of Output Waveform Accuracy.")	Adjacent period error: 5% or less				
	Duty cycle: 50 ±15% (35 to 65%)				
	Phase shift between phase A and phase B: 90 ±45 degrees (45 to 135 degrees)				
Type of waveform	Rectangular output waveform (open collector output, protective resistor 100 Ω)				
Connection of wire	Red line: Input voltage +Vcc				
	White line: Output signal phase A				
	Blue line: Output signal phase B				
	Black line: GND				
Wire size	AWG24 (UL)				
Connector	None/Optional				
Wire bending radius (mm)	Minimum radius: 12				
Wire length (mm)	500				
Ambient operating temperature (˚C)	-25 to 120				
Weight (kg) (Reference)	Approx. 0.10	Approx. 0.13	Approx. 0.25	Approx. 0.45	Approx. 0.48

Connect a pull-up resistor between the power supply terminal and the each signal output terminals.
See the "Electrical Circuit" section for the values of the pull-up resistor, and set it so that the sink current is 20 mA or less.

4 Calculation of Output Waveform Accuracy

The accuracy is calculated using the equations below for each output pulse per one rotation.

1. Adjacent period error (%)

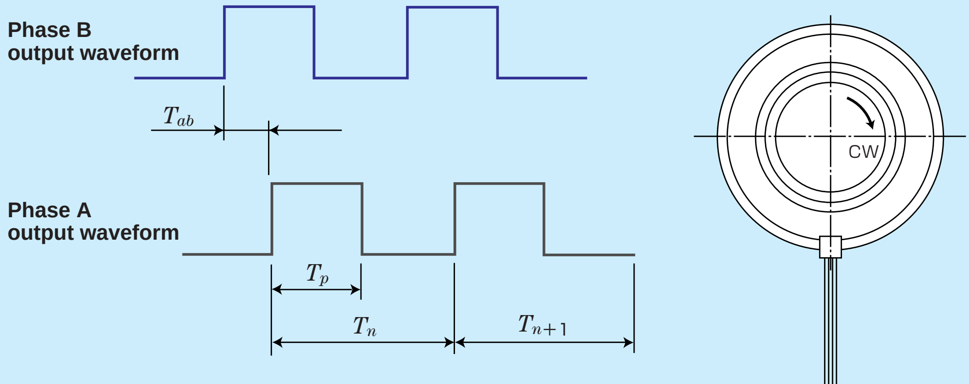
$$=\{|(T_n-T_{n+1})|/T_n\}\times 100$$

2. Duty cycle (%)

$$=(T_p/T_n)\times 100$$

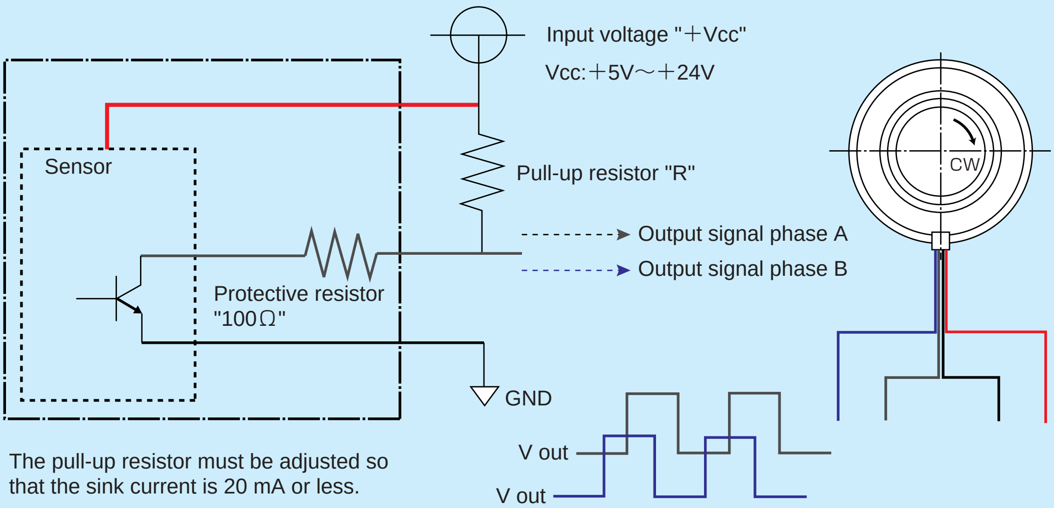
3. Phase shift between phase A and phase B (degrees)

$$=(T_{ab}/T_n)\times 360$$



As viewed from the sensor unit side, when the inner ring is rotated clockwise (CW), the phase B waveform rises before the rise of the phase A waveform.

5 Electrical Circuit



The pull-up resistor must be adjusted so that the sink current is 20 mA or less.

Pull-up Resistor Examples

Input voltage "+Vcc" (DC)	Value of "R"
+5V	270Ω
+9V	470Ω
+12V	680Ω
+24V	1.5kΩ

Caution:

V out (Low) is the voltage value when the sensor operates. (When the waveform is "Low.") This voltage value can be adjusted with the value of the pull-up resistor "R."

V out (Low) is calculated using the following equation:

V out (Low) =Vcc×100／(R+100)+Vce

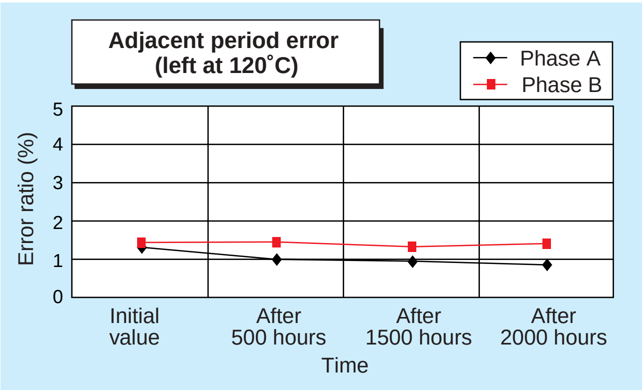
1. Internal protective resistance value: 100 Ω
2. Output saturation voltage for the sensor only. Vce (sat): 0.4 V (max)

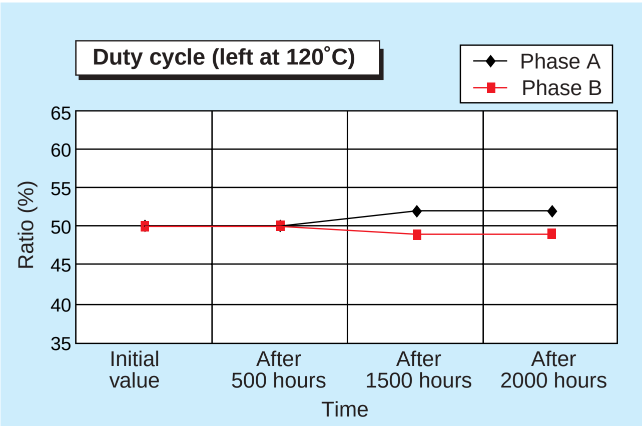
Maximum sink current: 20 mA (both phase A and phase B)

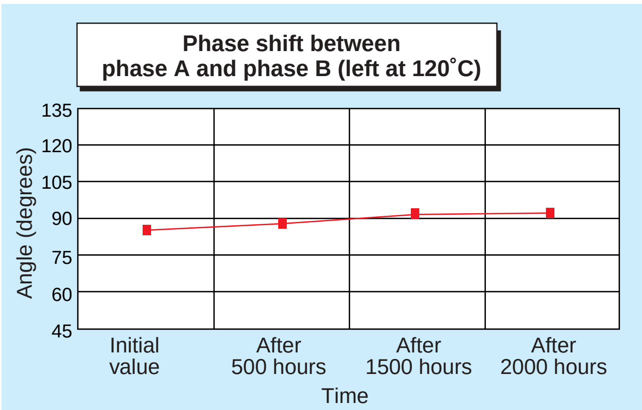
I sink=Vcc／(R+100)≦20mA

6 Reliability Test (Reference)

The signal accuracy measurement data for **NTN** integrated rotation sensor bearings is shown below. Even when kept static for 2,000 hours at 120˚C, the **NTN** integrated rotation sensor bearings have stable signal properties, contributing to improving the reliability of the units in which they are used.







Each measurement is made at room temperature at a speed of 60 min^{-1}.

7 EMC Standard Test (Reference)

Power supply frequency and magnetic field standard: EN61000-4-8

Handling Precautions

1. Do not let the ends of the wires come into contact with anything that has accumulated static electricity. It is possible that the static electricity could damage the bearings.
2. Do not build these bearings into machinery that produces electromagnetic waves. Also, do not use them in areas where electromagnetic waves are produced. It is possible that electromagnetic waves could damage the bearings.
3. Do not use these bearings in areas where they may have impact on human life.
4. In the unlikely event of a sensor signal error, be sure to take safety measures, such as a backup system, etc.
5. Do not apply any load to the sensor unit.
6. Do not subject the integrated sensor bearings to any shock.
7. Do not put any load to the wires. Also, do not carry the bearings by the wires.
8. Do not use the integrated sensor bearings in environments where they can come into contact with or be penetrated by water, oil or foreign matter (steel powder, dust).

Notes

1. These bearings are compatible with RoHS instructions (2002/95/EC).
2. **NTN has "high temperature application" models for use in locations where the ambient operating temperature exceeds 120˚C. Please contact your NTN branch office or sales office for details.**
3. **With respect to "Ferromagnetic Field Resistant application" models for use in areas with strong magnetic fields, such as near high output motors, please contact your NTN branch office or sales office for details.**
4. If you must use these bearings for purposes other than those specified in this catalog, please contact your nearest **NTN** sales office.

NTN®

Precision Rolling Bearings

CAT.No.2260-VIII/E

CONTENTS

NTN
PRECISION ROLLING BEARINGS

Warranty

NTN warrants, to the original purchaser only, that the delivered product which is the subject of this sale (a) will conform to drawings and specifications mutually established in writing as applicable to the contract, and (b) be free from defects in material or fabrication. The duration of this warranty is one year from date of delivery. If the buyer discovers within this period a failure of the product to conform to drawings or specifications, or a defect in material or fabrication, it must promptly notify **NTN** in writing. In no event shall such notification be received by **NTN** later than 13 months from the date of delivery. Within a reasonable time after such notification, **NTN** will, at its option, (a) correct any failure of the product to conform to drawings, specifications or any defect in material or workmanship, with either replacement or repair of the product, or (b) refund, in part or in whole, the purchase price. Such replacement and repair, excluding charges for labor, is at **NTN**'s expense. All warranty service will be performed at service centers designated by **NTN**. These remedies are the purchaser's exclusive remedies for breach of warranty.

NTN does not warrant (a) any product, components or parts not manufactured by **NTN**, (b) defects caused by failure to provide a suitable installation environment for the product, (c) damage caused by use of the product for purposes other than those for which it was designed, (d) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, or (g) any other abuse or misuse by the purchaser.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

In no case shall **NTN** be liable for any special, incidental, or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory,and in no case shall total liability of **NTN** exceed the purchase price of the part upon which such liability is based. Such damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the product or any associated equipment, cost of capital, cost of any substitute equipment, facilities or services, downtime, the claims of third parties including customers, and injury to property. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, the limits in this paragraph and in paragraph (2) shall apply to the extent allowable under case law and statutes in such states.

Any action for breach of warranty or any other legal theory must be commenced within 15 months following delivery of the goods.

Unless modified in a writing signed by both parties, this agreement is understood to be the complete and exclusive agreement between the parties, superceding all prior agreements, oral or written, and all other communications between the parties relating to the subject matter of this agreement. No employee of **NTN** or any other party is authorized to make any warranty in addition to those made in this agreement.

This agreement allocates the risks of product failure between **NTN** and the purchaser. This allocation is recognized by both parties and is reflected in the price of the goods. The purchaser acknowledges that it has read this agreement, understands it, and is bound by its terms.

Precision Rolling Bearings

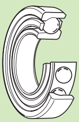
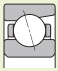
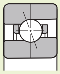
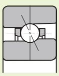
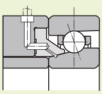
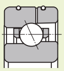
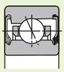
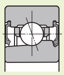
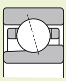
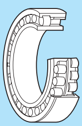
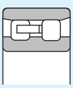
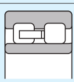
Page

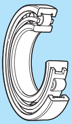
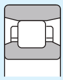
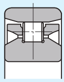
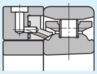
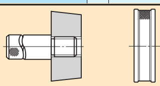
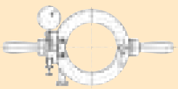
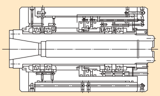
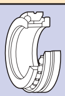
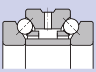
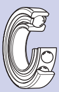
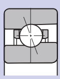
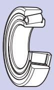
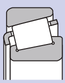
TECHNICAL DATA CONTENTS

1. Classification of Precision Rolling Bearings for Machine Tools

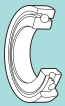
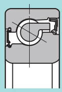
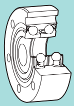
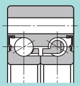
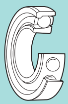
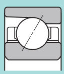
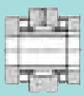
① Main spindle bearings

Table .1 Types of precision rolling bearings for machine tools

Bearing type		Cross section	Bearing type	Bearing bore mm	Contact angle	Remarks	Page
 Angular contact ball bearing	Standard		78C	φ25～φ170	15°	● A bearing type code containing a suffix U means an ULTAGE ULTAGE series bearing. Optimized interior structure and resin cage help positively inhibit temperature rise (applicable to 79 and 70 types with bore diameter of 10 to 130 mm). ● Bearings with prefix 5S have ceramic balls.	84 ～ 111
			79 (U), 5S-79 (U)	φ10～φ170	15°, 25°, 30°		
			70 (U), 5S-70 (U)	φ10～φ200	15°, 25°, 30°		
			72C	φ10～φ130	15°		
	High-speed		2LA-HSE9U 5S-2LA-HSE9	φ50～φ170	15°, 20°, 25°	● ULTAGE ULTAGE series ● Use of special material and introduction of surface modification contribute to much improved wear resistance and anti-seizure property. ● Optimized specifications for the interior structure lead to higher speed, rigidity and reliability. ● Bearings with prefix 5S have ceramic balls.	112 ～ 135
			2LA-HSE0 5S-2LA-HSE0				
	Super high-speed		5S-2LA-HSF0	φ50～φ100	25°	● ULTAGE ULTAGE series ● Maintaining the advantages of HSE type, this type has small diameter ceramic balls to achieve higher speed and limited heat buildup. ● Bearings with prefix 5S have ceramic balls.	136 ～ 137
	Eco-friendly		5S-2LA-HSL9U	φ50～φ170	20°, 25°	● ULTAGE ULTAGE series ● These bearings are identical to the HSE and HSF types except in that they are air-oil lubrication designs that have an eco-friendly nozzle. ● Featuring lower noise, reduced air and oil consumption, they positively improve operating environments and reduce energy consumption. ● Bearings with prefix 5S have ceramic balls.	138 ～ 147
			5S-2LA-HSL0				
			5S-2LA-HSFL0	φ50～φ100	25°		
	HSE with Lubrication hole		5S-2LA-HSEW9U	φ50～φ100	20°, 25°	● ULTAGE ULTAGE series ● High speed angular contact ball bearings with lubrication hole on outer ring, designed especially for air-oil lubrication based on HSE type. These bearings have an effect on compact design and high rigidity of spindle. Air flow rate and oil consumption can be reduced. ● Bearings with prefix 5S have ceramic balls.	148 ～ 155
			5S-2LA-HSEW0				
	Standard	 Non-contact sealed type	79 LLB 5S-79 LLB	φ10～φ50	15°, 25°	● ULTAGE ULTAGE series ● Featuring a two-side non-contact seal design and a special grease, these bearings are a dedicated grease lubricated type that has achieved limited heat buildup through optimization of the interior structure. ● Bearings with prefix 5S have ceramic balls.	156 ～ 171
			70 LLB 5S-70 LLB				
	High-speed	 Non-contact sealed type	2LA-BNS9 LLB 5S-2LA-BNS9 LLB	φ45～φ100	15°, 20°, 25°	● ULTAGE ULTAGE series ● Maintaining the advantages of HSE type, this dedicated grease lubricated type has an improved interior design (grease reservoir, both -side non-contact seal and special grease) to extend grease life. ● Bearings with prefix 5S have ceramic balls.	172 ～ 195
			2LA-BNS0 LLB 5S-2LA-BNS0 LLB				
			BNT9 5S-BNT9	φ10～φ65	15°	● Angular contact ball bearing series for grinding machines/motors. ● All variants are flush ground. ● Bearings with prefix 5S have ceramic balls.	196 ～ 207
			BNT0 5S-BNT0	φ10～φ70			
			BNT2 5S-BNT2	φ10～φ80			
 Double-row cylindrical roller bearing			NN49 (K)	φ100～φ320	――	● The bearing clearance can be either interchangeable radial clearance or non-interchangeable radial clearance. ● A variant (K) is available with a tapered bore to accommodate a tapered shaft. ● A bearing type code containing a suffix T6 means an ULTAGE ULTAGE series bearing. Optimized interior structure and resin cage help high speed and positively inhibit temperature rise (applicable to NN30 types with bore diameter of 65 to 130 mm).	224 ～ 229
			NN30 (K) NN30HS (K)	φ25～φ60 φ140～φ460			
			NN30HST6 (K) NN30HSRT6 (K)	φ65～φ130			
			NNU49 (K)	φ100～φ500	――		

Bearing type	Cross section	Bearing type	Bearing bore mm	Contact angle	Remarks	Page
 Single-row cylindrical roller bearing	Standard 	**N10HS (K)**	ϕ30〜ϕ160	———	● The boundary dimensions of the N10HS(K) high-speed single-row cylindrical roller bearing are the same as those of the N10(K). Only the bearing clearance is non-interchangeable. ● A ceramic-roller-type (5S-N10) is available on request.	230 〜 233
	High-speed 	**N10HSR (K)**	ϕ55〜ϕ100	———	● *ULTAGE* ULTAGE series ● Optimized internal design allows higher speed and results in lower temperature rise. ● The cage is made of a special resin to cope with a high-speed operation. ● The allowable maximum speed is higher than that of the conventional high-speed cylindrical roller bearing N10HS(K).	234 〜 235
	Eco-friendly 	**N10HSL (K)**	ϕ55〜ϕ100	———	● *ULTAGE* ULTAGE series ● This is a dedicated air-oil lubricated type identical to the N10HSR(K) type except in that it incorporates an eco-friendly nozzle. ● Still maintaining the high-speed performance of the N10HSR(K) type, this type boasts lower noise, reduced air and oil consumption, and positively improves operating environments and reduces energy consumption.	236 〜 237
 Plug gage Ring gage Taper gage		**Plug gage TA**	ϕ30〜ϕ160	———	● Taper gage for N10-HS(K) single-row cylindrical roller bearing and NN30(K) double-row cylindrical roller bearing.	238
		Ring gage TB	ϕ30〜ϕ160			
 Residual internal clearance adjustment gauge		**SB**	ϕ35〜ϕ160	———	● Clearance gage for N10-HSK(K), N10-HSR(K) single-row cylindrical roller bearing and NN30(K), NN30HS(K) double-row cylindrical roller bearing.	239
 Adjustable preload bearing unit		**Adjustable preload bearing unit**	———	———	● Fixed position adjustable preload bearing unit. ● Incorporation of an adjustable preload sleeve and a duplex angular ball bearing allows the user to adjust the preload of an angular ball bearing in a wider range from a light preload to a heavy preload. ● Fixed position preload leads to a greater rigidity.	—
 Double-direction angular contact thrust ball bearing		**5629 (M)**	Small-size ϕ100〜ϕ320 Large-size (M) ϕ104〜ϕ330	60°	● The small bearing is used on a cylinder bore or smaller-diameter side of a tapered bore of the NNU49, NN49 or NN30 double-row cylindrical roller bearing; the large bearing (suffix M) is used on the large hole side of a tapered bore.	250 〜 253
		5620 (M)	Small-size ϕ25〜ϕ320 Large-size (M) ϕ27〜ϕ330			
 Angular contact ball bearing for axial load		**HTA9U**	ϕ100〜ϕ320	30°, 40°	● *ULTAGE* ULTAGE series ● HTA9DB series bearings are fully compatible with 5629 series bearings.	254 〜 265
		HTA0U **5S-HTA0U**	ϕ25〜ϕ320 ϕ25〜ϕ130		● *ULTAGE* ULTAGE series ● HTA0DB series bearings are fully compatible with 5620 series bearings.	
 Tapered roller bearings		**329**	ϕ50〜ϕ190	Nominal contact angle of 10° or greater, 17° or smaller	● Thin-wall type, ISO-compatible metric series.	270 〜 273
		320	ϕ20〜ϕ170			

② Ball screw support bearings

Bearing type	Cross section	Bearing type	Bearing bore mm	Contact angle	Remarks	Page
 Angular contact thrust ball bearing for ball screws		**BST** **2A-BST** Open type **BST LXL/L588** **2A-BST LXL/L588** Light-contact sealed type	φ17～φ55	60°	● *ULTAGE* ULTAGE series ● Surface modification treatment on the bearing ring raceways has led to a longer bearing life and much improved fretting resistance. ● Owing to prelubrication with a special grease, the sealed type boasts a longer bearing life and simpler maintenance work. ● All variants are flush-ground and are provided with a standard preload.	290 ∫ 295
 Ball screw support double row thrust angular contact ball bearing unit		**BSTU LLX/L588** Light-contact sealed type	φ20～φ100	60°	● *ULTAGE* ULTAGE series. ● Greater high-load capacity with optimizations made to the internal bearing design. ● Use of newly developed light-contact seal to achieve both low torque and high dust resistance. ● Long operating life, and use of special grease with high fretting resistance. ● Outer ring mounting hole, and sealed grease lubrication groove for easier handling.	296 ∫ 299
 Angular contact ball bearing for ball screws		**HT**	φ6～φ40	30°	● The allowable axial load of this bearing type is greater owing to the improved interior design.	300 ∫ 301
 Needle roller bearings with double-direction thrust needle roller bearing		**AXN**	φ20～φ50	——	● A clearance remains between the inner ring of radial bearing and the inner rings of both thrust bearings, allowing the user to determine the preload by, for example, tightening a nut etc. ● The targeted preload is attained based on the starting torque. ● The bearing clearance on certain preloaded bearings is controlled in advance so that an intended preload is attained by fully tightening the inner rings on both thrust bearing with nuts, or equivalent means.	302 ∫ 303
 Cylindrical roller bearings with double-direction thrust needle roller bearing		**ARN**	φ20～φ70	——		304 ∫ 305

2. Bearing Selection and Shaft & Housing Design

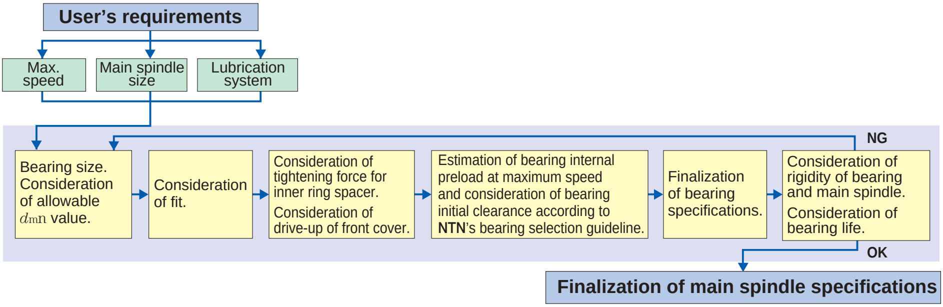
① Bearing selection

Generally, the optimal bearing must be selected to suit the nature of the machine, the area within the machine, the spindle specification, bearing type, lubrication system and drive system of the intended machine through considerations of the design life, precision, rigidity and critical speed, etc. of the bearing. **Table 2.1** summarizes a typical bearing selection procedure, and **Table 2.2** gives an example flowchart according to which considerations are made to select an optimal main spindle bearing for a machine tool.

Table 2.1 Bearing selection procedure

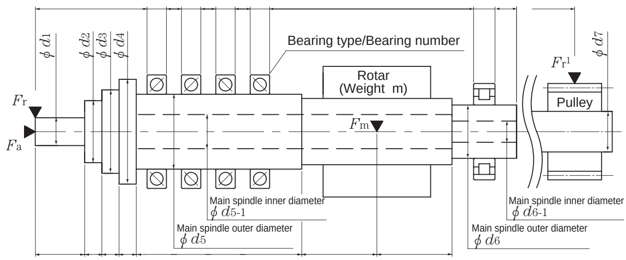
Step	Items being considered	Items being confirmed
Confirm operating conditions of bearing and consider bearing type.	● Function and construction of components to house bearings ● Bearing mounting location ● Dimensional limitations ● Magnitude and direction of bearing load ● Magnitude of vibration and shock load ● Shaft speed ● Bearing arrangement (fixed side, floating side) ● Noise and torque of the bearing ● Bearing operating temperature range ● Bearing rigidity ● Installation / disassembly requirements ● Maintenance and inspection ● Cost-effectiveness ● Allowable misalignment of inner/outer rings	Determine bearing type and arrangement.
Select bearing dimensions.	● Design life of components to house bearings ● Dynamic/static equivalent load conditions ● Safety factor So ● Allowable speed ● Allowable axial load	Determine bearing dimensions.
Select bearing tolerances.	● Shaft runout tolerances ● Torque fluctuation ● High-speed operation	Decide bearing grade.
Select bearing internal clearance.	● Material and shape of shaft and housing ● Fit ● Temperature difference between inner and outer rings ● Allowable misalignment of inner/outer rings ● Magnitude and nature of load ● Amount of preload	Decide bearing internal clearance.
Select cage.	● Rotational speed ● Noise level ● Vibration and shock load ● Lubrication	Cage type
Select lubrication method.	● Operating temperature ● Rotational speed ● Lubrication method ● Sealing method ● Maintenance and inspection	Decide lubrication method, lubricant, and sealing method.
Consider special specifications.	● Operating conditions (special environments: high or low temperature, chemical) ● Requirement for high reliability	Decide special bearing specifications.
Select installation and disassembly procedures.	● Mounting dimensions ● Installation and disassembly procedures	Decide installation and disassembly procedures.

Table 2.2 Bearing selection procedure



The articles necessary for basic considerations in selecting an optimal main spindle bearing for machine tool are summarized in **Table 2.3.**

Table 2.3 Selection procedure for bearings for main spindles of machine tools

(1) Type of Machine	NC Lathe, machining center, grinding machine, etc.
(2) Main spindle orientation	Vertical, horizontal, variable-direction, inclined, etc.
(3) Diameter and size of main spindle	#30, #40, #50, etc.
(4) Shape and mounting-related dimensions of main spindle	 **Fig. 2.1 Main spindle shape and mounting-related dimensions (example)**
(5) Intended bearing type, bearing size, and preloading method	Front (angular contact type, cylindrical roller type) or rear (angular contact type, cylindrical roller type) preloading system (fixed-position preloading, fixed-pressure preloading)
(6) Slide system free side	Cylindrical roller bearing, ball bushing (availability of cooling)
(7) Lubrication method	Grease, air-oil, oil mist (MicronLub)
(8) Drive system	Built-in motor, belt drive, coupling
(9) Presence/absence of jacket cooling arrangement on bearing area	Yes/No
(10) Jacket cooling conditions	Synchronization with room temperature, machine-to-machine synchronization, oil feed rate (L/min)
(11) Operating speed range	Max. speed (min^{-1})
	Normal speed range (min^{-1})
	Operating speed range (min^{-1})
(12) Load conditions (machining conditions)	Load center
	Applied load Radial load Fr (N) Axial load Fa (N)
	Speed
	Machining frequency
	Intended bearing life

② Bearing accuracy

■Bearing accuracy

Accuracies of rolling bearings, that is, dimensional accuracy and running accuracy of rolling bearings are defined by applicable ISO standards and JIS B 1514 standard (Rolling bearings - Tolerances) (**Tables 2.4** and **2.5**). The dimensional accuracy governs the tolerances that must be satisfied when mounting a bearing to a shaft or housing, while the running accuracy defines a permissible run-out occurring when rotating a bearing by one revolution. Methods for measuring the accuracy of rolling bearings (optional methods) are described in JIS B 1515 (Measuring methods for rolling bearings). **Table 2.6** summarizes some typical methods for measuring running accuracy of rolling bearings.

Table 2.4 Bearing types and applicable tolerance

Bearing type		Applicable standard	Tolerance class				
Angular contact ball bearings		JIS B 1514 (ISO492)	Class 0	Class 6	Class 5	Class 4	Class 2
Cylindrical roller beargns			Class 0	class 6	Class 5	Class 4	Class 2
Needle roller bearings			Class 0	class 6	Class 5	Class 4	—
Tapered roller bearings	Metric	JIS B 1514	Class 0,6X	class 6	Class 5	Class 4	—
	Inch	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00
	J series	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A
Double row angular contact thrust ball bearings		**NTN** standard	—	—	Class 5	Class 4	—

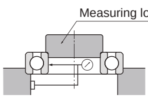
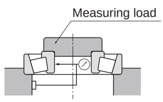
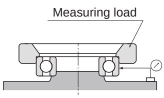
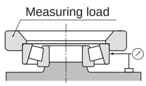
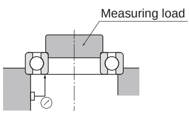
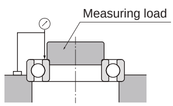
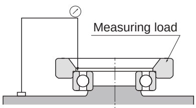
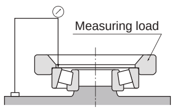
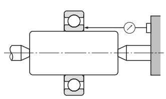
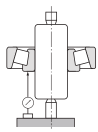
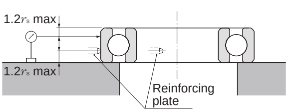
Table 2.5. Comparison of tolerance classifications of national standards

Standard	Applicable standerd	Tolerance Class					Bearing Types
Japanese industrial standard (JIS)	JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	All type
International Organization for Standardization (ISO)	ISO 492	Normal class Class 6X	Class 6	Class 5	Class 4	Class 2	Radial bearings
	ISO 199	Normal Class	Class 6	Class 5	Class 4	—	Thrust ball bearings
	ISO 578	Class 4	—	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)
	ISO 1224	—	—	Class 5A	Class 4A	—	Precision instrument bearings
Deutsches Institut fur Normung(DIN)	DIN 620	P0	P6	P5	P4	P2	All type
American National Standards Institute (ANSI)	ANSI/ABMA Std.20 ❶	ABEC-1 RBEC-1	ABEC-3 RBEC-3	ABEC-5 RBEC-5	ABEC-7	ABEC-9	Radial bearings (Except tapered roller bearings)
American Bearing Manufacturer's Association (ABMA)	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A	Tapered roller bearings (Metric series)
	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)

❶ "ABEC" is applied for ball bearings and "RBEC" for roller bearings.
Notes 1: JIS B 1514, ISO 492 and 199, and DIN 620 have the same specification level.
2: The tolerance and allowance of JIS B 1514 are slightly different from those of ABMA standards.

To attain a higher level of running accuracy required of a main spindle of machine tool, a high-precision bearing that satisfies the user's main spindle specifications must be chosen. Usually, a high-precision bearing per JIS accuracy class 5, 4 or 2 is selected according to an intended application. In particular, the radial run-out, axial run-out and non-repetitive run-out of a main spindle bearing greatly affect the running accuracy of the main spindle and therefore have to be strictly controlled. With the recent super high-precision machine tools, the control of N.R.R.O. (Non-Repetitive Run-Out) has increasing importance, and the main spindle on a turning machine or machining center incorporates an N.R.R.O. accuracy controlled bearing. For further information about N.R.R.O., refer to the following section. Note that to attain a higher accuracy with a main spindle, careful considerations need to be exercised for the accuracies (circularity, cylindricity, coaxiality) of machine components other than a bearing (shaft, housing) as well as machining method and finish accuracy of the shaft and housing. For the information about the accuracies of shaft and housing, refer to a section given later.

Table 2.6 Measuring methods for running accuracies

Characteristic tolerance	Measurement method		
Inner ring radial runout (K_{ia})			Radial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring radial runout (K_{ea})			Radial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Inner ring axial runout (S_{ia})			Axial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring axial runout (S_{ea})			Axial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Inner ring side runout with bore (S_d)			Inner ring side runout with bore is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution together with the tapered mandrel.
Outer ring outside surface inclination (S_D)			Outer ring outside surface inclination is the difference between the maximum and minimum reading of the measuring device when the outside ring is turned one revolution along the reinforcing plate.

■N.R.R.O. (Non-Repetitive Run-Out) of bearing

Accuracies of rolling bearings are defined by applicable ISO standards and a JIS (Japanese Industrial Standard) standard, wherein the accuracies are discussed under the descriptions of radial run-out (K_{ia}), axial run-out (S_{ia}), etc. According to the methods for measuring running accuracies in **Table 2.6**, run-out is read by turning a bearing by only one revolution (each reading is synchronized with the revolution of the bearing being analyzed).

In fact, however, a rolling bearing for machine tool is used in a continuous revolving motion that involves more than one revolution. As a result, the actual run-out accuracy with a rolling bearing includes elements that are not synchronous with the revolution of the bearing (for example, a difference in diameter among rolling elements involved, as well as roundness on the raceway surfaces of inner ring and outer ring), causing the trajectory of plotting with running accuracies to vary with each revolution.

The run-out of an element not in synchronization with the revolutions of bearing is known as N.R.R.O. (Non-Repetitive Run-Out) and is equivalent to the amplitude in the Lissajous figure illustrated in **Fig. 2.3**.

The effect of N.R.R.O. on a rolling bearing onto the accuracies is illustrated in **Fig. 2.4** by taking a main spindle of turning machine as an example.

This diagram illustrates a machining process where the outside surface of a work piece mounted to the main spindle is shaved by a turning operation. If the outside surface is cut with a new trajectory with every revolution, the outside shape of work piece will be distorted. Furthermore, if the accuracies of shaft and housing are not high enough or bearings are assembled onto the shaft and/or housing improperly, the bearing ring can be deformed, possibly leading to a run-out that is not in synchronization with the revolutions of bearing.

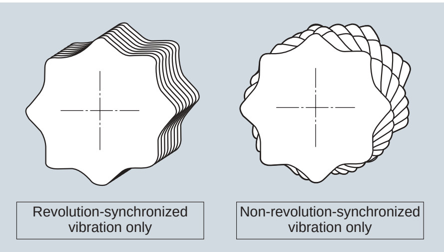


Fig. 2.2

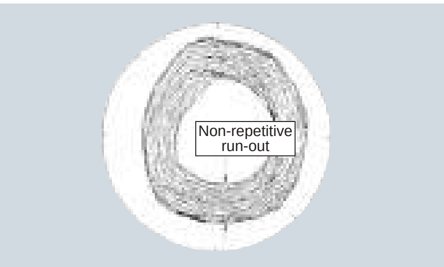


Fig. 2.3 Lissajous figure

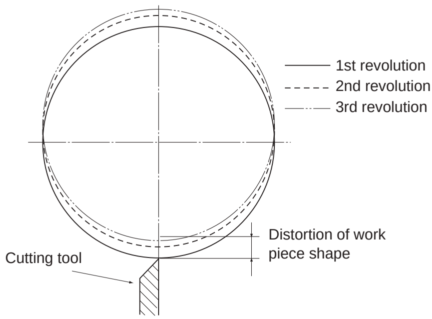


Fig. 2.4 Model of cutting operation

■Accuracies of shaft and housing

Depending on the fit of a bearing to a shaft and a housing, the bearing internal clearance can vary. For this reason, an adequate bearing fit has to be attained so that the bearing can perform as designed. (Refer to the recommended fit section.)

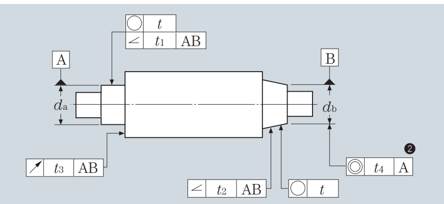
Also, the axial tightening torque on a bearing needs to be considered. To avoid deformation of bearing raceway surface owing to axial tightening of the bearing, it is necessary to carefully determine the dimensions of components associated with a tightening force the magnitude of tightening force and the number of tightening bolts.

The clearance on a tapered bore cylindrical roller bearing is adjusted by changing the drive-up to the taper. Because of this, the critical factors associated with an appropriate fit of a bearing to a shaft and/or a housing are the dimensional accuracies of the taper, contact surface on the taper, and the squareness of the end face of the inner ring relative to the shaft centerline during the drive-up process.

Typical accuracy values for a spindle and housing are summarized in **Tables 2.7** and **2.8**.

Typical accuracy for spindle

Table 2.7 Form accuracy of spindle ❶

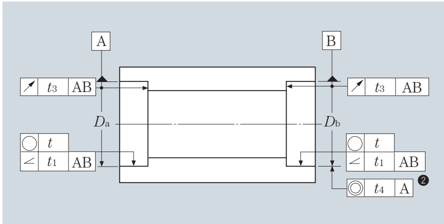


Accuracy	Symbol	Tolerance❸	Fundamental permissible tolerance IT		
			P5	P4	P2
Deviation from circular form	○	t	IT3/2	IT2/2	IT0❹/2
Angularity	∠	t_1	IT3/2	IT2/2	IT0❹/2
	∠	t_2	—	IT3/2	IT2/2
Run out	↗	t_3	IT3	IT3	IT2
Eccentricity	◎	t_4	IT5	IT4	IT3

❶ The form tolerance, symbol, and reference face of spindle are in accordance with ISO R1101.
❷ The length of the bearing fit surface is often too small to measure concentricity. Therefore, this criterion applies only when the fit surface has a width sufficient as a reference face.
❸ When determining a tolerance for permissible form accuracy, the reference dimensions used are shaft diameters d_a and d_b.
For example, when using a JIS class 5 bearing for a dia. 50 mm shaft, the tolerance of roundness is t = IT3/2 = 4/2=2 μm.
❹ IT0 is preferred if the diameter tolerance of the bearing fit surface is IT3.

Typical accuracy for housing

Table 2.8 Form accuracy of housing ❶



Accuracy	Symbol	Tolerance❸	Fundamental permissible tolerance IT		
			P5	P4	P2
Deviation from circular form	○	t	IT3/2	IT2/2	IT1/2
Angularity	∠	t_1	IT3/2	IT2/2	IT1/2
Run out	↗	t_3	IT3	IT3	IT2
Eccentricity	◎	t_4	IT5	IT4	IT3

❶ The form tolerance, symbol and reference face of the housing are in accordance with ISO R1101.
❷ The length of the bearing fit surface is often too small to measure concentricity. Therefore, this criterion applies only when the fit surface has a width sufficient as a reference face.
❸ Housing bore diameters D_a and D_b are the reference dimensions used when the tolerance for permissible form accuracy are determined.
For example, when a JIS class 5 bearing is used for a housing with a 50 mm inside bore, the tolerance of roundness is t = IT3/2 = 5/2 = 2.5 μm.

Fundamental tolerance IT

Table 2.9 Fundamental tolerance IT

Classification of nominal dimension mm		Fundamental tolerance IT value μm					
over	incl.	IT0	IT1	IT2	IT3	IT4	IT5
6	10	0.6	1	1.5	2.5	4	6
10	18	0.8	1.2	2	3	5	8
18	30	1	1.5	2.5	4	6	9
30	50	1	1.5	2.5	4	7	11
50	80	1.2	2	3	5	8	13
80	120	1.5	2.5	4	6	10	15
120	180	2	3.5	5	8	12	18
180	250	3	4.5	7	10	14	20
250	315	4	6	8	12	16	23
315	400	5	7	9	13	18	25
400	500	6	8	10	15	20	27

Note) For machine tool spindles, the shaft hardness is recommended to be at least HRC50 and the housing is recommended to be at least HRC30 to assist bearing replacement during repairs.

③ Bearings and rigidity

The rigidity of the main spindle of a machine tool is associated with both bearing rigidity and shaft rigidity. Bearing rigidity is typically governed by the elastic deformation between the rolling elements and raceway surface under load. Usually, bearings are preloaded in order to increase the rigidity.

Under same loading conditions, a roller bearing has a higher rigidity than a ball bearing of the same size. However, having sliding portions, a roller bearing is disadvantageous in supporting a high-speed shaft.

Shaft rigidity is greater with a larger shaft diameter. However, the supporting bearing must have a sufficient size and its $d_m n$ value (pitch center diameter across rolling elements d_m [mm] multiplied by speed [min^{-1}]) must be accordingly greater. Of course, a larger bearing is disadvantageous for high-speed applications.

To sum up, the rigidity required of the shaft arrangement must be considered before the bearing rigidity (bearing type and preload) and shaft rigidity are determined.

■Bearings rigidity

The rigidity of a bearing built into a spindle directly affects the rigidity of the spindle.

In particular, a high degree of rigidity is required of the main spindle of a machine tool to ensure adequate productivity and accurate finish of workpieces.

Bearing rigidity is governed by factors such as the following:

(1) Types of rolling elements
(2) Size and quantity of rolling elements
(3) Material of rolling elements
(4) Bearing contact angle
(5) Preload on bearing

■Type of rolling elements (roller or ball)

The surface contact pattern of the rolling element and raceway is line contact with a roller bearing, while a ball bearing is point contact. As a result, the dynamic deformation of a bearing relative to a given load is smaller with a roller bearing.

■Size and number of rolling elements

The size and number of rolling elements of a bearing are determined based on the targeted performance of the bearing.

Larger rolling elements lead to a greater bearing rigidity. However, a bearing having larger rolling elements tends to be affected by gyratory sliding centrifugal force, and, as a result, its high-speed performance will be degraded. Incidentally, a greater number of rolling elements helps increase bearing rigidity, but at the same time creates an increased number of heat generation sources, possibly leading to greater temperature rise.

For this reason, smaller size of rolling elements are used for high-speed applications.

To achieve both "high speed" and "high rigidity", each type of the **NTN** angular contact ball bearing for a machine tool is manufactured according to optimized specifications for interior structure.

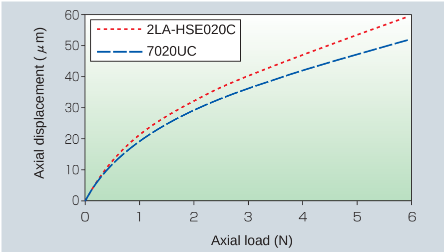


Fig. 2.5

■Material of rolling element (ceramic and steel)

Certain **NTN** bearings incorporate ceramic rolling elements. As Young's modulus of silicon nitride (315 GPa) is greater than that of bearing steel (210 GPa), the rigidity with this type of bearing is accordingly greater.

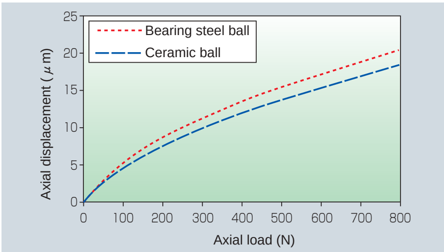


Fig. 2.6

■Bearing contact angle

A smaller contact angle on an angular contact ball bearing results in greater radial rigidity. When used as a thrust bearing, this type of bearing should have a greater contact angle to enable greater axial rigidity.

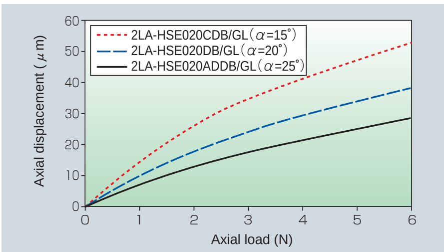


Fig. 2.7

■Preload on bearing

A greater preload on a given bearing results in greater rigidity (**Fig. 2.8**). However, too great of a preload on a bearing can lead to overheating, seizure, and/or premature wear of the bearing. It is possible to use bearings in three- or four-row configurations in order to achieve increased axial rigidity (**Fig. 2.9**).

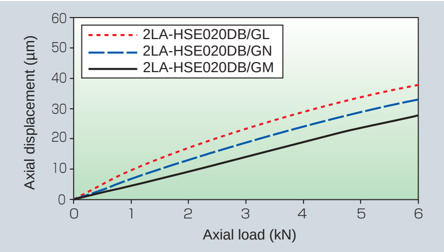


Fig. 2.8

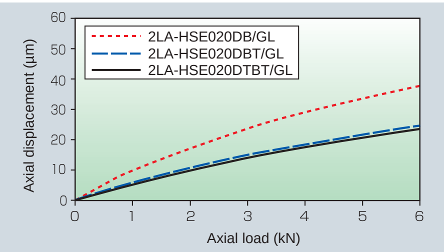


Fig. 2.9

■Preloading technique and preload

Bearing preloading techniques can be categorized as definite position preloading and constant pressure preloading (**Fig. 2.10**).

Definite position preloading is useful in enhancing the rigidity of a bearing unit, as the positional relationship across individual bearings can be maintained. On the other hand, as preloading is achieved with spring force, the constant pressure preloading technique can maintain a preload constant even when the bearing-to-bearing distance varies due to heat generation on the spindle or a change in load.

The basic preload for a duplex bearing is given in the relevant section for each bearing.

If an angular contact ball bearing is to be used for a high-speed application, such as for the main spindle of a machine tool, determine the optimal preload by considering the increase in contact surface pressure between rolling elements and the raceway surface that results from gyratory sliding and centrifugal force. When considering such an application, consult **NTN** Engineering.

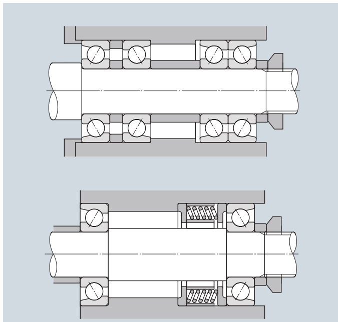


Fig. 2.10

■Preload and rigidity

The effect of preloading for an increase in bearing rigidity is summarized in **Fig. 2.11**.

When the inner rings in the diagram are tightened to bring them together, bearings Ⅰ and Ⅱ are each axially displaced by dimension δ_o, thereby attaining a preload F_o. In this situation, if an axial load F_a is further exerted from outside, the displacement on bearing Ⅰ increases by δ_a, while the displacement on bearing Ⅱ decreases.

At this point, the loads on bearings Ⅰ and Ⅱ are F_{I} and F_{II}, respectively. When compared with δ_b (the displacement occurring when an axial load F_a is exerted onto a non-preloaded bearing Ⅰ), displacement δ_a is small. Thus, a preloaded bearing has higher rigidity.

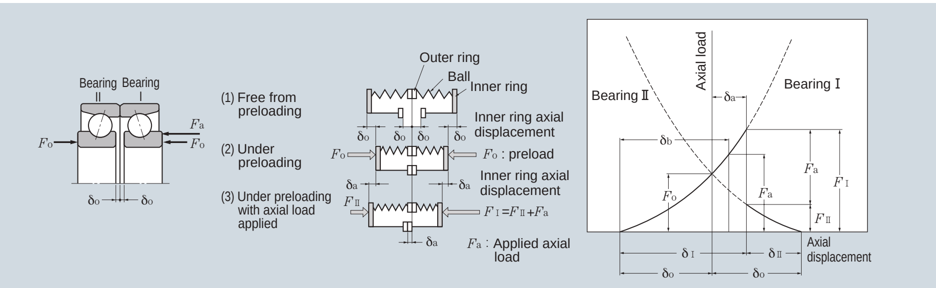


Fig. 2.11 Preload graph

■ Gyratory sliding

Every rolling element (ball) in an angular contact ball bearing revolves on the axis of rotation A-A' as illustrated in **Fig. 2.12**. A revolving object tends to force the axis of rotation to a vertical or horizontal attitude. As a result, the rolling element develops a force to alter the orientation of the axis of rotation. This force is known as a gyratory moment (M).

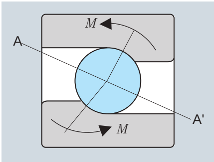


Fig. 2.12 Gyratory sliding

When the force due to the gyratory moment is greater than the resistance force (rolling element load multiplied by the coefficient of friction between the raceway and rolling element) , gyratory sliding occurs on the raceway surface. This leads to heat generation, wear and seizure. Therefore, it is necessary to provide a sufficient resistance force to inhibit gyratory sliding. **NTN**'s recommended preload is based on this theory.

The gyratory moment that will occur can be calculated by the formula below.

$$M = k \times \omega_b \times \omega_c \times \sin\beta$$

$$k = \frac{1}{10} \times m \times d_w^2$$

$$= 0.45 \times \rho \times d_w^5$$

$$M \propto d_w^5 \times n^2 \times \sin\beta$$

M : Gyratory moment
ω_b : Autorotation angular velocity of rolling element
ω_c : Angular velocity of revolution
m : Mass of rolling element
ρ : Density of rolling element
d_w : Diameter of rolling element
β : Angle of axis of rotation of rolling element
n : Speed of inner ring

■ Spin sliding

Every rolling element (ball) in an angular contact ball bearing develops spin sliding that is unavoidable owing to the structure of the bearing, relative to the raceway surface of either the inner ring or outer ring (**Fig. 2.13**).

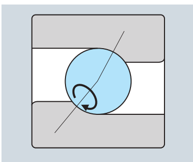


Fig. 2.13 Spin sliding

Usually, at a lower speed range, pure rolling motion occurs between an inner ring raceway and rolling elements and spin sliding develops between an outer ring raceway and rolling elements (this state is known as inner ring control). At a higher speed range, pure rolling motion occurs between an outer ring raceway and rolling elements and spin sliding develops between an inner ring raceway and rolling elements (this state is known as outer ring control). A point where transfer from inner ring control to outer ring control occurs is known as control transfer point. An amount of spin sliding and control transfer point can vary depending on the bearing type and bearing data. Generally, the amount of spin sliding will be greater with an outer ring control state.

According to J. H. Rumbarger and J. D. Dunfee, when the amount of spin sliding exceeds 4.20×10^6 (N/m m^2-mm/s), increase of heat generation and wear start.

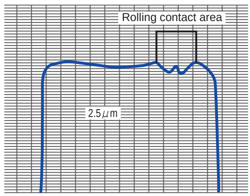
Generally, it is necessary for a bearing of a high-speed main spindle to have a preload that can prevent spin sliding.

The example of wear on a bearing owing to spin sliding is given in **Fig. 2.14**.

The magnitude of spin-derived wear is governed by a PV value (amount of spin sliding) during operation of the main spindle. Therefore, the optimum bearing for main spindle must be selected. Though the possibility of spin-derived wear occurrence varies depending on the bearing type, model number and specifications, we carefully determined a control transfer point in an operating arrangement for **NTN** angular contract ball bearings for main spindles of machine tools. Thus, we believe that the amount of spin sliding with this bearing category is not very large.

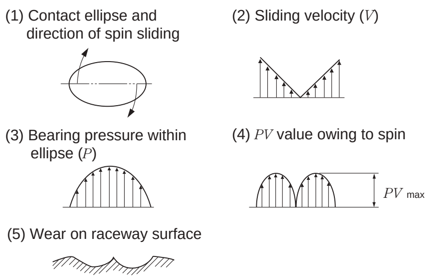
Additionally, the magnitude of spin-derived wear is significantly affected by how well the raceway surface is lubricated. Regardless of the type of sliding, even minor sliding can lead to wear if oil film is not formed well. For this reason, a reliable lubrication arrangement needs to be incorporated.

The form of wear on the bearing raceway derived from spin sliding appears as  . The wear on the raceway surface on inner ring that resulted from spin sliding is given below.



Bearing: 7026T1
Thrust load: 2 kN
Speed: 5000 min^{-1}
Lubrication: Grease
Run time: 50 h

Possible causes for  type wear



2.14 Mechanism of wear on bearing owing to spin sliding

④ Designing shaft and housing

In designing a bearing and housing, it is very important to provide a sufficient shoulder height for the bearing and housing so as to maintain bearing and housing accuracies and to avoid interference with the bearing related corner radius.

The chamfer dimensions are shown in **Table 2.10** and the recommended shoulder height and corner radii on the shaft and housing are listed in **Table 2.11**.

■Bearing corner radius dimensions

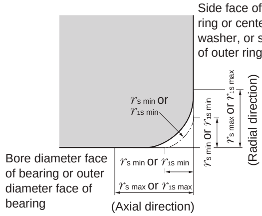


Fig. 2.15

Table 2.10 Allowable critical-value of bearing chamfer

(1) Radial bearings (Except tapered roller bearings)

Unit mm

$r_{s\,min}$ ❶ or $r_{1s\,min}$	Nominal bore diameter d over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
0.05	–	–	0.1	0.2
0.08	–	–	0.16	0.3
0.1	–	–	0.2	0.4
0.15	–	–	0.3	0.6
0.2	–	–	0.5	0.8
0.3	–	40	0.6	1
	40	–	0.8	1
0.6	–	40	1	2
	40	–	1.3	2
1	–	50	1.5	3
	50	–	1.9	3
1.1	–	120	2	3.5
	120	–	2.5	4
1.5	–	120	2.3	4
	120	–	3	5
2	–	80	3	4.5
	80	220	3.5	5
	220	–	3.8	6
2.1	–	280	4	6.5
	280	–	4.5	7
2.5	–	100	3.8	6
	100	280	4.5	6
	280	–	5	7
3	–	280	5	8
	280	–	5.5	8
4	–	–	6.5	9
5	–	–	8	10
6	–	–	10	13
7.5	–	–	12.5	17
9.5	–	–	15	19
12	–	–	18	24
15	–	–	21	30
19	–	–	25	38

❶ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

(2) Metric tapered roller bearings

Unit mm

$r_{s\,min}$ ❷ or $r_{1s\,min}$	Nominal bore❸ diameter of bearing "d" or nominal outside diameter "D" over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
0.3	–	40	0.7	1.4
	40	–	0.9	1.6
0.6	–	40	1.1	1.7
	40	–	1.3	2
1	–	50	1.6	2.5
	50	–	1.9	3
1.5	–	120	2.3	3
	120	250	2.8	3.5
	250	–	3.5	4
2	–	120	2.8	4
	120	250	3.5	4.5
	250	–	4	5
2.5	–	120	3.5	5
	120	250	4	5.5
	250	–	4.5	6
3	–	120	4	5.5
	120	250	4.5	6.5
	250	400	5	7
	400	–	5.5	7.5
4	–	120	5	7
	120	250	5.5	7.5
	250	400	6	8
	400	–	6.5	8.5
5	–	180	6.5	8
	180	–	7.5	9
6	–	180	7.5	10
	180	–	9	11

❷ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.
❸ Inner rings shall be in accordance with the division of "d" and outer rings with that of "D".

Note: This standard will be applied to bearings whose dimensional series (refer to the dimensional table) are specified in the standard of ISO 355 or JIS B 1512. For further information concerning bearings outside of these standards or tapered roller bearings using US customary units, please contact **NTN** Engineering.

(3) Thrust bearings

Unit mm

$r_{s\,min}$ or $r_{1\,min}$ ❹	$r_{s\,max}$ or $r_{1s\,max}$ Radial and axial direcition
0.05	0.1
0.08	0.16
0.1	0.2
0.15	0.3
0.2	0.5
0.3	0.8
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5
4	6.5
5	8
6	10
7.5	12.5
9.5	15
12	18
15	21
19	25

❹ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

■Abutment height and fillet radius

The shaft and housing abutment height (h) should be larger than the bearing's maximum allowable chamfer dimensions ($r_{s\ max}$), and the abutment should be designed so that it directly contacts the flat part of the bearing end face. The fillet radius (r_a) must be smaller than the bearing's minimum allowable chamfer dimension ($r_{s\ min}$) so that it does not interfere with bearing seating. **Table 2.11** lists abutment height (h) and fillet radius (r_a).

For bearings that support very large axial loads, shaft abutments (h) should be higher than the values in the table.

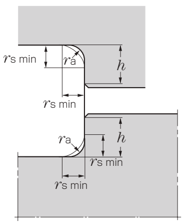


Table 2.11 Fillet radius and abutment height

Unit mm

Chamfer length $r_{s\ min}$ or $r_{s1\ min}$	Fillet radius (radius) $r_{as\ max}$	Shoulder height h (min) Normal use❶
0.05	0.05	0.3
0.08	0.08	0.3
0.1	0.1	0.4
0.15	0.15	0.6
0.2	0.2	0.8
0.3	0.3	1.25
0.6	0.6	2.25
1	1	2.75
1.1	1	3.5
1.5	1.5	4.25
2	2	5
2.1	2	6
2.5	2	6
3	2.5	7
4	3	9
5	4	11
6	5	14
7.5	6	18
9.5	8	22
12	10	27
15	12	32
19	15	42

❶ If bearing supports large axial load, the height of the shoulder must exceed the value given here.

Note: $r_{as\ max}$ maximum allowable fillet radius.

Where a fillet radius ($r_{a\ max}$) larger than the bearing chamfer dimension is required to strengthen the shaft or to relieve stress concentration (**Fig. 2.16a**), or where the shaft abutment height is too low to afford adequate contact surface with the bearing (**Fig. 2.16b**), spacers may be used effectively.

Relief dimensions for ground shaft and housing fitting surfaces are given in **Table 2.12**.

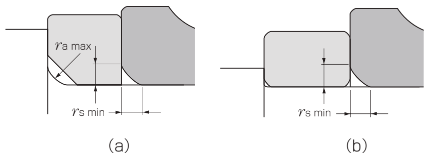
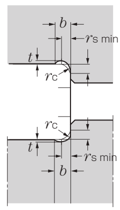


Fig. 2.16 Bearing mounting with spacer



2.12 Relief dimensions for grounding

$r_{s\ min}$	Relief dimensions b	t	r_c
1	2	0.2	1.3
1.1	2.4	0.3	1.5
1.5	3.2	0.4	2
2	4	0.5	2.5
2.1	4	0.5	2.5
2.5	4	0.5	2.5
3	4.7	0.5	3
4	5.9	0.5	4
5	7.4	0.6	5
6	8.6	0.6	6
7.5	10	0.6	7

3. Load Rating and Life

① Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly being subjected to repeated compressive stresses which causes flaking of these surfaces to occur. This flaking is due to material fatigue and will eventually cause the bearings to fail. The effective life of a bearing is usually defined in terms of the total number of revolutions a bearing can undergo before flaking of either the raceway surface or the rolling element surfaces occurs.

Other causes of bearing failure are often attributed to problems such as seizure, abrasions, cracking, chipping, scuffing, rust, etc. However, these so called "causes" of bearing failure are usually caused by improper installation, insufficient or improper lubrication, faulty sealing or improper bearing selection. Since the above mentioned "causes" of bearing failure can be avoided by taking the proper precautions, and are not simply caused by material fatigue, they are considered separately from the flaking aspect.

Usually, the load exerted on the main spindle of a machine tool is relatively small compared to the dynamic rated load on the bearing. Therefore, the fatigue life of a bearing seldom poses a problem.

The following operating conditions, rather than a bearing's rating life, can significantly affect the bearing functions (running accuracy, rigidity, heat generation, etc.) and require special consideration.

(1) High speed operation.
(2) Heavy preload.
(3) Large bending of the shaft.
(4) Large temperature difference between the inner and outer rings.

For further information, please consult **NTN** Engineering.

■Basic rating life and basic dynamic load rating

A group of seemingly identical bearings when subjected to identical load and operating conditions will exhibit a wide diversity in their durability.

This "life" disparity can be accounted for by the difference in the fatigue of the bearing material itself. This disparity is considered statistically when calculating bearing life, and the basic rating life is defined as follows.

The basic rating life is based on a 90% statistical model which is expressed as the total number of revolutions 90% of the bearings in an identical group of bearings subjected to identical operating conditions will attain or surpass before flaking due to material fatigue occurs. For bearings operating at fixed constant speeds, the basic rating life (90% reliability) is expressed in the total number of hours of operation.

Basic dynamic load rating expresses a rolling bearing's capacity to support a dynamic load. The basic dynamic load rating is the load under which the basic rating life of the bearing is 1 million revolutions. This is expressed as pure radial load for radial bearings and pure axial load for thrust bearings. These are referred to as "basic dynamic load rating (C_r)" and "basic dynamic axial load rating (C_a)." The basic dynamic load ratings given in the bearing tables of this catalog are for bearings constructed of **NTN** standard bearing materials, using standard manufacturing techniques.

The relationship between the basic rating life, the basic dynamic load rating and the bearing load is given in the formula below.

For ball bearings: $$L_{10} = \left(\frac{C}{P}\right)^3 \quad \cdots\cdots (3.1)$$

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3 \quad \cdots\cdots (3.2)$$

For roller bearings: $$L_{10} = \left(\frac{C}{P}\right)^{10/3} \quad \cdots\cdots (3.3)$$

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^{10/3} \quad \cdots\cdots (3.4)$$

where,

L_{10} : Basic rating life, 10^6 revolutions
L_{10h} : Basic rating life, h
C : Basic dynamic load rating, N {kgf}
(C_r: radial bearings, C_a: thrust bearings)
P : Equivalent dynamic load, N {kgf}
(P_r: radial bearings, P_a: thrust bearings)
n : Rotational speed, min^{-1}

When several bearings are incorporated in machines or equipment as complete units, all the bearings in the unit are considered as a whole when computing bearing life (see formula 3.5).

$$L = \frac{1}{\left(\frac{1}{L_1^e} + \frac{1}{L_2^e} + \cdots \frac{1}{L_n^e}\right)^{1/e}} \quad \cdots\cdots (3.5)$$

where,

L : Total basic rating life of entire unit, h
L_1 , L_2 ⋯L_n: Basic rating life of individual bearings, 1, 2, ⋯n, h
e = 10/9..........For ball bearings
e = 9/8............For roller bearings

When the load conditions vary at regular intervals, the life can be given by formula (3.6).

$$L_m = \left(\frac{\Phi_1}{L_1} + \frac{\Phi_2}{L_2} + \cdots \frac{\Phi_j}{L_j}\right)^{-1} \cdots\cdots (3.6)$$

where,

L_m : Total life of bearing

Φ_j : Frequency of individual load conditions ($\Sigma\Phi_j = 1$)

L_j : Life under individual conditions

■Adjusted rating life

The basic bearing rating life (90% reliability factor) can be calculated by the formula (3.2) mentioned. However, in some applications a bearing life factor of over 90% reliability may be required. To meet these requirements, bearing life can be lengthened by the use of specially improved bearing materials or manufacturing process. Bearing life is also sometimes affected by operating conditions such as lubrication, temperature and rotational speed.

Basic rating life adjusted to compensate for this is called "adjusted rating life," and is determined by using the formula (3.7).

$$L_{na} = a_1 \cdot a_2 \cdot a_3 \cdot L_{10} \cdots\cdots\cdots (3.7)$$

where,

L_{na} : Adjusted rating life in millions of revolutions (10^6)

a_1 : Reliability factor

a_2 : Bearing characteristics factor

a_3 : Operating conditions factor

●Life adjustment factor for reliability a_1

The value of reliability factor a_1 is provided in **Table 3.1** for reliability of 90% or greater.

Table 3.1 Reliability factor a_1

Reliability %	L_n	Reliability factor a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

●Life adjustment factor for material a_2

Bearing characteristics concerning life vary according to bearing material, quality of material and use of special manufacturing processes. In this case, life is adjusted by the bearing characteristics factor a_2.

The basic dynamic load ratings listed in the catalog are based on **NTN**'s standard material and process, therefore, the adjustment factor $a_2 = 1$. $a_2 > 1$ may be used for specially enhanced materials and manufacturing methods. If this applies, consult **NTN** Engineering.

●Life adjustment factor for operating conditions a_3

Operating conditions factor a_3 is used to compensate for when the lubrication condition worsens due to rise in temperature or rotational speed, lubricant deteriorates, or becomes contaminated with foreign matters.

Generally speaking, when lubricating conditions are satisfactory, the a_3 factor has a value of one. And when lubricating conditions are exceptionally favorable and all other operating conditions are normal, a_3 can have a value greater than one. a_3 is however less than 1 in the following cases:

- Dynamic viscosity of lubricating oil is too low for bearing operating temperature (13 mm^2/s or less for ball bearings, 20 mm^2/s for roller bearings)
- Rotational speed is particularly low (If multiplication of rotational speed n min^{-1} and pitch circle diameter across rolling elements d_m mm is $d_m n < 10{,}000$)
- Bearing operating temperature is too high
- Lubricant is contaminated with foreign matter or moisture

■New bearing life formula

By dramatic improvement in bearing materials and bearing manufacturing techniques, bearings can offer a life several times as long as that calculated from the formula (3.7) as long as they are mounted with minimal mounting errors are fully free from foreign matter and adequately lubricated. This finding was obtained by a series of experiments performed by **NTN**. **NTN**'s new bearing life calculation theory is based on a fatigue limit theory according to which under clean and efficient lubrication conditions, bearing life can be indefinite at a particular contact surface pressure. For this purpose, **NTN** performs calculations based on the contact surface pressure at a fatigue limit of 1.5 GPa that is defined in ISO281: 1990/Amd2: 2000. Incidentally, if foreign matter enters into a bearing, depending on the size and amount of foreign matter, the actual life of that bearing can be much shorter than the rating life that is calculated by formula (3.7). Also, poor lubricating conditions can cause the actual bearing life to be shorter than the rating life. **NTN**'s new bearing life calculation is designed to determine a new life correction factor a_{NTN} by the following formula.

$$L_{nm} = a_1 \cdot a_{NTN} \cdot \left(\frac{C}{P}\right)^p \quad \cdots\cdots (3.8)$$

■Bearing life theory

(1) Conventional Lundberg-Palmgren (L-P) theory

According to this theory, a stress that governs rolling fatigue is considered, that is, a maximum dynamic shear stress τ_o that is exerted, at a depth of Z_o from the rolling contact surface, in a plane parallel with the rolling contact surface. Referring to a theory of Neuber, et. al. which claims that the durability of a material deteriorates as the volume being subjected to a stress application decreases, the L-P theory assumes that a fissure occurring at a weak point of material at around the depth Z_o reaches the surface and leads to develop flaking. The probability of survival S of a volume V that is subjected to N times of stress application is determined by the formula below according to the Weibull theory.

$$\ln \frac{1}{S} \propto \frac{N^e \tau_0^c V}{z_0^h} \quad \cdots\cdots (3.9)$$

where,

- S : Probability of survival of stress volume V
- N : Number of repeated stress applications
- e : Weibull slope (index to represent variation in life)
- τ_o : Maximum shear stress
- Z_o : Depth from surface at which maximum shear stress occurs
- c, h : Indexes

From the basic formula for the bearing life relative to rolling fatigue (3.9), a generic life formula below is obtained:

$$L_{10} = \left(\frac{C}{P}\right)^p \quad \cdots\cdots (3.10)$$

where,

- L_{10} : Basic rating life
- C : Basic dynamic load rating
- P : Dynamic equivalent load
- p : $(c-h+2)/3e$ (point contact)
  $(c-h+1)/2e$ (line contact)

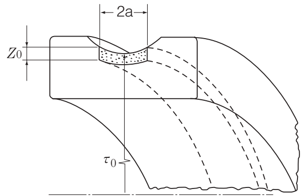


Fig. 3.1 Stress volume resulting from rolling contact according to L-P theory

(2) NTN's new bearing life theory

While the L-P theory intends to define internally occurring flaking owing to the shear stress within a material that results from hertzian contact, **NTN**'s new bearing life theory is designed not only to evaluate surface-initiated flaking but also to determine life of each small segment (ΔL_1) based on a local stress (σ_1). This is done by dividing an area from the interior to the contact surface of the material into small segments as illustrated in **Fig. 3.2**, and finally obtaining the overall bearing life L by the formula (3.13).

$$\ln \frac{1}{\Delta S_i} \propto \frac{\Delta N_i^e \sigma_i^c \Delta V_i}{z_i^h} \quad \cdots\cdots (3.11)$$

$$\Delta L_i = \Delta N_i \propto \left(\sigma_i^{-c} \Delta V_i^{-1} z_i^h\right)^{1/e} \quad \cdots\cdots (3.12)$$

$$L = \left\{\sum_{i=1}^{n} \Delta L_i^{-e}\right\}^{-1/e} \quad \cdots\cdots (3.13)$$

where,

- ΔS_i : probability of survival of stress volume ΔV_i of divided segment
- L : Overall bearing life
- Z_i : Depth of divided small stress volume ΔV_i from the surface
- n : Number of segments
- σ_u : Fatigue limit stress
  - A stress below which a bearing does not develop failure (flaking) under ideal lubrication conditions.
  - ISO 281: 1990/Amd2: 2000 specifies 1.5 GPa as a the maximum contact surface pressure at a fatigue limit. **NTN** uses it as a Von Misses stress equivalent to the maximum contact surface pressure 1.5 GPa.
  - When σ_i is smaller than σ_u (fatigue limit), the life of a region in question (ΔL_1) will be infinitely long.

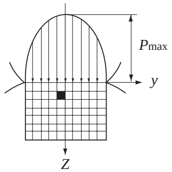


Fig. 3.2 Calculation model

■NTN's new bearing life formula

The correlation between the **NTN**'s life correction factor a_{NTN} and corrected rating life L_{nm} is defined by the formula (3.14) below.

$$L_{nm}=a_1\cdot a_{NTN}\cdot\left(\frac{C}{P}\right)^{p} \quad (3.14)$$

where,

- L_{nm} : Corrected rating life
- a_1 : Reliability coefficient
- a_{NTN} : Life correction factor that reflects material properties, fatigue limit stress, contamination with foreign matter and oil film parameter (Λ) ($0.1 \leqq a_{NTN} \leqq 50$)
- C : Basic dynamic load rating
- P : Dynamic equivalent load
- p : Index 3 (ball bearing) 10/3 (roller bearing)

(1) Effect of fatigue limit

NTN's new bearing life formula introduces a concept of fatigue life according to which the bearing life is infinitely long at a particular contact surface pressure as illustrated in **Fig. 3.3** assuming no foreign matter is trapped in the bearing and the bearing is reliably lubricated.

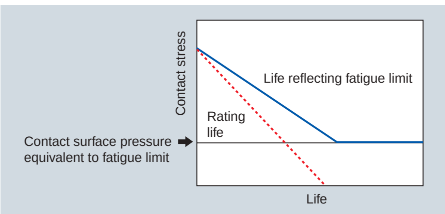


Fig. 3.3 Basic concept of fatigue limit

(2) Effect of foreign matter

The effect of foreign matter is treated as surface-initiated flaking that starts from a dent resulting from trapped foreign matter. **NTN** performs a bearing life calculation, assuming that the size of foreign matter and the stress concentration area in the middle portion (the size of this area corresponds with that of the foreign matter) in the surface layer as well as the amount of foreign matter significantly affect the bearing life.

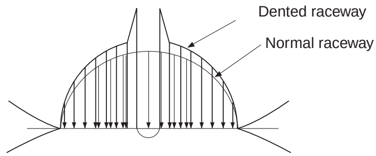


Fig. 3.4 Contact surface pressure distribution resulting from dent

(3) Effect of oil film parameter (Λ)

The oil film parameter can be used to calculate bearing life. The oil film parameter, designated by Λ, is the ratio of the oil film thickness to the roughness of the surface. It can be used to calculate the average stress across the surface layer of two contacting surfaces, such as a rolling element and raceway. From this surface layer stress, the contact surface pressure can be determined. Bearing life is then calculated from the contact surface pressure.

Conditions of two objects on surface layer
Calculation model

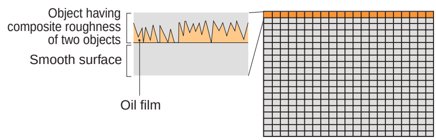


Fig. 3.5 Model of stress load onto the surface layer

■New life calculation formula chart

Various statuses of contamination with foreign matter are defined in **Table 3.2**. The values of ISO codes and NAS classes are those for ball bearings that are subjected to more severe operating conditions.

Table 3.2 Status of contamination

Condition of contamination	Extremely clean	Clean	Normal	Lightly contaminated	Moderately contaminated	Highly contaminated	Severely contaminated
Contamination coefficient	1	0.8	0.5	0.4	0.3	0.2	0.1
Guideline for application	Filtered						No filter
	Less than 10 m	10～30 μm	30～50 μm	50～70 μm	70～100 μm	100 m or more	Ingress of much dust
ISO cleanliness code (ISO 4406)	13/10	15/12	17/14	19/16	21/18	23/20	25/22
NAS class	0	3	6	8	9	10	12

(1) Effect of foreign matter on correlation between load (P/C) and life correction factor a_{NTN}

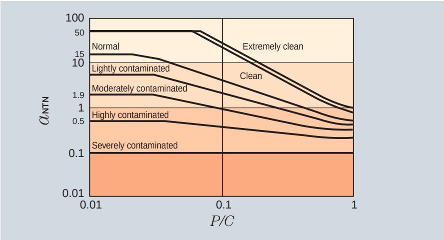


Fig. 3.6 Correlation between P/C and a_{NTN} (effect of foreign matter in ball bearing)

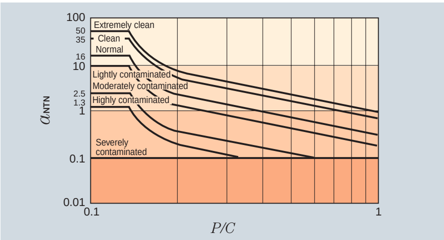


Fig. 3.7 Correlation between P/C and a_{NTN} (effect of foreign matter in roller bearing)

(2) Effect of oil film parameter (Λ) on correlation between load (P/C) and life correction factor a_{NTN}

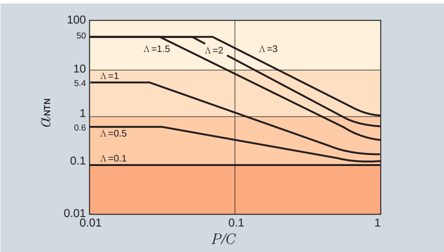


Fig. 3.8 Correlation between P/C and a_{NTN} (effect of Λ with ball bearing)

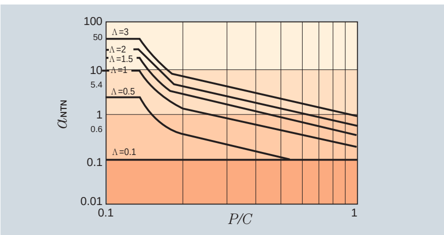


Fig. 3.9 Correlation between P/C and a_{NTN} (effect of Λ with roller bearing)

② Static load rating and allowable axial load

■Basic static load rating

When stationary rolling bearings are subjected to static loads, they suffer from partial permanent deformation of the contact surfaces at the contact point between the rolling elements and the raceway. The amount of deformity increases as the load increases, and if this increase in load exceeds certain limits, the subsequent smooth operation of the bearings is impaired.

It has been found through experience that a permanent deformity of 0.0001 times the diameter of the rolling element, occurring at the most heavily stressed contact point between the raceway and the rolling elements, can be tolerated without any impairment in running efficiency.

The basic static load rating refers to a fixed static load limit at which a specified amount of permanent deformation occurs. It applies to pure radial loads for radial bearings and to pure axial loads for thrust bearings. The maximum applied load values for contact stress occurring at the rolling element and raceway contact points are given below.

For ball bearings	4 200MPa	{428kgf/mm²}
For self-aligning ball bearings	4 600MPa	{469kgf/mm²}
For roller bearings	4 000MPa	{408kgf/mm²}

Referred to as "basic static radial load rating" for radial bearings and "basic static axial load rating" for thrust bearings, basic static load rating is expressed as C_{or} or C_{oa} respectively and is provided in the bearing dimensions table.

■Allowable static equivalent load

Generally the static equivalent load which can be permitted is limited by the basic static rating load as stated above. However, depending on requirements regarding friction and smooth operation, these limits may be greater or lesser than the basic static rating load.

This is generally determined by taking the safety factor S_o given in **Table 3.3** and formula (3.13) into account.

$$S_o = C_o / P_o \qquad (3.13)$$

where,

S_o : Safety factor
C_o : Basic static load rating, N {kgf}
radial bearings: C_{or},
thrust bearings: C_{oa}
P_o : Static equivalent load, N {kgf}
radial bearings: P_{or},
thrust bearings: P_{oa}

Table 3.3 Minimum safety factor values S_0

Operating conditions	Ball bearings	Roller bearings
High rotational accuracy necessary	2	3
Normal rotating accuracy necessary (Universal application)	1	1.5
Slight rotational accuracy deterioration permitted (Low speed, heavy loading, etc.)	0.5	1

Note: When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_0 max value.

■Allowable axial load

A greater axial load can be exerted on a main spindle bearing on a machine tool allowing for tool changes while the machine is stationary. When an angular contact ball bearing is subjected to a larger axial load, the contact ellipse between its rolling elements and raceway surface can overflow the raceway surface (**Fig. 3.10**). Furthermore, even if the contact ellipse remains within the raceway surface, overstressing can cause problems such as denting.

The maximum allowable load that does not cause such problems is defined as the "allowable axial load."

The allowable axial load is reached when either of the following conditions occurs.

- **The end of contact ellipse on the raceway surface reaches the shoulder of either an inner or outer ring.**
- **The contact surface pressure on the raceway surface reaches 3650 MPa in either the inner or outer ring raceway.**

Note that the contact surface pressure of 3650 MPa on the raceway surface is a value that leads to a permanent deformation of 0.00002 to 0.00005 times as much as the rolling element diameter and has been determined through many years of experience.

The allowable axial load for each bearing is found in the associated dimensions table.

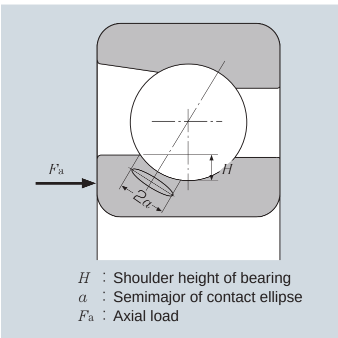


Fig. 3.10

4. Allowable Speed

High bearing speed leads to high temperature rise on the bearing owing to frictional heating within the bearing. When the temperature of the bearing exceeds a particular limit, the lubricant performance deteriorates significantly, possibly leading to bearing overheating or seizure.

The factors that can affect the maximum allowable bearing speed include:

(1) Bearing type
(2) Bearing size
(3) Lubrication system (grease lubrication, air-oil lubrication, jet lubrication, etc.)
(4) Internal clearance or preload on the bearing
(5) Bearing arrangement (2-row, 3-row, 4-row)
(6) Bearing load
(7) Accuracies of shaft, housing, etc.

The maximum allowable speeds listed in the bearing dimensions tables are reference values and are applicable only to individual bearings that are adequately lubricated and correctly preloaded under a condition where the heat is reliably removed from the bearing arrangement.

In the case of grease lubrication, these speeds are attainable only when the bearing is filled with an adequate amount of high-quality grease as given in **Table 7.3**, the bearing is sufficiently run in, and heat is removed by an arrangement such as a cooling jacket. In the case of oil lubrication, these speeds are attained only by an air-oil lubrication system if an adequate amount of VG10 or 32 spindle oil is supplied and the heat is removed by an arrangement such as a cooling jacket. When using a large amount of lubricant, a jet lubrication system excels in lubrication and cooling performance, and can permit operation at the maximum allowable speed. However, this lubrication system involves a high power loss and should be employed carefully.

■Speed factor

The maximum allowable speed of a particular bearing can vary depending on the relation between heat generation and heat dissipation in the bearing as well as how well the bearing is lubricated. The bearing arrangements (2-row to 4-row) and speed reduction ratios (speed factors) for maximum allowable speed due to post-assembly preloads are summarized in **Table 4.1**.

Table 4.1 Speed factor by bearing arrangement and preload

Bearing arrangement	Matching	GL	GN	GM
	DB	0.85	0.8	0.65
	DBT	0.7	0.6	0.5
	DTBT	0.8	0.75	0.6

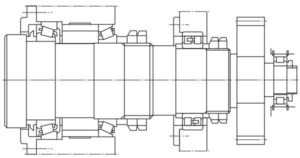
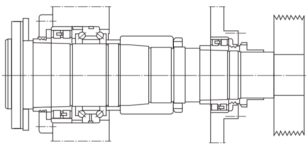
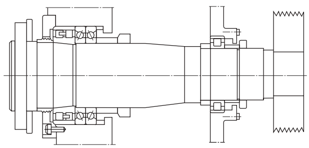
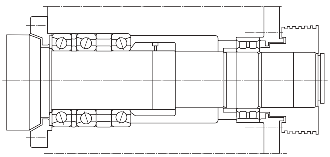
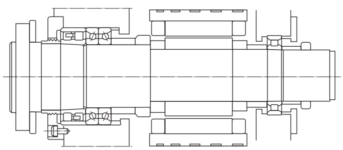
5. Bearing Arrangements and Structures of Bearings for Main Spindles

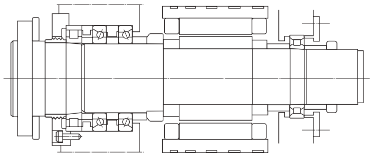
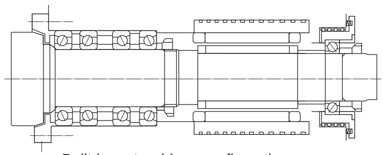
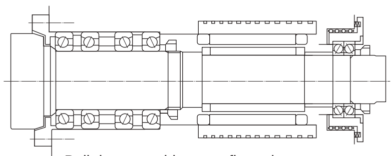
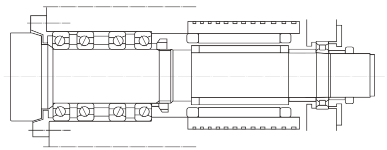
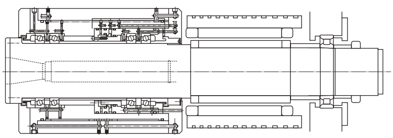
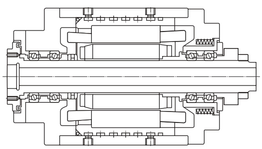
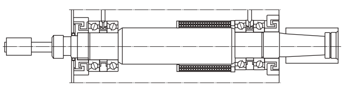
① Bearing Arrangement for Main Spindles

Typical examples of bearing arrangements for main spindles of machine tools are summarized in **Table 5.1**.

An optimal bearing arrangement must be determined through considerations about the properties required of the main spindle in question (maximum speed, radial and axial rigidities, main spindle size, required accuracies, lubrication system, etc.). Recently, an increasing number of new machine tool models incorporate built-in motor type main spindles. However, heat generation on a built-in motor can affect the accuracy of the main spindle and performance of lubricant, so a main spindle bearing should be selected very carefully.

Table 5.1 Typical examples of bearing arrangements for main spindles

Bearing arrangement for main spindle	Bearing type	Typical applications
 Gear-driven configuration	[Type Ⅰ] Tapered roller bearing + Tapered roller bearing + Double-row cylindrical roller bearing	Large turning machine Oil country lathe General-purpose turning machine Typical lubrication ● Grease lubrication
 Belt-driven configuration	[Type Ⅱ] Double-row cylindrical roller bearing + Double-direction angular contract thrust ball bearing + Double-row cylindrical roller bearing	CNC turning machine Machining center Boring machine Milling machine Typical lubrication ● Grease lubrication
 Belt-driven configuration	[Type Ⅲ] Double-row cylindrical roller bearing + High-speed duplex angular contact ball bearing for axial load + Single-row cylindrical roller bearing NOTE: high-speed variant of type Ⅱ	CNC turning machine Machining center Milling machine Typical lubrication ● Grease lubrication
 Belt-driven configuration	[Type Ⅳ] Duplex angular contact ball bearing (DBT arrangement) + Double-row cylindrical roller bearing NOTE: high-speed variant of type Ⅱ or Ⅲ	CNC turning machine Machining center Milling machine Typical lubrication ● Grease lubrication
 Built-in motor-driven configuration	[Type Ⅴ] Double-row cylindrical roller bearing + High-speed duplex angular contact ball bearing for axial load + Single-row cylindrical roller bearing NOTE: high-speed variant of type Ⅲ with built-in motor-driven configuration	CNC turning machine Machining center Milling machine Typical lubrication ● Grease lubrication ● Air-oil lubrication

Bearing arrangement for main spindle	Bearing type	Typical applications
 Built-in motor-driven configuration	[Type VI] Single-row cylindrical roller bearing + High-speed duplex angular contact ball bearing for axial load + Single-row cylindrical roller bearing NOTE: high-speed variant of type V	CNC turning machine Machining center Typical lubrication ● Grease lubrication ● Air-oil lubrication
 Built-in motor-driven configuration	[Type VII] Duplex angular contact ball bearing (DTBT arrangement) + Single-row angular contact roller bearing (w/ ball slide) NOTE: super high-speed variant	Machining center <vertical> Typical lubrication ● Grease lubrication ● Air-oil lubrication
 Built-in motor-driven configuration	[Type VIII] Duplex angular contact ball bearing (DTBT arrangement) + Duplex angular contact roller bearing (w/ ball slide) NOTE: super high-speed variant	Machining center <vertical> Typical lubrication ● Grease lubrication ● Air-oil lubrication
 Built-in motor-driven configuration	[Type IX] Duplex angular contact ball bearing (DTBT arrangement) + Single-row cylindrical roller bearing NOTE: super high-speed variant	Machining center Typical lubrication ● Grease lubrication ● Air-oil lubrication
 Built-in motor-driven configuration	[Type X] Adjustable preload bearing unit + Duplex angular contact ball bearing (DBT arrangement) + Single-row cylindrical roller bearing NOTE: high-rigidity/super high-speed variant	Machining center Typical lubrication ● Air-oil lubrication
 Built-in motor-driven configuration	[Type XI] Duplex angular contact ball bearing (DT arrangement) + Duplex angular contact ball bearing (DT arrangement)	Machining center Small turning machine Grinding machine Typical lubrication ● Grease lubrication ● Air-oil lubrication
 Belt-driven configuration	[Type XII] Duplex angular contact ball bearing (DT arrangement) + Duplex angular contact ball bearing (DT arrangement)	Grinding machine Typical lubrication ● Grease lubrication ● Air-oil lubrication ● Oil-mist lubrication

② Bearing selection based on bearing arrangement for main spindle

An optimal bearing product that best suits the application is selected by referring to the bearing selection table in **Table 5.2**, which contains the possible bearing arrangements for main spindles.

- Designate the free side and fixed side.
- Select the bearing arrangement type (I to XII) on the free or fixed side.
- Select a set of bearing specifications applicable to the selected arrangement type.
- Choose a lubrication system suitable for the selected bearing specifications.
- Select a product group that satisfies the above-mentioned considerations.

Table 5 2 Bearing selection table

Fix side	Free side	Bearing specifications	Lubrication system		Applicable product groups/ULTAGE Steel balls/ceramic balls	Considerations for selection procedure
Duplex angular contact ball bearing or adjustable preload bearing mechanism + Duplex angular contact ball bearing Bearing arrangement [Type IV, VI, VII, IX, XI, or XII]	Single-row angular contact ball bearing or duplex angular contact ball bearing (w/ ball bush) Bearing arrangement [Type VII, VIII, XI, or XII]	Angular contact ball bearing for radial load Contact angle 30° or smaller		Grease lubrication	Sealed: 【15°, 25°】 79 LLB/5S-79 LLB 70 LLB/5S-70 LLB 【15°, 20°, 25°】 2LA-BNS9 LLB/5S-2LA-BNS9 LLB 2LA-BNS0 LLB/5S-2LA-BNS0 LLB	Bearing selection ① High-speed performance (general) High ⇔ Low Contact angle 15°, 20°, 25°, 30° ② Rigidity · Radial rigidity High ⇔ Low Contact angle 15°, 20°, 25°, 30° · Axial rigidity Low ⇔ High Contact angle 15°, 20°, 25°, 30°, 40°, 60° · Complex rigidity (radial and axial) High (4-row) Medium (3-row) Low (2-row) ③ Recommended arrangement 4-row (DTBT) or 2-row (DB) ④ Recommended lubrication specifications Standard main spindle : Grease High-speed main spindle : Air-oil Low-noise : Grease or eco-friendly air-oil ⑤ Presence of cooling jacket around the bearing. In particular, grease lubrication is recommended.
			Air-oil lubrication	Grease lubrication	【15°】 78C, 72C 【15°, 25°, 30°】 79U/5S-79U, 70U/5S-70U 【15°, 20°, 25°】 2LA-HSE9U/5S-2LA-HSE9U 2LA-HSE0/5S-2LA-HSE0	
			Air-oil lubrication	Grease lubrication	Grinding machine main spindle/ motor shaft series 【15°】 BNT9/5S-BNT9 BNT0/5S-BNT0 BNT2/5S-BNT2	
			Air-oil lubrication		Super high-speed/dedicated air-oil lubrication series 【25°】 5S-2LA-HSF0	
			Air-oil lubrication		Eco-friendly type 【20°, 25°】 5S-2LA-HSL9U 5S-2LA-HSL0 5S-2LA-HSFL0 With re-lubricating hole on the outer ring 【20°, 25°】 5S-2LA-HSEW9U 5S-2LA-HSEW0	
Cylindrical roller bearing + Duplex angular contact ball bearing Bearing arrangement [Type II, III, V or VI]	Double-row cylindrical roller bearing or single-row cylindrical roller bearing Bearing arrangement [Type I, II, III, IV, V, VI, IX, or X]	Cylindrical roller bearing	Air-oil lubrication	Grease lubrication	Double-row: NN30/NN30K NN30HS/NN30HSK NN30HST6/NN30HST6K NN30HSRT6/NN30HSRT6K NN49/NN49K NNU49/NNU49K	
			Air-oil lubrication	Grease lubrication	Single-row: N10HS/N10HSK N10HSRT6/N10HSRT6K	
			Air-oil lubrication	Grease lubrication	Single-row: Eco-friendly type N10HSLT6/N10HSLT6K	
		Angular contact ball bearing for axial load Contact angle less than 60°	Air-oil lubrication	Grease lubrication	【30°】 HTA9A HTA0A/5S-HTA0A 【40°】 HTA9U HTA0U/5S-HTA0 【60°】 5629/5629M 5620/5620M	
		Thrust contract ball bearing		Grease lubrication		
Tapered roller bearing + Cylindrical roller bearing Bearing arrangement [Type I]		Cylindrical roller bearing	Oil lubrication	Grease lubrication	329XU 4T-320X/320XU Inch series tapered roller bearing	

③ Adjustable preload bearing unit

A recent trend in the machine tool industry is a steady increase of operating speeds. The maximum d_mn value (pitch circle diameter across rolling elements d_m [mm] multiplied by speed n [min^{-1}]) reached by main spindles with air-oil lubricated lubrication can be as high as 2.5 to 3.8 $\times 10^6$. At the same time, main spindles are requiring increased rigidity. Therefore, main spindle bearings must be capable of both high-speed operation and high rigidity. This can be achieved through optimal preloading.

A fixed preload (spring preload) system is usually employed to satisfy both these high speed and high rigidity requirements. A spindle unit with fixed-position preload that is adjustable for different speed conditions is advantageous for optimizing the rigidity of the unit.

The **NTN** Adjustable Preload Bearing Unit is a high-speed, high-rigidity unit that features fixed position preload that can be adjusted for different speed conditions.

The **NTN** Adjustable Preload Bearing Unit is illustrated in **Fig. 5.1**. Hydraulic pressure is used to shift the position of the adjustable preload sleeve situated in the rear bearing section of the unit. This changes the preload on the bearings.

A spindle incorporating a 3-step adjustable preload bearing unit is illustrated in **Fig. 5.2**. The sleeve in the adjustable preload section is comprised of two hydraulic pressure chambers, A and B, as well as a spiral groove for sliding motion. The preload can be adjusted to one of three settings by changing the hydraulic pressure in each of the chambers. To achieve instantaneous and reliable adjustment, high-pressure oil (at the same pressure as in the hydraulic chambers) is supplied to the spiral groove on the outside of the sleeve. This oil provides lubrication so that the sleeve can move smoothly.

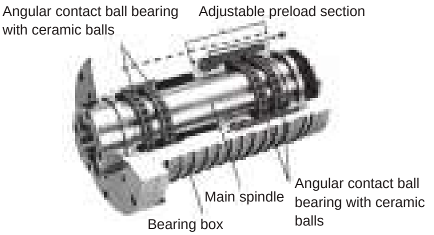


Fig. 5.1 Adjustable preload bearing unit

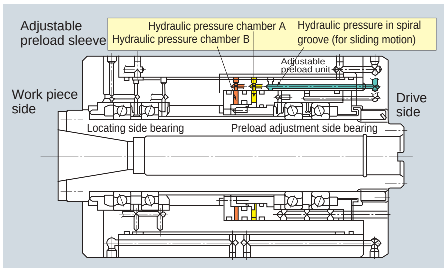


Fig. 5.2 Typical spindle configuration incorporating 3-step Adjustable Preload Type Bearing Unit

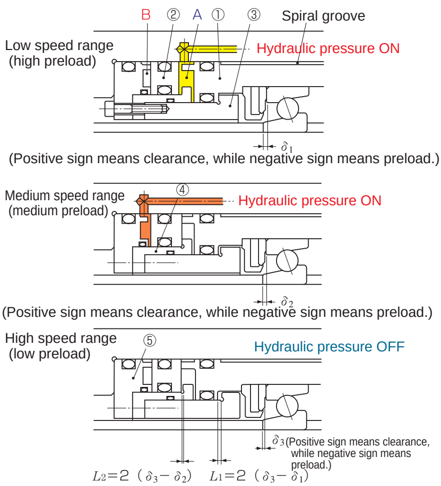


Fig. 5.3 Operating mechanism of Adjustable preload

■ Operating mechanism

Fig. 5.3 shows the hydraulic operation of the unit for three preloading conditions as well as the associated motion of the adjustable preload sleeve.

- **Low speed operation(high preload): Chamber A is pressurized.**
  Component ① moves to the right by a preset clearance L_1 and contacts component ③. The axial clearance is δ_1.
- **Medium speed operation(medium preload):Chamber B is pressurized**.
- Components ① and ② move to the right by a preset clearance L_2, causing Component ② to contact Component ④. The axial clearance is δ_2.
- **High speed operation(low preload):Chambers A and B are not pressurized.**
  Components ① and ② return to the left due to the reaction force on the bearing. This causes Component ② to contact Component ⑤, thereby returning the axial clearance to the initial setting of δ_3.

NOTE: The return motion of the components ① and ② is achieved by the reaction force of bearing or a separately provided spring.

④ Bearing jacket cooling system

With a built-in motor drive system, the main spindle is directly driven by a motor and is therefore suitable for rapid acceleration or deceleration. However, this system can be adversely affected by temperature rise. A cooling jacket with a spiral groove around the housing allows cooling oil to flow through the unit.

If heat generated by the motor affects the bearing, overheating of the bearing as well as degradation of the grease can occur. This situation must be strictly avoided. When designing a cooling system with jacket cooling, the following should be considered.

■Considerations about cooling of jacket

A typical bearing arrangement is shown in **Fig. 5.4** and **5.5**, comprising a double-row cylindrical roller bearing and an angular contact ball bearing set. The cooling groove on the jacket in **Fig. 5.4** starts at around an area above the angular contact ball bearings and does not cool the double-row cylindrical roller bearing effectively.

(Note that the fit of the angular contact ball bearings with the bore of the housing is a clearance fit-the bearings are not in direct contact with the housing) In the configuration in **Fig. 5.5**, the cooling groove extends to the region above the double-row cylindrical roller bearing, and cools both the angular contact ball bearings and the double-row cylindrical roller bearing effectively.

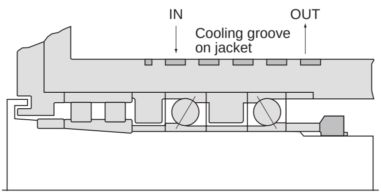


Fig. 5.4 Inadequate cooling groove on jacket

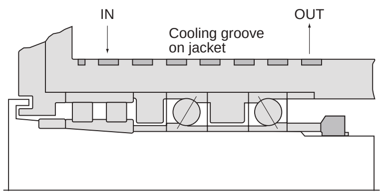


Fig. 5.5 Adequate cooling groove on jacket

【Test conditions】

Test bearing	5S-2LA-HSE014DB
Preload after assembled	100N (Fixed position preloading)
Lubrication system	Air-oil lubrication

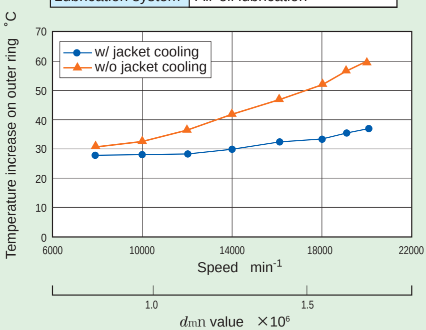


Fig. 5.6 Variation in bearing temperature depending on presence/absence of jacket cooling (angular ball bearing)

【Test conditions】

Test bearing	NN3028HST7
Mounted radial clearance	-5m
Lubrication system	Grease lubrication

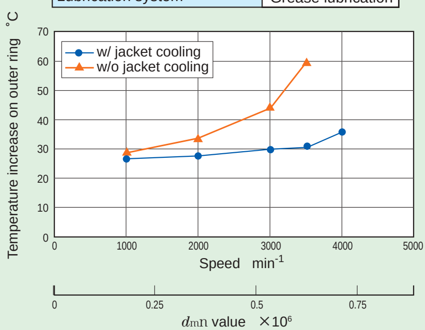


Fig. 5.7 Variation in bearing temperature depending on presence/absence of jacket cooling (cylindrical roller bearing)

6. Handling of Bearings

① Cleaning and filling with grease

To achieve maximum speed and limited temperature rise with a precision rolling bearing, it is vital to handle the bearing correctly.

The handling of bearings involves cleaning, drying, filling with grease (if necessary), and the running-in operation. For each step, follow the precautions and instructions.

A sealed bearing contains prefilled grease. Do not clean (rinse) and dry this type of bearing. Only wipe away rust-preventive oil with a clean cloth before assembling the bearing.

■Cleaning (removal of rust-preventive oil)

- Immerse the bearing in kerosene or a highly volatile solvent such as naphthesol and wash it by hand. Then remove the kerosene using benzene or alcohol. Use clean compressed air to blow away the rinsing fluid.
  (The bearing may be used as delivered for the air-oil lubrication. However, we recommend that after cleaning, the bearing either be coated with the lubricant to be used or a less viscous oil, or be immersed in the lubricant or other low-viscosity oil.)

■Drying

If the bearing is to be used with grease lubrication, it is necessary to thoroughly dry the bearing to avoid leakage of grease. After drying, be sure to immediately fill the bearing with grease.

Drying can be performed by blowing hot air onto the bearing or placing the bearing in a chamber at constant temperature. When drying by hot air, be sure to consider the cleanliness of the air.

■Filling with grease

The procedures for greasing ball and roller bearings can be found below.

After filling with grease, turn the bearing by hand to uniformly distribute the grease to the whole rolling surface.

<Ball bearings> See Photo 6.1

- By using an injector or small plastic bag, fill grease between balls in equal amounts, aiming at the inner ring rolling surface.
- For a bearing with a ring-guided cage, also apply grease to the guide surface of the cage using a spatula or similar tool.
- If grease cannot be filled into the inner ring rolling surface because of a small gap between the cage and the inner ring add grease to the outer ring rolling surface. In this case, carefully turn the bearing so that the grease is fully spread on the inner ring side.

<Roller bearings> See Photo 6.2

- Apply grease to the outer (inner) side of rollers, and while turning the rollers with fingers, spread the grease to the inner ring (outer ring) side.

By using an injector or small plastic bag, fill grease between balls in equal amounts, aiming at the rolling surface of the inner ring.

After completion of filling

Turn the bearing by hand while applying an appropriate load in the contact angle direction so that the any area in the interior of bearing is sufficiently lubricated with grease.

Photo. 6.1 Filling grease into angular contact ball bearing

Apply grease to the outer circumference of cage.

Apply grease to the outer side of the rollers, and while turning the rollers with fingers, spread the grease to the inner ring (outer ring) side.

(After applying grease)
If a lump of grease remains on the outer face of cage rib, the running-in operation can take a longer time. With fingers, spread the grease deposited on the outer surface of the rib on the cage.

Photo. 6.2 Filling grease into cylindrical roller bearing

■Running-in operation

(1) Air-oil or oil-mist lubrication

The running-in operation is relatively simple with oil lubrication because no peak temperature occurs and the bearing temperature stabilizes within a relatively short time. **NTN** recommends that the speed of bearing is to be increased in steps of 2000 to 3000 min^{-1} until the maximum speed is reached.

Every speed setting should be maintained for about 30 minutes. However, for the speed range where the $d_m n$ (pitch circle diameter across rolling elements multiplied by speed) exceeds 1.0×10^6, increase the bearing speed in steps of 1000 to 2000 min^{-1} to ensure the stable running.

(2) Grease lubrication

For a grease-lubricated bearing, a running-in operation is very important in attaining stable temperature rise. During a running-in operation, a large temperature rise (peak) occurs while the bearing speed is increased, and then the bearing temperature eventually stabilizes. Before temperature stabilization, a certain lead time will be needed.

Ball bearing

NTN recommends that the bearing speed be increased in steps of 1000 to 2000 min^{-1} and be further increased only after the temperature has stabilized at the current speed setting.

However, for the speed range where the $d_m n$ exceeds 0.4×10^6, increase the bearing speed in steps of 500 to 1000 min^{-1} to ensure the stable running.

Roller bearing

Compared with contact ball bearings, the time to peak temperature or saturation in running-in operation of roller bearings tends to be longer. Also, there will be temperature rise due to whipping of the grease and the temperature rise may be unstable. To cope with this problem, run the roller bearing in the maximum speed range for a prolonged period.

Increase the bearing speed in steps of 500 to 1000 min^{-1} only after the bearing temperature has stabilized at the current speed setting.

For the speed range where the $d_m n$ exceeds 0.3×10^6, increase the bearing speed in steps of 500 min^{-1} to ensure safety.

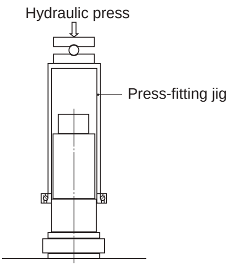


Fig. 6.1 Press-fitting pressure

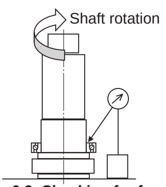


Fig. 6.2 Checking for face runout of inner ring

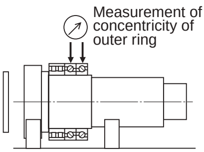


Fig. 6.3 Checking for concentricity of outer ring

② Mounting

When mounting a bearing to a main spindle, follow either of the mounting techniques described below

(1) Press-fitting with hydraulic press

(2) Mounting by heating bearings

With either technique, it is important to minimize the adverse effects of the mounting process to maintain bearing accuracy.

(1) Press-fitting with hydraulic press

Before press-fitting a bearing with a hydraulic press or hand press, the press-fitting force due to the interference between the shaft and inner ring must be calculated. A hydraulic press having a capacity greater than the required press-fitting force must used. Next, using an inner ring press-fitting jig, the inner ring is correctly press-fitted to the shoulder of shaft. Please be careful not to exert a force on the outer ring.

After the press-fitting operation, it is important to measure the accuracies of various portions of the bearing to verify that the bearing has been correctly mounted to the shaft. When using a multi row bearings, measure the runout after assembly and correct misalignment across the outer rings as necessary.

■Calculation of press-fitting force

The press-fitting force occurring from the interference between the shaft and inner ring can be determined by the formula given below.

According to the calculated press-fitting force, a hydraulic press having a sufficiently large capacity must be used to mount the bearing. The variations in dimensional errors among the bearings should be considered. The force needed to press the inner ring to the shaft can be obtained with the following formula (6.1).

Force to press-fit inner ring to shaft

$$K_d = \mu \cdot P \cdot \pi \cdot d \cdot B \quad \cdots\cdots (6.1)$$

where,

K_d: Force for press-fitting or extracting an inner ring N
P : Surface pressure on fitting surface MPa (see **Table 6.1**)
d : Shaft diameter, inner ring bore diameter mm
D : Outer ring outside diameter mm
B : Inner ring width
μ : Sliding friction coefficient (when press-fitting inner ring over cylindrical shaft: 0.12)

Table 6.1

	Fitting conditions and calculation formulas	Symbol (unit N [kgf]-mm)
Fitting surface pressure MPa [kgf/mm²]	Fits between solid steel shaft and inner ring $P=\frac{E}{2}\frac{\Delta deff}{d}\left[1-\left(\frac{d}{D_i}\right)^2\right]$ ·············· (6.2)	d : Shaft diameter, inner ring bore diameter do : Hollow shaft bore diameter D_i :Inner ring average raceway groove diameter
	Fits between hollow steel shaft and inner ring $P=\frac{E}{2}\frac{\Delta deff}{d}\frac{[1-(do/D_i)^2]\,[1-(do/d)^2]}{[1-(do/D_i)^2]}$ ·············· (6.3)	$\Delta deff$: Effective interference E : Modulus of longitudinal elasticity = 210 GPa

$$\Delta deff=\frac{d}{d+2}\Delta d \quad\cdots\cdots\quad (6.4)$$

(In the case of a ground shaft)

Δd : Theoretical interference fitting

$$D_i=1.05\frac{4d+D}{5} \quad\cdots\cdots\quad (6.5)$$

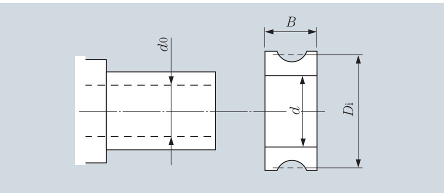


Fig. 6.4

Example of calculation for press-fitting force

The calculation for press-fitting force for tight fit of 2 μm interference between the shaft and inner ring for the standard angular contact ball bearing is as summarized below:

- 7020UC (ϕ100×ϕ150× 24)
- Interference fit of 2μm (solid shaft)

$$\Delta deff=\frac{100}{102}\times 0.002=0.00196$$

$$D_i=1.05\times\frac{4\times 100+150}{5}=115.5$$

$$P=\frac{210000}{2}\times\frac{0.00196}{100}\left[1-\left(\frac{100}{115.5}\right)^2\right]=0.52\ \text{MPa}$$

$$=0.12\times 0.52\times\pi\times 100\times 24=470\ \text{N}$$

To accommodate for variation in the lubrication conditions, incorporate a safety factor of 2 to 3. As a result, the required press-fitting force is:

470×(2 to 3) = 940 to 1410 N

(2) Mounting by heating bearings

When mounting a bearing to a shaft using a constant temperature chamber, bearing heater or the like, follow the instructions below.

Heat the bearing at a temperature that reflects the interference between the shaft and inner ring (see **Fig. 6.5**).

Assuming linear expansion coefficient 12.5×10⁻⁶, heating temperature Δ , inner ring bore diameter ϕd, and interference fit

δ =12.5×10⁻⁶×d×Δ

Ex.) If ϕd = 100 mm, and δ = 0.030 (30 μm, tight fit), then the required heating temperature Δ = 23.8˚C.

Therefore, the bearing should be heated to approximately room temperature + 30˚C. Note that in practice , the lower-temperature shaft will cool the bearing, causing it to shrink. Consequently the bearing may need to be heated by more than 30˚C for assembly.

NOTE

- If a resin material is used for the cage of angular contact ball bearing, do not excessively heat the bearing (approx. 80˚C max.).
- As a result of heating bearings after cooling, the inner ring will axially shrink, and there will be clearance between the bearing side face and shaft shoulder (**Fig. 6.6**). For this reason, keep the bearing and shaft forced together with a press or the like after the unit returns to normal temperature. After cooling, check that the bearing is mounted to the shaft correctly.
- When using a bearing heater, be sure to avoid overheating. To prevent bearing from being magnetized, use equipment that has a demagnetizing feature.

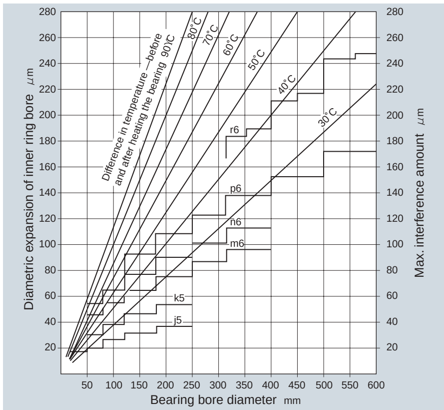


Fig. 6.5 Required heating temperature for mounting by heating inner ring

Remarks: The maximum interference amounts are interference values associated with class 0 bearings.

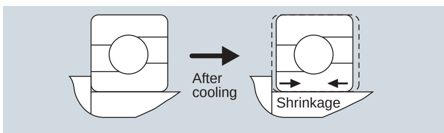


Fig. 6.6 Cooling after mounting by heating bearings

③ Tightening of inner ring

When mounting and securing a bearing to a main spindle, the inner ring side face is usually clamped with a stepped sleeve or precision bearing nut, and the front cover situated on the outer ring side face is bolted down. When utilizing a stepped sleeve or precision bearing nut to clamp the inner ring, the following precautions must be followed.

■Tightening with stepped sleeve

The stepped sleeve is designed that the hydraulically expanded sleeve is inserted over the shaft, and a predetermined drive-up force (tightening force) is applied to the shaft. Then the hydraulic pressure is released in order to secure the sleeve onto shaft and provide a tightening force to the bearing. This technique is a relatively simple locking method (**Fig. 6.7**).

Note however after being locked in position by interference with the shaft, the sleeve can come loose because of deflection of the shaft or a moment load applied to the shaft.

For this reason, in many cases, a stepped sleeve is used together with a bearing nut as illustrated in **Fig. 6.8**.

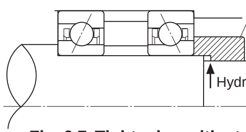


Fig. 6.7 Tightening with stepped sleeve

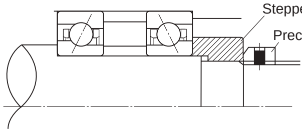


Fig. 6.8 Tightening with stepped sleeve + precision bearing nut

■Tightening with precision bearing nut

Required tightening force is achieved with the precision bearing nut (precision locknut) by correctly controlling the tightening torque.

Note that when a bearing has been locked with a precision bearing nut (lock nut), the nut can develop inclination owing to the clearance on the threaded portions. If this problem occurs, fine adjustment will be necessary to obtain necessary running accuracy for the shaft.

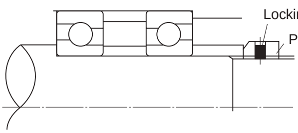


Fig. 6.9 Tightening with precision bearing nut

■Correlation between tightening torque and tightening force with precision bearing nut

The correlation between tightening torque and tightening force with a precision bearing nut can be defined with the formula given below.

Because the thread face of the precision bearing nut, the thread face of the shaft and the bearing surface and nut constitute sliding surfaces, the correlation between tightening torque and tightening force will vary depending on the friction coefficient. Therefore, the nut needs to be thoroughly run on the shaft thread in advance to ensure smooth and uniform tightening.

It is also necessary to determine the correlation between tightening torque and tightening force by using a load washer or the like in advance.

$$F = \frac{M}{(d/2)\tan(\beta+\rho)+r_n\mu_n} \quad \cdots\cdots (6.6)$$

F : Thread tightening force N
M : Nut tightening torque N-mm
d : Effective diameter of thread mm
ρ : Friction angle of thread face

$$\tan\rho = \frac{\mu}{\cos\alpha} \quad \cdots\cdots (6.7)$$

β : Lead angle of thread
$\tan\beta$ = number of threads × pitch/πd ⋯ (6.8)
r_n : Average radius of bearing nut surface mm
μ_n : Friction coefficient of bearing nut surface
$\mu_n \cong 0.15$
μ : Friction coefficient of thread face $\mu \cong 0.15$
α : Half angle of thread

Example calculation

・Bearing nut
AN20 (**Fig. 6.10**)
・Thread data
M100×2 (class 2 thread)
Effective diameter
$d = \phi 98.701$ mm
Half angle of thread $\alpha = 30°$

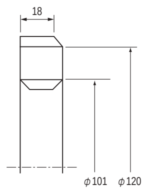


Fig. 6.10

The correlation between a tightening torque and tightening force with the precision bearing nut can be calculated as follows:

$$\tan\rho = \frac{0.15}{\cos 30°} \qquad \rho = 9.826°$$

$$\tan\beta = \frac{1\times 2}{\pi \times 98.701} \qquad \beta = 0.370°$$

$$r_n = \frac{(101+120)/2}{2} = 55.25$$

$$F = \frac{M}{\frac{98.701}{2}\tan(0.370+9.826)+55.25\times 0.15} = \frac{M}{17.163}$$

④ Elastic deformation of spacer by tightening force

When incorporating a bearing into a main spindle, the bearing must be correctly forced into a predetermined position and maintained with a predetermined bearing pressure in order to maintain appropriate accuracies, clearances and rigidities of the bearing and main spindle.

When axially locating a duplex angular contact ball bearing by using a bearing spacer the cross-sectional area of spacer as well as (depending on the tightening force) the bearing pressure and elastic deformation by tightening of the spacer must be considered.

■Correlation between inner ring spacer tightening force and amount of elastic deformation

When securing an angular contact ball bearing onto a main spindle, the bearing inner ring is tightened and locked by the shoulder of main spindle and a bearing nut and/or stepped sleeve. This inner ring tightening force causes the spacer to develop elastic deformation in the axial direction, varying the axial clearance on the bearing. In the case of a back-to-back duplex bearing (DB, DTBT or DBT) for a main spindle in particular, the inner ring tightening force will decrease the bearing clearance, possibly leading to an increased post-assembly preload and operating preload. A possible inner ring tightening force-derived axial deformation can develop in the form of deformation of both the inner ring and inner ring spacer. However, **NTN**'s experience has shown that only the elastic deformation on inner ring spacers needs to be considered.

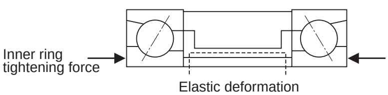


Fig. 6.11 Elastic deformation of inner ring spacer

The amount of deformation of a spacer is calculated using the following formula:

$$\delta = \frac{P \times L}{A \times E} \quad (6.9)$$

δ : Elastic deformation mm
P : Inner ring tightening force N
L : Inner ring spacer width mm
A : Inner ring cross-sectional area mm²
E : Young's modulus 210,000 MPa

The require tightening force exerted onto inner ring spacers varies depending on the bearing manufacturer. From its experience, **NTN** adopts the typical values listed in **Table 6.2**.

Table 6.2 Nut tightening force

Bearing bore diameter (mm)	Nut tightening force (N)	Nut tightening torque <reference value> (N·m)	Front cover drive-up (mm)
6	1470	2	0.01～0.02
8		2	
10	2200	4	
12		5	
15	2900	8	
17		9	
20	2940～4900	10～17	
25		13～22	
30		15～26	
35		18～30	
40	4900～9800	34～68	
45		38～75	
50		42～83	
55	9800～14700	92～138	
60		100～150	
65		108～162	
70		116～174	
75		124～186	
80	14700～24500	199～331	
85		211～351	
90		223～372	
95		235～392	
100		247～412	
105		259～432	
110		271～452	
120		295～492	
130		319～532	
140	24500～34300	572～800	0.02～0.03
150		613～858	
160		655～917	
170		695～973	
180		736～1031	
190		779～1090	
200		818～1145	
220	<reference value> (34300～44100)	—	
240		—	
260		—	
280		—	
300		—	

Note 1) **NTN** has specified the nut tightening forces in this table based on experiences from reviewing and assessing the drawings from users. However, **NTN** has no production record for bore diameter of 220 mm or larger. Thus, the nut tightening forces in parentheses are estimated values.
Note 2) The nut tightening torque is calculated with a friction coefficient of 0.15 between the nut seating face and screw thread surface.
Note 3) When tightening nuts, it is recommended to tighten them to twice the set value, then loosen them, and finally re-tighten them to the recommended set value.
Note 4) For ball screw support bearings (BST), a tightening torque approximately 3 times as large as the preload is recommended.

⑤ Front cover drive-up

When mounting and securing a bearing onto a main spindle, the inner ring is usually tightened with a stepped sleeve or precision bearing nut and the outer ring side is bolted down. When locking the outer ring with a front cover, the following points need to be considered.

■Front cover pressing amount

The bearing outer ring is tightened and locked between the shoulder of the housing and front cover at the main spindle front section. The front cover is installed by utilizing bolt holes (6 to 8 positions) on its flange. The usual pressing allowance on the outer ring and the front cover, which **NTN** has adopted through experience, falls in a range of 0.01 to 0.02 mm. Too large a pressing amount on the outer ring or a smaller number of fastening bolts may lead to poor roundness of the bearing ring.

Typical fit and deterioration in roundness of a raceway surface resulting from a pressing amount of 0.05 mm on the outer ring are shown in **Fig. 6.14**. Also, typical outer ring pressing amount and deterioration of a raceway surface with a fit of 5 μm loose are provided in **Fig. 6.15**.

To avoid deformation of the outer ring raceway surface, **NTN** recommends that the outer ring be installed to a highly accurate housing in transition fit with a large number of bolts.

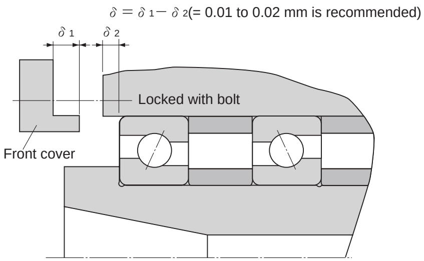


Fig. 6.12 Front cover pressing allowance

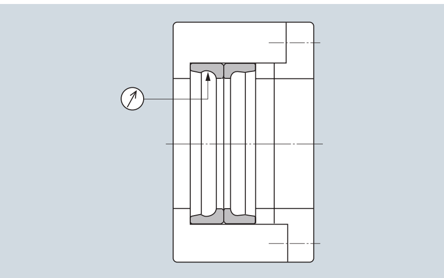


Fig. 6.13 Measuring position for roundness on outer ring raceway surface

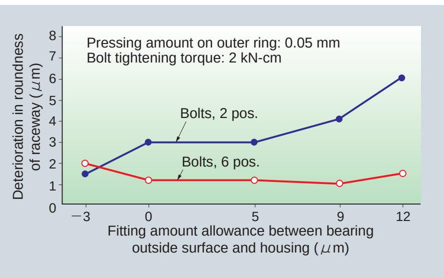


Fig. 6.14 Effect of fit of outer ring on roundness of raceway surface

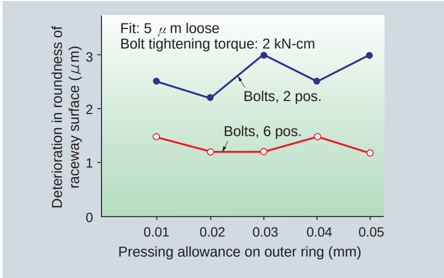


Fig. 6.15 Pressing allowance on outer ring vs. deterioration in roundness of raceway surface

⑥ Checking axial rigidity

In the typical method for checking for the axial rigidity of a bearing installed to a machine tool, the main spindle itself is pushed with a push-pull gage to measure the resultant axial displacement. A method using a dial indicator is described below.

Two dial indicator are placed on two locations (axisymmetric locations separated by 180˚) at the leading end of the main spindle. Use magnetic stands to secure the dial indicator to the end face of housing. Then, apply the load onto the main spindle and the resultant axial displacement is measured.

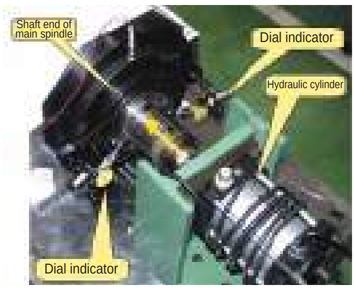


Photo 6.3

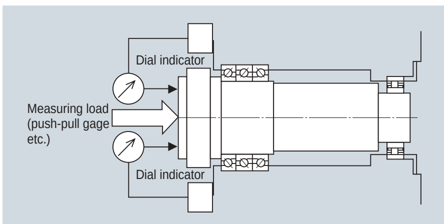


Fig. 6.16 Checking for axial rigidity

⑦ Clearance adjustment for cylindrical roller bearing

When incorporating a cylindrical roller bearing into a main spindle of a machine tool such as an NC turning machine or machining center, and setting the internal clearance to zero or to a negative clearance, the inner ring of the bearing usually has a tapered bore.

The internal clearance is adjusted by fitting the tapered bore bearing onto the tapered portion of the main spindle and driving the bearing in the axial direction to expand the inner ring.

For adjusting the internal clearance, two methods are available: a method consisting of clearance measurement for each bearing and adjustment with a spacer(s), and a method with a post-mounting internal clearance adjustment gage.

■Method with clearance measurement and adjustment with spacer (s)

Adjust the bearing internal clearance by following the procedure described below:

(1) Calculation of outer ring shrinkage (see Fig. 6.17)

- Calculate the interference at the fitting area Δd_{eff} between the outer ring and housing.

  Measure the housing bore diameter first, and then calculate the interference Δd_{eff} from the outer ring outside diameter listed on the bearing inspection sheet.

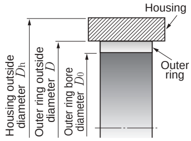


Fig. 6.17 Fit between outer ring and housing

EX. 1

Bearing outer ring outside diameter

ϕ150 mm (Inspection sheet = -0.005)

Housing bore diameter D

ϕ150 mm (measurement data = -0.007)

Interference at fitting area

Δd_{eff} = 0.002 (2 μm tight)

- Calculate the outer ring shrinkage ΔG with the formula (6.10).

$$\Delta G = \Delta d_{eff} \cdot \frac{D_0}{D} \cdot \frac{1-(D/D_h)^2}{1-(D_0/D)^2 \cdot (D/D_h)^2} \cdots\cdots\cdots\cdots \quad (6.10)$$

EX. 2

Housing outside diameter $D_h=\phi 200$, outer ring outside diameter $D=\phi 150$, outer ring bore diameter D_0 = $\phi 137$

$$\Delta G = 0.002 \cdot \frac{137}{150} \cdot \frac{1-(150/200)^2}{1-(137/150)^2 \cdot (150/200)^2} = 0.0015 \cdots\cdots \quad (6.11)$$

(2) Measurement of bearing position and bearing radial clearance on a temporarily mounted bearing

- Mount the bearing inner ring with the cage and rollers onto the tapered shaft (see **Fig. 6.18**).

  In this process, force the inner ring until its tapered bore face is fully seated, and then measure the distance between the shaft shoulder and inner ring side face (L_1).

NOTE: After mounting the inner ring, check that the bearing side face is square to the main spindle centerline.

- At this point, mount the outer ring, move the outer ring up and down by hand and then measure the internal clearance after mounting (Δr_1)(see **Fig. 6.19**).
- Calculate the estimated bearing clearance Δ_1 after press-fitting the outer ring into the housing with the formula (6.12). The result of the calculation reflects the outer ring shrinkage ΔG.

$$\Delta_1 = \Delta r_1 - \Delta G \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (6.12)$$

EX. 3

Internal clearance after mounting Δr_1= 0.030

Outer ring shrinkage ΔG= 0.0015

Estimated bearing clearance

Δ_1 = 0.030 - 0.0015 = 0.0285

(3) Adjustment of spacer width between shaft shoulder and inner ring

To adjust the bearing clearance to a predetermined target value (δ) after mounting, determine the spacer width L_n with the formula (6.13) (refer to **Figs. 6.20** and **6.21**).

$$L_n = L_1 + f\,(\delta - \Delta_1) \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (6.13)$$

$$(n=2,\ 3,\ 4 \cdots)$$

The value f in the formula (6.13) is found in the table below.

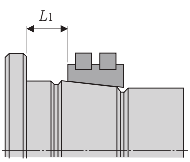


Fig. 6.18 Measurement of bearing position

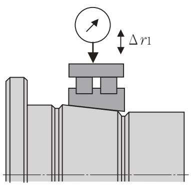


Fig. 6.19 Measurement of bearing radial clearance

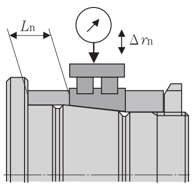


Fig. 6.20 Clearance measurement after insertion of spacer

Table 6.3 Value f

Value d_m/d_i	Value f
0 ~0.2	13
0.2~0.3	14
0.3~0.4	15
0.4~0.5	16
0.5~0.6	17
0.6~0.7	18

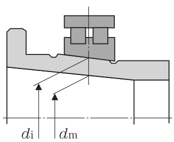


Fig. 6.21 Explanation of d_m/d_i

EX. 4

In the case of NN3020K, if d = dia. ϕ100, width B = 37, and $d_i = d$ + 1/12 · B/2,

then d_i = dia. ϕ101.54717.

If the targeted post-mounting clearance value δ = 0.015, L_1 = 15, d_m = dia. ϕ60, Δ_1 = 0.0285, then d_m/d_i= 60/101.5417 = 0.5909, and, therefore, f = 17.

Thus, the spacer width L_n between the shoulder and inner ring equivalent to δ = 0.015 will be the value shown by the formula below:

$$L_n = 15 + 17 \times (0.015 - 0.0285) = 14.7705$$

(4) Bearing clearance measurement after insertion of spacer (see Fig. 6.20)

Insert a spacer that satisfies the spacer width L_n between the shoulder and inner ring determined in the previous step, and tighten the inner ring until the spacer does not move. Next, move the bearing outer ring up and down by hand and measure the internal clearance after mounting (post-mounting internal clearance) Δr_n. The estimated bearing clearance Δ_n after press-fitting of the outer ring into the housing is determined with the formula below:

$$(n = 2, 3, 4 \cdots)$$
$$\Delta_n = \Delta r_n - \Delta_G \cdots\cdots \quad (6.14)$$

(5) Final adjustment for spacer width

- Repeat the steps (3) and (4) above to gradually decrease the spacer width L_n so as to adjust the post-mounting bearing clearance to the targeted clearance.
- By plotting the correlation between the spacer width and post-mounting clearance as illustrated in **Fig. 6.22**, the spacer width for the final targeted clearance will be more readily obtained.

  Positive clearance:
  All rollers are sliding rather than rolling.

  Clearance = 0:
  About half of the rollers are rolling but the rest are sliding.

  Negative clearance:
  All rollers are rolling.

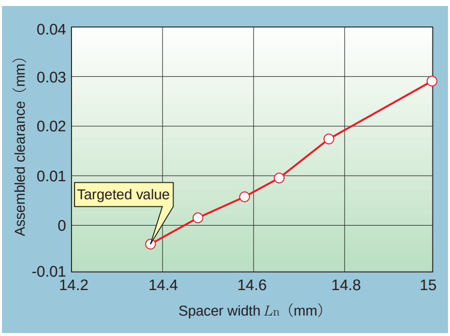


Fig. 6.22 Correlation between spacer width L_n and post-mounting clearance Δ_n

■Measurement with mounted internal clearance gage

The mounted internal clearance gage has a cylindrical ring, which has a cut-out so that the ring can be opened and closed. The bore surface of the ring is used as a location for measurement. The clearance at the location for measurement is proportional to the reading on the dial indicator. As illustrated in **Fig. 6.23**, the clearance gage consists of a ring gage, dial indicator, and attachment components. Its fixture protects the interference gage against possible deformation when not in use. For the measuring operation, detach the fixture.

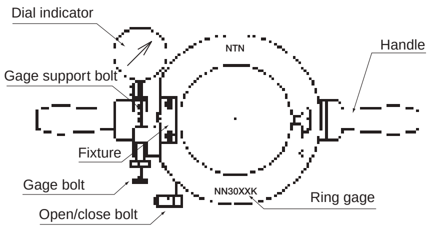


Fig. 6.23 Descriptions of various components on mounted internal clearance measurement gage

●Usage of mounted internal clearance gage

(1) Measurement of outer ring raceway diameter (bore diameter)

- Mount the outer ring into the housing.
  (For easy mounting, heat the housing.)
- Wait until the temperature of the outer ring is same as that of the inner ring, and then measure the outer ring raceway diameter (bore diameter). Take measurements at several points and calculate the average, and then zero the gage at this average value.

Photo 6.4

(2) Setup of mounted internal clearance gage

- Place the cylinder gage, onto the bore surface of clearance adjustment gage as shown in **Photo 6.5**, and adjust it with the open/close bolt so that its dial 1 is set to zero (see **Photo 6.6**).
- When the reading of dial 1 of the cylinder gage is zero, adjust the gage bolt so that the pointer of dial 2 points at the red mark (correction amount of the gage). (**Photo 6.6**)
  With the gage bolt, adjust the gage so that the short pointer is situated at the scale 2 position. (With the large size, insert the pin into the hole of the open/close bolt and make fine-adjustment.)

NOTE 1) **Photo 6.6** shows the inner ring and rollers. When the correction amount of the gage is adjusted, adjust it only with the thickness gage.
NOTE 2) The pointer of dial 2 is directed to the red mark. The purpose of this is to compensate clearance error caused due to the structure of mounted internal clearance gage. The correction amount can vary from gage to gage.
NOTE 3) When the pointer of dial 2 is in line with the red mark, the zero reading on dial 2 coincides with the zero bearing clearance.

(3) Setting up the mounted internal clearance gage on the main spindle

- Mount the inner ring onto the main spindle, and lightly tighten the bearing nut.
- Tightening the open/close bolt (see **Fig. 6.23**) on the clearance adjustment gage will cause the gage bore to expand.
  With the gage bore expanded by about 0.15 mm, insert the gage into the outside diameter portion of the roller set in the inner ring. Be careful not to damage the rollers (**Photo 6.7**).
- Loosening the open/close bolt will cause the gage bore to shrink.
  Loosen the open/close bolt to bring the gage bore into contact with the outside diameter of the ball set in the inner ring.
- Lightly swing the clearance adjustment gage in the circumferential direction to stabilize the pointer on the dial indicator.

(4) Setup of inner ring clearance

- Tighten the shaft nut of the main spindle. This should be done gradually to prevent shock loading.
- Tightening the nut further until the reading on the dial of the clearance adjustment gage becomes zero in case the clearance is aimed at 0 μm.
- Once the reading on gage gets zero, carefully swing the adjustment gage again to check that the measurement value is correct.
- Loosen the open/close bolt on the clearance adjustment gage to expand the gage bore and remove the gage from the inner ring.

(5) Determination of spacer width

- The inner ring should now be in the position where the reading on the dial of clearance adjustment gage was zero in step (4). By using a block gage, measure the distance between the inner ring side face and shaft shoulder (dimension ℓ in **Fig. 6.24**).
- Measure this dimension in at least three locations, and finally adjust the spacer width ℓ to the average of three measurements.
- Loosen and remove the shaft nut, inner ring spacer and inner ring from the main spindle.

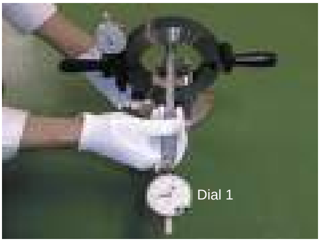


Photo 6.5

Photo 6.6

Photo 6.7

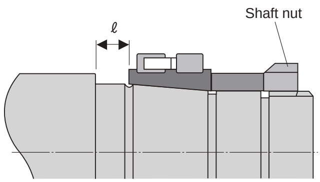


Fig. 6.24 Spacer width dimension

(6) Assembly and check of the mounted roller outside diameter

- Insert a spacer of width ℓ. Then insert the inner ring and mounting spacer and tighten the shaft nut.
- According to a procedure similar to that in steps (3) "Setting up the mounted internal clearance gage on the main spindle" and (4) "Setup of inner ring clearance", check the mounted roller outside diameter and the clearance setting. Note this process is only a re-check procedure, and may be omitted once the clearance measurements fall in a smaller range.

●Clearance correction factor and mounted internal clearance reading

(1) Clearance correction factor

Because of the structure of the **NTN** mounted internal clearance adjustment gage, the ratio of the clearance reading on location for measurement to the reading on dial indicator is 1:2.5 (clearance indication factor). The clearance reading on the dial indicator is 2.5 times as large as the remaining internal clearance. For reference, a clearance reading conversion table is given in **Table 6.4**.

NOTE: Note that the clearance correction factor of certain bearing numbers is not 1:2.5. Correction factor is given on the table of inspection results.

(2) Remaining internal clearance (where clearance indication value 1:2.5)

The reading on the dial indicator is converted into a mounted internal clearance in the following manner:

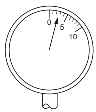


Fig.6.25

- CASE 1: The reading relative to the zero point is in the clockwise direction (CW) (**Fig. 6.25**). The value of the mounted internal clearance (+) is 1/2.5 times as large as the reading on dial gage.
  Reading on dial gage in **Fig. 6.25** = 2.5
  Remaining internal clearance = 2.5/2.5 = (+)1 μm
- CASE 2: The reading relative to the zero point is in the counterclockwise direction (CCW) (**Fig. 6.26**). The value of the mounted internal clearance (-) is 1/2.5 times as large as the reading on dial gage.
  Reading on dial gage in **Fig. 6.26** = 5.0
  Remaining internal clearance = 5.0/2.5 = (-)2 μm

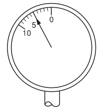


Fig.6.26

Table 6.4 Clearance reading conversion table

Reading on dial gage (μm)	Remaining internal clearance on location for measurement (μm)	Reading on dial gage (μm)	Remaining internal clearance on location for measurement (μm)
0.5	0.2	5.5	2.2
1.0	0.4	6.0	2.4
1.5	0.6	6.5	2.6
2.0	0.8	7.0	2.8
2.5	1.0	7.5	3.0
3.0	1.2	8.0	3.2
3.5	1.4	8.5	3.4
4.0	1.6	9.0	3.6
4.5	1.8	9.5	3.8
5.0	2.0	10.0	4.0

●Setup of mounted internal clearance

When setting the mounted internal clearance to a specific negative or positive value, the zero point on dial indicator by a value [targeted clearance multiplied by 2.5] may be shifted prior to the setup of the clearance adjustment gage. (In case that the mounted clearance value is divided by the correction factor, it is not necessary to the value [targeted clearance multiplied by 2.5])

(2.5: clearance correction factor)

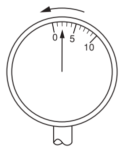


Fig. 6.27 Adjustment for negative clearance (remaining internal clearance: -0.8 μm)

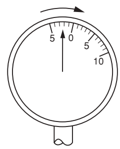


Fig. 6.28 Adjustment for positive clearance (remaining internal clearance: +1.0 μm)

Precautions for using and storing the mounted internal clearance adjustment gage

When using the mounted internal clearance adjustment gage, follow the precautions described below:

- When transferring the outer ring raceway diameter measured with the cylinder gage to the mounted internal clearance adjustment gage, use the adjustment gage in a vertical attitude (**Photo 6.8**).
- When not using the mounted internal clearance adjustment gage, place it in a horizontal attitude (**Photo 6.9**). Also, after completion of clearance measuring operation, apply rust-preventive oil to the internal clearance adjustment gage and store in a dry location.

Photo 6.8 Vertical storage attitude

Photo 6.9 Horizontal storage attitude

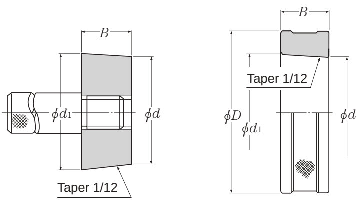
⑧ Tapered bore cylindrical roller bearing and main spindle taper angle

In order for a precision bearing to perform as designed, it must be correctly mounted to a shaft and housing. In particular, when employing a tapered bore cylindrical roller bearing, accurate finish for the tapered main spindle and appropriate fit between the bearing bore and the main spindle are very important to ensure high accuracy of the main spindle. **NTN** recommends that the customer use the **NTN** tapered shaft ring gage, which that is finished to same accuracies as the bearing, so that the customer can achieve higher precision. **NTN** also offers a plug gage so that the customer can check the accuracy of the ring gage.

■Taper gage for precision roller bearings

Each **NTN** precision cylindrical roller bearing taper gage consists of a female gage and a male gage (plug gage) (**Fig. 6.29**).

Using blue paste or an equivalent as well as a ring gage, check the fit of the bearing bore with the main spindle taper. The correct fit between the main spindle and the bearing leads to higher accuracy of the main spindle. The plug gage is intended to check the accuracy of the associated ring gage. Use the plug gage to verify the taper accuracies of the associated ring gage (**Fig. 6.30**).



Plug gage (TA)　　Ring gage (TB)

Fig. 6.29 Taper gage

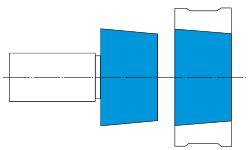


Fig. 6.30 Blue paste on taper gage

■Taper angle

NTN machines the tapered bore of its cylindrical roller bearings and the taper angle of its taper gages according to the tolerances below:

- Nominal taper angle 1/12 (4° 46' 18.8")
- Tolerance for precision roller bearing with 1/12 taper angle is +12"±12" (JIS class 4 and 2)
- Targeted tolerance for taper gage 1/12 is +9".

Usually, Using blue paste between the tapered bore of a cylindrical roller bearing and a plug gage exhibits a strong contact mark on the small diameter side as show in **Fig. 6.31**. This is because **NTN** has slightly adjusted the taper angle of the bearing bore to accommodate for the difference in thickness of the inner ring below each row of rollers.

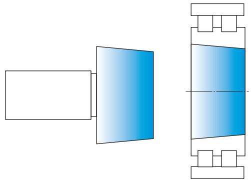


Fig. 6.31

■Checking main spindle taper with ring gage

When checking the main spindle taper angle with a ring gage, perform the following steps.

- Thoroughly clean the surface of the ring gage, and apply a thin layer of blue paste to four equally-spaced points.
- Clean the tapered surface of the shaft, and gently insert into the ring gage.
- The ring gage to be lightly turning it.
- Check the patterns of blue paste deposited on the shaft surface.
- At this point, attach a strip of clear adhesive tape onto each blue paste spot, and peel off each strip.
  Attach strips of adhesive tape onto white paper and check how much blue paste was deposited onto each point. Check that more than 80% of the applied blue paste was deposited on the tapered surface.

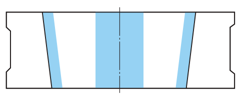


Fig. 6.32 Application of blue paste to ring gage

Table 6.5 Examples of blue paste records

Region A	Small　Large
Region B	Small　Large
Region C	Small　Large
Region D	Small　Large

Small: small diameter side
Large: large diameter side

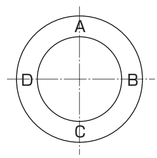


Fig. 6.33 Regions subjected to measurement with blue paste

⑨ Running-in operation for main spindle bearings

Run-in is important for ensuring smooth operation of grease-lubricated main spindle bearings.

The following two modes of running-in are recommended:

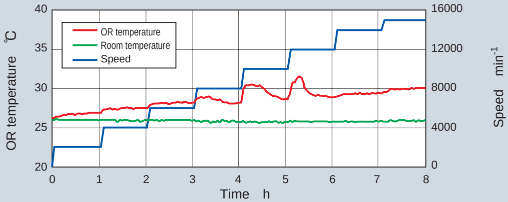
(1) The bearing speed is gradually increased in steps. After the temperature is saturated at each speed setting, the speed is increased to the next step (**Fig. 6.34**).

(2) The bearing is run for one minute at around the maximum operating speed of the spindle. This cycle is repeated two or three times (**Fig. 6.35**) as needed.

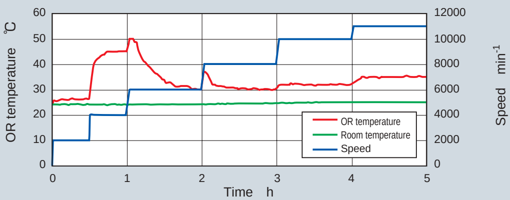
(1) is the ordinary method used, however it takes slightly longer to reach the maximum operating speed of the spindel. In contrast, (2) can shorten the running-in time, however higher risk of sudden bearing temperature increase is considerable, so that running speed and its holding time must be set carefully.

Generally, the temperature of a main spindle bearing is measured on the front cover. The temperature difference across the bearing outer ring and front cover reaches 2 to 3˚C, and at the same time, the temperature difference between the hottest rolling element and the inner ring raceway surface seems to reach 50 to 10˚C. For this reason, **NTN** recommends that the machine is stopped if the temperature on front cover reaches approximately 60˚C. The machine should be allowed to cool off before the running-in operation is restarted.

Bearing	5S-7006CDLLBDB（φ30×φ55×13×2 rows）
Mounted preload	180N（Fixed-position preload）
Jacket cooling	Yes



Bearing	5S-2LA-BNS020LLBDB（φ100×φ150×24×2 rows）
Mounted preload	4kN（Constant pressure preload）
Jacket cooling	Yes



Bearing	NN3020HSK（φ100×φ150×37）
Mounted radial clearance	-5μm
Jacket cooling	Yes

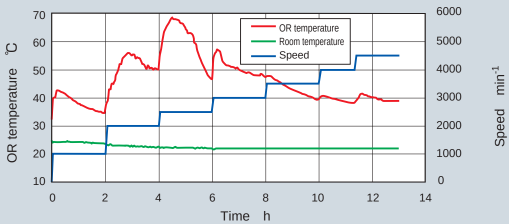


Fig. 6.34

Bearing	NN3020HSK（φ100×φ150×37）
Mounted radial clearance	-5μm
Jacket cooling	Yes

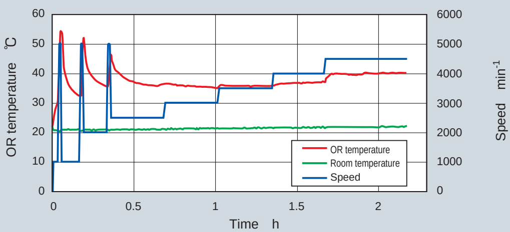


Fig. 6.35

7. Lubrication of Bearings

In a bearing, lubrication forms a thin oil film on both rolling and sliding surfaces to prevent metal-to-metal contact. The benefits of lubrication can be summarized as follows:

(1) Alleviation of friction and wear
(2) Removal of heat due to friction
(3) Longer bearing life
(4) Rust prevention
(5) Protection against contamination by foreign material

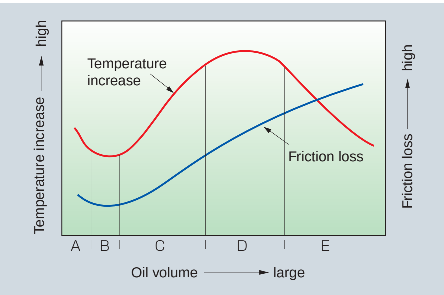


Fig. 7.1

Table 7.1 Oil volume, friction loss and bearing temperature (Fig. 7.1)

Zone	Features	Typical lubrication method
A	With an extremely low volume of oil, partial metal-to-metal contact occurs between the rolling elements and raceway surface, possibly leading to abnormal wear and bearing seizure.	——
B	A uniform, uninterrupted oil film is formed. Friction is minimal and bearing temperature is kept low.	Grease lubrication Oil mist lubrication Air-oil lubrication
C	Even with a greater oil volume, heat generation and cooling are in balance.	Circulating lubrication
D	Temperature increase is constant regardless of oil volume.	Circulating lubrication
E	A further increase in oil volume contributes to a significant cooling effect, and the bearing temperature drops.	Forced circulating lubrication Jet lubrication

To achieve the full lubricating effect, it is necessary to use a lubricating system suited to the operating conditions, select a quality lubricant, remove dust from the lubricant, and design an appropriate sealing structure to prevent contamination as well as lubricant leakage.

The main spindle of a machine tool usually uses an extremely low volume of lubricant so heat generation from stirring of the lubricant is minimal.

Fig. 7.1 summarizes the relationships between oil volume, friction loss, and bearing temperature.

The lubrication methods available for bearings in a machine tool include grease lubrication, oil mist lubrication, air-oil lubrication, and jet lubrication. Each method has unique advantages. Therefore, the lubricating system that best suits the lubrication requirements should be used.

Tables 7.1 and **7.2** summarize the features of various lubrication methods.

Table 7.2 Evaluation of various lubricating systems

Lubrication method / Criterion	Grease lubrication	Oil mist lubrication	Air-oil lubrication	Jet lubrication
Handling	☆☆☆☆☆	☆☆☆	☆☆☆	☆☆
Reliability	☆☆☆	☆☆	☆☆☆	☆☆☆☆☆
Temperature increase	☆☆	☆☆	☆☆☆	☆☆☆☆☆
Cooling effect	☆	☆☆	☆☆☆	☆☆☆☆☆
Sealing structure	☆☆	☆☆☆	☆☆☆	☆
Power loss	☆☆☆	☆☆☆	☆☆☆	☆
Environmental contamination	☆☆☆	☆	☆☆	☆☆☆
Allowable $d_m n$ value ❶	1.4×10^6	2.2×10^6	2.5×10^6	4.0×10^6

Legend ☆☆☆☆ : Excellent ☆☆☆ : Good ☆☆ : Fair ☆ : Poor

❶ The permissible $d_m n$ values are approximate values:
$d_m n$: pitch circle diameter across rolling elements [mm] multiplied by speed [min^{-1}]

① Grease lubrication

Grease lubrication is the most common, as it simplifies the main spindle structure more than other lubricating systems. With an adequate amount of quality grease prefilled, this system can be used over a wide range of speed. The allowable maximum speed varies with the type and size of bearing: for a high-speed angular contact ball bearing, the $d_m n$ value should be 1.4×10^6 as a guideline. For applications exceeding this range, consult **NTN** Engineering.

■Grease types

A lithium-based grease, with a mineral oil base, is commonly used as a lubricant for rolling bearings. Its operating temperature range is -30˚C to 130˚C.

When the temperature increase must be limited, as with the main spindle of a machine tool, **NTN** recommends the use of a synthetic-oil-based grease (diester, diester+mineral oil) which penetration is NLGI grade 1 or 2.

Table 7.3 lists technical data for greases commonly used for machine tool main spindles.

■Amount of grease required

Usually, a bearing for the main spindle of a machine tool requires that grease volume be low so heat generated by the stirring of the grease during high-speed operation is minimal. A guideline for the amount of grease used for a main spindle bearing is given below.

- Angular contact ball bearing
  ($d_m n$ value $\leqq 0.65 \times 10^6$); 15% of bearing free space
  ($d_m n$ value $> 0.65 \times 10^6$); 12% of bearing free space
- Cylindrical roller bearing; 10% of bearing free space
- Tapered roller bearing; 15% of bearing free space

The space in the bearing typically used for main spindles are listed in dimension tables. Determine a fill amount by referring to the relevant dimension table.

Before filling a bearing with grease, remove the rustproof coating from the bearing with clean wash oil and allow the bearing to dry completely. Then fill and uniformly distribute an appropriate amount of grease in the bearing with an syringe, plastic bag, etc.

Table 7.3 Typical greases for machine tool main spindle bearings

Grease brand	SE-1	MP-1	ISOFLEX NBU15	Stabllugs NBU 8EP	Multemp LRL3	Multemp PS2	ISOFLEX LDS18
Thickener	Urea		Ba complex soap		Li soap		
Base oil	Ester	Synthetic oil	Ester	Mineral oil	Synthetic oil	Diester+mineral oil	Synthetic oil
Base oil viscosity (40˚C) mm²/S	22	40.6	20	105	37.3	15.3	16
Dropping point ˚C	＞220	254	＞200	220	208	190	＞180
Operating temperature range ˚C	−50～+120	−40～+150	−60～+130	−35～+150	−40～+150	−55～+130	−60～+130
Application	Applied to ULTAGE Series grease-lubricated sealed angular contact ball bearings	Applied to ULTAGE Series grease-lubricated sealed angular contact ball bearings	Most commonly used for main spindles	Suitable for roller bearings subject to large loads	Wider operating temperature range	Excellent low temperature and friction characteristics	Suitable for ball bearing
NTN grease code	L749	L448	15K	L135	12K	1K	6K

② Air-oil lubrication

Air-oil lubrication (also known as oil-air lubrication or oil and air lubrication) is widely adopted for main spindle bearings in order to cope with the higher speed and precision of machine tools and to ensure more reliable lubrication.

Air-oil lubrication employs a method by which compressed air is used to provide lubricating oil in precisely controlled amounts. Generally, an air-oil lubrication unit a volumetric piston-type distributor that accurately meters the required minimum amount of lubricating oil and provides it at optimal intervals controlled by a timer.

■Special features of air-oil lubrication

Air-oil lubrication has the following advantages over conventional oil mist lubrication:

- Accurately supplies a minimal amount of oil.
- Can be adjusted to provide the proper amount of lubricant for individual bearings.
- No limitations exist regarding lubricant viscosity and extreme pressure additives.
- Compressed air helps cool the bearing.
- Variations in the distance and height of lubrication points do not affect lubrication efficiency.
- Health hazards of oil mist are minimized.
- Low oil consumption.
- Use of compressed air can prevent contamination of the bearing by other coolants.
- The recommended oil viscosity is 10 to 32 mm^2/s.

■Example of an air-oil lubrication unit

Fig. 7.2 shows the structure of an air-oil lubrication unit.

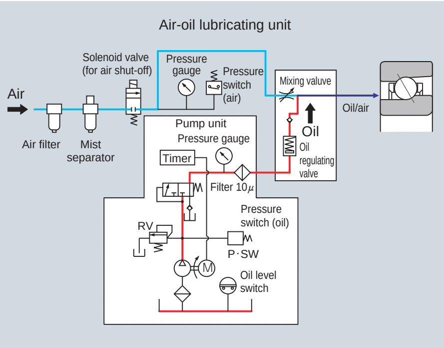


Fig. 7.2 Air-oil lubricating system

■Air-oil lubrication nozzle spacer

Air-oil lubrication requires a specialized nozzle because it supplies the lubricating oil to the inside of the bearing by means of compressed air. (**Fig. 7.3**)

A nozzle with a hole diameter of 1.0 to 1.5 mm and a length 4 to 6 times the hole diameter is recommended.

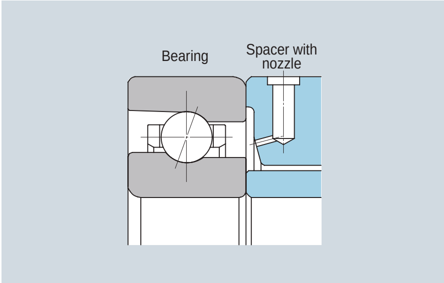


Fig. 7.3 Feed system for air-oil lubrication

■Exhaust method for air-oil lubrication

Air-oil lubrication uses a large volume of air to feed lubricating oil to the bearing. Therefore, it is essential that the air fed into the bearing be allowed to escape. If the air is not smoothly exhausted, the lubricating oil will remain in the bearing and possibly contribute to bearing seizure. In the design stage, remember to allow ample space on the exhaust side of the bearing in order to increase exhaust efficiency and provide a larger oil drain hole to ensure smooth airflow. In addition, for types that allow for repositioning of the spindle, it is recommended that the shoulder dimensions of all parts is designed to prevent lubricating oil from flowing back into the bearing after a change in the attitude of the main spindle. Unnecessary dimensional differences can also contribute to stagnancy of the lubricating oil.

■Recommended targeted position with nozzle

(1) Angular contact ball bearings

Table 7.4 Air-oil/oil mist nozzle spacer dimensions
Note: Spacer dimensions are the same for all contact angles (15°, 25°and 30°).

Bearing No.	θ	A	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	D	E
7900U	15°	14.6	12.4	13.4	18.5	1
7901U	15°	16.6	14.4	15.4	20.5	1
7902U	15°	19.5	17.2	18.2	25	1
7903U	15°	21.5	19.2	20.2	27	1
7904U	15°	26.3	24	25	32.5	1
7905U	15°	31.3	29	30	37.5	1
7906U	15°	36.3	34	35	42.5	1
7907U	15°	41.5	39.2	40.2	50.5	1
7908U	15°	48.1	45.8	46.8	56.5	1
7909U	15°	52.8	50.5	51.5	63	1
7910U	15°	57.3	54.3	55.8	67.5	1.5
7911U	15°	64.1	61.1	62.6	73.5	1.5
7912U	15°	69.1	66.1	67.6	78.5	1.5
7913U	15°	74.1	71.1	72.6	84	1.5
7914U	15°	80.9	77.9	79.4	93	1.5
7915U	15°	85.9	82.9	84.4	97.5	1.5
7916U	15°	91.4	88.4	89.9	103	1.5
7917U	15°	97.4	94.4	95.9	112	1.5
7918U	15°	102.4	99.4	100.9	117	1.5
7919U	15°	107.4	104.4	105.9	122	1.5
7920U	15°	113.9	110	112	131	1.5
7921U	15°	118.9	115	117	136	1.5
7922U	15°	123.9	120	122	141	1.5
7924U	15°	135.4	132	134	155	1.5
7926U	15°	146.9	143	145	169	1.5
7000U	15°	15.4	13.1	14.1	22	1
7001U	15°	18.1	15.8	16.8	24.5	1
7002U	15°	21.3	19	20	27.5	1
7003U	15°	23.3	21	22	31	1
7004U	15°	28.6	25.8	26.8	37.5	1
7005U	15°	33.1	30.5	31.5	41.5	1
7006U	15°	39.6	36.5	37.5	49.5	1
7007U	15°	44.6	41	42	56	1
7008U	15°	50.4	47	48	61.5	1
7009U	15°	55.9	52	54	67.5	1
7010U	15°	60.9	57	59	72.5	1.5
7011U	15°	67.4	63	65	82	1.5
7012U	15°	72.4	68	70	87	1.5
7013U	15°	77.4	73	75	92	1.5
7014U	15°	83.9	78	80	101	1.5
7015U	15°	88.9	83	85	106	1.5
7016U	15°	95.4	90	92	115	1.5
7017U	15°	100.4	95	97	120	1.5
7018U	15°	106.9	101	103	129	1.5
7019U	15°	111.9	106	108	134	1.5
7020U	15°	116.9	112	114	139	1.5
7021U	15°	123.4	117	120	148	1.5
7022U	15°	129.9	122	125	157	1.5
7024U	15°	139.9	133	136	167	1.5
7026U	15°	153.9	143	146	184	1.5

Table 7.5 Air-oil/oil mist nozzle spacer dimensions
Note: Spacer dimensions are the same for all contact angles (15°, 20° and 25°).

Bearing No.	θ	A	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	D	E
HSE910U	15°	58.9	55	56	67	1.5
HSE911U	15°	64.8	61	62	74	1.5
HSE912U	15°	69.8	66	67	79	1.5
HSE913U	15°	74.8	71	72	84	1.5
HSE914U	15°	81.6	77	79	93	1.5
HSE915U	15°	86.6	82	84	98	1.5
HSE916U	15°	91.6	87	89	103	1.5
HSE917U	15°	98.1	93	95	112	1.5
HSE918U	15°	103.1	98	100	117	1.5
HSE919U	15°	108.1	103	105	122	1.5
HSE920U	15°	115.3	109	111	131	1.5
HSE921U	15°	120.3	114	116	136	1.5
HSE922U	15°	125.3	119	121	141	1.5
HSE924U	15°	136.9	130	132	155	1.5
HSE926U	15°	148.4	141	143	169	1.5
HSE928U	15°	158.4	151	153	179	1.5
HSE930U	15°	172.1	164	166	196	1.5
HSE932U	15°	182.1	174	176	206	1.5
HSE934U	15°	192.1	184	186	216	1.5
HSE010	15°	61.6	57	59	73	1.5
HSE011	15°	69.7	63	65	82	1.5
HSE012	15°	74.7	68	70	87	1.5
HSE013	15°	79.7	73	75	92	1.5
HSE014	15°	86.9	76	80	101	1.5
HSE015	15°	91.9	83	85	106	1.5
HSE016	15°	99.2	90	92	115	1.5
HSE017	15°	104.2	95	97	120	1.5
HSE018	15°	111.4	101	103	129	1.5
HSE019	15°	116.4	106	108	134	1.5
HSE020	15°	121.4	112	114	138	1.5
HSE021	15°	128.7	117	119	148	1.5
HSE022	15°	135.2	122	126	158	1.5
HSE024	15°	145.2	133	136	167	1.5
HSE026	15°	158.5	143	149	187	1.5
HSE028	15°	170.8	153	160	197	1.5
HSE030	15°	181.5	165	171	210	1.5
HSE032	15°	193.2	175	183	225	1.5
HSE034	15°	207.8	185	197	245	1.5

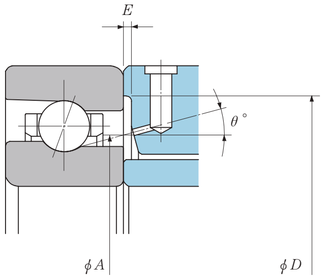


Fig. 7.4 7U, HSE, BNT and HTA types

Table 7.6 Air-oil/oil mist nozzle spacer dimensions

Bearing No.	θ	A	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	D	E
BNT900	12°	14.3	12.2	13.2	18.5	1
BNT901	12°	16.3	14.2	15.2	20.5	1
BNT902	12°	19.2	17.1	18.1	24	1
BNT903	12°	21.2	19.1	20.1	26	1
BNT904	12°	26	23.5	24.5	32.5	1
BNT905	12°	31	28.5	29.5	37.5	1
BNT906	12°	35.8	33.5	34.5	42.5	1
BNT907	12°	41.1	38.5	39.5	50	1
BNT908	12°	47.1	44.4	45.4	56	1
BNT909	12°	52.3	49	50	61.5	1
BNT000	15°	15.1	13	14	22	1
BNT001	15°	17.7	15.6	16.6	24	1
BNT002	15°	21	18.6	19.6	28	1
BNT003	15°	22.9	20.6	21.6	30	1
BNT004	15°	28.1	25	26	37	1
BNT005	15°	32.6	30.5	31.5	41.5	1
BNT006	15°	39.1	35.5	36.5	49.5	1
BNT007	15°	44	41	42	56	1
BNT008	15°	49.8	47	48	61	1
BNT009	15°	55.2	52	53	68	1
BNT200	15°	17.5	15.4	16.4	24.5	1
BNT201	15°	18.9	16.8	17.8	26.5	1
BNT202	15°	21.4	19.3	20.3	29	1
BNT203	15°	24.6	22	23	34	1
BNT204	15°	30	26.5	27.5	40.5	1
BNT205	15°	34.8	32	33	45.5	1
BNT206	15°	40.9	37.5	38.5	54.5	1
BNT207	15°	46.6	43.5	44.5	64	1
BNT208	15°	52.5	49	50	71.5	1
BNT209	15°	56.9	54.5	55.5	76.5	1

Table 7.7 Air-oil/oil mist nozzle spacer dimensions

Note: Spacer dimensions are the same for all contact angles (30°and 40°).

Bearing No.	θ	A	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	D	E
HTA920	15°	116.4	110	112	130	1.5
HTA921	15°	121.4	115	117	135	1.5
HTA922	15°	126.4	120	122	140	1.5
HTA924	15°	138.7	132	134	153	1.5
HTA926	15°	151	143	145	167	1.5
HTA928	15°	161	153	155	177	1.5
HTA930	15°	174.9	165	167	195	1.5
HTA932	15°	184.9	175	177	205	1.5
HTA934	15°	194.9	185	187	215	1.5
HTA936	15°	208.1	197	199	233	1.5
HTA938	15°	218.1	208	210	242	1.5
HTA940	15°	232.5	220	222	260	1.5
HTA006	15°	39.5	35.5	36.5	49.5	1
HTA007	15°	44.3	41	42	56	1
HTA008	15°	49.9	47	48	61	1
HTA009	15°	56.1	52	53	68	1
HTA010	15°	61.1	57	59	73	1.5
HTA011	15°	69.3	63	65	82	1.5
HTA012	15°	74.3	68	70	87	1.5
HTA013	15°	79.3	73	75	92	1.5
HTA014	15°	86.4	78	80	101	1.5
HTA015	15°	91.4	83	85	106	1.5
HTA016	15°	98.7	90	92	115	1.5
HTA017	15°	103.7	95	97	120	1.5
HTA018	15°	111	101	103	129	1.5
HTA019	15°	116	106	108	134	1.5
HTA020	15°	121	112	114	138	1.5
HTA021	15°	128.4	117	119	148	1.5
HTA022	15°	134.9	122	126	158	1.5
HTA024	15°	144.9	133	136	167	1.5
HTA026	15°	158.1	143	149	187	1.5
HTA028	15°	170.4	153	160	197	1.5
HTA030	15°	181.2	165	171	210	1.5
HTA032	15°	192.7	175	183	225	1.5
HTA034	15°	207.4	185	197	245	1.5

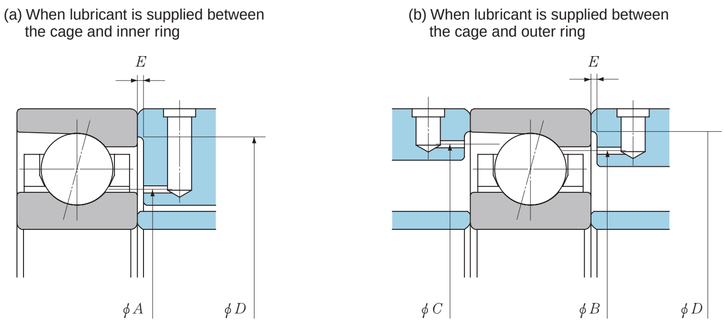


Fig. 7.5 78C, 79C, 70C and 72C types

Table 7.8 Air-oil/oil mist nozzle spacer dimensions

Bearing No.	(b) When lubricant is supplied between the cage and outer ring					
	B	*C*	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*D*	*E*
7805C	32.6	33.3	28	29	34	1
7806C	37.6	38.2	33	34	39	1
7807C	42.6	43.1	38	39	44	1
7808C	47.8	48.4	43	44	49	1
7809C	53.2	54.3	48.5	49.5	54	1
7810C	59.5	60.2	54	55	60.5	1
7811C	66.2	67.4	59	61	68	1
7812C	71.7	72.8	64.5	66.5	73.5	1
7813C	77.7	78.7	70.5	72.5	79.5	1
7814C	82.4	83.6	75.5	77.5	84.5	1
7815C	87.8	88.8	80.5	82.5	89.5	1
7816C	92.5	93.6	85.5	87.5	94.5	1
7817C	101	102.5	91.5	93.5	103.5	1
7818C	106	107.3	96.5	98.5	108.5	1
7819C	111	112.4	101.5	104	113.5	1
7820C	115.6	117	106.5	110	118.5	1
7821C	120.7	122	111.5	115	123.5	1
7822C	129.2	131.1	117.5	122	132.5	1
7824C	139.2	141.1	127.5	132	142.5	1
7826CT1	152.3	154.5	139	144	156.5	1.5
7828CT1	162.3	164.5	149	155	166.5	1.5
7830CT1	175.3	177.8	160.5	167.5	180.5	1.5
7832CT1	185.5	188	170.5	177.5	190.5	1.5
7834CT1	198.7	201.5	181	188	204.5	1.5
7928CT1B	171.3	176.9	153	163	179	1.5
7930CT1B	187.2	193.8	165	179	197	1.5
7932CT1B	198.3	201.9	175	190	205	1.5
7934CT1B	208.2	211.9	185	200	215	1.5

7805C～7834CT1, 7928CT1B～7934CT1B, 7200C～7218C …………B is recommended.
7028CT1B～7040CT1B, 7219C～7226C ……………………………………A is recommended.
If targeting at A is impossible, B is acceptable. If both A and B are impossible, targeting from C is acceptable.

Table 7.9 Air-oil/oil mist nozzle spacer dimensions

Bearing No.	(a) When lubricant is supplied between the cage and inner ring			(b) When lubricant is supplied between the cage and outer ring				Common to (a) & (b)	
	A	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*B*	*C*	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*D*	*E*
7200C	—	—	—	23	23.8	15.5	17.5	25	1
7201C	—	—	—	24.9	25.8	17.5	19.5	27	1
7202C	—	—	—	28.3	29.4	20.5	22.5	30	1
7203C	—	—	—	32.4	33.7	23.5	26.5	35	1
7204C	—	—	—	38.4	40.2	26.5	31	41.5	1
7205C	—	—	—	43.3	44.7	32	36	46.5	1
7206C	—	—	—	51.1	53	37.5	44	54.5	1
7207C	—	—	—	59.1	61.2	43.5	52	64	1
7208C	—	—	—	65.9	68.3	49	58	71.5	1
7209C	—	—	—	71.3	73.8	54.5	63	76.5	1
7210C	—	—	—	76.4	78.8	59.5	68	81	1.5
7211C	—	—	—	84.6	87.4	66	76	90	1.5
7212C	—	—	—	94.4	97.5	72	85	99.5	1.5
7213C	—	—	—	100.8	104.1	77.5	92	108.5	1.5
7214C	—	—	—	106.2	109.6	83	96	114	1.5
7215C	—	—	—	112.2	115.6	88.5	102	118	1.5
7216C	—	—	—	119.5	123.2	94	109	127	1.5
7217C	—	—	—	128	131.8	100	117	136	1.5
7218C	—	—	—	136.2	140.4	106	125	146	1.5
7219C	119.4	111.5	113.5	144.4	149	111.5	132	155	1.5
7220C	126.1	117.5	120	152.7	157.7	117.5	141	164	1.5
7221C	131.6	122.5	125	159.9	165.1	122.5	148	173.5	1.5
7222C	138.3	129	131	168.5	174.1	129	157	182	1.5
7224C	149.3	141	143	181.5	187.2	141	169	196	1.5
7226C	161.3	152.5	155	193	199.2	152.5	181	210	1.5
7028CT1B	162.9	153	157	183.5	187.4	153	172	197	1.5
7030CT1B	174.4	165	169	196.6	200.9	165	185	210	1.5
7032CT1B	185.7	175	180	209.8	214.2	175	198	225	1.5
7034CT1B	199.2	185	193	226	231.3	185	214	245	1.5
7036CT1B	212.2	197	206	242	248	197	230	263	1.5
7038CT1B	222.2	210	216	252	258	210	240	270	1.5
7040CT1B	235.2	220	229	268	275	220	255	290	1.5

(2) Cylindrical roller bearings

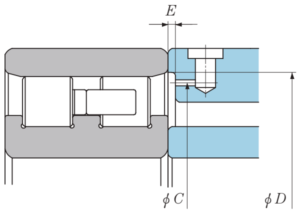


Fig. 7.6 NN30 and NN30T6 types

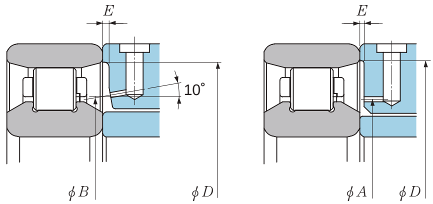


Fig. 7.7 N10HS type

Table 7.10

Bearing No.	*C*	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*D*	*E*
NN3005	40.3	31	33.8	42	1
NN3006	47	38	40.5	50	1
NN3007	53.5	43	47.0	57	1
NN3008	59.5	48	53.0	63	1
NN3009	66	54	59.5	69	1
NN3010	71	59	64.5	74	1.5
NN3011	79	65	72.5	83	1.5
NN3012	84	70	77.5	88	1.5
NN3013	90 (89)	75	82.5	93	1.5
NN3014	98	82	90	102	1.5
NN3015	103	87	95	107	1.5
NN3016	111	93	103	115	1.5
NN3017	116	98	108	120	1.5
NN3018	125	105	117	130	1.5
NN3019	130	110	122	135	1.5
NN3020	135	115	127	140	1.5
NN3021	144 (143)	120	135	149	1.5
NN3022	153 (152)	127	144	158	1.5
NN3024	163 (162)	137	154	168	1.5
NN3026	179	150	171	185	1.5
NN3028	189	160	181	195	1.5
NN3030	202	172	194	210	1.5
NN3032	215.5	183	208	223	1.5
NN3034	232	196	224	240	1.5
NN3036	251	209	243	259	1.5
NN3038	261	219	253	269	1.5

NOTE) With certain products, the dimension C of L1 cage differs from that of T6 cage. The values in parentheses ( ) are dimensions C of L1 cages. Other dimensions of L1 cages are same as those of T6 cages.

Table 7.11

Bearing No.	*A*	*B*	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*D*	*E*
N1006HS	—	40.4	37	38	50	1
N1007HS	—	46.5	42	43	57	1
N1008HS	—	51.7	47	48	63	1
N1009HS	—	57.7	52	53	69	1
N1010HS	—	62.7	57	58	74	1.5
N1011HS	—	69.7	63.5	64.5	83	1.5
N1012HS	—	74.8	68.5	69.5	88	1.5
N1013HS	—	79.7	73.5	74.5	93	1.5
N1014HS	86	—	78.5	80.5	102	1.5
N1015HS	91	—	83.5	85.5	107	1.5
N1016HS	97.5	—	88.5	90.5	115	1.5
N1017HS	102.5	—	93.5	95.5	120	1.5
N1018HS	110	—	102	104	130	1.5
N1019HS	115	—	107	109	135	1.5
N1020HS	120	—	112	114	140	1.5
N1021HS	125.9	—	118	120	149	1.5
N1022HS	133.1	—	123	125	158	1.5
N1024HS	143.3	—	133	135	168	1.5
N1026HS	157.2	—	143	145	185	1.5
N1028HS	167.2	—	153	155	195	1.5
N1030HS	179.6	—	165	167	210	1.5
N1032HS	191.1	—	175	177	223	1.5

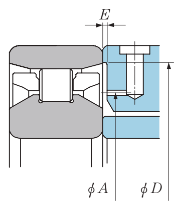


Fig. 7.8 N10HSR type

Table 7.12

Bearing No.	*A*	Outer diameter of inner ring spacer	Inner diameter of outer ring spacer	*D*	*E*
N1011 HSRT6	71.5	63.5	64.5	83	1.5
N1012 HSRT6	76.6	68.5	69.5	88	1.5
N1013 HSRT6	81.5	73.5	74.5	93	1.5
N1014 HSRT6	89.7	78.5	80.5	102	1.5
N1016 HSRT6	101.3	88.5	90.5	115	1.5
N1018 HSRT6	113.8	102	104	130	1.5
N1020 HSRT6	123.8	112	114	140	1.5

③ Jet lubrication

With this lubricating system, a high-speed jet of lubricant is injected into the bearing from the side. This is the most reliable lubricating technique and is typically used on the main spindle bearings of jet engines and gas turbines. It is currently capable of a $d_{m}n$ value of up to approximately 4.0×10^6.

When used as a lubricating system for the main spindle of a machine tool, it can minimize the temperature increase of the bearing. However, the resultant torque loss is great, as a large amount of oil is supplied to each bearing. Therefore, this arrangement requires a powerful motor to drive the main spindle. Low viscosity oil (2-3 mm^2/s) is used.

Fig. 7.9 shows examples of the temperature increase with air-oil lubrication and jet lubrication, while **Fig. 7.10** graphically plots test results of power loss.

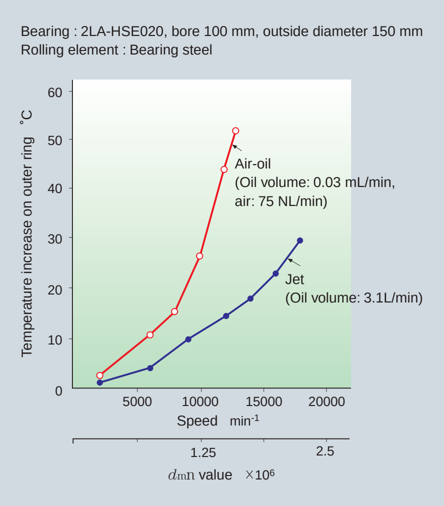


Fig. 7.9 Comparison of temperature increase of outer ring with air-oil lubrication and jet lubrication

(The temperature increase with air-oil lubrication is relative to room temperature; the temperature with jet lubrication is relative to lubricant temperature.)

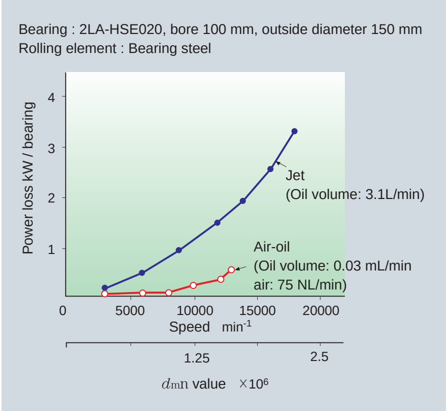


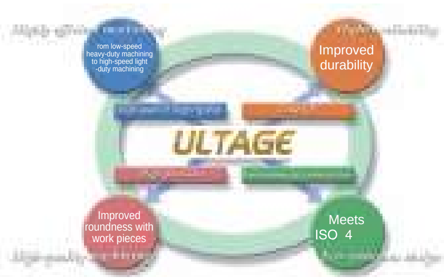
Fig. 7.10 Comparison of power loss with air-oil lubrication and with jet lubrication

8. New Technologies

① The new ULTAGE Series of super-high-speed precision bearings for machine tool main spindles

NTN has responded to need for improved efficiency, reliability, quality and environmental responsibility for machine tools by developing the ULTAGE Series of super-high-speed precision bearings. This new line of bearings demonstrates excellent performance thanks to the optimal internal design; a new approach to surface quality; and the use of special materials, special grease, and seals on both sides.

ULTAGE is the name for **NTN**'s goal of achieving the ultimate performance with precision bearings, and expresses the "ULTIMATE" performance on any type of "STAGE."



■Concept

Our ideal is to offer a super high-speed precision bearing that offers excellent reliability while remaining eco-friendly.

【 Design 】

The internal bearing design has been optimized to cope with varying applications and operating conditions in order to realize high speed and high rigidity, limited temperature increase, high precision, energy saving and low noise emission. It performs optimally in a variety of situations.

【 Material 】

Adoption of special material and a special surface modification technique has resulted in greatly enhanced reliability.

【 Lubrication 】

Use of unique eco-conscious technology and special grease contributes to decreased pollution and enhanced energy savings.

【 Precision 】

Our super high-precision technology, in conjunction with our proven precision bearing technology, will help attain further improved precision.

② New material and new surface modification technology

The ULTAGE super high-speed precision bearing series for machine tool main spindles employs a special material that boasts excellent anti-seizure properties and wear resistance, as well as a unique surface modification technique.

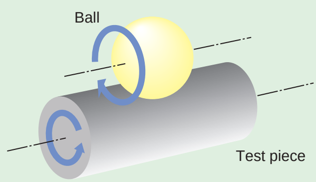
■Life under normal temperatures

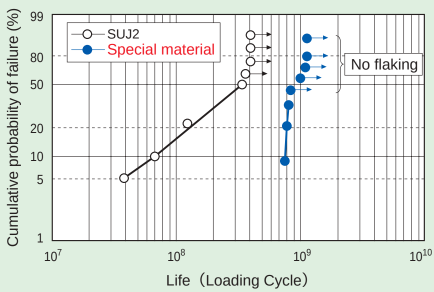
The test results obtained from point contact test pieces under greater loading are graphically plotted in **Fig. 8.1**.

【Test conditions】

Test piece	φ12×22 mm cylindrical roller
Ball	φ19.05 (3/4")
Max. contact stress	5.88 GPa
Loading frequency	46,240 cycles/min
Lubricant	Turbine VG56 (oil bath)

【Schematic of test rig】





	L_{10} (×10^7cycles)	Life ratio
SUJ2	6.3	1
Special material	79.8	12.7

The rolling fatigue life of the special material is approximately 13 times as long as that of SUJ2.

Fig. 8.1 Life test results with point contact test pieces

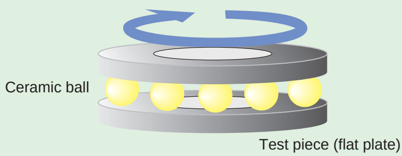
■Life under high temperature

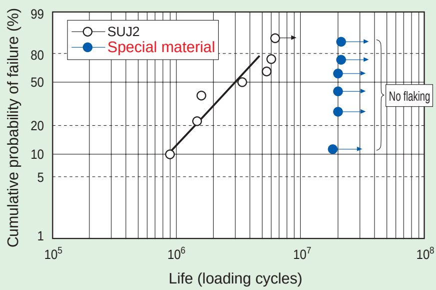
The test results obtained from thrust-type test pieces at 200˚C are graphically plotted in **Fig. 8.2**.

【Test conditions】

Test piece	φ47×φ29×t7 flat plate
Ball	φ6.35（1/4"）Ceramic ball
Max. contact stress	5.5 GPa
Loading frequency	3,000 cycles/min
Oil temperature	200˚C
Lubricant	Ether-based oil

【Schematic of test rig】





	L_{10} (×10⁵cycles)	Life ratio
SUJ2	9.1	1
Special material	No flaking	>30

The rolling fatigue life of the special material at a high temperature of 200˚C is more than 30 times as long as that of SUJ2.

Fig. 8.2 High temperature life test results with thrust-type test pieces

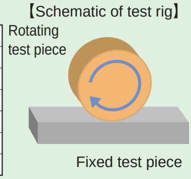
■ Improved wear resistance

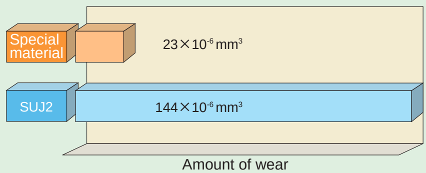
Test results with a Sawin type friction and wear test machine are illustrated in **Fig. 8.3**.

【Test conditions】

Speed	4775 min^{-1}
Peripheral speed	10 m/s
Test duration	10 min
Max. contact stress	2.0 GPa
Lubricant	VG2
Rotating test piece	Material being tested
Fixed test piece	Si_3N_4

【Schematic of test rig】





The wear resistance of the special material is 6 times better than that with SUJ2.

Fig. 8.3 Test results with Sawin type friction and wear test machine

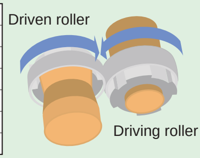
■ Improved anti-seizure property

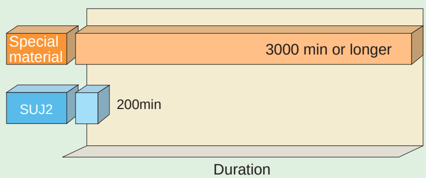
Test results with a two roller testing machine are illustrated in **Fig. 8.4**.

【Test conditions】

Driving side speed	200 min^{-1}
Driven side speed	120 min^{-1}
Sliding velocity	10.1 m/s
Max. contact stress	2.9 GPa
Lubricant	VG2
Driving roller	Material being tested
Driven roller	Material being tested

【Schematic of test rig】





The anti-seizure property of the special material is more than 15 times better than as that with SUJ2.

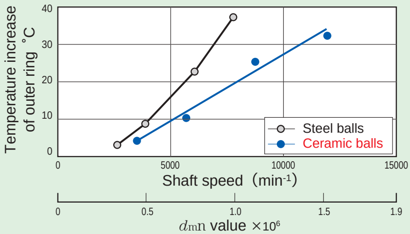
Fig. 8.4 Test results with a two roller testing machine

■Adoption of ceramic balls

A comparison of temperature increase, which can vary depending on the material of rolling element, is illustrated in **Fig. 8.5.**

【Test conditions】

Test bearing	Basic bearing number HSE020 (φ100×φ150×24×2 rows)
Preload	2.5 kN (constant pressure preloading)
Lubrication	Grease
Outer casing cooling	None



The ULTAGE series bearings employ well-proven ceramic balls to efficiently limit temperature increase.

Fig. 8.5 Comparison of temperature increase with steel and ceramic rolling elements

③ Environmentally conscious technology

The eco-friendly ULTAGE Series is available in two specifications: an eco-friendly air-oil lubrication design that offers energy savings by reducing air and oil consumptions; and a grease-lubricated, sealed design that reduces environmental impact by employing a grease lubrication system that is capable of higher-speed operation.

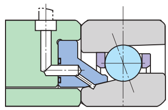
Required functions for the main spindle bearing

Speed | Rigidity | Durability | Precision | Eco-friendly design

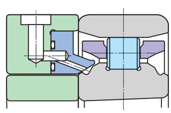
For main spindles

Eco-friendly air-oil lubrication

HSL type



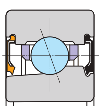
N10HSL type



Reduced air/oil consumption contributes to energy savings.

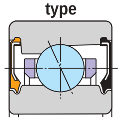
Grease lubrication

High-speed BNS LLB type



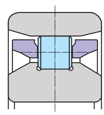
Sealed

Standard 70/79AD, CD LLB type



Sealed

N10HSRT6 type

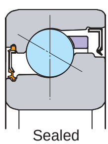


The introduction of a grease lubrication system that is capable of high-speed operation reduces the environmental impact.

For ball screw support

Grease lubrication

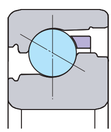
2A-BST LXL type



Sealed

Combines durability with ease of handling.

2A-BST type



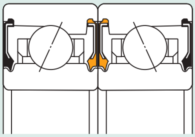
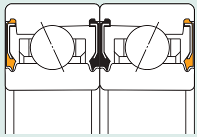
Durability

■ Grease-lubricated sealed angular contact ball bearings

(1) Ease of handling

ULTAGE angular contact ball bearings with seals are grease-prefilled bearings. No grease filling is necessary; you need only wipe off the rust-preventive oil before assembly. Seals of different colors are employed to differentiate the front and back. The black front face and orange back face are easily identified, which also makes it easy to orient the bearings in combinations (**Table 8.1**).

Table 8.1 Bearing combinations and seal colors

DB set (back-to-back)		DF set (face-to-face)	
Orange seal + Orange seal		Black seal + Black seal	
			

(2) Suggestions for simplified spindle structure

The ULTAGE Series sealed angular contact ball bearing makes possible high-speed operation with grease lubrication thanks to optimized internal design. Grease lubrication with minimal mist splash simplifies main spindle structure and contributes to lower environmental impact as well as cost reduction (**Fig. 8.6**).

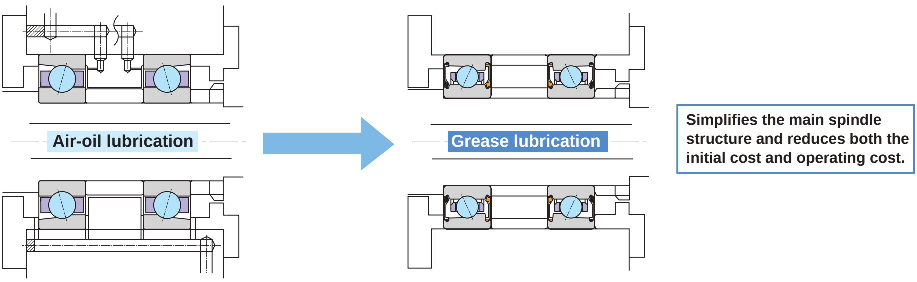


Fig. 8.6 Alteration to lubrication system (air-oil lubrication to grease lubrication)

■Eco-friendly air-oil lubricated angular contact ball bearings and cylindrical roller bearings

When combined with the eco-friendly nozzle, the eco-friendly air-oil lubricated angular contact ball bearing (HSL/HSFL Series) or cylindrical roller bearing (N10HSL[K] Series) can reduce the emissions of oil mist and noise.

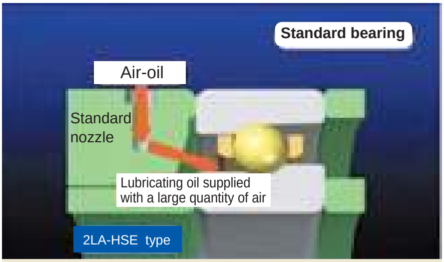
(1) Reduction of oil mist

The eco-friendly air-oil lubricated bearing does not spray compressed air from the nozzle; instead, it uses the centrifugal force of the rotating inner ring to supply lubricating oil into the bearing. For this reason, this type of bearing conserves both air and oil. In addition, it reduces the amount of oil mist emitted from the labyrinth seal of the spindle. The following photographs reveal the difference between the amount of oil mist emitted from the conventional standard bearing and that emitted from the eco-friendly bearing.

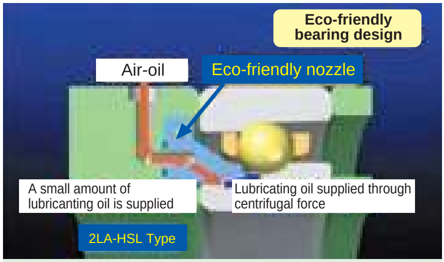
The lubricating oil discharged with air passes through the inside of the bearing and is then exhausted as a large volume of mist.

The lubricating oil exhausted from the bearing in the mist state is collected through the discharge port of the main spindle housing, but some of the oil mist leaks from the main spindle labyrinth seal and contaminates the immediate environment around the machine.

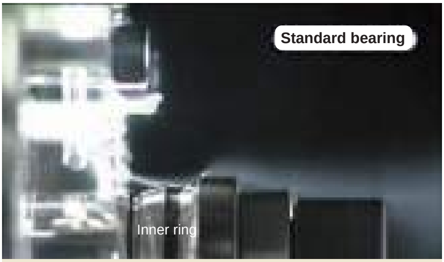
Adoption of the eco-friendly bearing therefore improves the working environment.



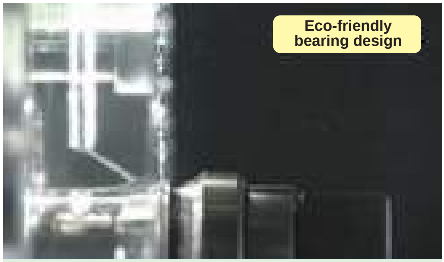
Conventional bearings consume a great deal of air when supplying lubricating oil to the bearing.



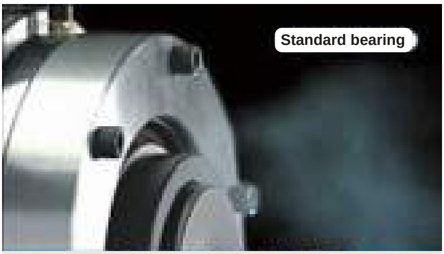
The eco-friendly type uses centrifugal force to supply lubricating oil into the bearing.



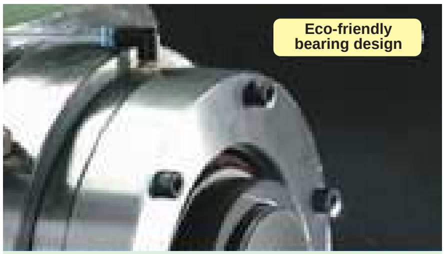
Atomized when emitted from the nozzle



The oil emitted from the nozzle is in a liquid state.



A large amount of oil mist passes through the bearing, contaminating the working environment.



The amount of oil mist is reduced, minimizing environmental contamination in work areas.

(2) Noise Reduction

The standard air-oil lubrication method uses air to supply a slight amount of oil. It also uses a special nozzle spacer, as shown in **Figs. 8.7** and **8.9**.

In addition, this method uses a nozzle measuring 1 to 1.5 mm in diameter to supply oil to the raceway surface of the bearing at the rate of 30 to 40 NL/min/bearing. To supply this oil, the nozzle emits compressed air as a jet to break the air barrier of the bearing, which is created when running at high speed. In this way, the air is used as a tool for supplying oil. The eco-friendly bearing developed by **NTN** reduces the amount of air consumed, thus reducing the whistling noise of the flowing air. The mechanism used in this type of bearing is as follows: the centrifugal force of the bearing inner ring feeds a small amount of oil from the nozzle to the raceway surface of the bearing along the tapered surface. (**Figs. 8.8** and **8.10**).

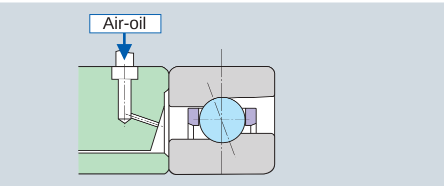


Fig. 8.7 Standard nozzle

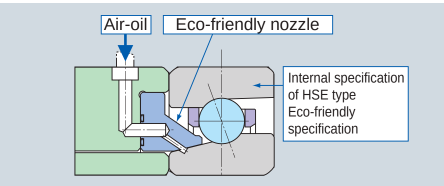


Fig. 8.8 Eco-friendly type nozzle

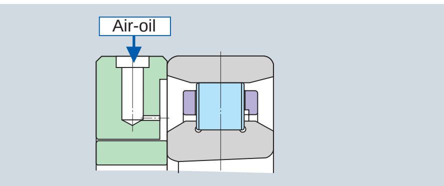


Fig. 8.9 Current bearing N10HS type

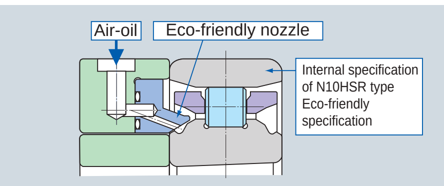


Fig. 8.10 ULTAGE N10HSL type

Since the function of the compressed air is only to deliver lubricating oil to the cavity of the inner ring, a large quantity of air is not required. In addition, since the air used to supply the oil is released between the tapered surfaces, the whistling noise of air is also reduced.

When the eco-friendly bearing is employed, the noise is reduced by 6 to 8 dBA.

Example:

In the high-speed region in excess of 10,000 min^{-1}, noise is reduced by 6 to 8 dBA (**Fig. 8.11**).

【Test conditions】

Test bearing	**5S-2LA-HSFL020 (eco-friendly bearing)** 5S-2LA-HSF020 (φ100×φ150×24, 2 rows)
Shaft speed	20,000 min^{-1}
Preload	2.5 kN (constant pressure preloading)

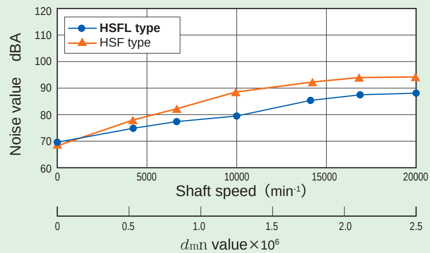


Fig. 8.11 Comparison of noise values

The eco-friendly bearing is particularly good for reducing “screeching” noise. The high-frequency component of the noise generated at high speeds is well attenuated. The reason for this is as follows: when the air jet emitted from the standard nozzle hits the rolling elements, a high-pitched noise is generated; in contrast, the eco-friendly nozzle does not emit air on the rolling elements, which reduces screeching noise.

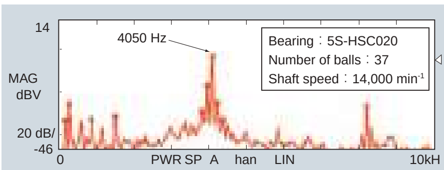


Fig. 8.12 Frequency characteristics of bearing noise (standard nozzle)

Main Spindle Bearings

9. Angular Contact Ball Bearings for Radial Loads CONTENTS

9. Angular Contact Ball Bearings for Radial Loads

Angular contact ball bearings for radial loads used in machine tools are bearings which inner and outer rings cannot be separated. This type of bearing includes series 78, 79U, 70U, 72, HSE9, HSE0, BNS9, BNS0, BNT9, BNT0 and BNT2. For angular contact ball bearings, an imaginary straight line connecting the contact points between the balls and inner and outer rings forms an angle with the radial axis. The optimal contact angle can be selected to meet functional requirements such as high speed or high rigidity. The available contact angles are 15° (contact angle symbol "C"), 20° (no symbol), 25° ("AD"), and 30° (no symbol). (**Fig. 9.1**)

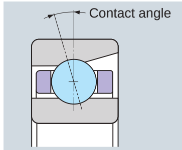


Fig. 9.1 Contact angle

① Features of various types

Open bearings

■Standard angular contact ball bearings (78, 79, 70 and 72 Types)

Standard angular contact ball bearings are available in four types: 78, 79, 70 and 72. Types 79 and 70 include the 79U and 70U ULTAGE Series, which accommodate high speed and low temperature rise with optimized specifications of the internal design. For these types, three contact angles are available: 15° (contact angle symbol "C"), 25° ("AD"), and 30° (no symbol). The contact angle of 25°, however, is also available with 79U and 70U types. This bearing series has an accuracy of JIS class 5 or better. The features include high speed, high rigidity, and high load capacity. Some models incorporate ceramic balls.

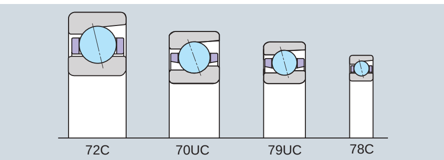


Fig. 9 2. Standard angular contact ball bearings

■High-speed angular contact ball bearings (HSE type)

High-speed angular contact bearings are available in two types: HSE9 and HSE0. The boundary dimensions of this bearing series are determined according to the JIS dimension series (9, 0), and three types of contact angles are available: 15° (contact angle symbol "C"), 20° (no symbol), and 25° ("D"). The accuracy of this ball bearing series is JIS class 5 or better, and the ball diameter is smaller than that of the standard angular contact ball bearing in order to accommodate high speeds. The outer surface of the inner ring and the bore of the outer ring are relieved on one side, and this bearing series employs an air-oil lubrication system to ensure smooth oil flow. In addition, it employs special materials, and its surface is modified to protect the bearing from wear and seizure more positively. The HSE type bearing is available with either steel balls or ceramic balls.

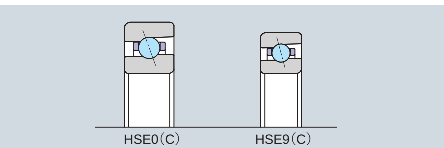


Fig. 9.3 High-speed angular contact ball bearings

■Ultra-high-speed angular ceramic ball bearings (HSF type)

The HSF0 type ultra-high-speed angular contact ceramic ball bearing employs smaller balls than the HSE0C type to ensure rigidity and prevent temperature rise. In addition, it employs a contact angle of 25° to accommodate the reduction in contact angle caused by centrifugal force during operation.

These features allow the use of an air-oil lubrication system ($d_m n$ value $< 2.6 \times 10^6$) in a speed region that was previously possible only with a conventional jet lubrication system.

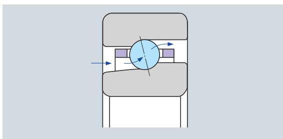


Fig. 9.4 Ultra-high-speed angular contact ball bearings

■Eco-friendly air-oil lubricated angular ball bearings (HSL and HSFL types)

For eco-friendly air-oil lubricated angular contact ball bearings (HSL and HSFL types), the angle of the inner ring outer surface (counterbore area) is optimized compared with that of HSE and HSF types. In addition, these angular contact ball bearings are dedicated to air-oil lubrication by adopting a circumferential groove and an eco-friendly nozzle. They accommodate the same high speed as HSE and HSF types while being more eco-friendly. They generate less noise and conserve energy since they consume less air and oil. The accuracies of these bearing types are JIS class 5 or better. For the HSL type, three contact angles [20˚ (no symbol), and 25˚ ("AD")] are available. For the HSFL type, however, only one contact angle (25˚) is available. The HSFL type utilizes a specially designed eco-friendly nozzle.

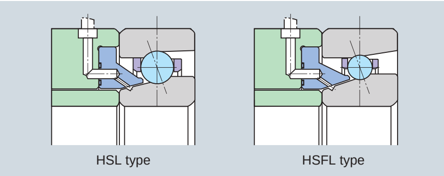


Fig. 9.5 Eco-friendly angular contact ball bearings

■Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring (HSEW type)

HSEW type is designed based on HSE type as high speed angular contact ball bearing for air-oil lubrication with lubrication hole on outer ring.

Spacers next to these bearings don't need length for nozzle to be mounted, and can be short. These short spacers have an effect on compact design and rigidity of spindle as a result of shortened distance between bearing and tool.

In addition, direct air-oil supply through the hole on outer ring achieves improved lubricating reliability with low air flow rate and small oil consumption.

JIS Class 5 or higher bearing accuracy is applied on this type. Two kind of contact angles are available, 20˚ (no suffix) and 25˚ (AD).

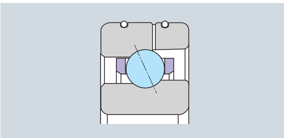


Fig. 9.6 Ultra-high-speed angular contact ball bearings

■High-speed angular contact ball bearings for grinding machines/motors (BNT type)

The boundary dimensions of high-speed angular ball bearings for grinding machines/motors (BNT type) are determined according to the JIS dimension series (9, 0, 2). For this bearing type, only one contact angle (15˚, no symbol) is available, and the bearing accuracies are JIS class 5 or better. This bearing uses mainly air-oil lubrication and oil mist lubrication. The features of this bearing are high speed capability and high load capacity. This type of bearing is available with either steel balls or ceramic balls.

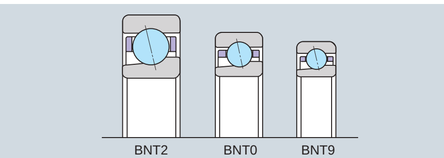


Fig. 9.7 High-speed angular contact ball bearings for grinding machines/motors

Sealed bearings

■Standard grease-lubricated sealed angular contact ball bearings (79LLB/70LLB types)

The standard grease-lubricated sealed angular contact ball bearings are available in 79 and 70 series. Non-contact rubber seals are mounted on both sides and special grease is used. As a result, these bearings accommodate high speed, offer prolonged service life, and help to maintain a comfortable working environment. These bearings are available in contact angles of 15˚ (contact angle symbol "CD") and 25˚ ("AD") and with a special accuracy of P42 (JIS class 4 dimensional accuracy and JIS class 2 running accuracy). Since they are prefilled with grease, these bearings require no cleaning before use and are therefore easy to handle. They are available with either steel balls or ceramic balls.

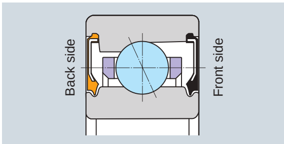


Fig. 9.8 Standard grease-lubricated sealed angular contact ball bearings

■High-speed grease-lubricated sealed angular contact ball bearings (BNS type)

High-speed grease-lubricated sealed angular contact ball bearings (BNS type) are available with the boundary dimensions of HSE type. Non-contact rubber seals are incorporated on both sides and its inner structure is optimized. It is also prefilled with a special grease to achieve high speed capability, inhibit temperature rise, extend service life and create a comfortable working environment. This bearing type is available in contact angles of 15˚ (contact angle symbol "CD"), 20˚ (no symbol), and 25˚ ("AD"). Bearing accuracy is JIS class 4 or better. The bearing ring is made of a special material, and the surface is modified to protect the bearing from wear and seizure. Since this type is prefilled with grease, it requires no cleaning before use and is therefore easy to handle. It is available with either steel balls or ceramic balls.

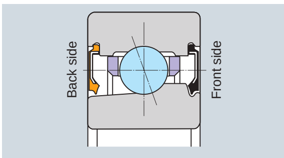


Fig. 9.9 High-speed grease-lubricated sealed angular contact ball bearings

② Standard cage design

Table 9.1 Standard cages of angular contact ball bearings for radial loads

Bearing series	Molded nylon cage	Machined phenol resin cage	Machined high tensile brass cage
78C	—	7805C ～ 7824C	7826C ～ 7834C
79U (15˚, 25˚, 30˚), 79C	7900U ～ 7926U	—	7928C ～ 7934C
70U (15˚, 25˚, 30˚), 70C	7000U ～ 7028U	—	7028C ～ 7040C
72C	7200C ～ 7220C	7221C ～ 7228C	—
HSE9U (15˚, 20˚, 25˚)	—	HSE910U ～ HSE934U	—
HSE0 (15˚, 20˚, 25˚)	—	HSE010 ～HSE034	—
HSF	—	HSF010 ～ HSF020	—
HSL9U (20˚, 25˚)	—	HSL910U ～ HSL926U	—
HSL0 (20˚, 25˚)	—	HSL010 ～ HSL026	—
HSFL0	—	HSFL010 ～ HSFL020	—
HSEW9U (20˚, 25˚)	—	HSEW910U ～ HSEW920U	—
HSEW0 (20˚, 25˚)	—	HSEW010 ～ HSEW020	—
79 LLB (15˚, 25˚)	7900 LLB ～ 7910 LLB	—	—
70 LLB (15˚, 25˚)	7000 LLB ～ 7010 LLB	—	—
BNS9 LLB (15˚, 20˚, 25˚)	—	BNS910 LLB ～ BNS920 LLB	—
BNS0 LLB (15˚, 20˚, 25˚)	—	BNS010 LLB ～ BNS020 LLB	—
BNT9	—	BNT900 ～ BNT913	—
BNT0	—	BNT000 ～ BNT014	—
BNT2	—	BNT200 ～ BNT216	—

Note 1) Cage design is subject to change without notice. For detailed information, contact **NTN** Engineering.
Note 2) The polyamide plastic cage can be used up to the following rotating speeds depending on the material of the rolling element. The $d_m n$ value 0.9×10^6 for bearing steel and $d_m n$ value 1.0×10^6 for ceramics. Machined phenol resin cages must be used if the allowable rotational speed of the dimensions listed exceeds the figures above. For detailed information, contact **NTN** Engineering.

③ Bearing designations

78, 79, 70, 72, BNT type

5S- 7 0 20 U C T1 DB /GL P4

Precision class
P5: JIS class 5, P4: JIS class 4, P2: JIS class 2

Internal clearance code
GL: Light preload, GN: Normal preload, GM: central preload, Gxx: Special preload, CSxx: Special clearance

Matching code
DB: Back-to-back (double-row)
DT: Tandem (double-row)
DTBT: Tandem back-to-back (quad-row)

Cage code
No code: Standard cage
T1: Machined phenol resin cage
T2: Molded polyamide resin cage
L1: Machined high tensile brass cage

Contact angle code
C: 15˚, AD: 25˚, No symbol: 20˚

Bearing series (ULTAGE Series)

Bore diameter code (See dimension table)

Dimension series code

Bearing type

Material code
5S: Ceramic rolling elements
No code: Steel rolling elements

HSE type

5S- 2LA-HSE 0 20 AD T2 DB /GL P4

- **Contact angle code** (AD)
  C: 15˚, AD: 25˚, No symbol: 20˚
- **Bore diameter code (See dimension table)** (20)
- **Dimension series code** (0)
- **Bearing type** (HSE)
- **2LA：Special material with improved surface treatment** (2LA)

HSL type

5S- 2LA-HSL 0 20 DB +xx Dn /GL P4 +TKZ

- **Spacer code** (+TKZ)
  （Located beside bearings）
- **Spacer code** (Dn)
  （Located between bearings）
- **Spacer width dimension** (+xx)
- **Bearing type** (HSL)

（notes）HSL：Bearing series code
xxDn：Eco-friendly nozzle, or Spacer with Eco- friendly nozzle located between bearings
TKZ：Eco-friendly nozzle, or Spacer with Eco- friendly nozzle located beside bearings

HSEW type

5S- 2LA-HSEW 0 20 DB/GL P4

- **Bearing type** (HSEW)

79LLB / 70LLB type

5S- 7006 CD LLB DB /GL P42 /L749

- **Accuracy class** (P42)
  P42: Dimensional accuracy = JIS class 4,
  running accuracy = JIS class 2
- **Bearing type (ULTAGE Series)** (CD)
  CD : Contact angle 15˚
  AD : Contact angle 25˚

BNS type

5S- 2LA-BNS 0 20 LLB DB /GL P4 /L749

- **Grease code** (/L749)
  /L448 : Special grease （MP-1）
  /L749 : Special grease （SE-1）
- **Seal code** (LLB)
  LLB: Non-contact rubber seal on both sides
- **Bearing type** (BNS)

④ Bearing accuracy

Table 9.2 Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation dmp						Single radial plane bore diameter variation V_{dsp} max						Mean bore diameter deviation V_{dmp} max			Inner ring radial runout K_{ia} max		
		Class 5		Class 4❶		Class 2 ❶		Diameter series 9			Diameter series 0, 2								
over	incl.	high	low	high	low	high	low	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
2.5	10	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
10	18	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
18	30	0	−6	0	−5	0	−2.5	6	5	2.5	5	4	2.5	3	2.5	1.5	4	3	2.5
30	50	0	−8	0	−6	0	−2.5	8	6	2.5	6	5	2.5	4	3	1.5	5	4	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	5	4	2.5
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	6	5	2.5
120	150	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	8	6	2.5
150	180	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	8	6	5
180	250	0	−15	0	−12	0	−8	15	12	8	12	9	8	8	6	4	10	8	5

❶ The tolerance of bore diameter deviation ds, applicable to classes 4 and 2, is the same as the tolerance of mean bore diameter deviation dmp.
This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.
❷ Applicable to individual bearing rings manufactured for duplex bearings.

Table 9.3 Outer rings

Nominal outside diameter D mm		Single plane mean outside diameter deviation Dmp						Single radial plane outside diameter variation V_{Dsp} max						Mean single plane outside diameter variation V_{Dmp} max			Outer ring radial runout K_{ea} max		
		Class 5		Class 4 ❸		Class 2 ❸		Diameter series 9			Diameter series 0, 2								
over	incl.	high	low	high	low	high	low	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
18	30	0	−6	0	−5	0	−4	6	5	4	5	4	4	3	2.5	2	6	4	2.5
30	50	0	−7	0	−6	0	−4	7	6	4	5	5	4	4	3	2	7	5	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	8	5	4
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	10	6	5
120	150	0	−11	0	−9	0	−5	11	9	5	8	7	5	6	5	2.5	11	7	5
150	180	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	13	8	5
180	250	0	−15	0	−11	0	−8	15	11	8	11	8	8	8	6	4	15	10	7
250	315	0	−18	0	−13	0	−8	18	13	8	14	10	8	9	7	4	18	11	7

❸ The tolerance of outside diameter deviation Ds, applicable to classes 4 and 2, is the same as the tolerance of mean outside diameter deviation Dmp.
This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.

Unit: μm

Perpendicularity of inner ring face with respect to the bore S_d			Axial runout S_{ia}			Width deviation B_s				Duplex bearing❷		Width variation VB_s		
						Single bearing								
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5 Class 4		Class 2		Class 5 Class 4		Class 5	Class 4	Class 2
max			max			high	low	high	low	high	low	max		
7	3	1.5	7	3	1.5	0	− 40	0	− 40	0	−250	5	2.5	1.5
7	3	1.5	7	3	1.5	0	− 80	0	− 80	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	3	1.5
8	5	1.5	8	5	2.5	0	−150	0	−150	0	−250	6	4	1.5
9	5	2.5	9	5	2.5	0	−200	0	−200	0	−380	7	4	2.5
10	6	2.5	10	7	2.5	0	−250	0	−250	0	−380	8	5	2.5
10	6	4	10	7	5	0	−250	0	−250	0	−380	8	5	4
11	7	5	13	8	5	0	−300	0	−300	0	−500	10	6	5

Unit: μm

Perpendicularity of outer ring outside surface with respect to the face S_D			Axial runout S_{ea}			Width deviation C_s	Width variation VC_s		
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	All types	Class 5	Class 4	Class 2
max			max				max		
8	4	1.5	8	5	2.5	Identical to of B_s relative to d of the same bearing.	5	2.5	1.5
8	4	1.5	8	5	2.5		5	2.5	1.5
8	4	1.5	10	5	4		6	3	1.5
9	5	2.5	11	6	5		8	4	2.5
10	5	2.5	13	7	5		8	5	2.5
10	5	2.5	14	8	5		8	5	2.5
11	7	4	15	10	7		10	7	4
13	8	5	18	10	7		11	7	5

⑤ Internal clearance and standard preload of duplex angular contact ball bearings

The initial internal clearance or preload for duplex angular contact ball bearings is determined with consideration for two factors: temperature rise during operation and the rigidity and accuracy required after assembly or during operation.

The internal clearance of the bearing may be significantly affected during operation due to three factors: the reduction in clearance caused by fits, the temperature difference between the inner and outer rings during operation, and the effects of centrifugal force. Depending on the initial internal clearance, a significantly reduced clearance may result in extreme temperature rise, vibration, noise, and short service life. In addition, seizure may result in some cases. For this reason, it is important to determine the optimal initial internal clearance and initial preload required for operation. When using a duplex angular contact ball bearing on the main spindle of a machine tool, the preload is determined by considering the type, main spindle configuration, lubrication system, drive system, intended functions, and other factors. However, preload can also be generalized by the $d_m n$ value ($d_m n$: pitch circle diameter across rolling elements [mm] multiplied by speed [min^{-1}]), as shown below:

$d_m n \leqq 0.5\times10^6$ ……………..Normal preload (GN)
$0.5\times10^6 < d_m n \leqq 0.65\times10^6$ …Light preload (GL)
$d_m n > 0.65\times10^6$ ……………..0 to positive clearance

For detailed information, contact **NTN** Engineering.

Table 9.4 Radial internal clearance of duplex angular contact ball bearings

Unit: μm

Nominal bore diameter *d* mm		C1		C2		CN (normal)	
over	incl.	min	max	min	max	min	max
–	10	3	8	6	12	8	15
10	18	3	8	6	12	8	15
18	30	3	10	6	12	10	20
30	50	3	10	8	14	14	25
50	80	3	11	11	17	17	32
80	100	3	13	13	22	22	40
100	120	3	15	15	30	30	50
120	150	3	16	16	33	35	55
150	180	3	18	18	35	35	60
180	200	3	20	20	40	40	65

For duplex angular contact ball bearings, **NTN** recommends the initial radial clearances and standard preloads shown in **Tables 9.4** through **9.21**. Select the optimal radial internal clearance and initial preload for your application. When ordering a duplex angular ball bearing, please specify the desired preload and clearance. If these are not specified in the order, we will ship a bearing with standard clearance. However, some product types do not have a standard clearance. In this case, we will inform you of the available clearances.

■Standard preloads of angular contact ball bearings (DB and DF arrangements)

Table 9.5 Standard angular contact ball bearings (78C type)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°		
	78xxC		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
25	10	29	78
30	10	29	78
35	10	29	78
40	10	29	78
45	20	49	98
50	20	49	98
55	29	98	196
60	29	98	196
65	29	98	196
70	29	98	196
75	29	98	196
80	29	98	196
85	49	147	294
90	49	147	294
95	49	147	294
100	49	147	294
105	49	147	294
110	78	196	490
120	78	196	490
130	98	294	590
140	98	294	590
150	147	390	785
160	147	390	785
170	147	490	980

Table 9.6 Standard angular contact ball bearings (79 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15° 79xxUC/5S-79xxUC Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Contact angle: 25° 79xxUAD/5S-79xxUAD Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Contact angle: 30° 79xxU/5S-79xxU Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	—	20	39	—	29	59	—	39	78
12	—	20	39	—	29	69	—	39	78
15	—	29	59	—	49	98	20	59	118
17	—	29	69	20	49	98	20	69	127
20	20	49	88	20	69	147	29	88	186
25	20	49	98	20	78	157	29	98	196
30	20	49	108	20	78	167	29	98	206
35	29	78	167	39	127	255	49	167	325
40	29	88	177	39	137	275	49	167	345
45	39	108	216	49	167	345	69	216	420
50	39	118	226	49	177	355	69	226	450
55	39	118	236	59	186	375	69	235	460
60	39	127	245	59	196	380	78	245	480
65	39	127	245	59	196	390	78	245	490
70	59	177	365	88	284	560	108	355	695
75	59	177	365	88	284	570	108	355	705
80	59	186	365	88	284	580	108	365	715
85	78	245	490	118	390	770	147	480	970
90	88	255	500	118	390	780	147	490	980
95	88	255	510	118	400	795	157	500	990
100	108	325	655	157	510	1 020	196	635	1 270
105	108	335	655	157	520	1 040	196	645	1 300
110	108	335	665	157	530	1 060	206	655	1 310
120	137	410	835	196	655	1 300	245	815	1 620
130	167	510	1 020	235	800	1 600	305	990	1 990
	79xxC								
140	196	490	980						
150	245	685	1 470						
160	245	685	1 470						
170	245	685	1 470						

Table 9.7 Standard angular contact ball bearings (70 series)

d (mm)	15			25			30		
	70 5 70			70 5 70			70 5 70		
10	—	29	59	20	49	108	20	69	127
12	—	39	69	20	59	108	20	69	137
15	—	39	78	20	59	127	29	78	157
17	20	49	98	20	78	157	29	98	196
20	20	69	137	29	108	216	39	137	265
25	29	78	147	39	118	235	49	147	294
30	29	98	186	49	147	305	59	186	375
35	39	118	235	59	186	380	69	235	480
40	39	127	255	59	206	400	78	255	510
45	49	147	305	69	245	480	88	305	600
50	49	157	325	78	255	510	98	325	635
55	69	216	420	98	335	665	127	420	845
60	69	216	430	108	345	685	127	430	855
65	78	226	460	108	365	725	137	450	900
70	98	294	580	137	460	920	177	580	1 150
75	98	294	600	137	470	940	177	590	1 180
80	118	365	725	177	580	1 150	216	715	1 430
85	127	375	750	177	590	1 180	226	735	1 470
90	147	440	890	206	705	1 400	265	875	1 750
95	157	460	910	216	715	1 430	275	900	1 790
100	157	460	930	226	740	1 470	284	920	1 830
105	186	550	1 090	255	860	1 720	335	1 070	2 140
110	206	630	1 250	294	990	1 980	380	1 230	2 460
120	216	635	1 270	305	1 010	2 020	380	1 260	2 510
130	265	800	1 600	380	1 270	2 530	480	1 570	3 150
140	275	815	1 630	380	1 280	2 570	490	1 600	3 200
	70xxC								
150	294	785	1 960						
160	490	980	2 450						
170	490	980	2 450						
180	490	980	2 450						
190	590	1 470	3 450						
200	590	1 470	3 450						

Table 9.8 Standard angular contact ball bearings (72C series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°		
	72xxC		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	20	49	98
12	20	49	98
15	20	49	147
17	20	49	147
20	49	98	294
25	49	98	294
30	49	98	294
35	78	196	490
40	78	196	490
45	98	294	590
50	98	294	590
55	147	390	785
60	147	390	785
65	147	390	785
70	196	490	980
75	196	490	980
80	196	490	980
85	294	685	1 470
90	294	685	1 470
95	294	685	1 960
100	294	685	1 960
105	390	980	2 450
110	390	980	2 450
120	390	980	2 450
130	490	1 470	2 940

Table 9.9 High-speed angular contact ball bearings (HSE9 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°			Contact angle: 20°			Contact angle: 25°		
	HSE9xxUC/5S-HSE9xxUC			HSE9xxU/5S-HSE9xxU			HSE9xxUAD/5S-HSE9xxUAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	34	88	177	39	127	255	39	177	345
55	44	108	216	49	157	345	49	216	440
60	44	118	226	49	167	345	54	226	440
65	44	118	226	49	167	345	54	226	440
70	69	167	345	74	245	490	78	345	685
75	69	177	345	74	255	490	83	345	685
80	69	177	345	74	255	540	83	345	685
85	98	235	490	98	345	685	108	490	930
90	98	245	490	108	345	735	118	490	980
95	98	255	490	108	345	735	118	490	980
100	118	294	590	127	440	835	137	590	1170
105	118	294	590	127	440	885	137	590	1170
110	118	294	590	127	440	885	137	590	1170
120	157	390	785	167	540	1080	177	785	1570
130	186	490	930	196	685	1370	226	930	1860
140	186	490	930	206	685	1370	226	930	1860
150	255	635	1270	276	930	1860	294	1270	2550
160	255	635	1270	276	930	1860	294	1270	2550
170	255	635	1270	276	930	1860	294	1270	2550

Table 9.10 High-speed angular contact ball bearings (HSE0 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°			Contact angle: 20°			Contact angle:25°		
	HSE0xxC/5S-HSE0xxC			HSE0xx/5S-HSE0xx			HSE0xxAD/5S-HSE0xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	59	157	315	69	235	460	78	305	600
55	69	177	345	78	255	510	78	325	645
60	69	186	365	78	265	530	88	345	685
65	69	186	365	78	265	540	88	345	695
70	88	226	450	98	325	655	108	420	845
75	98	235	480	108	355	695	118	450	900
80	108	275	550	118	400	805	127	520	1 030
85	108	275	560	118	400	815	127	520	1 040
90	127	325	645	137	470	940	157	610	1 220
95	127	325	645	147	480	960	157	620	1 240
100	137	345	675	147	490	990	157	635	1 270
105	157	390	775	167	570	1 140	186	725	1 450
110	196	480	960	206	695	1 400	226	900	1 800
120	196	480	960	216	705	1 410	226	910	1 820
130	275	695	1 380	305	1 020	2 030	325	1 300	2 610
140	284	715	1 430	315	1 050	2 090	345	1 350	2 710
150	294	735	1 470	325	1 080	2 150	345	1 380	2 770
160	345	865	1 730	375	1 260	2 520	410	1 630	3 250
170	390	990	1 980	430	1 450	2 900	470	1 860	3 750

Table 9.11 Eco-friendly air-oil lubricated angular contact ball bearings (HSL9 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 20°			Contact angle: 25°		
	5S-HSL9xxU			5S-HSL9xxUAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	39	127	255	39	177	345
55	49	157	345	49	216	440
60	49	167	345	54	226	440
65	49	167	345	54	226	440
70	74	245	490	78	345	685
75	74	255	490	83	345	685
80	74	255	540	83	345	685
85	98	345	685	108	490	930
90	108	345	735	118	490	980
95	108	345	735	118	490	980
100	127	440	835	137	590	1170
105	127	440	885	137	590	1170
110	127	440	885	137	590	1170
120	167	540	1080	177	785	1570
130	196	685	1370	226	930	1860

Table 9.12 Eco-friendly air-oil lubricated angular contact ball bearings (HSL0 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 20°			Contact angle: 25°		
	5S-HSL0xx			5S-HSL0xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	69	235	460	78	305	600
55	78	255	510	78	325	645
60	78	265	530	88	345	685
65	78	265	540	88	345	695
70	98	325	655	108	420	845
75	108	355	695	118	450	900
80	118	400	805	127	520	1 030
85	118	400	815	127	520	1 040
90	137	470	940	157	610	1 220
95	147	480	960	157	620	1 240
100	147	490	990	157	635	1 270
105	167	570	1140	186	725	1450
110	206	695	1400	226	900	1800
120	216	705	1410	226	910	1820
130	305	1020	2030	325	1300	2610

Table 9.13 Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring (HSEW9U series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 20°			Contact angle: 25°		
	5S-HSEW9xxU			5S-HSEW9xxUAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	39	127	255	39	177	345
55	49	157	345	49	216	440
60	49	167	345	54	226	440
65	49	167	345	54	226	440
70	74	245	490	78	345	685
75	74	255	490	83	345	685
80	74	255	540	83	345	685
85	98	345	685	108	490	930
90	108	345	735	118	490	980
95	108	345	735	118	490	980
100	127	440	835	137	590	1170

Table 9.14 Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring (HSEW0 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 20°			Contact angle: 25°		
	5S-HSEW0xx			5S-HSEW0xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	69	235	460	78	305	600
55	78	255	510	78	325	645
60	78	265	530	88	345	685
65	78	265	540	88	345	695
70	98	325	655	108	420	845
75	108	355	695	118	450	900
80	118	400	805	127	520	1 030
85	118	400	815	127	520	1 040
90	137	470	940	157	610	1 220
95	147	480	960	157	620	1 240
100	147	490	990	157	635	1 270

Table 9.15 Grease-lubricated sealed angular contact ball bearings (79CD and AD series)

Unit: N

Nominal bore diameter *d* ÅimmÅj	Contact angle: 15°			Contact angle: 25°		
	79xxCD/5S-79xxCD			79xxAD/5S-79xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	10	29	78	—	39	78
12	10	29	78	—	39	78
15	10	29	78	—	49	147
17	10	29	78	—	49	147
20	20	49	98	29	98	196
25	20	49	98	29	98	196
30	20	49	98	29	98	196
35	29	78	196	49	147	294
40	29	78	196	49	147	294
45	39	98	245	49	196	390
50	39	98	245	49	196	390

Table 9.16 Grease-lubricated sealed angular contact ball bearings (70CD and AD series)

Unit: N

Nominal bore diameter *d* ÅimmÅj	Contact angle: 15°			Contact angle: 25°		
	70xxCD/5S-70xxCD			70xxAD/5S-70xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	20	29	98	29	78	147
12	20	29	98	29	78	147
15	20	29	98	29	78	147
17	20	29	98	29	78	147
20	29	78	147	49	147	294
25	29	78	147	49	147	294
30	29	78	147	49	147	294
35	49	147	294	78	294	590
40	49	147	294	78	294	590
45	49	147	294	78	294	590
50	49	147	294	78	294	590

Table 9.17 High-speed grease-lubricated sealed angular contact ball bearings (BNS9 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°			Contact angle: 20°			Contact angle: 25°		
	BNS9xxC/5S-BNS9xxC			BNS9xx/5S-BNS9xx			BNS9xxAD/5S-BNS9xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
50	29	78	167	39	118	235	39	157	305
55	39	108	206	49	147	305	49	196	390
60	39	108	216	49	157	315	49	196	400
65	39	108	216	49	157	315	49	206	410
70	59	137	275	59	196	400	69	255	520
75	59	137	284	59	206	410	69	265	530
80	59	147	294	59	216	420	69	275	550
85	69	177	345	78	255	510	78	325	655
90	69	177	355	78	265	520	88	335	665
95	69	186	365	78	265	540	88	345	685
100	98	255	510	108	375	755	118	480	970

Table 9.18 High-speed grease-lubricated sealed angular contact ball bearings (BNS0 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°			Contact angle: 20°			Contact angle: 25°		
	BNS0xxC/5S-BNS0xxC			BNS0xx/5S-BNS0xx			BNS0xxAD/5S-BNS0xxAD		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
45	49	118	235	49	177	345	59	226	450
50	59	157	315	69	235	460	78	305	600
55	69	177	345	78	255	510	78	325	645
60	69	186	365	78	265	530	88	345	685
65	69	186	365	78	265	540	88	345	695
70	88	226	450	98	325	655	108	420	845
75	98	235	480	108	355	695	118	450	900
80	108	275	550	118	400	805	127	520	1 030
85	108	275	560	118	400	815	127	520	1 040
90	127	325	645	137	470	940	157	610	1 220
95	127	325	645	147	480	960	157	620	1 240
100	137	345	675	147	490	990	157	635	1 270

Table 9.19 High-speed sealed angular contact ball bearings (BNT9 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°		
	BNT9xx/5S-BNT9xx		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	10	29	78
12	10	29	78
15	10	29	78
17	10	29	78
20	20	49	98
25	20	49	98
30	20	49	98
35	29	78	196
40	29	78	196
45	39	98	245
50	39	98	245
55	49	118	294
60	49	118	294
65	49	118	294

Table 9.20 High-speed sealed angular contact ball bearings (BNT0 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°		
	BNT0xx/5S-BNT0xx		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	20	29	98
12	20	29	98
15	20	29	98
17	20	29	98
20	29	78	147
25	29	78	147
30	29	78	147
35	49	147	294
40	49	147	294
45	49	147	294
50	49	147	294
55	98	196	490
60	98	196	490
65	98	196	490
70	98	294	685

Table 9.21 High-speed sealed angular contact ball bearings (BNT2 series)

Unit: N

Nominal bore diameter *d* (mm)	Contact angle: 15°		
	BNT2xx/5S-BNT2xx		
	Light preload (GL)	Normal preload (GN)	Medium preload (GM)
10	20	49	98
12	20	49	98
15	20	49	147
17	20	49	147
20	49	98	294
25	49	98	294
30	49	98	294
35	78	196	490
40	78	196	490
45	98	294	590
50	98	294	590
55	147	390	785
60	147	390	785
65	147	390	785
70	196	490	980
75	196	490	980
80	196	490	980

⑥ Recommended fit for angular contact ball bearings

If the $d_m n$ value is in the range of $d_m n \leqq 0.75 \times 10^6$ (d_m : pitch circle diameter across rolling elements [mm], n: speed [min^{-1}]), the fit values shown in **Tables 9.22** and **9.23** are recommended to ensure high accuracies of precision bearings.

If the $d_m n$ value is in the range of $d_m n > 0.75 \times 10^6$, it is necessary to consider expansion of inner ring caused by centrifugal force. In this case, contact **NTN** Engineering for the recommended fit. As for the fit of the outer ring with the housing, consider the influence of the ambient temperature (such as heat buildup on a built-in motor or the cooling effect of jacket). For technical assistance, contact **NTN** Engineering.

Table 9.22 Shaft fit

Unit: μm

Nominal bore diameter *d* mm Over	Incl.	Fit of inner ring with shaft
2.5	10	0~2T
10	18	0~2T
18	30	0~2T
30	50	0~3T
50	80	1T~4T
80	120	1T~5T
120	180	2T~7T
180	250	2T~8T

Notes:
1. The mean value should be the target value.
2. If the dmn value of the high-speed machine is in the range of $d_m n > 0.75 \times 10^6$, it is necessary to increase the amount of interference In this case, contact **NTN** Engineering for technical assistance.

T: Tight (Interference) Fit

Table 9.23 Housing fit

Unit: μm

Nominal outside diameter *D* mm		Fit of outer ring with housing	
Over	Incl.	Bearing on fixed side	Bearing on free side
10	50	2L~ 5L	6L~10L
50	80	3L~ 7L	6L~12L
80	120	4L~ 9L	8L~13L
120	150	5L~11L	10L~16L
150	180	6L~13L	11L~17L
180	250	7L~15L	13L~20L
250	315	8L~17L	15L~23L

Notes:
1. The mean value should be the target value.
2. If the $d_m n$ value is in the range of $d_m n > 1.0 \times 10^6$, spacer width and bearing arrangement, it is necessary to increase the amount of interference.
   In this case, contact **NTN** Engineering for technical assistance.

L: Loose fit

⑦ Duplex angular contact ball bearings

Duplex angular contact ball bearings can be combined in rows of two, three or four bearings to accommodate required specifications.

The back-to-back duplex (DB) arrangement and the face-to-face duplex (DF) arrangement allow for the application of both radial loads and axial loads in both directions. The DB arrangement has a wide space between load points and can handle large moment loads. For this reason, this type of duplex arrangement is preferable for use on the main spindles of machine tools.

The DF arrangement cannot handle large moment loads, but its allowable inclination angle is greater than that of the DB arrangement. The tandem duplex (DT) arrangement can handle both a radial load and large axial load, but this bearing can take the axial load in one direction only. The 4-row duplex (type DTBT) arrangement ensures high rigidity in the radial and axial directions and accommodates high-speed operation. For this reason, this type of duplex bearing is commonly used for the main spindles of machining centers.

Each duplex angular contact ball bearing is manufactured as a set to enable adjustment of the preload and clearance. For this reason, combine only duplex bearings of the same product number.

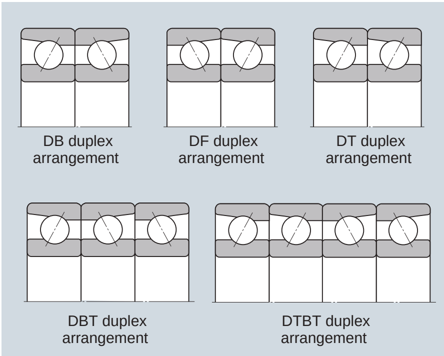


Fig. 9.10

⑧ Duplex arrangement codes for angular contact ball bearings

Each duplex ball bearing has a product number and duplex arrangement code etched on its side face. On angular contact ball bearing sets of three or more, each matching bearing has a "<" mark on its outside surface. Be sure to align the "<" mark when assembling the bearings.

Note that duplex angular contact ball bearing types DB and DF do not have the "<" mark. To match them, align the duplex arrangement codes.

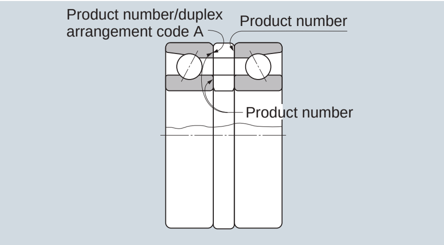


Fig. 9.11

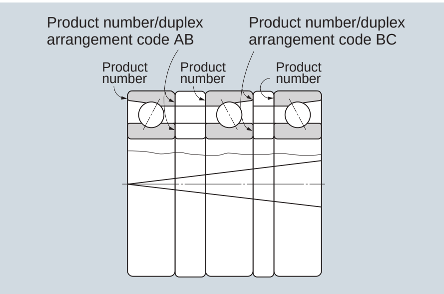


Fig. 9.12

⑨ Flush grinding and universal matching

Angular contact ball bearings are often combined for a special purpose. Face-to-face duplex (DF) arrangement, back-to-back duplex (DB) arrangement and tandem duplex (DT) arrangement may be combined in rows of two or more. When combining many bearings, it is important to control the accuracies of the bearings and to align their face heights in a common plane.

■Flush grinding

"Flush grinding" is a finishing technique in which the front and back faces of the inner and outer rings are aligned with each other to eliminate differences in face height (**Fig. 9.13**). Such alignment can ensure the specified clearance and preload for DF, DB, and DT sets, but it is possible only if the combined bearings have the same clearance/preload symbols. The flush grinding technique is employed for standard BNT series, 0 series, and 2 series bearings designed for main spindles of machine tools, and for 2A-BST thrust angular contact ball bearings designed to support ballscrews.

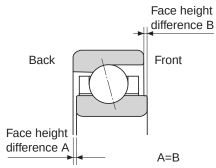


Fig. 9.13 Flush grinding

Note: The flush grinding technique is also adopted for other types of angular contact ball bearings. When ordering a bearing, append "G" to the product number to specify the flush ground type. **Example: 7010UC G/GNP4**

■Universal Matching

In addition to the flush grinding technique, universal matching is employed for duplex angular contact ball bearings. Universal matching controls the bearing-to-bearing dimensional differences in the bore and outside diameters.

NTN can control the bearing-to-bearing difference in the bore and outside diameters to no more than one-third the tolerance (a minimum of 2 μm). Universal matching is adopted for duplex angular contact ball bearings of JIS class 5 or better. When ordering a bearing, specify the desired number of duplex bearings to be used in combination ("D2" for DB, DF or DT; and "D3" for DBT, DFT or DTT). Alternately, indicate the basic combination and specify universal matching.

If two duplex bearings are combined, "D2" is appended to the product number.

Example: 7010UC G D2/GNP4

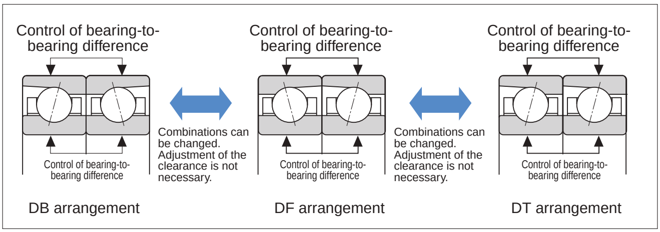


Fig. 9.14 Universal matching

⑩ Angular contact ball bearings with ceramic balls

Recently, the main spindles of machining centers, NC machines and other machine tools have been required to operate at much higher speeds. Bearings for main spindles therefore must meet the requirements of high speed and rigidity as well as accuracy. To meet such requirements, many of our customers want the rolling element made of ceramic material. The features of angular contact ball bearings with ceramic balls are described below.

■Limited temperature rise and ultra-high speeds

The specific gravity of ceramic material is one-half that of bearing steel. In addition, the ball diameter of 5S-HSE type is smaller than that of the standard 70 type. For this reason, use of ceramic balls greatly reduces the influence of centrifugal force (ball sliding and spinning caused by gyratory moment).

As a result, these angular contact ball bearings inhibit temperature buildup and ensure ultra-high speed.

■High bearing rigidity for high accuracy of manufactured products

The Young's modulus of ceramic material is approximately 1.5 times that of bearing steel. The rigidity of these angular contact ball bearings is therefore greatly increased.

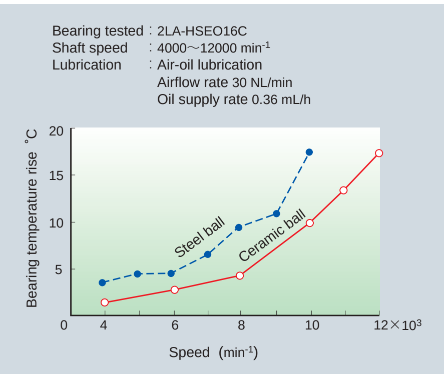


Fig. 9.15 Comparison of temperature rise between bearings with ceramic balls and those with steel balls

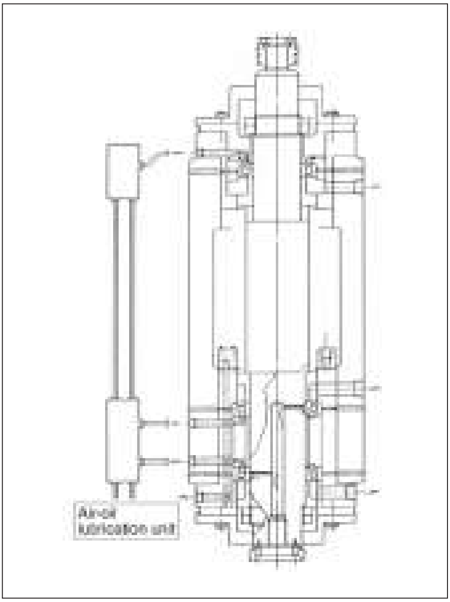


Fig. 9.16 Test rig for measuring temperature rise

Table 9.24 Comparison of physical properties between ceramic and steel balls

Item	Ceramic (Si_3N_4)	Bearing steel (SUJ2)
Density (g/cm³)	3.304	7.8
Young's modulus (GPa)	315	210
Poisson's ratio	0.25	0.3
Thermal expansion ($\times 10^{-6}$/°C)	3.2	12.5
Thermal conductivity ratio (Cal/cm·s·°C)	0.07	0.1～0.12

⑪ Operating life of bearings with ceramic balls

Test conditions

Bearing tested : 6206
Bearing load : 6860 N {700 kgf}
Shaft speed : 2000 min^{-1}
Lubrication : Class 1 turbine oil (VG56), circulating lubrication

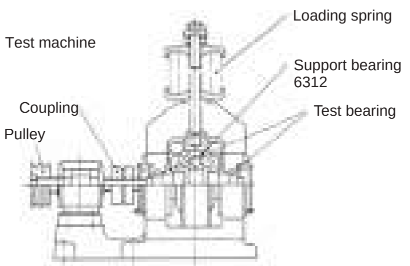


Fig. 9.17 Radial load-type bearing life test machine

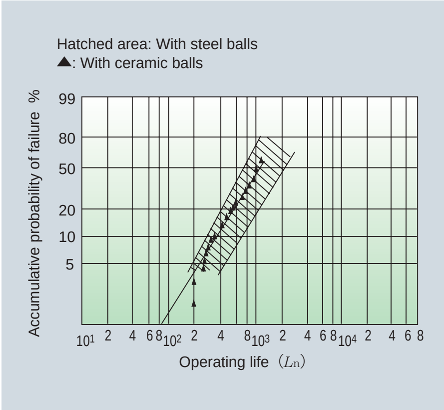


Fig. 9.18 Operating life of ball bearing with ceramic balls

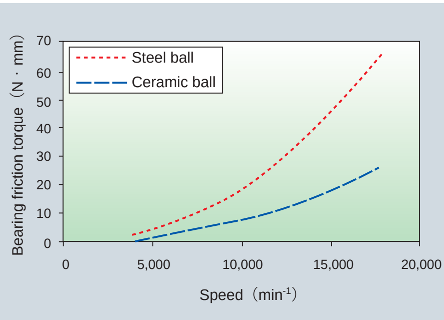


Fig. 9.19 Frictional torque

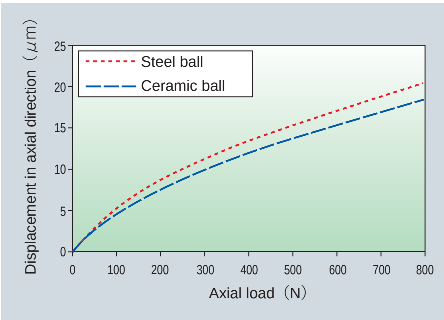


Fig. 9.20 Displacement in axial direction

⑫ Recommended lubrication

Angular contact ball bearings are usually used with grease lubrication or air-oil lubrication. Recommended lubrication specifications are described below.

■Grease lubrication

● **Recommended brand of grease**

Refer to 7. Lubrication of Bearings, 7-1 Grease lubrication in the Technical Data section.

● **Recommended grease fill**

$d_m n$ value≦0.65×10^6

15% of the capacity shown in the dimension tables

$d_m n$ value＞0.65×10^6

12% of the capacity shown in the dimension tables

● **Recommended grease filling method**

Refer to 6. Handling of Bearings, 6-1 Cleaning of bearings and filling with grease in the Technical Data section.

● **Notes**

Grease-lubricated sealed angular contact ball bearings (79 LLB/70 LLB type, and BNS type bearings) are prefilled with long-life SE-1 grease. Wipe rust preventive oil from the outside of the bearing with a clean cloth.

■Air-oil lubrication

● **Recommended location of nozzle**

Refer to 7. Lubrication of Bearings, 7-2 Air-oil lubrication in the Technical Data section.

● Recommended specifications of nozzle

Nozzle bore dia.: 1 to 1.5 mm

Number of nozzles: One nozzle per bearing, depth of nozzle bore should be four to six times as large as the bore diameter.

● Recommended specifications of air-oil

Oil type: Spindle oil

Viscosity grade: ISO VG from 10 to 32 (32 is preferable)

Table. 9.25 Air and oil amount

Bearing type	$d_m n$ value ($\times10^6$)		Oil valume per shot	Lubrication intervals	Oil consumption	Recommended air consumption
	Over	Incl.	mL	min	mL/h	*NL/min
78C,79U,70U, 72C		～ 1.0	0.03	8	0.23	20～40
HSE9, HSE0	1.0	～ 1.5		5	0.36	
HSF	1.5	～ 2.6		2	0.90	
HSL		～ 2.6		10	0.18	
HSFL						
HSEW		～ 2.2				

*N ℓ /min (Normal liter/minute) ... N ℓ means the volume of air at 0˚C and 1 atmosphere.

Note) The amount of oil and air needs to be adjusted to suit the spindle structure or the differences in discharge channels.
Set the amounts after checking with actual machine tests.

⑬ ULTAGE Standard angular contact ball bearings 79U and 70U types

ULTAGE 79U and 70U series bearings were developed from standard angular contact ball bearings (79 and 70). Optimized internal design and adoption of a new resin cage allows high-speed operation and ensures high rigidity.

■Features

1. Optimized internal design enables high-speed operation and high rigidity.
2. A new resin cage enables improvement in grease retention for grease lubrication and enhanced performance in feeding and discharge of oil for air-oil lubrication.
3. Bearings are available with either steel or ceramic balls.
4. Three contact angles (15˚, 20˚, and 30˚) are available to handle a wide range of applications.

■Bearing specifications

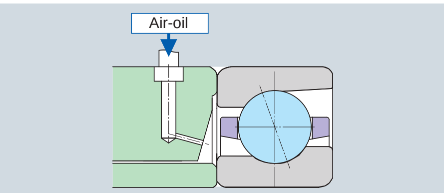


Fig. 9.21 79U and 70U types

Photo 9.1 New resin cage

■High-speed operation

Optimized internal design and adoption of a new resin cage enable stable operation at $d_m n$ value 0.95×10⁶, with grease lubrication.

【Test conditions】

Test Bearing	7010UCDB (φ50×φ80×16)
Shaft speed	0~15000 min⁻¹
Preload after assembled	200 N (Fixed position preloading)
Grease lubrication	NBU15

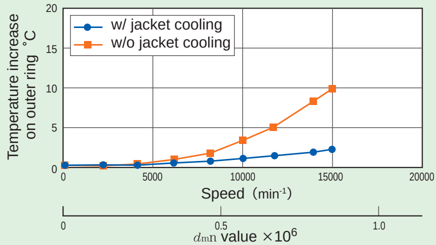


Fig. 9.22 High-speed test with grease lubrication

Stable operation is possible with $d_m n$ value 1.5×10⁶, with air-oil lubrication.

【Test conditions】

Tested Bearing	7010UCDB (φ50×φ80×16)
Speed	0~23000 min⁻¹
Preload after assembled	200 N (Fixed position preloading)
Air-oil lubrication	0.03 mL/shot (oil injection intervals: 5 min, air consumption: 40 NL/min)

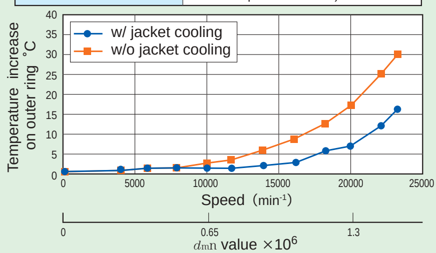
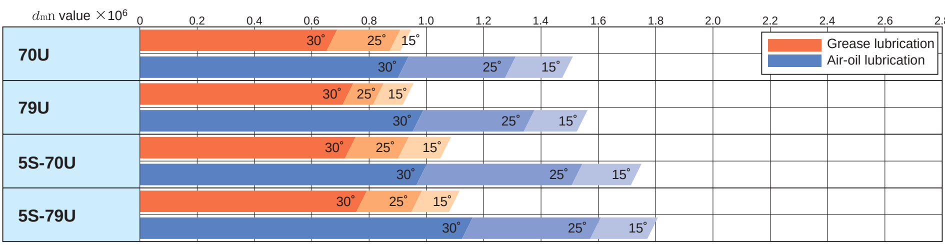


Fig. 9.23 High-speed test with air-oil lubrication

■Permissible speed range



Notes) Permissible speed of each bearing ($d_m n$ value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement), and then, contact **NTN** Engineering for technical assistance.

⑭ ULTAGE High-speed angular contact ball bearings HSE type

The HSE type employs a special material featuring greatly improved wear resistance and anti-seizure properties as well as a special surface modification technique. Furthermore, thanks to an optimized internal design, this type achieves high speed, high rigidity and high reliability.

■Features

1. Adoption of special materials and a unique internal design improve anti-seizure properties (15 times better than the conventional type) and wear resistance (6 times better than of the conventional type).
2. Optimized internal design enables high-speed operation and high rigidity.
3. Bearings are available with either steel or ceramic balls.
4. Three contact angles (15˚, 20˚, and 25˚) are available to handle a wide range of applications.

■Bearing specification

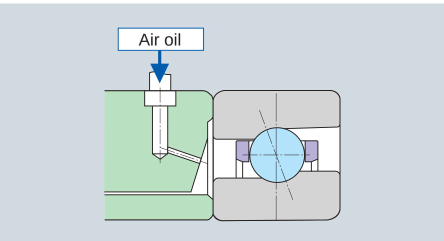


Fig. 9.24 HSE type

Preload and low temperature rise

The 5S-HSE type features high speed and limited temperature increase. Even if its preload is increased after assembly into the spindle, it maintains stable performance at high speeds (**Fig. 9.25**).

【Test condition】

Test bearing	5S-2LA-HSE020 (contact angle 20˚) (φ100×φ150×24×2 rows)
Shaft speed	0～15000 min^{-1}
ubricatio n	Air-oil lubrication
Oil consumption	0.03 mL/shot (Oil shot intervals 5 min)
Air consumption	40NL/min
Outer casing cooling	Provided

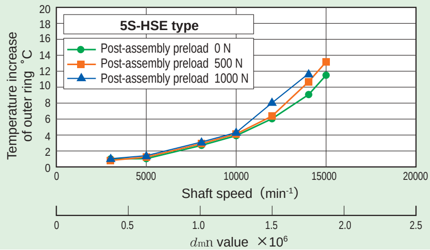


Fig. 9.25 elationship bet een preload and te perature increase

Improved main spindle rigidity

When built into a high-speed main spindle, the preload of the 5S-HSE standard type is maintained, allowing high rigidity (1.9 times greater than a conventional bearing) (**Fig. 9.26**).

【Test condition】

Test bearing	5S-HSB020 (contact angles 15˚and 20˚) 5S-2LA-HSE020 (contact angle 20˚) (φ100×φ150×24×2 rows)	
Post-assembly preload	5S-HSB020	0 N
	5S-HSE020	500 N

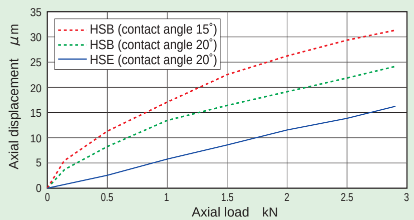
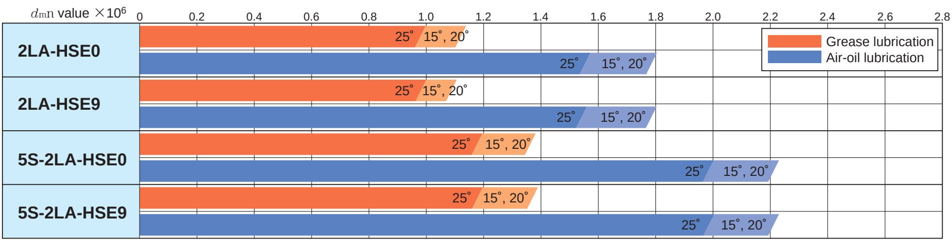


Fig. 9.26 Comparison of rigidity relative to conventional bearing (HSB type) in terms of post-assembly preload

■Permissible speed range



Notes) Permissible speed of each bearing (dmn value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and then contact **NTN** Engineering for technical assistance.

⑮ ULTAGE Super high-speed angular contact ball bearings HSF type

The HSF type realizes further improvement in high-speed running and inhibited temperature rise by adoption of smaller diameter ceramic balls, while retaining features of the HSE type. This type attains d_mn values as high as 2.6×10^6 with fixed pressure preloading.

■Features

1. Adoption of special materials and a unique internal design improve anti-seizure property (15 times better than the conventional type) and wear resistance (6 time better than the conventional type).
2. Optimized internal design enables high-speed operation and high rigidity.
3. Ceramic balls are used.
4. Initial contact angle is set to 25° to accommodate the change in contact angle during super high-speed operation.

■Bearing specification

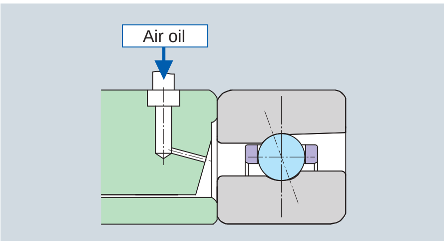


Fig. 9.27 HSF type

■Low temperature rise

Super high-speed 5S-HSF series angular contact ball bearings utilize smaller balls than those of the high-speed HSE series. This reduces heating due to centrifugal force and ensures lower temperature rise. Thus, the 5S-HSF type boasts an approximately 10% reduction in temperature rise as compared to the 5S-HSE type. (**Fig. 9.28**)

【Test condition】

Test bearing	5S-2LA-HSE020 (contact angle 20°) 5S-2LA-HSF020 (contact angle 25°) (φ100×φ150×24×2 rows)
Shaft speed	0～14000 min⁻¹
Lubrication	Air-oil lubrication
Oil consumption	0.03 mL/shot (Oil shot intervals 5 min)
Air consumption	40NL/min
Outer casing cooling	None

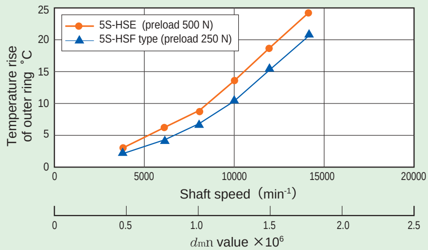
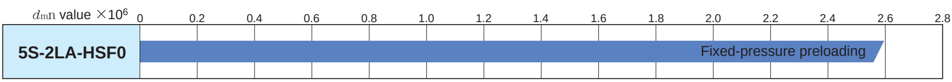


Fig. 9.28 o parison o te perature rise

■Permissible speed range



Notes) Permissible speed of each bearing (d_mn value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and contact **NTN** Engineering for technical assistance.

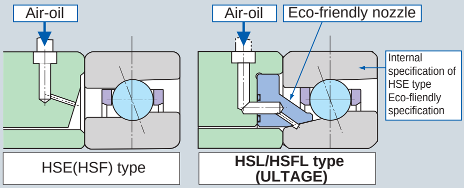
⑯ ULTAGE Eco-friendly air-oil lubricated angular contact ball bearings HSL type HSFL type

The HSL/HSFL type is an advanced variation of the HSE/HSF type, characterized by incorporation of **NTN**'s unique eco-conscious lubrication technology. The HSL type helps decrease oil mist emissions and consumption of air and oil, improving the working environment for machine tool operators and reducing energy consumption.

■Features

1. Adoption of special materials and a unique internal design improve anti-seizure properties (15 times better compared with the conventional type) and wear resistance (6 times better than the conventional type).
2. Bearings are available with either steel or ceramic balls (HSFL is available with ceramic balls only).
3. Adoption of eco-friendly nozzle reduces noise (reduction of 2 to 8 dBA), air consumption (reduction of 50 to 75%) and oil consumption (reduction of 20 to 90%)

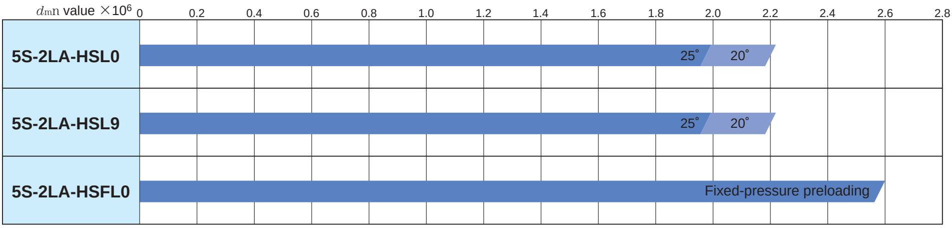
■Bearing specification



NOTE) The HSL/HSFL type is packed together with the spacer with the eco-fliendly nozzle. The bearing type code HSL represents the bearing proper, while a spacer code stands for an eco-conscious nozzle proper or a spacer having a built-in nozzle.
For more details, see "3. Bearing Designation".

Fig. 9.29 HSL and HSFL types

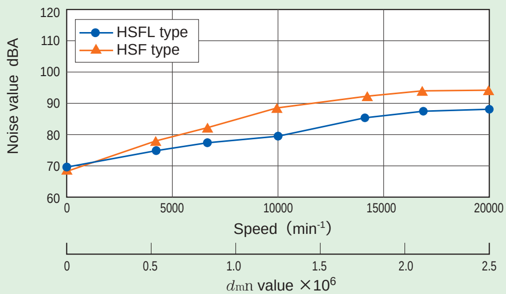
■Permissible speed range



Notes) Permissible speed of each bearing (d_mn value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and contact **NTN** Engineering for technical assistance.

Data 1

In the high-speed region of 10000 min^{-1}, the noise level of the HSL type is 6 dBA to 8 dBA lower than that of the conventional type (HSC type) (**Fig. 9.30**).



【Test conditions】

Test bearing	5S-2LA-HSFL020DB 5S-2LA-HSF020DB (φ100×φ150×24×2 rows)
Shaft speed	20000 min^{-1}
Preload	2.5 kN (constant pressure preloading)

Fig. 9.30 Comparison of noise levels

Data 2

For 5S-HSFL typebearings, the temperature of the outer rings remains stable even with an air consumption as low as 10 N ℓ /min (50 to 25% of the recommended air consumption for standard bearings) at a speed of 21000 min^{-1} ($d_m n$ value 2.6×10^6) (**Fig. 9.31**).

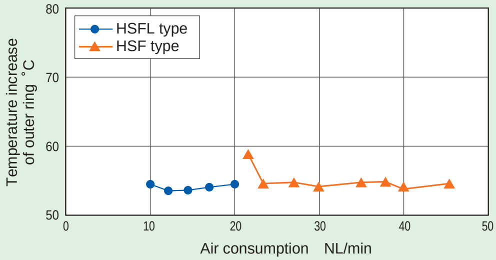


Fig. 9.31 Relationship between air consumption and temperature increase

【Test conditions】

Test bearing	5S-2LA-HSFL020DB 5S-2LA-HSF020DB (φ100×φ150×24×2 rows)
Shaft speed	21000 min^{-1}
Preload	2.5 kN (constant pressure preloading)
Oil consumption	0.03 mL/shot (oil shot intervals, 5 min)

Data 3

The 5S-HSFL type bearings can operate at 21000 min^{-1} ($d_m n$ value 2.6×10^6) with oil shot intervals of 21 min (reduction of 20 to 90% as compared with the recommended oil consumption for standard bearings) (**Fig. 9.32**).

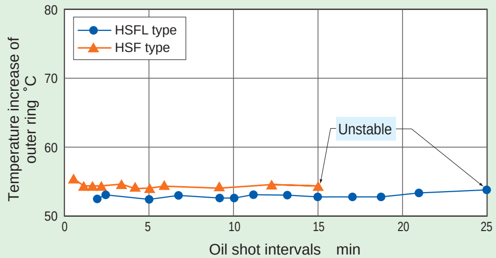


Fig. 9.32 Relationship between oil shot intervals and temperature increase

【Test conditions】

Test bearing	5S-2LA-HSFL020DB 5S-2LA-HSF020DB (φ100×φ150×24×2 rows)
Shaft speed	21000 min^{-1}
Preload	2.5 kN (constant pressure preloading)
Oil consumption	0.03 mL/shot
Air consumption	12.5 NL/min (HSFL) 30 NL/min (HSF)

Data 4

5S-HSL type bearings can reliably run at a speed of 19000 min^{-1} (fixed position preloading) (**Fig. 9.33**) with both decrease air and oil consumption.

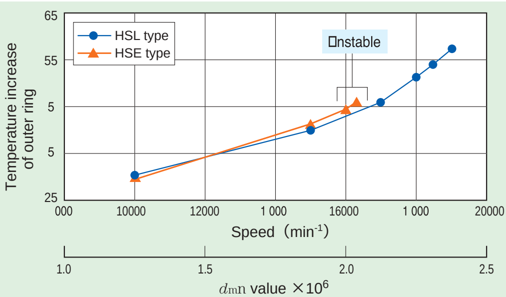


Fig. 9.33 High-speed test results (fixed position preloading)

【Test conditions】

Test bearing	5S-2LA-HSL020DB 5S-2LA-HSE020DB (φ100×φ150×24×2 rows)
Shaft speed	10000～19000 min^{-1}
Preload	After assembly, 0 (fixed position preloading)
Oil consumption	0.03 mL/shot (oil shot intervals, 10 min)
Air consumption	10 NL/min (HSL) 30 NL/min (HSE)

⑰ ULTAGE Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring – HSEW Type

HSEW type is an air-oil lubricated high-speed angular ball bearing equipped with re-lubricating holes on the outer ring of the HSE type. Because there is no requirement for providing a nozzle hole on the spacer, the spacer width can be kept short, contributing to the more compact main spindle and improvement of spindle rigidity due to the placement of the bearings on the tool tip side.

In addition, lubrication reliability is increased due to the direct lubrication from the outer ring, enabling the reduction of air consumption and the supplied oil amount.

■Bearing specification

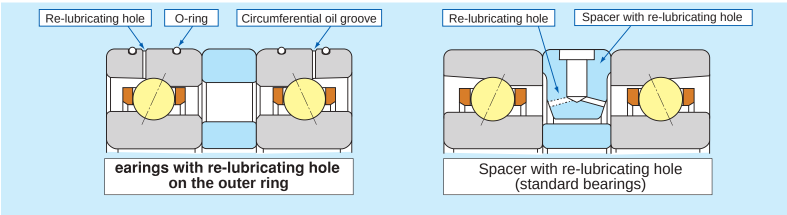
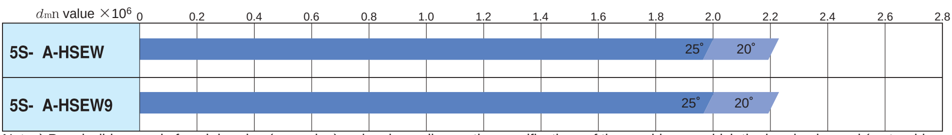


Fig. 9.34 HSEW Type

■Features

1. Compact main spindle design is possible due to the shorter spacer
2. Higher re-lubricating efficiency by the direct lubrication from the outer ring
3. Reduced noise level due to the air reduction effect

■Permissible speed range



Notes) Permissible speed of each bearing (d_mn value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and contact **NTN** Engineering for technical assistance.

■About chamfering of re-lubricating hole on the housing

Ensure to provide chamfering on the re-lubricating hole of the housing to avoid damage of outer O-ring when the HSEW type is inserted into the housing (**Fig. 9.35**).

We recommend that chamfering is only applied to the hole.

■About phases of re-lubricating hole on the housing and re-lubricating hole on the outer ring

For producing the air reduction effect, be sure to stagger the position of re-lubricating hole on the housing and re-lubricating hole on the outer ring.

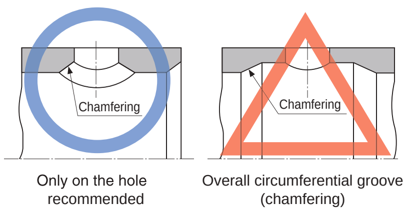


Fig. 9.35 Chamfering of re-lubricating hole on the housing

■Data 1

For the HSEW type bearings, the temperature of the outer rings remains stable even with an air consumption as low as 20 Nℓ/min (1/2 of the recommended air consumption for standard bearings) at a speed of 18,000 min^{-1} ($d_m n$ value 2.25×10^6) (**Fig. 9.36**).

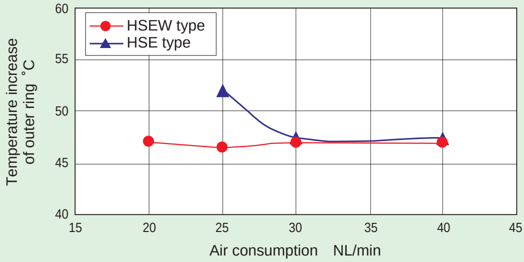


Fig. 9.36 Relationship between air consumption and temperature increase

【Test conditions】

Test bearing	5S-2LA-HSEW020 5S-2LA-HSE020 (φ100×φ150×24×2 rows)
Shaft speed	18000 min^{-1}
Preload	98 N after assembled (Fixed position preloading)
Oil consumption	0.03 mL/shot (oil shot intervals) HSEW : 10 min, HSE : 5 min

■Data 2

The HSEW type bearings can operate at 18,000 min^{-1} ($d_m n$ value 2.25×10^6) with an oil shot interval of 20 min (1/4 of the recommended oil consumption for standard bearings) (**Fig. 9.37**).

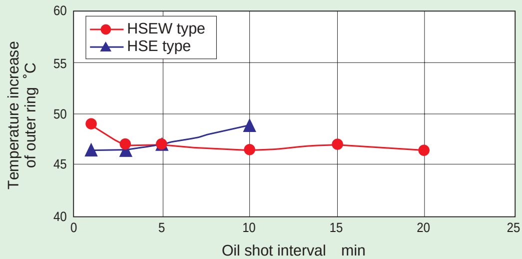


Fig. 9.37 Relationship between oil shot interval and temperature increase

【Test conditions】

Test bearing	5S-2LA-HSEW020 5S-2LA-HSE020 (φ100×φ150×24×2 rows)
Shaft speed	18000 min^{-1}
Preload	98 N after assembled (Fixed position preloading)
Air consumption	HSEW : 20NL/min HSE : 40NL/min
Oil consumption	0.03ml/shot

■Data 3

The HSEW type has achieved reduced noise level compared with the HSE type (**Fig. 9.38**).

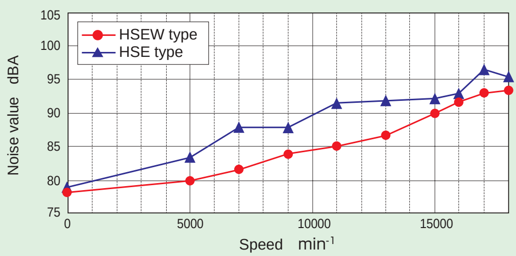


Fig. 9.38 Comparison of noise levels

【Test conditions】

Test bearing	5S-2LA-HSEW020 5S-2LA-HSE020 (φ100×φ150×24×2 rows)
Shaft speed	18000 min^{-1}
Preload	98 N after assembled (Fixed position preloading)
Air consumption	HSEW : 20NL/min HSE : 40NL/min
Oil consumption	0.03 mL/shot (oil shot intervals) HSEW : 10 min, HSE : 5 min

⑱ ULTAGE Grease-lubricated sealed standard angular contact ball bearings 79LLB and 70LLB, 5S-79LLB and 5S-70LLB types

The 79LLB and 70LLB types are grease-lubricated, eco-friendly bearings that can achieve stable high-speed operation with limited temperature rise.
They can allow, longer service life and preservation of healthy working environment for rotating tools with shaft diameters less than 50 mm.

■Features

1. Internal design is optimized for high-speed operation and limited temperature rise.
2. Longer grease life due to adoption of special grease and non-contact seals for grease retention.
3. Contact angles of 15˚ and 25˚ are available.
4. The standard types meet special precision P42 requirements (dimensional precision JIS P4 and running accuracy JIS P2).
5. Seals of different colors are used for front (black) and back (orange) sides. Bearing configuration can be easily identified by color.
6. Available with either steel or ceramic balls.

■Bearing specifications

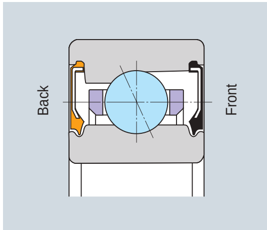


Fig. 9.39
79LLB and 70LLB types

■Simplified main spindle configuration

Due to the optimized internal structure, the 79LLB and 70LLB types can reliably run at a higher speed with grease lubrication. The grease lubricating system is virtually free from oil mist emission, and contributes to a simpler main spindle structure, reduction in environmental impact and decrease in cost. (**Fig. 9.40**)

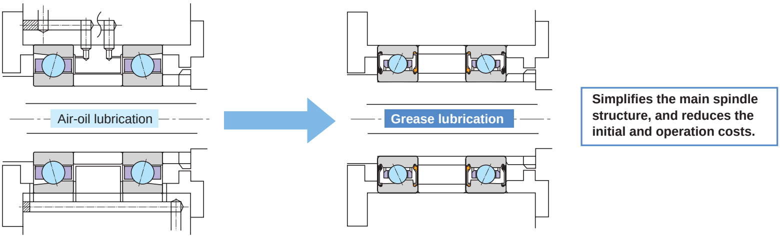
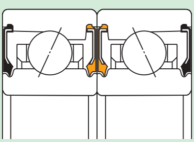
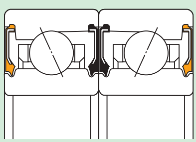


Fig. 9.40 Modification of lubrication system (air-oil lubrication to grease lubrication)

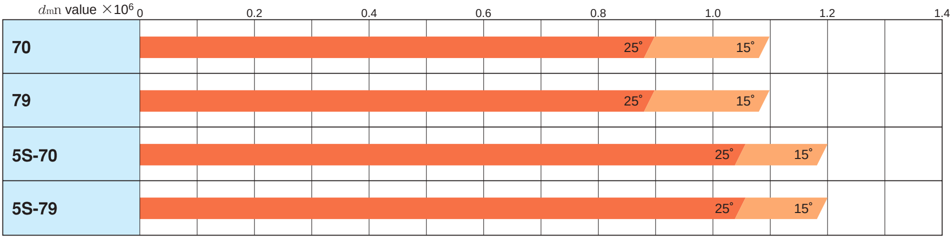
■Easier handling with 79LLB and 70LLB types

The 79LLB and 70LLB types are prefilled with grease. They can be readily used after only wiping away rust preventive oil. Seals of different colors are used for the front and back sides of the bearing. Black seals are used for the front sides and orange seals are used for the back sides, so configurations are readily identified by colors. (**Table 9.26**)

Table 9.26 Bearing Combinations and Seal Colors

DB set (back faces in combination)	DF set (front faces in combination)
Orange seal ＋ Orange seal	Black seal ＋ Black seal
 	 

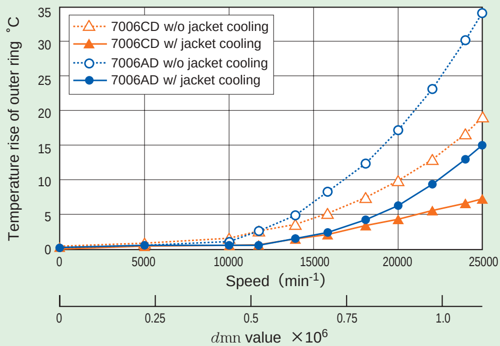
■Permissible speed range



Notes) Permissible speed of each bearing (dmn value) varies depending on the specifications of the machine on which the bearing is used (motor drive s stem cooling s stem and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and contact **NTN** ngineering for technical assistance.

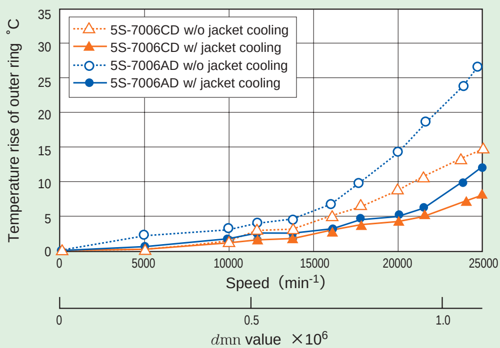
■High-speed test

Optimization of the internal design promotes stable operation of dmn value 1.1×10⁶. (**Figs.9.41** and **9.42**)



Tested bearing	7006CDLLBDBP42 7006ADLLBDBP42 (φ30×φ55×13×2 rows)
Shaft speed	0~25000 min-1
Pre-load after assembled	180 N (5S-7006CDLLB) 250 N (5S-7006ADLLB)

Fig. 9.41 High-speed test results (7006CD, contact angle 15°) (7006AD, contact angle 25°)



【Test conditions】

Tested bearing	5S-7006CDLLBDBP42 5S-7006ADLLBDBP42 (φ30×φ55×13×2 rows)
Shaft speed	0~25000 min-1
Pre-load after assembled	180 N (5S-7006CDLLB) 250 N (5S-7006ADLLB)

Fig. 9.42 High-speed test results (5S-7006CD, contact angle 15°) (5S-7006AD, contact angle 25°)

⑲ ULTAGE Grease-lubricated sealed angular contact ball bearings BNS LLB and 5S-2LA-BNS LLB types

By the optimized material and internal structure, BNS LLB type bearings have excellent performance at higher speeds. This helps to reduce pollution and cost.

■Features

1. Adoption of special materials and unique internal design improve anti-seizure properties (15 times better than the conventional type) and wear resistance (6 times better than the conventional type).
2. Optimized internal design enables high-speed operation and high rigidity.
3. Available with either steel or ceramic balls.
4. Adoption of grease pockets, special grease, and non-contact seals improves service life of the grease.

■Bearing specification

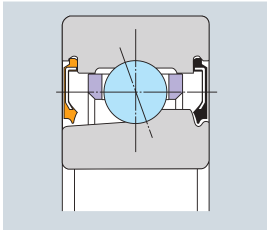


Fig. 9.43 BNS LLB type

■Simplified main spindle configuration

BNS LLB type bearings can reliably operate at a higher speed with grease lubrication. The grease lubrication system is virtually free from oil mist emission can simplify the main spindle structure, reduce pollution and decrease cost **(Fig. 9.44**).

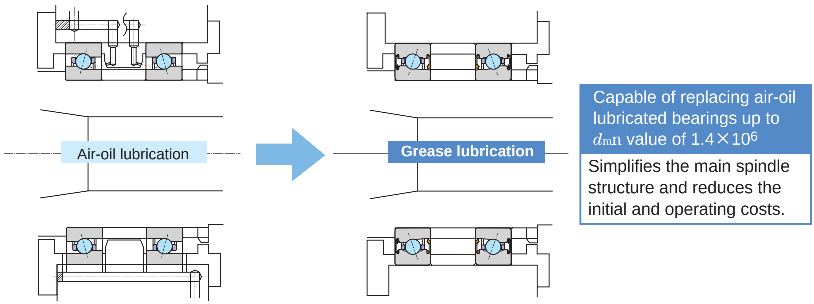
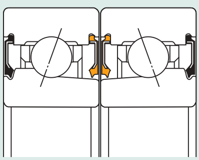
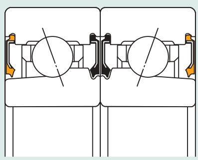


Fig. 9.44 Modification of lubrication system (air-oil lubrication to grease lubrication)

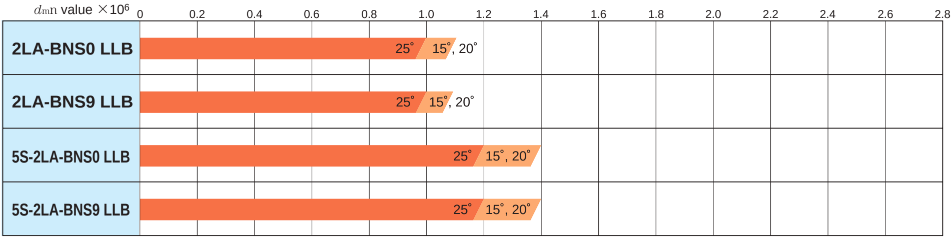
■Easier handling with BNS LLB type

The BNS LLB type has been packed with grease in advance. They can be used after wiping away rust preventive oil. Seals in different colors are used for the front and back sides of the bearings. Black seals are used for the front sides and orange seals are used for the back sides, so configurations can be easily identified by color. (**Table 9.27**)

Table 9.27 Bearing Combinations and Seal Colors

DB set (back faces in combination)	DF set (front faces in combination)
Orange seal + Orange seal	Black seal + Black seal
 	 

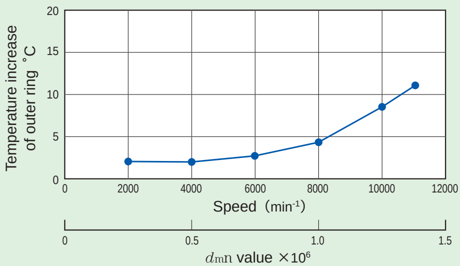
■Permissible speed range



Notes) Permissible speed of each bearing ($d_{m}n$ value) varies depending on the specifications of the machine on which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline (for two-row arrangement) and contact **NTN** Engineering for technical assistance.

Temperature increase

5S-2LA-BNS LLB type bearings exhibit stable temperature increase up to a $d_{m}n$ value of 1.4×10⁶ (**Fig. 9.45**).



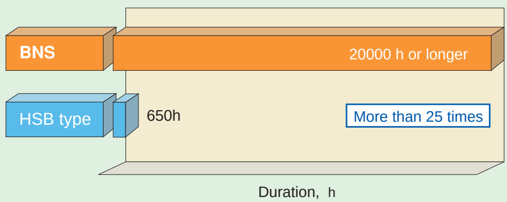
【Test conditions】

Test bearing	5S-2LA-BNS020 LLBDB (φ100×φ150×24×2 rows)
Shaft speed	11000 min⁻¹
Outer casing cooling	Provided

Fig. 9.45 High-speed test results

Durability test

As a result of optimized design (such as grease reservoir) and special grease, 5S-2LA-BNS LLB type bearing have successfully achieved continuous operation in excess of 20,000 hours at a $d_{m}n$ value of 1.4×10⁶ (**Fig. 9.46**).



【Test conditions】

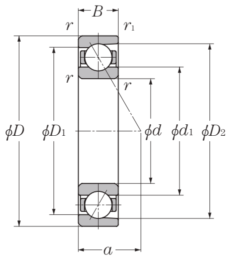
Test bearing	5S-2LA-BNS020 LLBDB 5S-HSB020C (φ100×φ150×24×2 rows)
Shaft speed	11000 min⁻¹
Preload	After assembly, 0
Outer casing cooling	Provided

Fig. 9.46 Durability test results

⑳ Dimension tables for angular contact ball bearings

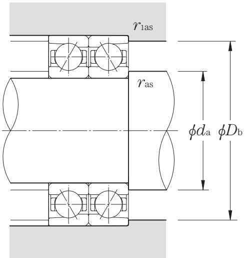
Standard angular contact ball bearings (steel ball type) 78 series

Contact angle 15° d 25～170mm

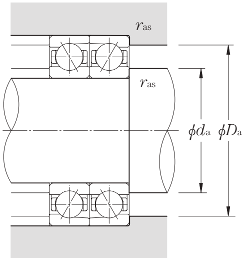


Part number	Boundary dimensions mm					Basic load ratings dynamic C_r kN	static C_{or} kN	dynamic C_r kgf	static C_{or} kgf	Static axial load capacity kN	kgf	Factor f_o	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶									
7805C	25	37	7	0.3	0.15	5.05	3.85	515	390	1.04	106	16.2	27 100	36 100
7806C	30	42	7	0.3	0.15	5.35	4.50	545	460	1.20	122	16.5	23 300	31 100
7807C	35	47	7	0.3	0.15	5.80	5.25	590	535	1.41	144	16.4	20 500	27 300
7808C	40	52	7	0.3	0.15	6.05	5.75	615	585	1.57	160	16.2	18 300	24 300
7809C	45	58	7	0.3	0.15	6.25	6.25	640	640	1.73	176	16.0	16 300	21 700
7810C	50	65	7	0.3	0.15	7.90	8.05	805	820	2.31	236	16.1	14 600	19 500
7811C	55	72	9	0.3	0.15	13.1	12.7	1 330	1 300	5.55	565	16.4	13 200	17 600
7812C	60	78	10	0.3	0.15	13.4	13.6	1 370	1 390	6.00	610	16.3	12 200	16 200
7813C	65	85	10	0.6	0.3	14.1	14.9	1 440	1 520	5.30	540	16.2	11 200	14 900
7814C	70	90	10	0.6	0.3	14.5	15.8	1 470	1 610	7.10	720	16.1	10 500	14 000
7815C	75	95	10	0.6	0.3	14.8	16.7	1 510	1 700	6.00	615	16.0	9 900	13 200
7816C	80	100	10	0.6	0.3	15.1	17.6	1 540	1 790	7.95	810	15.9	9 300	12 400
7817C	85	110	13	1	0.6	22.1	24.7	2 250	2 520	10.7	1 090	16.1	8 600	11 500
7818C	90	115	13	1	0.6	22.7	26.1	2 320	2 670	10.5	1 070	16.1	8 200	10 900
7819C	95	120	13	1	0.6	23.4	27.6	2 380	2 820	12.1	1 240	16.0	7 800	10 400
7820C	100	125	13	1	0.6	23.5	28.3	2 400	2 890	12.5	1 270	16.0	7 500	10 000
7821C	105	130	13	1	0.6	24.1	29.8	2 460	3 050	13.2	1 340	15.9	7 100	9 500
7822C	110	140	16	1	0.6	34.5	42.5	3 550	4 350	21.0	2 140	16.1	6 700	9 000
7824C	120	150	16	1	0.6	35.0	44.5	3 600	4 550	22.1	2 260	16.0	6 200	8 300
7826C	130	165	18	1.1	0.6	47.0	59.5	4 750	6 050	28.4	2 900	16.1	5 700	7 600
7828C	140	175	18	1.1	0.6	47.5	62.5	4 850	6 350	30.0	3 050	16.0	5 300	7 100
7830C	150	190	20	1.1	0.6	60.5	79.5	6 150	8 100	48.5	4 950	16.1	4 900	6 600
7832C	160	200	20	1.1	0.6	62.0	83.5	6 300	8 500	41.0	4 200	16.0	4 700	6 200
7834C	170	215	22	1.1	0.6	76.0	102	7 750	10 400	49.0	4 950	16.1	4 400	5 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

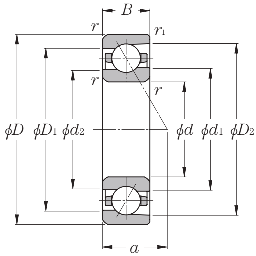
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

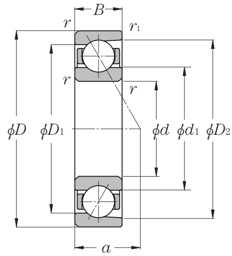
Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	Single-row (approx.)	d_1	D_1	D_2	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
7.7	0.8	0.021	28.6	33.2	34.6	27.5	34.5	35.8	0.3	0.15	**7805C**
8.3	1.1	0.025	33.6	38.4	39.6	32.5	39.5	40.8	0.3	0.15	**7806C**
9.0	1.3	0.028	38.6	43.4	44.6	37.5	44.5	45.8	0.3	0.15	**7807C**
9.7	1.4	0.031	43.6	48.4	49.6	42.5	49.5	50.8	0.3	0.15	**7808C**
10.4	1.6	0.039	49.1	53.9	55.1	47.5	55.5	56.8	0.3	0.15	**7809C**
11.2	1.8	0.049	54.8	60.2	61.6	52.5	62.5	63.8	0.3	0.15	**7810C**
13.0	3.2	0.079	60.1	66.9	69.2	57.5	69.5	70.8	0.3	0.15	**7811C**
14.3	3.9	0.10	65.6	72.4	74.7	62.5	75.5	76.8	0.3	0.15	**7812C**
15.1	4.4	0.12	71.4	78.6	80.7	69.5	80.5	82.5	0.6	0.3	**7813C**
15.7	5.1	0.13	76.6	83.4	85.7	74.5	85.5	87.5	0.6	0.3	**7814C**
16.4	5.0	0.14	81.4	88.6	90.7	79.5	90.5	92.5	0.6	0.3	**7815C**
17.1	5.7	0.15	86.6	93.4	95.7	84.5	95.5	97.5	0.6	0.3	**7816C**
19.6	9.8	0.26	93.1	101.9	104.9	90.5	104.5	105.5	1	0.6	**7817C**
20.3	11	0.27	98.0	107.0	109.8	95.5	109.5	110.5	1	0.6	**7818C**
20.9	11	0.28	103.1	111.9	114.8	100.5	114.5	115.5	1	0.6	**7819C**
21.6	12	0.30	108.1	116.9	119.8	105.5	119.5	120.5	1	0.6	**7820C**
22.3	13	0.31	113.1	122.0	124.8	110.5	124.5	125.5	1	0.6	**7821C**
24.8	19	0.49	119.8	130.2	134.0	115.5	134.5	135.5	1	0.6	**7822C**
26.1	20	0.52	129.8	140.2	144.0	125.5	144.5	145.5	1	0.6	**7824C**
28.8	28	0.91	141.3	153.7	158.1	137	158	160.5	1	0.6	**7826C**
30.1	30	0.97	151.3	163.7	168.1	147	168	170.5	1	0.6	**7828C**
32.8	45	1.33	163.4	177.1	182.2	157	183	185.5	1	0.6	**7830C**
34.2	46	1.41	172.9	187.1	192.2	167	193	195.5	1	0.6	**7832C**
36.8	53	1.87	184.4	200.6	206.3	177	208	210.5	1	0.6	**7834C**

ULTAGE Standard angular contact ball bearings (steel ball type) 79 series

Contact angle 15° d 10～170mm



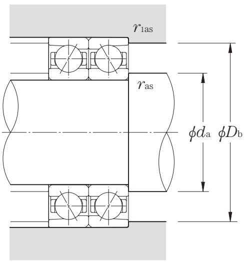
d=10～130



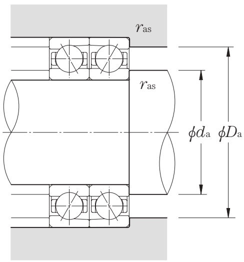
d=140～170

Part number	Boundary dimensions (mm)					Basic load ratings: dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed (min^{-1})	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	kN	kgf	f_o	grease lubrication	oil lubrication
7900UC	10	22	6	0.3	0.15	3.20	1.65	325	169	2.40	245	14.2	73 200	117 200
7901UC	12	24	6	0.3	0.15	3.35	1.86	340	189	2.61	267	14.7	65 100	104 100
7902UC	15	28	7	0.3	0.15	5.10	2.90	520	296	3.85	395	14.4	54 500	87 200
7903UC	17	30	7	0.3	0.15	5.35	3.20	545	325	4.15	425	14.8	49 900	79 800
7904UC	20	37	9	0.3	0.15	7.65	4.90	780	500	6.45	655	14.9	41 100	65 800
7905UC	25	42	9	0.3	0.15	8.15	5.75	835	590	7.35	750	15.5	35 000	56 000
7906UC	30	47	9	0.3	0.15	8.60	6.60	880	675	8.20	840	15.9	30 400	48 700
7907UC	35	55	10	0.6	0.3	13.7	10.3	1 400	1 050	13.7	1 400	15.5	26 000	41 700
7908UC	40	62	12	0.6	0.3	14.5	11.8	1 480	1 200	15.4	1 570	15.9	23 000	36 800
7909UC	45	68	12	0.6	0.3	17.9	14.8	1 830	1 510	19.4	1 980	15.8	20 700	33 200
7910UC	50	72	12	0.6	0.3	18.9	16.6	1 930	1 700	21.4	2 190	16.1	19 200	30 700
7911UC	55	80	13	1	0.6	19.7	18.5	2 010	1 890	23.4	2 390	16.3	17 400	27 800
7912UC	60	85	13	1	0.6	20.5	20.3	2 090	2 080	25.5	2 600	16.5	16 200	25 900
7913UC	65	90	13	1	0.6	20.8	21.2	2 120	2 160	26.5	2 700	16.5	15 100	24 200
7914UC	70	100	16	1	0.6	29.7	30.0	3 050	3 100	38.0	3 850	16.4	13 800	22 100
7915UC	75	105	16	1	0.6	30.0	31.5	3 050	3 250	39.5	4 000	16.5	13 000	20 800
7916UC	80	110	16	1	0.6	30.5	33.0	3 100	3 350	41.0	4 200	16.5	12 300	19 600
7917UC	85	120	18	1.1	0.6	41.0	44.0	4 200	4 500	54.0	5 500	16.5	11 400	18 300
7918UC	90	125	18	1.1	0.6	41.5	46.0	4 250	4 700	56.0	5 700	16.6	10 900	17 400
7919UC	95	130	18	1.1	0.6	42.5	47.5	4 300	4 850	58.0	5 950	16.5	10 400	16 700
7920UC	100	140	20	1.1	0.6	54.5	61.0	5 550	6 200	76.5	7 800	16.5	9 800	15 600
7921UC	105	145	20	1.1	0.6	55.0	63.5	5 600	6 500	79.5	8 100	16.6	9 400	15 000
7922UC	110	150	20	1.1	0.6	56.0	65.5	5 700	6 700	82.5	8 400	16.5	9 000	14 400
7924UC	120	165	22	1.1	0.6	69.0	81.5	7 050	8 300	100	10 200	16.6	8 200	13 200
7926UC	130	180	24	1.5	1	85.0	102	8 650	10 400	128	13 000	16.5	7 600	12 100
7928CT1B	140	190	24	1.5	1	83.5	101	8 500	10 300	48.0	4 900	16.5	5 100	6 600
7930CT1B	150	210	28	2	1	108	132	11 000	13 400	60.5	6 200	16.5	4 700	6 100
7932CT1B	160	220	28	2	1	109	136	11 100	13 900	63.0	6 400	16.5	4 400	5 700
7934CT1B	170	230	28	2	1	113	145	11 500	14 800	79.0	8 050	16.4	4 200	5 400

❶ Minimum allowable value for corner radius dimension r or r_1.
A part number containing a suffix **U** means an **ULTAGE Series**.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

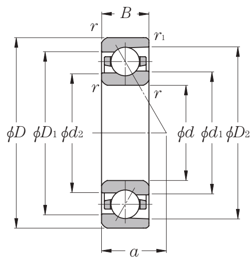
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
5.2	0.4	0.01	14.3	13.5	17.7	19.4	12.5	19.5	20.8	0.3	0.15	**7900UC**
5.4	0.4	0.01	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**7901UC**
6.4	0.8	0.02	19.3	18.3	23.7	25.6	17.5	25.5	26.8	0.3	0.15	**7902UC**
6.7	0.8	0.02	21.3	20.3	25.7	27.8	19.5	27.5	28.8	0.3	0.15	**7903UC**
8.3	1.5	0.04	25.9	24.7	31.1	33.6	22.5	34.5	35.8	0.3	0.15	**7904UC**
9.0	1.8	0.04	30.9	29.7	36.1	38.6	27.5	39.5	40.8	0.3	0.15	**7905UC**
9.7	2.0	0.05	35.9	34.7	41.1	43.6	32.5	44.5	45.8	0.3	0.15	**7906UC**
11.1	3.4	0.07	41.6	39.9	48.4	51.7	39.5	50.5	52.5	0.6	0.3	**7907UC**
12.9	4.7	0.11	47.6	45.9	54.4	57.8	44.5	57.5	59.5	0.6	0.3	**7908UC**
13.6	5.9	0.12	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**7909UC**
14.2	6.2	0.13	57.2	55.3	64.9	68.5	54.5	67.5	69.5	0.6	0.3	**7910UC**
15.6	7.5	0.18	63.7	61.8	71.4	75.1	60.5	74.5	75.5	1	0.6	**7911UC**
16.3	8.0	0.19	68.7	66.8	76.4	80.1	65.5	79.5	80.5	1	0.6	**7912UC**
16.9	8.6	0.21	73.7	71.8	81.4	85.1	70.5	84.5	85.5	1	0.6	**7913UC**
19.4	14	0.34	80.3	78.0	89.7	94.3	75.5	94.5	95.5	1	0.6	**7914UC**
20.1	15	0.36	85.3	83.0	94.7	99.3	80.5	99.5	100.5	1	0.6	**7915UC**
20.8	16	0.38	90.8	88.5	100.2	104.8	85.5	104.5	105.5	1	0.6	**7916UC**
22.8	22	0.54	96.9	94.3	108.1	113.5	92	113	115.5	1	0.6	**7917UC**
23.5	23	0.56	101.9	99.3	113.1	118.5	97	118	120.5	1	0.6	**7918UC**
24.1	24	0.59	106.9	104.3	118.1	123.5	102	123	125.5	1	0.6	**7919UC**
26.1	33	0.81	113.6	110.5	126.4	132.7	107	133	135.5	1	0.6	**7920UC**
26.8	34	0.84	118.6	115.5	131.4	137.7	112	138	140.5	1	0.6	**7921UC**
27.5	36	0.87	123.6	120.5	136.4	142.7	117	143	145.5	1	0.6	**7922UC**
30.2	48	1.19	135.2	131.7	149.8	156.8	127	158	160.5	1	0.6	**7924UC**
32.9	63	1.57	146.9	143.0	163.2	171.0	138.5	171.5	174.5	1.5	1	**7926UC**
34.2	67	1.66	156.0	—	174.1	180.5	148.5	181.5	184.5	1.5	1	**7928CT1B**
38.2	100	2.59	169.5	—	190.5	198.0	160	200	204.5	2	1	**7930CT1B**
39.6	106	2.72	179.5	—	200.6	208.0	170	210	214.5	2	1	**7932CT1B**
40.9	109	2.89	190.0	—	210.5	218.0	180	220	224.5	2	1	**7934CT1B**

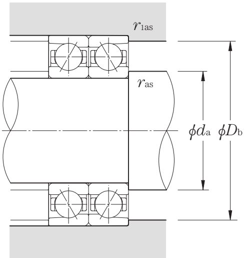
ULTAGE Standard angular contact ball bearings (steel ball type) 79 series

Contact angle 25° d 10～130mm

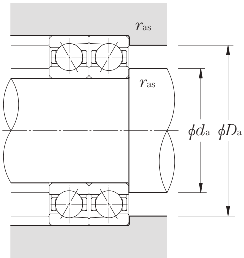


Part number	Boundary dimensions mm					Basic load ratings				Static axial load capacity		Limiting speed min⁻¹	
						dynamic kN	static kN	dynamic kgf	static kgf	kN	kgf	grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
7900UAD	10	22	6	0.3	0.15	3.05	1.58	310	161	1.77	180	63 400	102 500
7901UAD	12	24	6	0.3	0.15	3.20	1.77	325	181	1.92	196	56 400	91 100
7902UAD	15	28	7	0.3	0.15	4.85	2.77	495	283	2.81	287	47 200	76 300
7903UAD	17	30	7	0.3	0.15	5.10	3.05	520	310	3.00	310	43 200	69 800
7904UAD	20	37	9	0.3	0.15	7.25	4.65	740	475	4.70	480	35 600	57 500
7905UAD	25	42	9	0.3	0.15	7.75	5.50	790	560	5.35	545	30 300	49 000
7906UAD	30	47	9	0.3	0.15	8.15	6.30	830	640	6.00	610	26 400	42 600
7907UAD	35	55	10	0.6	0.3	13.0	9.75	1 320	995	10.1	1 030	22 600	36 400
7908UAD	40	62	12	0.6	0.3	13.7	11.2	1 400	1 140	11.3	1 160	19 900	32 200
7909UAD	45	68	12	0.6	0.3	17.0	14.1	1 730	1 440	14.6	1 490	18 000	29 000
7910UAD	50	72	12	0.6	0.3	17.9	15.8	1 820	1 610	16.2	1 650	16 600	26 900
7911UAD	55	80	13	1	0.6	18.6	17.5	1 900	1 790	17.7	1 800	15 000	24 300
7912UAD	60	85	13	1	0.6	19.4	19.1	1 970	1 950	19.2	1 960	14 000	22 600
7913UAD	65	90	13	1	0.6	19.6	19.7	2 000	2 010	19.9	2 030	13 100	21 200
7914UAD	70	100	16	1	0.6	28.0	28.6	2 860	2 920	27.9	2 840	11 900	19 300
7915UAD	75	105	16	1	0.6	28.4	29.6	2 900	3 000	29.0	2 960	11 300	18 200
7916UAD	80	110	16	1	0.6	28.7	30.5	2 930	3 100	30.0	3 050	10 600	17 200
7917UAD	85	120	18	1.1	0.6	38.5	41.5	3 950	4 250	39.5	4 000	9 900	16 000
7918UAD	90	125	18	1.1	0.6	39.5	43.0	4 000	4 400	41.0	4 200	9 400	15 300
7919UAD	95	130	18	1.1	0.6	40.0	44.5	4 050	4 500	42.5	4 350	9 000	14 600
7920UAD	100	140	20	1.1	0.6	51.0	57.5	5 200	5 850	56.0	5 750	8 500	13 700
7921UAD	105	145	20	1.1	0.6	52.0	59.0	5 300	6 050	58.5	5 950	8 100	13 100
7922UAD	110	150	20	1.1	0.6	52.5	61.0	5 400	6 250	60.5	6 150	7 800	12 600
7924UAD	120	165	22	1.1	0.6	65.0	76.0	6 650	7 750	73.5	7 500	7 100	11 500
7926UAD	130	180	24	1.5	1	80.0	95.0	8 150	9 700	94.0	9 550	6 600	10 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

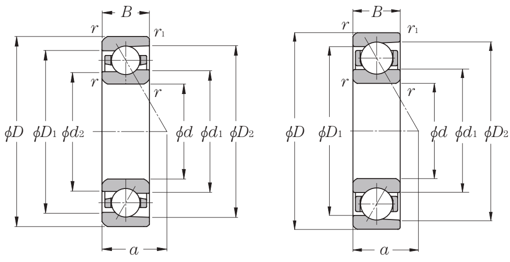
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm				Abutment and fillet dimensions mm					Part number
			d_1	d_2	D_1	D_2	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
6.8	0.4	0.01	14.3	13.5	17.7	19.4	12.5	19.5	20.8	0.3	0.15	**7900UAD**
7.2	0.4	0.01	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**7901UAD**
8.6	0.8	0.02	19.3	18.3	23.7	25.7	17.5	25.5	26.8	0.3	0.15	**7902UAD**
9.0	0.8	0.02	21.3	20.3	25.7	27.7	19.5	27.5	28.8	0.3	0.15	**7903UAD**
11.2	1.5	0.04	25.9	24.7	31.1	33.6	22.5	34.5	35.8	0.3	0.15	**7904UAD**
12.4	1.8	0.04	30.9	29.7	36.1	38.6	27.5	39.5	40.8	0.3	0.15	**7905UAD**
13.5	2.0	0.05	35.9	34.7	41.1	43.6	32.5	44.5	45.8	0.3	0.15	**7906UAD**
15.6	3.4	0.07	41.6	39.9	48.4	51.7	39.5	50.5	52.5	0.6	0.3	**7907UAD**
18.0	4.7	0.11	47.6	45.9	54.4	57.7	44.5	57.5	59.5	0.6	0.3	**7908UAD**
19.2	5.9	0.12	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**7909UAD**
20.3	6.2	0.13	57.2	55.3	64.9	68.5	54.5	67.5	69.5	0.6	0.3	**7910UAD**
22.3	7.5	0.18	63.7	61.8	71.4	75.1	60.5	74.5	75.5	1	0.6	**7911UAD**
23.5	8.0	0.19	68.7	66.8	76.4	80.0	65.5	79.5	80.5	1	0.6	**7912UAD**
24.6	8.6	0.21	73.7	71.8	81.4	85.0	70.5	84.5	85.5	1	0.6	**7913UAD**
27.9	14	0.34	80.3	78.0	89.7	94.3	75.5	94.5	95.5	1	0.6	**7914UAD**
29.1	15	0.36	85.3	83.0	94.7	99.3	80.5	99.5	100.5	1	0.6	**7915UAD**
30.4	16	0.38	90.8	88.5	100.2	104.7	85.5	104.5	105.5	1	0.6	**7916UAD**
33.0	22	0.54	96.9	94.3	108.1	113.5	92	113	115.5	1	0.6	**7917UAD**
34.2	23	0.56	101.9	99.3	113.1	118.5	97	118	120.5	1	0.6	**7918UAD**
35.3	24	0.59	106.9	104.3	118.1	123.4	102	123	125.5	1	0.6	**7919UAD**
38.1	33	0.81	113.6	110.5	126.4	132.6	107	133	135.5	1	0.6	**7920UAD**
39.3	34	0.84	118.6	115.5	131.4	137.6	112	138	140.5	1	0.6	**7921UAD**
40.4	36	0.87	123.6	120.5	136.4	142.6	117	143	145.5	1	0.6	**7922UAD**
44.4	48	1.19	135.2	131.7	149.8	156.7	127	158	160.5	1	0.6	**7924UAD**
48.3	63	1.57	146.9	143.0	163.2	170.9	138.5	171.5	174.5	1.5	1	**7926UAD**

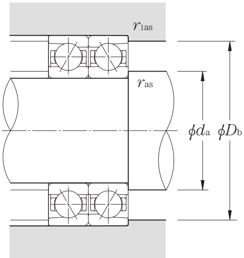
ULTAGE Standard angular contact ball bearings (steel ball type) 79 series

Contact angle 30° d 10～130mm

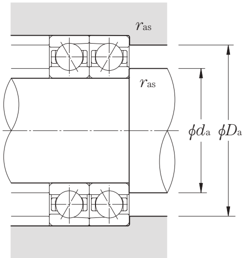


Part number	Boundary dimensions mm					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}				
7900U	10	22	6	0.3	0.15	2.95	1.53	300	156	1.36	139	53 700	73 200
7901U	12	24	6	0.3	0.15	3.10	1.71	315	175	1.48	151	47 700	65 000
7902U	15	28	7	0.3	0.15	4.70	2.68	480	274	2.14	218	40 000	54 500
7903U	17	30	7	0.3	0.15	4.90	2.95	500	300	2.29	234	36 600	49 800
7904U	20	37	9	0.3	0.15	7.00	4.50	715	460	3.60	365	30 100	41 100
7905U	25	42	9	0.3	0.15	7.45	5.30	760	540	4.10	415	25 600	35 000
7906U	30	47	9	0.3	0.15	7.80	6.05	800	615	4.60	465	22 300	30 400
7907U	35	55	10	0.6	0.3	12.5	9.40	1 270	960	7.85	800	19 100	26 000
7908U	40	62	12	0.6	0.3	13.1	10.7	1 340	1 100	8.75	895	16 900	23 000
7909U	45	68	12	0.6	0.3	16.3	13.6	1 660	1 380	11.4	1 160	15 200	20 700
7910U	50	72	12	0.6	0.3	17.2	15.2	1 750	1 550	12.6	1 280	14 100	19 200
7911U	55	80	13	1	0.6	17.8	16.8	1 820	1 720	13.8	1 410	12 700	17 400
7912U	60	85	13	1	0.6	18.6	18.2	1 890	1 850	15.0	1 530	11 900	16 200
7913U	65	90	13	1	0.6	18.8	18.8	1 910	1 910	15.6	1 590	11 100	15 100
7914U	70	100	16	1	0.6	26.9	27.3	2 740	2 780	21.5	2 190	10 100	13 800
7915U	75	105	16	1	0.6	27.2	28.2	2 780	2 870	22.3	2 280	9 600	13 000
7916U	80	110	16	1	0.6	27.5	29.1	2 810	2 970	23.2	2 370	9 000	12 300
7917U	85	120	18	1.1	0.6	37.0	39.5	3 800	4 050	30.5	3 100	8 400	11 400
7918U	90	125	18	1.1	0.6	37.5	41.0	3 850	4 150	31.5	3 200	8 000	10 900
7919U	95	130	18	1.1	0.6	38.0	42.0	3 900	4 300	32.5	3 350	7 600	10 400
7920U	100	140	20	1.1	0.6	49.0	54.5	5 000	5 550	43.5	4 450	7 200	9 800
7921U	105	145	20	1.1	0.6	50.0	56.5	5 100	5 750	45.0	4 600	6 900	9 400
7922U	110	150	20	1.1	0.6	50.5	58.0	5 150	5 900	46.5	4 750	6 600	9 000
7924U	120	165	22	1.1	0.6	62.5	72.5	6 350	7 350	56.5	5 750	6 000	8 200
7926U	130	180	24	1.5	1	76.5	90.5	7 800	9 250	72.5	7 400	5 500	7 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.8	1	0	0.39	0.76	1	0.78	0.63	1.24

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

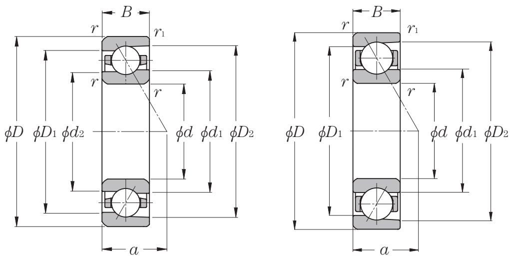
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.33	1	0.66

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
7.7	0.4	0.01	14.3	13.5	17.7	19.3	12.5	19.5	20.8	0.3	0.15	**7900U**
8.2	0.4	0.01	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**7901U**
9.8	0.8	0.02	19.3	18.3	23.7	25.6	17.5	25.5	26.8	0.3	0.15	**7902U**
10.3	0.8	0.02	21.3	20.3	25.7	27.7	19.5	27.5	28.8	0.3	0.15	**7903U**
12.8	1.5	0.04	25.9	24.7	31.1	33.5	22.5	34.5	35.8	0.3	0.15	**7904U**
14.2	1.8	0.04	30.9	29.7	36.1	38.5	27.5	39.5	40.8	0.3	0.15	**7905U**
15.7	2.0	0.05	35.9	34.7	41.1	43.5	32.5	44.5	45.8	0.3	0.15	**7906U**
18.1	3.4	0.07	41.6	39.9	48.4	51.6	39.5	50.5	52.5	0.6	0.3	**7907U**
20.8	4.7	0.11	47.6	45.9	54.4	57.7	44.5	57.5	59.5	0.6	0.3	**7908U**
22.4	5.9	0.12	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**7909U**
23.7	6.2	0.13	57.2	55.3	64.9	68.4	54.5	67.5	69.5	0.6	0.3	**7910U**
26.1	7.5	0.18	63.7	61.8	71.4	75.0	60.5	74.5	75.5	1	0.6	**7911U**
27.5	8.0	0.19	68.7	66.8	76.4	80.0	65.5	79.5	80.5	1	0.6	**7912U**
29.0	8.6	0.21	73.7	71.8	81.4	85.0	70.5	84.5	85.5	1	0.6	**7913U**
32.6	14	0.34	80.3	78.0	89.7	94.2	75.5	94.5	95.5	1	0.6	**7914U**
34.1	15	0.36	85.3	83.0	94.7	99.2	80.5	99.5	100.5	1	0.6	**7915U**
35.7	16	0.38	90.8	88.5	100.2	104.7	85.5	104.5	105.5	1	0.6	**7916U**
38.7	22	0.54	96.9	94.3	108.1	113.4	92	113	115.5	1	0.6	**7917U**
40.2	23	0.56	101.9	99.3	113.1	118.4	97	118	120.5	1	0.6	**7918U**
41.6	24	0.59	106.9	104.3	118.1	123.4	102	123	125.5	1	0.6	**7919U**
44.8	33	0.81	113.6	110.5	126.4	132.6	107	133	135.5	1	0.6	**7920U**
46.2	34	0.84	118.6	115.5	131.4	137.6	112	138	140.5	1	0.6	**7921U**
47.7	36	0.87	123.6	120.5	136.4	142.6	117	143	145.5	1	0.6	**7922U**
52.3	48	1.19	135.2	131.7	149.8	156.7	127	158	160.5	1	0.6	**7924U**
56.9	63	1.57	146.9	143.0	163.2	170.9	138.5	171.5	174.5	1.5	1	**7926U**

ULTAGE Standard angular contact ball bearings (steel ball type) 70 series

Contact angle 15° d 10～200mm

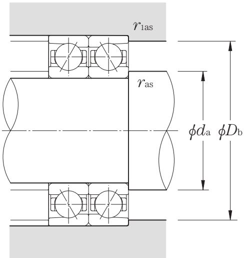


d=10～130 d=140～170

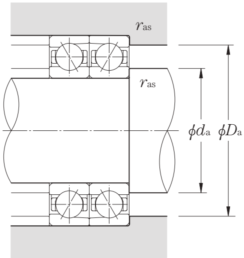
Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	Static axial load capacity (kgf)	Factor	Limiting speed (min⁻¹)	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	kN	kgf	f_o	grease lubrication	oil lubrication
7000UC	10	26	8	0.3	0.15	5.30	2.48	540	253	3.80	390	12.6	65 800	105 300
7001UC	12	28	8	0.3	0.15	5.80	2.93	595	299	4.25	435	13.4	57 100	91 400
7002UC	15	32	9	0.3	0.15	6.60	3.70	675	375	5.15	525	14.1	49 900	79 800
7003UC	17	35	10	0.3	0.15	8.25	4.55	840	460	6.60	670	13.8	45 100	72 100
7004UC	20	42	12	0.6	0.3	11.1	6.6	1 130	670	9.60	980	14.1	37 200	59 500
7005UC	25	47	12	0.6	0.3	12.3	8.0	1 250	815	11.3	1 150	14.7	32 500	52 100
7006UC	30	55	13	1	0.6	15.8	11.0	1 620	1 120	15.4	1 570	14.9	27 200	43 600
7007UC	35	62	14	1	0.6	20.0	14.6	2 040	1 490	19.5	1 990	15.0	24 200	38 700
7008UC	40	68	15	1	0.6	21.4	16.8	2 180	1 720	22.0	2 250	15.4	21 700	34 700
7009UC	45	75	16	1	0.6	25.3	20.4	2 580	2 080	27.1	2 770	15.4	19 500	31 200
7010UC	50	80	16	1	0.6	26.9	23.1	2 740	2 350	30.0	3 100	15.7	18 000	28 800
7011UC	55	90	18	1.1	0.6	35.5	30.0	3 600	3 100	39.0	4 000	15.5	16 200	25 900
7012UC	60	95	18	1.1	0.6	36.5	32.5	3 700	3 300	41.5	4 200	15.7	15 100	24 200
7013UC	65	100	18	1.1	0.6	38.5	36.0	3 900	3 650	45.5	4 650	15.9	14 200	22 700
7014UC	70	110	20	1.1	0.6	48.5	45.0	4 950	4 600	59.0	6 050	15.7	13 000	20 800
7015UC	75	115	20	1.1	0.6	49.5	48.0	5 050	4 900	62.0	6 350	15.9	12 300	19 700
7016UC	80	125	22	1.1	0.6	60.5	58.0	6 200	5 900	74.5	7 600	15.7	11 400	18 300
7017UC	85	130	22	1.1	0.6	62.0	61.5	6 350	6 250	78.5	8 000	15.9	10 900	17 400
7018UC	90	140	24	1.5	1	74.0	72.5	7 550	7 400	95.0	9 700	15.7	10 200	16 300
7019UC	95	145	24	1.5	1	76.0	76.5	7 750	7 800	100	10 200	15.9	9 800	15 600
7020UC	100	150	24	1.5	1	77.5	81.0	7 900	8 250	104	10 600	16.0	9 400	15 000
7021UC	105	160	26	2	1	91.0	93.5	9 250	9 550	120	12 300	15.9	8 800	14 100
7022UC	110	170	28	2	1	104	106	10 600	10 900	140	14 200	15.7	8 400	13 400
7024UC	120	180	28	2	1	106	113	10 800	11 500	147	14 900	16.0	7 800	12 500
7026UC	130	200	33	2	1	133	144	13 600	14 700	186	19 000	15.9	7 100	11 400
7028UC	140	210	33	2	1	136	152	13 900	15 500	193	19 700	16.0	6 700	10 700
7030CT1B	150	225	35	2.1	1.1	151	168	15 400	17 200	81.0	8 300	16.0	4 500	5 800
7032CT1B	160	240	38	2.1	1.1	171	193	17 400	19 700	87.5	8 950	16.0	4 200	5 400
7034CT1B	170	260	42	2.1	1.1	205	234	20 900	23 900	118	12 000	15.9	3 900	5 100
7036CT1B	180	280	46	2.1	1.1	241	290	24 500	29 600	144	14 700	15.7	3 700	4 700
7038CT1B	190	290	46	2.1	1.1	247	305	25 100	31 500	151	15 400	15.9	3 500	4 500
7040CT1B	200	310	51	2.1	1.1	277	355	28 200	36 000	173	17 600	15.7	3 300	4 300

❶ Minimum allowable value for corner radius dimension r or r_1.

A part number containing a suffix **U** means an **ULTAGE Series**.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

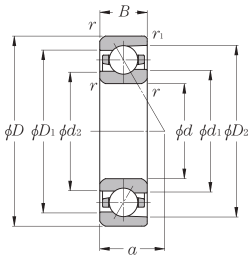
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.4	0.9	0.019	15.2	14.0	20.4	22.7	12.5	23.5	24.8	0.3	0.15	**7000UC**
6.8	1.0	0.021	17.9	16.7	23.1	25.6	14.5	25.5	26.8	0.3	0.15	**7001UC**
7.7	1.3	0.030	20.9	19.7	26.1	28.5	17.5	29.5	30.8	0.3	0.15	**7002UC**
8.5	1.8	0.037	23.0	21.6	29.0	32.0	19.5	32.5	33.8	0.3	0.15	**7003UC**
10.3	2.9	0.067	28.1	26.4	34.9	38.4	24.5	37.5	39.5	0.6	0.3	**7004UC**
10.9	3.3	0.079	32.6	30.9	39.4	42.9	29.5	42.5	44.5	0.6	0.3	**7005UC**
12.3	4.8	0.11	39.2	37.3	46.9	50.7	35.5	49.5	50.5	1	0.6	**7006UC**
13.5	6.3	0.15	44.2	42.2	52.8	57.0	40.5	56.5	57.5	1	0.6	**7007UC**
14.8	7.4	0.19	49.7	47.7	58.3	62.5	45.5	62.5	63.5	1	0.6	**7008UC**
16.1	9.4	0.24	55.3	53.0	64.7	69.4	50.5	69.5	70.5	1	0.6	**7009UC**
16.8	11	0.26	60.3	58.0	69.7	74.4	55.5	74.5	75.5	1	0.6	**7010UC**
18.8	16	0.38	66.9	64.3	78.1	83.6	62	83	85.5	1	0.6	**7011UC**
19.4	17	0.41	71.9	69.3	83.1	88.6	67	88	90.5	1	0.6	**7012UC**
20.1	18	0.44	76.9	74.3	88.1	93.5	72	93	95.5	1	0.6	**7013UC**
22.1	24	0.61	83.6	80.5	96.4	102.7	77	103	105.5	1	0.6	**7014UC**
22.8	26	0.64	88.6	85.5	101.4	107.7	82	108	110.5	1	0.6	**7015UC**
24.8	34	0.86	95.2	91.7	109.8	116.9	87	118	120.5	1	0.6	**7016UC**
25.5	36	0.90	100.2	96.7	114.8	121.9	92	123	125.5	1	0.6	**7017UC**
27.5	47	1.17	106.9	103.0	123.2	131.1	98.5	131.5	134.5	1.5	1	**7018UC**
28.2	49	1.22	111.9	108.0	128.2	136.1	103.5	136.5	139.5	1.5	1	**7019UC**
28.8	51	1.27	116.9	113.0	133.2	141.1	108.5	141.5	144.5	1.5	1	**7020UC**
30.8	70	1.58	123.5	119.2	141.5	150.2	115	150	154.5	2	1	**7021UC**
32.9	83	1.98	130.2	125.4	149.9	159.4	120	160	164.5	2	1	**7022UC**
34.2	90	2.11	140.2	135.4	159.9	169.4	130	170	174.5	2	1	**7024UC**
38.7	131	3.25	153.9	148.5	176.2	187.1	140	190	194.5	2	1	**7026UC**
40.1	144	3.38	164.0	158.7	186.3	197.1	150	200	204.5	2	1	**7028UC**
42.7	166	4.19	174.2	—	200.8	210.5	162	213	218	2	1	**7030CT1B**
45.9	214	5.14	185.5	—	214.5	224.6	172	228	233	2	1	**7032CT1B**
49.9	278	6.94	199.0	—	231.0	242.9	182	248	253	2	1	**7034CT1B**
53.9	360	9.12	212.0	—	248.0	261.2	192	268	273	2	1	**7036CT1B**
55.2	375	9.53	222.0	—	258.0	271.2	202	278	283	2	1	**7038CT1B**
59.8	492	12.3	235.0	—	275.0	289.5	212	298	303	2	1	**7040CT1B**

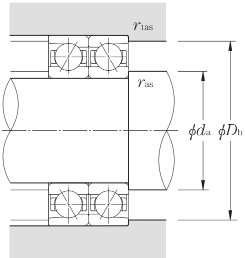
ULTAGE Standard angular contact ball bearings (steel ball type) 70 series

Contact angle 25° d 10～130mm

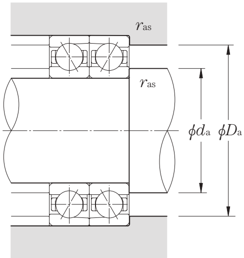


Part number	Boundary dimensions					Basic load ratings				Static axial load capacity		Limiting speed	
	mm					dynamic kN	static kN	dynamic kgf	static kgf	kN	kgf	min⁻¹ grease lubrication	min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
7000UAD	10	26	8	0.3	0.15	5.15	2.40	525	244	2.77	283	57 000	92 100
7001UAD	12	28	8	0.3	0.15	5.60	2.82	570	287	3.10	315	49 500	80 000
7002UAD	15	32	9	0.3	0.15	6.35	3.55	645	360	3.75	380	43 200	69 800
7003UAD	17	35	10	0.3	0.15	7.90	4.35	805	445	4.85	495	39 000	63 100
7004UAD	20	42	12	0.6	0.3	10.6	6.30	1 080	645	7.10	720	32 200	52 100
7005UAD	25	47	12	0.6	0.3	11.7	7.65	1 190	780	8.30	845	28 200	45 600
7006UAD	30	55	13	1	0.6	15.1	10.5	1 540	1 070	11.5	1 170	23 600	38 100
7007UAD	35	62	14	1	0.6	19.0	13.9	1 940	1 420	14.3	1 460	20 900	33 800
7008UAD	40	68	15	1	0.6	20.3	16.0	2 070	1 630	16.1	1 650	18 800	30 400
7009UAD	45	75	16	1	0.6	24.0	19.4	2 450	1 980	19.9	2 030	16 900	27 300
7010UAD	50	80	16	1	0.6	25.5	21.9	2 600	2 230	22.2	2 260	15 600	25 200
7011UAD	55	90	18	1.1	0.6	33.5	28.7	3 400	2 930	28.6	2 920	14 000	22 600
7012UAD	60	95	18	1.1	0.6	34.5	30.5	3 500	3 150	30.0	3 100	13 100	21 200
7013UAD	65	100	18	1.1	0.6	36.0	34.0	3 700	3 500	33.5	3 400	12 300	19 900
7014UAD	70	110	20	1.1	0.6	46.0	43.0	4 700	4 350	43.5	4 450	11 300	18 200
7015UAD	75	115	20	1.1	0.6	47.0	45.5	4 800	4 650	45.5	4 650	10 700	17 300
7016UAD	80	125	22	1.1	0.6	57.5	55.0	5 850	5 600	55.0	5 600	9 900	16 000
7017UAD	85	130	22	1.1	0.6	58.5	58.5	6 000	5 950	57.5	5 850	9 400	15 300
7018UAD	90	140	24	1.5	1	70.0	69.0	7 150	7 050	70.0	7 150	8 800	14 300
7019UAD	95	145	24	1.5	1	71.5	73.0	7 300	7 400	73.5	7 500	8 500	13 700
7020UAD	100	150	24	1.5	1	73.5	76.5	7 500	7 800	77.0	7 850	8 100	13 100
7021UAD	105	160	26	2	1	86.0	89.0	8 750	9 050	88.0	9 000	7 700	12 400
7022UAD	110	170	28	2	1	98.5	101	10 100	10 300	103	10 500	7 300	11 700
7024UAD	120	180	28	2	1	101	107	10 300	10 900	108	11 000	6 800	10 900
7026UAD	130	200	33	2	1	126	136	12 900	13 900	137	14 000	6 200	9 900
7028UAD	140	210	33	2	1	128	144	13 100	14 700	141	14 400	5 800	9300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

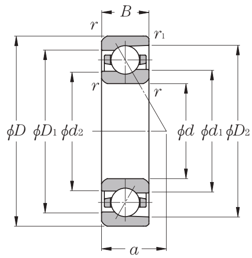
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
8.2	0.9	0.019	15.2	14.0	20.4	22.9	12.5	23.5	24.8	0.3	0.15	**7000UAD**
8.8	1.0	0.021	17.9	16.7	23.1	25.6	14.5	25.5	26.8	0.3	0.15	**7001UAD**
10.0	1.3	0.030	20.9	19.7	26.1	28.6	17.5	29.5	30.8	0.3	0.15	**7002UAD**
11.1	1.8	0.037	23.0	21.6	29.0	32.0	19.5	32.5	33.8	0.3	0.15	**7003UAD**
13.4	2.9	0.067	28.1	26.4	34.9	38.3	24.5	37.5	39.5	0.6	0.3	**7004UAD**
14.5	3.3	0.079	32.6	30.9	39.4	42.8	29.5	42.5	44.5	0.6	0.3	**7005UAD**
16.6	4.8	0.11	39.2	37.3	46.9	50.7	35.5	49.5	50.5	1	0.6	**7006UAD**
18.4	6.3	0.15	44.2	42.2	52.8	56.9	40.5	56.5	57.5	1	0.6	**7007UAD**
20.2	7.4	0.19	49.7	47.7	58.3	62.5	45.5	62.5	63.5	1	0.6	**7008UAD**
22.1	9.4	0.24	55.3	53.0	64.7	69.3	50.5	69.5	70.5	1	0.6	**7009UAD**
23.2	11	0.26	60.3	58.0	69.7	74.3	55.5	74.5	75.5	1	0.6	**7010UAD**
26.0	16	0.38	66.9	64.3	78.1	83.5	62	83	85.5	1	0.6	**7011UAD**
27.2	17	0.41	71.9	69.3	83.1	88.5	67	88	90.5	1	0.6	**7012UAD**
28.3	18	0.44	76.9	74.3	88.1	93.5	72	93	95.5	1	0.6	**7013UAD**
31.1	24	0.61	83.6	80.5	96.4	102.7	77	103	105.5	1	0.6	**7014UAD**
32.3	26	0.64	88.6	85.5	101.4	107.7	82	108	110.5	1	0.6	**7015UAD**
35.0	34	0.86	95.2	91.7	109.8	116.9	87	118	120.5	1	0.6	**7016UAD**
36.2	36	0.90	100.2	96.7	114.8	121.9	92	123	125.5	1	0.6	**7017UAD**
39.0	47	1.17	106.9	103.0	123.2	131.0	98.5	131.5	134.5	1.5	1	**7018UAD**
40.1	49	1.22	111.9	108.0	128.2	136.0	103.5	136.5	139.5	1.5	1	**7019UAD**
41.3	51	1.27	116.9	113.0	133.2	141.0	108.5	141.5	144.5	1.5	1	**7020UAD**
44.1	70	1.58	123.5	119.2	141.5	150.2	115	150	154.5	2	1	**7021UAD**
46.8	83	1.98	130.2	125.4	149.9	159.3	120	160	164.5	2	1	**7022UAD**
49.2	90	2.11	140.2	135.4	159.9	169.3	130	170	174.5	2	1	**7024UAD**
55.2	131	3.25	153.9	148.5	176.2	187.0	140	190	194.5	2	1	**7026UAD**
57.5	144	3.38	164.0	158.7	186.3	197.0	150	200	204.5	2	1	**7028UAD**

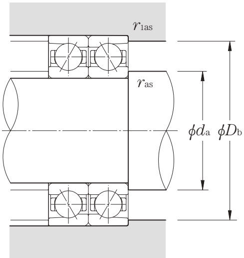
ULTAGE Standard angular contact ball bearings (steel ball type) 70 series

Contact angle 30° d 10～130mm

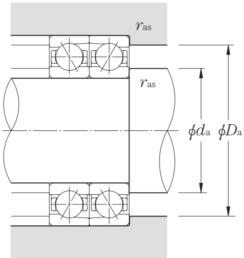


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
7000U	10	26	8	0.3	0.15	5.00	2.33	510	238	2.12	216	48 200	65 700
7001U	12	28	8	0.3	0.15	5.45	2.74	555	279	2.37	242	41 900	57 100
7002U	15	32	9	0.3	0.15	6.15	3.45	625	350	2.86	292	36 600	49 800
7003U	17	35	10	0.3	0.15	7.65	4.20	780	430	3.70	380	33 000	45 000
7004U	20	42	12	0.6	0.3	10.3	6.10	1 050	620	5.45	560	27 300	37 200
7005U	25	47	12	0.6	0.3	11.3	7.40	1 150	755	6.40	655	23 900	32 500
7006U	30	55	13	1	0.6	14.5	10.2	1 480	1 040	8.90	910	20 000	27 200
7007U	35	62	14	1	0.6	18.3	13.4	1 870	1 370	11.0	1 120	17 700	24 100
7008U	40	68	15	1	0.6	19.5	15.4	1 990	1 570	12.4	1 260	15 900	21 700
7009U	45	75	16	1	0.6	23.1	18.7	2 360	1 910	15.4	1 570	14 300	19 500
7010U	50	80	16	1	0.6	24.5	21.1	2 500	2 150	17.1	1 740	13 200	18 000
7011U	55	90	18	1.1	0.6	32.5	27.7	3 300	2 830	22.0	2 240	11 900	16 200
7012U	60	95	18	1.1	0.6	33.0	29.5	3 350	3 000	23.2	2 360	11 100	15 100
7013U	65	100	18	1.1	0.6	35.0	33.0	3 550	3 350	25.5	2 600	10 400	14 200
7014U	70	110	20	1.1	0.6	44.0	41.5	4 500	4 200	33.5	3 450	9 500	13 000
7015U	75	115	20	1.1	0.6	45.0	43.5	4 600	4 450	35.0	3 600	9 000	12 300
7016U	80	125	22	1.1	0.6	55.0	53.0	5 600	5 400	42.0	4 300	8 400	11 400
7017U	85	130	22	1.1	0.6	56.5	56.0	5 750	5 700	44.0	4 500	8 000	10 900
7018U	90	140	24	1.5	1	67.5	66.5	6 850	6 750	54.0	5 500	7 500	10 200
7019U	95	145	24	1.5	1	69.0	70.0	7 050	7 150	56.5	5 800	7 200	9 800
7020U	100	150	24	1.5	1	70.5	74.0	7 200	7 500	59.5	6 050	6 900	9 400
7021U	105	160	26	2	1	82.5	85.5	8 400	8 750	68.0	6 900	6 500	8 800
7022U	110	170	28	2	1	95.0	97.5	9 650	9 950	79.5	8 100	6 100	8 400
7024U	120	180	28	2	1	96.5	103	9 850	10 500	83.5	8 500	5 700	7 800
7026U	130	200	33	2	1	121	131	12 300	13 400	106	10 800	5 200	7 100
7028U	140	210	33	2	1	123	139	12 600	14 100	109	11 100	4 900	6 700

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.8	1	0	0.39	0.76	1	0.78	0.63	1.24

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

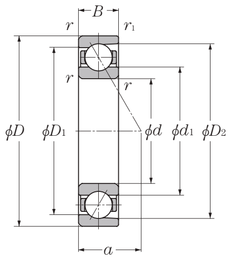
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.33	1	0.66

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm				Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	D_2	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
9.2	0.9	0.019	15.2	14.0	20.4	22.7	12.5	23.5	24.8	0.3	0.15	**7000U**
10.0	1.0	0.021	17.9	16.7	23.1	25.5	14.5	25.5	26.8	0.3	0.15	**7001U**
11.3	1.3	0.030	20.9	19.7	26.1	28.6	17.5	29.5	30.8	0.3	0.15	**7002U**
12.6	1.8	0.037	23.0	21.6	29.0	31.9	19.5	32.5	33.8	0.3	0.15	**7003U**
15.2	2.9	0.067	28.1	26.4	34.9	38.3	24.5	37.5	39.5	0.6	0.3	**7004U**
16.5	3.3	0.079	32.6	30.9	39.4	42.8	29.5	42.5	44.5	0.6	0.3	**7005U**
19.0	4.8	0.11	39.2	37.3	46.9	50.6	35.5	49.5	50.5	1	0.6	**7006U**
21.1	6.3	0.15	44.2	42.2	52.8	56.9	40.5	56.5	57.5	1	0.6	**7007U**
23.2	7.4	0.19	49.7	47.7	58.3	62.4	45.5	62.5	63.5	1	0.6	**7008U**
25.4	9.4	0.24	55.3	53.0	64.7	69.3	50.5	69.5	70.5	1	0.6	**7009U**
26.9	11	0.26	60.3	58.0	69.7	74.3	55.5	74.5	75.5	1	0.6	**7010U**
30.1	16	0.38	66.9	64.3	78.1	83.5	62	83	85.5	1	0.6	**7011U**
31.5	17	0.41	71.9	69.3	83.1	88.5	67	88	90.5	1	0.6	**7012U**
32.9	18	0.44	76.9	74.3	88.1	93.4	72	93	95.5	1	0.6	**7013U**
36.1	24	0.61	83.6	80.5	96.4	102.6	77	103	105.5	1	0.6	**7014U**
37.6	26	0.64	88.6	85.5	101.4	107.6	82	108	110.5	1	0.6	**7015U**
40.8	34	0.86	95.2	91.7	109.8	116.8	87	118	120.5	1	0.6	**7016U**
42.2	36	0.90	100.2	96.7	114.8	121.8	92	123	125.5	1	0.6	**7017U**
45.4	47	1.17	106.9	103.0	123.2	131.0	98.5	131.5	134.5	1.5	1	**7018U**
46.8	49	1.22	111.9	108.0	128.2	136.0	103.5	136.5	139.5	1.5	1	**7019U**
48.3	51	1.27	116.9	113.0	133.2	141.0	108.5	141.5	144.5	1.5	1	**7020U**
51.5	70	1.58	123.5	119.2	141.5	150.1	115	150	154.5	2	1	**7021U**
54.6	83	1.98	130.2	125.4	149.9	159.3	120	160	164.5	2	1	**7022U**
57.5	90	2.11	140.2	135.4	159.9	169.2	130	170	174.5	2	1	**7024U**
64.4	131	3.25	153.9	148.5	176.2	186.9	140	190	194.5	2	1	**7026U**
67.3	144	3.38	164.0	158.7	186.3	197.0	150	200	204.5	2	1	**7028U**

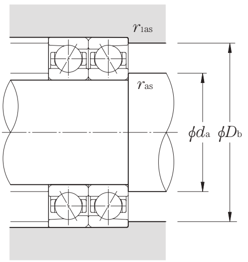
Standard angular contact ball bearings (steel ball type) 72 series

Contact angle 15° d 10～130mm

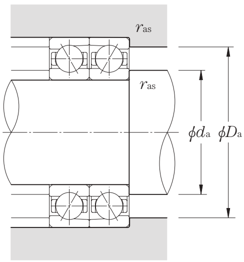


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	Static axial load capacity kgf	Factor	Limiting speed min⁻¹ grease lubrication	Limiting speed min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}			f_0		
7200C	10	30	9	0.6	0.3	5.40	2.64	555	269	1.01	103	13.4	42 900	55 600
7201C	12	32	10	0.6	0.3	7.10	3.45	720	355	1.59	162	12.9	40 000	51 800
7202C	15	35	11	0.6	0.3	9.00	4.50	915	460	1.89	193	12.9	35 200	45 600
7203C	17	40	12	0.6	0.3	11.2	5.75	1 140	590	2.67	272	13.0	30 500	39 600
7204C	20	47	14	1	0.6	14.6	8.15	1 490	835	3.70	375	13.4	25 500	33 000
7205C	25	52	15	1	0.6	16.6	10.2	1 690	1 050	3.75	385	14.0	22 600	29 200
7206C	30	62	16	1	0.6	23.0	14.7	2 350	1 500	7.10	725	14.0	18 900	24 500
7207C	35	72	17	1.1	0.6	30.5	19.9	3 100	2 030	10.6	1 090	13.9	16 400	21 300
7208C	40	80	18	1.1	0.6	36.5	25.2	3 700	2 570	14.4	1 470	14.2	14 700	19 000
7209C	45	85	19	1.1	0.6	41.0	28.8	4 150	2 940	14.8	1 510	14.2	13 500	17 500
7210C	50	90	20	1.1	0.6	43.0	31.5	4 350	3 250	15.3	1 560	14.5	12 600	16 300
7211C	55	100	21	1.5	1	53.0	40.0	5 400	4 100	21.6	2 200	14.5	11 400	14 700
7212C	60	110	22	1.5	1	64.0	49.5	6 550	5 050	26.1	2 660	14.5	10 200	13 200
7213C	65	120	23	1.5	1	70.0	55.0	7 100	5 600	28.5	2 910	14.6	9 500	12 300
7214C	70	125	24	1.5	1	76.0	60.0	7 750	6 150	31.0	3 150	14.6	9 000	11 700
7215C	75	130	25	1.5	1	79.5	65.5	8 100	6 700	33.5	3 400	14.8	8 500	11 000
7216C	80	140	26	2	1	93.0	77.5	9 450	7 900	34.5	3 550	14.7	8 000	10 400
7217C	85	150	28	2	1	104	90.5	10 600	9 200	46.5	4 750	14.9	7 500	9 700
7218C	90	160	30	2	1	123	105	12 500	10 700	53.5	5 450	14.6	7 000	9 100
7219C	95	170	32	2.1	1.1	139	120	14 200	12 200	62.0	6 350	14.6	6 600	8 600
7220C	100	180	34	2.1	1.1	149	127	15 200	12 900	67.0	6 800	14.5	6 300	8 100
7221CT1B	105	190	36	2.1	1.1	162	143	16 600	14 600	74.5	7 600	14.5	6 000	7 700
7222CT1B	110	200	38	2.1	1.1	176	160	17 900	16 300	86.0	8 800	14.5	5 700	7 400
7224CT1B	120	215	40	2.1	1.1	199	192	20 200	19 600	91.5	9 300	14.6	5 300	6 800
7226CT1B	130	230	40	3	1.1	213	214	21 700	21 800	111	11 300	14.7	4 900	6 300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38	1	0	0.44	1.47	1	1.65	0.72	2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47				1.19		1.34		1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

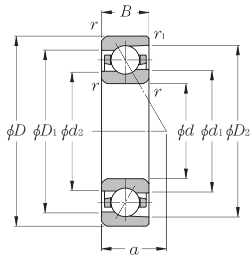
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
7.3	0.9	0.029	17.4	23.5	25.5	14.5	25.5	27.5	0.6	0.3	**7200C**
8.0	1.3	0.036	18.4	25.6	27.8	16.5	27.5	29.5	0.6	0.3	**7201C**
8.9	1.5	0.045	20.8	29.0	31.6	19.5	30.5	32.5	0.6	0.3	**7202C**
9.9	2.1	0.062	24.2	33.2	36.2	21.5	35.5	37.5	0.6	0.3	**7203C**
11.6	3.1	0.10	29.4	39.4	42.8	25.5	41.5	42.5	1	0.6	**7204C**
12.7	4.1	0.12	33.8	44.2	47.3	30.5	46.5	47.5	1	0.6	**7205C**
14.3	6.6	0.19	40.6	52.2	56.4	35.5	56.5	57.5	1	0.6	**7206C**
15.7	8.8	0.27	46.8	60.2	65.0	42	65	67.5	1	0.6	**7207C**
17.1	11	0.35	53.0	67.0	72.3	47	73	75.5	1	0.6	**7208C**
18.2	14	0.40	57.3	72.5	78.1	52	78	80.5	1	0.6	**7209C**
19.4	17	0.45	62.2	77.6	83.2	57	83	85.5	1	0.6	**7210C**
20.9	21	0.59	69.0	86.0	92.3	63.5	91.5	94.5	1.5	1	**7211C**
22.6	28	0.76	77.0	96.0	102.9	68.5	101.5	104.5	1.5	1	**7212C**
23.9	34	0.95	82.5	102.5	109.7	73.5	111.5	114.5	1.5	1	**7213C**
25.1	40	1.04	87.0	108.0	115.5	78.5	116.5	119.5	1.5	1	**7214C**
26.4	43	1.14	93.0	114.0	121.5	83.5	121.5	124.5	1.5	1	**7215C**
27.8	54	1.39	98.1	121.4	129.6	90	130	134.5	2	1	**7216C**
29.9	63	1.73	106.1	129.9	138.5	95	140	144.5	2	1	**7217C**
31.8	80	2.13	111.6	138.5	147.9	100	150	154.5	2	1	**7218C**
33.8	96	2.58	118.2	146.8	157.0	107	158	163	2	1	**7219C**
35.8	119	3.21	124.8	155.2	166.2	112	168	173	2	1	**7220C**
37.8	147	3.81	131.3	163.7	175.3	117	178	183	2	1	**7221CT1B**
39.9	171	4.49	138.0	172.0	184.4	122	188	193	2	1	**7222CT1B**
42.5	206	5.44	149.0	186.0	198.6	132	203	208	2	1	**7224CT1B**
44.2	232	6.19	161.0	199.0	212.6	144	216	223	2.5	1	**7226CT1B**

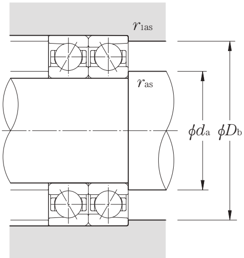
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-79 series

Contact angle 15° d 10～130mm

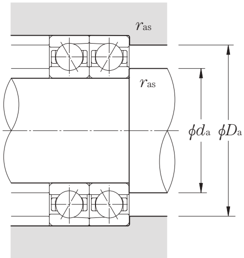


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed (min⁻¹)	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	kN	kgf	f_o	grease lubrication	oil lubrication
5S-7900UC	10	22	6	0.3	0.15	3.20	1.15	325	117	1.94	198	9.8	84 000	136 800
5S-7901UC	12	24	6	0.3	0.15	3.35	1.29	340	131	2.18	223	10.2	74 600	121 600
5S-7902UC	15	28	7	0.3	0.15	5.10	2.01	520	205	3.40	345	10.0	62 500	101 900
5S-7903UC	17	30	7	0.3	0.15	5.35	2.22	545	226	3.75	385	10.3	57 200	93 200
5S-7904UC	20	37	9	0.3	0.15	7.65	3.40	780	345	5.75	585	10.3	47 100	76 800
5S-7905UC	25	42	9	0.3	0.15	8.15	4.00	835	405	6.80	695	10.7	40 100	65 400
5S-7906UC	30	47	9	0.3	0.15	8.60	4.60	880	470	7.85	800	11.0	34 900	56 900
5S-7907UC	35	55	10	0.6	0.3	13.7	7.10	1 400	725	12.1	1 240	10.7	29 900	48 700
5S-7908UC	40	62	12	0.6	0.3	14.5	8.15	1 480	830	13.9	1 420	11.0	26 300	42 900
5S-7909UC	45	68	12	0.6	0.3	17.9	10.3	1 830	1 050	17.6	1 790	11.0	23 800	38 800
5S-7910UC	50	72	12	0.6	0.3	18.9	11.5	1 930	1 180	19.7	2 010	11.1	22 000	35 900
5S-7911UC	55	80	13	1	0.6	19.7	12.8	2 010	1 310	22.0	2 240	11.3	19 900	32 400
5S-7912UC	60	85	13	1	0.6	20.5	14.1	2 090	1 440	24.2	2 460	11.4	18 500	30 200
5S-7913UC	65	90	13	1	0.6	20.8	14.8	2 120	1 510	25.4	2 590	11.4	17 300	28 300
5S-7914UC	70	100	16	1	0.6	29.7	20.9	3 050	2 140	36.0	3 650	11.4	15 800	25 800
5S-7915UC	75	105	16	1	0.6	30.0	22.0	3 050	2 240	37.5	3 850	11.5	14 900	24 300
5S-7916UC	80	110	16	1	0.6	30.5	23.0	3 100	2 340	39.5	4 000	11.4	14 100	22 900
5S-7917UC	85	120	18	1.1	0.6	41.0	30.5	4 200	3 100	52.0	5 350	11.4	13 100	21 400
5S-7918UC	90	125	18	1.1	0.6	41.5	32.0	4 250	3 250	54.5	5 550	11.5	12 500	20 400
5S-7919UC	95	130	18	1.1	0.6	42.5	33.5	4 300	3 400	57.0	5 800	11.4	11 900	19 500
5S-7920UC	100	140	20	1.1	0.6	54.5	42.5	5 550	4 300	72.5	7 400	11.4	11 200	18 200
5S-7921UC	105	145	20	1.1	0.6	55.0	44.0	5 600	4 500	75.5	7 700	11.5	10 800	17 500
5S-7922UC	110	150	20	1.1	0.6	56.0	46.0	5 700	4 700	78.5	8 050	11.4	10 300	16 800
5S-7924UC	120	165	22	1.1	0.6	69.0	56.5	7 050	5 800	97.0	9 900	11.5	9 400	15 400
5S-7926UC	130	180	24	1.5	1	85.0	70.5	8 650	7 200	121	12 300	11.5	8 700	14 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

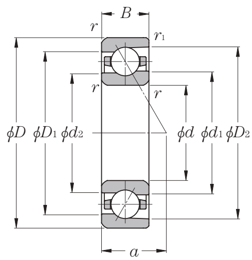
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm				Abutment and fillet dimensions mm					Part number
a			d_1	d_2	D_1	D_2	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
5.2	0.4	0.009	14.3	13.5	17.7	19.4	12.5	19.5	20.8	0.3	0.15	**5S-7900UC**
5.4	0.4	0.010	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**5S-7901UC**
6.4	0.8	0.013	19.3	18.3	23.7	25.6	17.5	25.5	26.8	0.3	0.15	**5S-7902UC**
6.7	0.8	0.015	21.3	20.3	25.7	27.8	19.5	27.5	28.8	0.3	0.15	**5S-7903UC**
8.3	1.5	0.033	25.9	24.7	31.1	33.6	22.5	34.5	35.8	0.3	0.15	**5S-7904UC**
9.0	1.8	0.039	30.9	29.7	36.1	38.6	27.5	39.5	40.8	0.3	0.15	**5S-7905UC**
9.7	2.0	0.044	35.9	34.7	41.1	43.6	32.5	44.5	45.8	0.3	0.15	**5S-7906UC**
11.1	3.4	0.062	41.6	39.9	48.4	51.7	39.5	50.5	52.5	0.6	0.3	**5S-7907UC**
12.9	4.7	0.10	47.6	45.9	54.4	57.8	44.5	57.5	59.5	0.6	0.3	**5S-7908UC**
13.6	5.9	0.11	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**5S-7909UC**
14.2	6.2	0.11	57.2	55.3	64.9	68.5	54.5	67.5	69.5	0.6	0.3	**5S-7910UC**
15.6	7.5	0.16	63.7	61.8	71.4	75.1	60.5	74.5	75.5	1	0.6	**5S-7911UC**
16.3	8.0	0.17	68.7	66.8	76.4	80.1	65.5	79.5	80.5	1	0.6	**5S-7912UC**
16.9	8.6	0.19	73.7	71.8	81.4	85.1	70.5	84.5	85.5	1	0.6	**5S-7913UC**
19.4	14	0.30	80.3	78.0	89.7	94.3	75.5	94.5	95.5	1	0.6	**5S-7914UC**
20.1	15	0.32	85.3	83.0	94.7	99.3	80.5	99.5	100.5	1	0.6	**5S-7915UC**
20.8	16	0.33	90.8	88.5	100.2	104.8	85.5	104.5	105.5	1	0.6	**5S-7916UC**
22.8	22	0.47	96.9	94.3	108.1	113.5	92	113	115.5	1	0.6	**5S-7917UC**
23.5	23	0.49	101.9	99.3	113.1	118.5	97	118	120.5	1	0.6	**5S-7918UC**
24.1	24	0.52	106.9	104.3	118.1	123.5	102	123	125.5	1	0.6	**5S-7919UC**
26.1	33	0.70	113.6	110.5	126.4	132.7	107	133	135.5	1	0.6	**5S-7920UC**
26.8	34	0.73	118.6	115.5	131.4	137.7	112	138	140.5	1	0.6	**5S-7921UC**
27.5	36	0.76	123.6	120.5	136.4	142.7	117	143	145.5	1	0.6	**5S-7922UC**
30.2	48	1.03	135.2	131.7	149.8	156.8	127	158	160.5	1	0.6	**5S-7924UC**
32.9	63	1.34	146.9	143.0	163.2	171.0	138.5	171.5	174.5	1.5	1	**5S-7926UC**

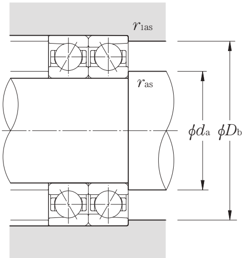
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-79 series

Contact angle 25° *d* 10～130mm

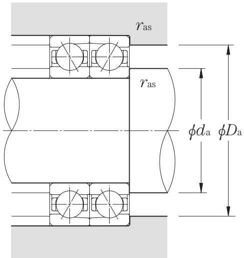


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-7900UAD	10	22	6	0.3	0.15	3.05	1.10	310	112	2.12	216	73 200	120 100
5S-7901UAD	12	24	6	0.3	0.15	3.20	1.23	325	125	2.30	234	65 100	106 800
5S-7902UAD	15	28	7	0.3	0.15	4.85	1.92	495	196	3.35	345	54 500	89 400
5S-7903UAD	17	30	7	0.3	0.15	5.10	2.12	520	216	3.60	370	49 800	81 800
5S-7904UAD	20	37	9	0.3	0.15	7.25	3.25	740	330	5.60	575	41 100	67 400
5S-7905UAD	25	42	9	0.3	0.15	7.75	3.80	790	385	6.40	650	35 000	57 400
5S-7906UAD	30	47	9	0.3	0.15	8.15	4.35	830	445	7.15	730	30 400	49 900
5S-7907UAD	35	55	10	0.6	0.3	13.0	6.75	1 320	690	12.1	1 240	26 000	42 700
5S-7908UAD	40	62	12	0.6	0.3	13.7	7.75	1 400	790	13.6	1 380	23 000	37 700
5S-7909UAD	45	68	12	0.6	0.3	17.0	9.75	1 730	995	17.5	1 790	20 700	34 000
5S-7910UAD	50	72	12	0.6	0.3	17.9	10.9	1 820	1 110	19.3	1 970	19 200	31 500
5S-7911UAD	55	80	13	1	0.6	18.6	12.2	1 900	1 240	21.1	2 160	17 400	28 500
5S-7912UAD	60	85	13	1	0.6	19.4	13.3	1 970	1 360	23.0	2 340	16 200	26 500
5S-7913UAD	65	90	13	1	0.6	19.6	14.0	2 000	1 430	23.9	2 430	15 100	24 800
5S-7914UAD	70	100	16	1	0.6	28.0	19.8	2 860	2 020	33.5	3 400	13 800	22 600
5S-7915UAD	75	105	16	1	0.6	28.4	20.8	2 900	2 120	34.5	3 550	13 000	21 400
5S-7916UAD	80	110	16	1	0.6	28.7	21.7	2 930	2 220	36.0	3 700	12 300	20 100
5S-7917UAD	85	120	18	1.1	0.6	38.5	28.9	3 950	2 950	47.0	4 800	11 400	18 800
5S-7918UAD	90	125	18	1.1	0.6	39.5	30.0	4 000	3 100	49.0	5 000	10 900	17 900
5S-7919UAD	95	130	18	1.1	0.6	40.0	31.5	4 050	3 200	51.0	5 200	10 400	17 100
5S-7920UAD	100	140	20	1.1	0.6	51.0	40.0	5 200	4 100	67.5	6 850	9 800	16 000
5S-7921UAD	105	145	20	1.1	0.6	52.0	41.5	5 300	4 250	70.0	7 100	9 400	15 400
5S-7922UAD	110	150	20	1.1	0.6	52.5	43.5	5 400	4 450	72.5	7 400	9 000	14 800
5S-7924UAD	120	165	22	1.1	0.6	65.0	53.5	6 650	5 450	88.0	8 950	8 200	13 500
5S-7926UAD	130	180	24	1.5	1	80.0	66.5	8 150	6 800	112	11 400	7 600	12 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

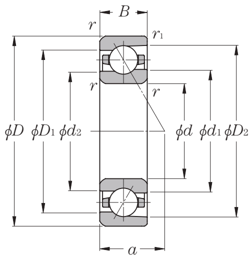
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.8	0.4	0.009	14.3	13.5	17.7	19.4	12.5	19.5	20.8	0.3	0.15	**5S-7900UAD**
7.2	0.4	0.010	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**5S-7901UAD**
8.6	0.8	0.013	19.3	18.3	23.7	25.7	17.5	25.5	26.8	0.3	0.15	**5S-7902UAD**
9.0	0.8	0.015	21.3	20.3	25.7	27.7	19.5	27.5	28.8	0.3	0.15	**5S-7903UAD**
11.2	1.5	0.033	25.9	24.7	31.1	33.6	22.5	34.5	35.8	0.3	0.15	**5S-7904UAD**
12.4	1.8	0.039	30.9	29.7	36.1	38.6	27.5	39.5	40.8	0.3	0.15	**5S-7905UAD**
13.5	2.0	0.044	35.9	34.7	41.1	43.6	32.5	44.5	45.8	0.3	0.15	**5S-7906UAD**
15.6	3.4	0.062	41.6	39.9	48.4	51.7	39.5	50.5	52.5	0.6	0.3	**5S-7907UAD**
18.0	4.7	0.100	47.6	45.9	54.4	57.7	44.5	57.5	59.5	0.6	0.3	**5S-7908UAD**
19.2	5.9	0.110	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**5S-7909UAD**
20.3	6.2	0.110	57.2	55.3	64.9	68.5	54.5	67.5	69.5	0.6	0.3	**5S-7910UAD**
22.3	7.5	0.160	63.7	61.8	71.4	75.1	60.5	74.5	75.5	1	0.6	**5S-7911UAD**
23.5	8.0	0.170	68.7	66.8	76.4	80.0	65.5	79.5	80.5	1	0.6	**5S-7912UAD**
24.6	8.6	0.190	73.7	71.8	81.4	85.0	70.5	84.5	85.5	1	0.6	**5S-7913UAD**
27.9	14	0.300	80.3	78	89.7	94.3	75.5	94.5	95.5	1	0.6	**5S-7914UAD**
29.1	15	0.320	85.3	83	94.7	99.3	80.5	99.5	100.5	1	0.6	**5S-7915UAD**
30.4	16	0.330	90.8	88.5	100.2	104.7	85.5	104.5	105.5	1	0.6	**5S-7916UAD**
33.0	22	0.470	96.9	94.3	108.1	113.5	92	113	115.5	1	0.6	**5S-7917UAD**
34.2	23	0.490	101.9	99.3	113.1	118.5	97	118	120.5	1	0.6	**5S-7918UAD**
35.3	24	0.520	106.9	104.3	118.1	123.4	102	123	125.5	1	0.6	**5S-7919UAD**
38.1	33	0.700	113.6	110.5	126.4	132.6	107	133	135.5	1	0.6	**5S-7920UAD**
39.3	34	0.730	118.6	115.5	131.4	137.6	112	138	140.5	1	0.6	**5S-7921UAD**
40.4	36	0.760	123.6	120.5	136.4	142.6	117	143	145.5	1	0.6	**5S-7922UAD**
44.4	48	1.03	135.2	131.7	149.8	156.7	127	158	160.5	1	0.6	**5S-7924UAD**
48.3	63	1.34	146.9	143	163.2	170.9	138.5	171.5	174.5	1.5	1	**5S-7926UAD**

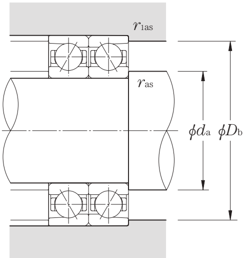
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-79 series

Contact angle 30° d 10〜130mm

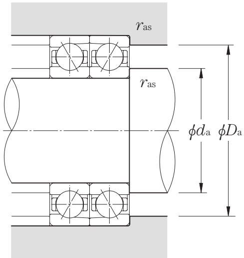


Part number	Boundary dimensions mm					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity kN	kgf	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-7900U	10	22	6	0.3	0.15	2.95	1.06	300	108	1.63	166	58 600	78 000
5S-7901U	12	24	6	0.3	0.15	3.10	1.19	315	121	1.77	181	52 100	69 400
5S-7902U	15	28	7	0.3	0.15	4.70	1.86	480	190	2.56	261	43 600	58 100
5S-7903U	17	30	7	0.3	0.15	4.90	2.05	500	209	2.74	280	39 900	53 100
5S-7904U	20	37	9	0.3	0.15	7.00	3.10	715	320	4.30	440	32 900	43 800
5S-7905U	25	42	9	0.3	0.15	7.45	3.65	760	375	4.90	500	28 000	37 300
5S-7906U	30	47	9	0.3	0.15	7.80	4.20	800	430	5.50	560	24 300	32 400
5S-7907U	35	55	10	0.6	0.3	12.5	6.50	1 270	665	9.35	955	20 800	27 800
5S-7908U	40	62	12	0.6	0.3	13.1	7.45	1 340	760	10.5	1 070	18 400	24 500
5S-7909U	45	68	12	0.6	0.3	16.3	9.40	1 660	960	13.6	1 390	16 600	22 100
5S-7910U	50	72	12	0.6	0.3	17.2	10.5	1 750	1 070	15.0	1 530	15 400	20 500
5S-7911U	55	80	13	1	0.6	17.8	11.7	1 820	1 190	16.5	1 680	13 900	18 500
5S-7912U	60	85	13	1	0.6	18.6	12.8	1 890	1 310	18.0	1 830	12 900	17 200
5S-7913U	65	90	13	1	0.6	18.8	13.5	1 910	1 370	18.7	1 910	12 100	16 100
5S-7914U	70	100	16	1	0.6	26.9	19.1	2 740	1 940	25.7	2 620	11 000	14 700
5S-7915U	75	105	16	1	0.6	27.2	20.0	2 780	2 040	26.7	2 730	10 400	13 900
5S-7916U	80	110	16	1	0.6	27.5	20.9	2 810	2 130	27.8	2 830	9 800	13 100
5S-7917U	85	120	18	1.1	0.6	37.0	27.8	3 800	2 830	36.0	3 700	9 100	12 200
5S-7918U	90	125	18	1.1	0.6	37.5	29.0	3 850	2 960	37.5	3 850	8 700	11 600
5S-7919U	95	130	18	1.1	0.6	38.0	30.5	3 900	3 100	39.0	4 000	8 300	11 100
5S-7920U	100	140	20	1.1	0.6	49.0	38.5	5 000	3 900	52.0	5 300	7 800	10 400
5S-7921U	105	145	20	1.1	0.6	50.0	40.0	5 100	4 100	54.0	5 500	7 500	10 000
5S-7922U	110	150	20	1.1	0.6	50.5	41.5	5 150	4 250	56.0	5 700	7 200	9 600
5S-7924U	120	165	22	1.1	0.6	62.5	51.5	6 350	5 250	67.5	6 900	6 600	8 800
5S-7926U	130	180	24	1.5	1	76.5	64.0	7 800	6 550	86.5	8 850	6 000	8 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.8	1	0	0.39	0.76	1	0.78	0.63	1.24

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

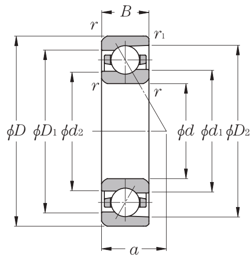
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.33	1	0.66

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm				Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	D_2	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
7.7	0.4	0.009	14.3	13.5	17.7	19.3	12.5	19.5	20.8	0.3	0.15	**5S-7900U**
8.2	0.4	0.010	16.3	15.5	19.7	21.3	14.5	21.5	22.8	0.3	0.15	**5S-7901U**
9.8	0.8	0.013	19.3	18.3	23.7	25.6	17.5	25.5	26.8	0.3	0.15	**5S-7902U**
10.3	0.8	0.015	21.3	20.3	25.7	27.7	19.5	27.5	28.8	0.3	0.15	**5S-7903U**
12.8	1.5	0.033	25.9	24.7	31.1	33.5	22.5	34.5	35.8	0.3	0.15	**5S-7904U**
14.2	1.8	0.039	30.9	29.7	36.1	38.5	27.5	39.5	40.8	0.3	0.15	**5S-7905U**
15.7	2.0	0.044	35.9	34.7	41.1	43.5	32.5	44.5	45.8	0.3	0.15	**5S-7906U**
18.1	3.4	0.062	41.6	39.9	48.4	51.6	39.5	50.5	52.5	0.6	0.3	**5S-7907U**
20.8	4.7	0.10	47.6	45.9	54.4	57.7	44.5	57.5	59.5	0.6	0.3	**5S-7908U**
22.4	5.9	0.11	52.7	50.8	60.4	64.0	49.5	63.5	65.5	0.6	0.3	**5S-7909U**
23.7	6.2	0.11	57.2	55.3	64.9	68.4	54.5	67.5	69.5	0.6	0.3	**5S-7910U**
26.1	7.5	0.16	63.7	61.8	71.4	75.0	60.5	74.5	75.5	1	0.6	**5S-7911U**
27.5	8.0	0.17	68.7	66.8	76.4	80.0	65.5	79.5	80.5	1	0.6	**5S-7912U**
29.0	8.6	0.19	73.7	71.8	81.4	85.0	70.5	84.5	85.5	1	0.6	**5S-7913U**
32.6	14	0.30	80.3	78.0	89.7	94.2	75.5	94.5	95.5	1	0.6	**5S-7914U**
34.1	15	0.32	85.3	83.0	94.7	99.2	80.5	99.5	100.5	1	0.6	**5S-7915U**
35.7	16	0.30	90.8	88.5	100.2	104.7	85.5	104.5	105.5	1	0.6	**5S-7916U**
38.7	22	0.47	96.9	94.3	108.1	113.4	92	113	115.5	1	0.6	**5S-7917U**
40.2	23	0.49	101.9	99.3	113.1	118.4	97	118	120.5	1	0.6	**5S-7918U**
41.6	24	0.52	106.9	104.3	118.1	123.4	102	123	125.5	1	0.6	**5S-7919U**
44.8	33	0.70	113.6	110.5	126.4	132.6	107	133	135.5	1	0.6	**5S-7920U**
46.2	34	0.73	118.6	115.5	131.4	137.6	112	138	140.5	1	0.6	**5S-7921U**
47.7	36	0.76	123.6	120.5	136.4	142.6	117	143	145.5	1	0.6	**5S-7922U**
52.3	48	1.03	135.2	131.7	149.8	156.7	127	158	160.5	1	0.6	**5S-7924U**
56.9	63	1.34	146.9	143.0	163.2	170.9	138.5	171.5	174.5	1.5	1	**5S-7926U**

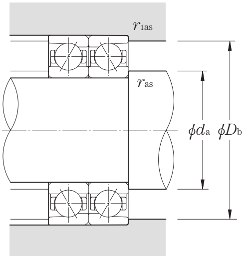
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-70 series

Contact angle 15° d 10～130mm

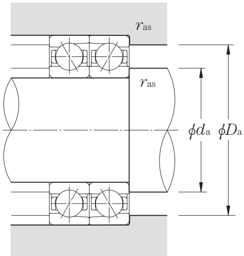


Part number	Boundary dimensions mm					Basic load ratings dynamic static kN		dynamic static kgf		Static axial load capacity kN	kgf	Factor	Limiting speed min^{-1}	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	grease lubrication	oil lubrication
5S-7000UC	10	26	8	0.3	0.15	5.30	1.72	540	175	2.88	293	8.7	75 500	123 000
5S-7001UC	12	28	8	0.3	0.15	5.80	2.03	595	207	3.40	350	9.3	65 500	106 800
5S-7002UC	15	32	9	0.3	0.15	6.60	2.56	675	261	4.35	440	9.7	57 200	93 200
5S-7003UC	17	35	10	0.3	0.15	8.25	3.15	840	320	5.30	540	9.6	51 700	84 200
5S-7004UC	20	42	12	0.6	0.3	11.1	4.55	1 130	465	7.70	785	9.8	42 700	69 500
5S-7005UC	25	47	12	0.6	0.3	12.3	5.55	1 250	565	9.40	960	10.2	37 300	60 800
5S-7006UC	30	55	13	1	0.6	15.8	7.65	1 620	780	13.0	1 320	10.3	31 200	50 900
5S-7007UC	35	62	14	1	0.6	20.0	10.1	2 040	1 030	17.2	1 750	10.4	27 700	45 100
5S-7008UC	40	68	15	1	0.6	21.4	11.7	2 180	1 190	19.9	2 020	10.6	24 900	40 500
5S-7009UC	45	75	16	1	0.6	25.3	14.1	2 580	1 440	24.1	2 460	10.7	22 400	36 500
5S-7010UC	50	80	16	1	0.6	26.9	16.0	2 740	1 630	27.3	2 780	10.9	20 700	33 700
5S-7011UC	55	90	18	1.1	0.6	35.5	20.9	3 600	2 140	35.5	3 650	10.7	18 500	30 200
5S-7012UC	60	95	18	1.1	0.6	36.5	22.4	3 700	2 280	38.0	3 900	10.9	17 300	28 300
5S-7013UC	65	100	18	1.1	0.6	38.5	24.9	3 900	2 540	42.5	4 350	11.0	16 300	26 500
5S-7014UC	70	110	20	1.1	0.6	48.5	31.5	4 950	3 200	53.5	5 450	10.9	14 900	24 300
5S-7015UC	75	115	20	1.1	0.6	49.5	33.0	5 050	3 400	56.5	5 750	11.0	14 100	23 000
5S-7016UC	80	125	22	1.1	0.6	60.5	40.0	6 200	4 100	68.5	7 000	10.9	13 100	21 400
5S-7017UC	85	130	22	1.1	0.6	62.0	42.5	6 350	4 350	72.5	7 400	11.0	12 500	20 400
5S-7018UC	90	140	24	1.5	1	74.0	50.5	7 550	5 150	86.0	8 750	10.9	11 700	19 000
5S-7019UC	95	145	24	1.5	1	76.0	53.0	7 750	5 400	90.5	9 250	11.0	11 200	18 200
5S-7020UC	100	150	24	1.5	1	77.5	56.0	7 900	5 700	95.5	9 750	11.1	10 800	17 500
5S-7021UC	105	160	26	2	1	91.0	65.0	9 250	6 600	111	11 300	11.0	10 100	16 500
5S-7022UC	110	170	28	2	1	104	74.0	10 600	7 500	126	12 800	10.9	9 600	15 600
5S-7024UC	120	180	28	2	1	106	78.5	10 800	8 000	134	13 600	11.1	9 000	14 600
5S-7026UC	130	200	33	2	1	133	99.5	13 600	10 200	170	17 300	11.0	8 100	13 300
5S-7028UC	140	210	33	2	1	136	105.0	13 900	10 700	179	18 300	11.1	7 600	12 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

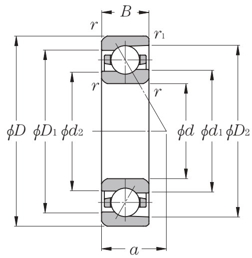
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.4	0.9	0.017	15.2	14.0	20.4	22.7	12.5	23.5	24.8	0.3	0.15	**5S-7000UC**
6.8	1.0	0.018	17.9	16.7	23.1	25.6	14.5	25.5	26.8	0.3	0.15	**5S-7001UC**
7.7	1.3	0.027	20.9	19.7	26.1	28.7	17.5	29.5	30.8	0.3	0.15	**5S-7002UC**
8.5	1.8	0.033	23.0	21.6	29.0	32.0	19.5	32.5	33.8	0.3	0.15	**5S-7003UC**
10.3	2.9	0.060	28.1	26.4	34.9	38.4	24.5	37.5	39.5	0.6	0.3	**5S-7004UC**
10.9	3.3	0.071	32.6	30.9	39.4	42.9	29.5	42.5	44.5	0.6	0.3	**5S-7005UC**
12.3	4.8	0.10	39.2	37.3	46.9	50.7	35.5	49.5	50.5	1	0.6	**5S-7006UC**
13.5	6.3	0.13	44.2	42.2	52.8	57.0	40.5	56.5	57.5	1	0.6	**5S-7007UC**
14.8	7.4	0.17	49.7	47.7	58.3	62.5	45.5	62.5	63.5	1	0.6	**5S-7008UC**
16.1	9.4	0.21	55.3	53.0	64.7	69.4	50.5	69.5	70.5	1	0.6	**5S-7009UC**
16.8	11	0.23	60.3	58.0	69.7	74.4	55.5	74.5	75.5	1	0.6	**5S-7010UC**
18.8	16	0.33	66.9	64.3	78.1	83.6	62	83	85.5	1	0.6	**5S-7011UC**
19.4	17	0.36	71.9	69.3	83.1	88.6	67	88	90.5	1	0.6	**5S-7012UC**
20.1	18	0.38	76.9	74.3	88.1	93.5	72	93	95.5	1	0.6	**5S-7013UC**
22.1	24	0.53	83.6	80.5	96.4	102.7	77	103	105.5	1	0.6	**5S-7014UC**
22.8	26	0.56	88.6	85.5	101.4	107.7	82	108	110.5	1	0.6	**5S-7015UC**
24.8	34	0.74	95.2	91.7	109.8	116.9	87	118	120.5	1	0.6	**5S-7016UC**
25.5	36	0.78	100.2	96.7	114.8	121.9	92	123	125.5	1	0.6	**5S-7017UC**
27.5	47	1.00	106.9	103.0	123.2	131.1	98.5	131.5	134.5	1.5	1	**5S-7018UC**
28.2	49	1.04	111.9	108.0	128.2	136.1	103.5	136.5	139.5	1.5	1	**5S-7019UC**
28.8	51	1.09	116.9	113.0	133.2	141.1	108.5	141.5	144.5	1.5	1	**5S-7020UC**
30.8	70	1.34	123.5	119.2	141.5	150.2	115	150	154.5	2	1	**5S-7021UC**
32.9	83	1.69	130.2	125.4	149.9	159.4	120	160	164.5	2	1	**5S-7022UC**
34.2	90	1.80	140.2	135.4	159.9	169.4	130	170	174.5	2	1	**5S-7024UC**
38.7	131	2.80	153.9	148.5	176.2	187.1	140	190	194.5	2	1	**5S-7026UC**
40.1	144	2.90	164.0	158.7	186.3	197.1	150	200	204.5	2	1	**5S-7028UC**

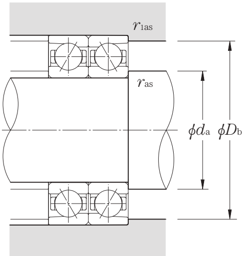
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-70 series

Contact angle 25° d 10〜130mm

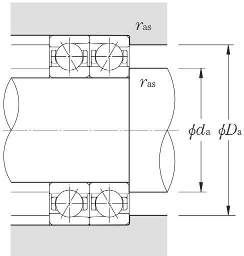


Part number	Boundary dimensions mm					Basic load ratings dynamic static kN		dynamic static kgf		Static axial load capacity kN	kgf	Limiting speed min^{-1}	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			grease lubrication	oil lubrication
5S-7000UAD	10	26	8	0.3	0.15	5.15	1.66	525	169	3.30	340	65 800	107 900
5S-7001UAD	12	28	8	0.3	0.15	5.60	1.95	570	199	3.70	380	57 100	93 700
5S-7002UAD	15	32	9	0.3	0.15	6.35	2.45	645	250	4.45	455	49 800	81 800
5S-7003UAD	17	35	10	0.3	0.15	7.90	3.00	805	305	5.80	590	45 000	73 900
5S-7004UAD	20	42	12	0.6	0.3	10.6	4.35	1 080	445	8.45	865	37 200	61 000
5S-7005UAD	25	47	12	0.6	0.3	11.7	5.30	1 190	540	9.90	1 010	32 500	53 400
5S-7006UAD	30	55	13	1	0.6	15.1	7.30	1 540	745	13.8	1 400	27 200	44 700
5S-7007UAD	35	62	14	1	0.6	19.0	9.65	1 940	980	17.1	1 740	24 100	39 600
5S-7008UAD	40	68	15	1	0.6	20.3	11.1	2 070	1 130	19.3	1 970	21 700	35 600
5S-7009UAD	45	75	16	1	0.6	24.0	13.4	2 450	1 370	23.8	2 430	19 500	32 000
5S-7010UAD	50	80	16	1	0.6	25.5	15.2	2 600	1 550	26.5	2 710	18 000	29 600
5S-7011UAD	55	90	18	1.1	0.6	33.5	19.9	3 400	2 030	34.5	3 500	16 200	26 500
5S-7012UAD	60	95	18	1.1	0.6	34.5	21.2	3 500	2 170	36.0	3 700	15 100	24 800
5S-7013UAD	65	100	18	1.1	0.6	36.0	23.6	3 700	2 410	40.0	4 050	14 200	23 300
5S-7014UAD	70	110	20	1.1	0.6	46.0	29.7	4 700	3 050	52.0	5 300	13 000	21 400
5S-7015UAD	75	115	20	1.1	0.6	47.0	31.5	4 800	3 200	54.5	5 550	12 300	20 200
5S-7016UAD	80	125	22	1.1	0.6	57.5	38.0	5 850	3 900	65.5	6 700	11 400	18 800
5S-7017UAD	85	130	22	1.1	0.6	58.5	40.5	6 000	4 100	68.5	7 000	10 900	17 900
5S-7018UAD	90	140	24	1.5	1	70.0	48.0	7 150	4 850	84.0	8 550	10 200	16 700
5S-7019UAD	95	145	24	1.5	1	71.5	50.5	7 300	5 150	88.0	8 950	9 800	16 000
5S-7020UAD	100	150	24	1.5	1	73.5	53.0	7 500	5 400	92.0	9 350	9 400	15 400
5S-7021UAD	105	160	26	2	1	86.0	61.5	8 750	6 300	106	10 800	8 800	14 500
5S-7022UAD	110	170	28	2	1	98.5	70.0	10 100	7 150	123	12 500	8 400	13 700
5S-7024UAD	120	180	28	2	1	101	74.5	10 300	7 600	129	13 200	7 800	12 800
5S-7026UAD	130	200	33	2	1	126	94.5	12 900	9 650	164	16 700	7 100	11 600
5S-7028UAD	140	210	33	2	1	128	100.0	13 100	10 200	170	17 300	6 700	11 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

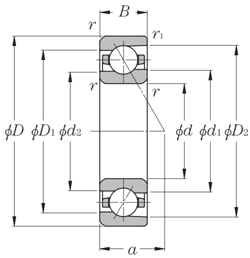
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
8.2	0.9	0.017	15.2	14.0	20.4	22.9	12.5	23.5	24.8	0.3	0.15	**5S-7000UAD**
8.8	1.0	0.018	17.9	16.7	23.1	25.6	14.5	25.5	26.8	0.3	0.15	**5S-7001UAD**
10.0	1.3	0.027	20.9	19.7	26.1	28.4	17.5	29.5	30.8	0.3	0.15	**5S-7002UAD**
11.1	1.8	0.033	23.0	21.6	29.0	32.0	19.5	32.5	33.8	0.3	0.15	**5S-7003UAD**
13.4	2.9	0.060	28.1	26.4	34.9	38.3	24.5	37.5	39.5	0.6	0.3	**5S-7004UAD**
14.5	3.3	0.071	32.6	30.9	39.4	42.8	29.5	42.5	44.5	0.6	0.3	**5S-7005UAD**
16.6	4.8	0.10	39.2	37.3	46.9	50.7	35.5	49.5	50.5	1	0.6	**5S-7006UAD**
18.4	6.3	0.13	44.2	42.2	52.8	56.9	40.5	56.5	57.5	1	0.6	**5S-7007UAD**
20.2	7.4	0.17	49.7	47.7	58.3	62.5	45.5	62.5	63.5	1	0.6	**5S-7008UAD**
22.1	9.4	0.21	55.3	53.0	64.7	69.3	50.5	69.5	70.5	1	0.6	**5S-7009UAD**
23.2	11	0.23	60.3	58.0	69.7	74.3	55.5	74.5	75.5	1	0.6	**5S-7010UAD**
26.0	16	0.33	66.9	64.3	78.1	83.5	62	83	85.5	1	0.6	**5S-7011UAD**
27.2	17	0.36	71.9	69.3	83.1	88.5	67	88	90.5	1	0.6	**5S-7012UAD**
28.3	18	0.38	76.9	74.3	88.1	93.5	72	93	95.5	1	0.6	**5S-7013UAD**
31.1	24	0.53	83.6	80.5	96.4	102.7	77	103	105.5	1	0.6	**5S-7014UAD**
32.3	26	0.56	88.6	85.5	101.4	107.7	82	108	110.5	1	0.6	**5S-7015UAD**
35.0	34	0.74	95.2	91.7	109.8	116.9	87	118	120.5	1	0.6	**5S-7016UAD**
36.2	36	0.78	100.2	96.7	114.8	121.9	92	123	125.5	1	0.6	**5S-7017UAD**
39.0	47	1.00	106.9	103.0	123.2	131.0	98.5	131.5	134.5	1.5	1	**5S-7018UAD**
40.1	49	1.04	111.9	108.0	128.2	136.0	103.5	136.5	139.5	1.5	1	**5S-7019UAD**
41.3	51	1.09	116.9	113.0	133.2	141.0	108.5	141.5	144.5	1.5	1	**5S-7020UAD**
44.1	70	1.34	123.5	119.2	141.5	150.2	115	150	154.5	2	1	**5S-7021UAD**
46.8	83	1.69	130.2	125.4	149.9	159.3	120	160	164.5	2	1	**5S-7022UAD**
49.2	90	1.80	140.2	135.4	159.9	169.3	130	170	174.5	2	1	**5S-7024UAD**
55.2	131	2.80	153.9	148.5	176.2	187.0	140	190	194.5	2	1	**5S-7026UAD**
57.5	144	2.90	164.0	158.7	186.3	197.0	150	200	204.5	2	1	**5S-7028UAD**

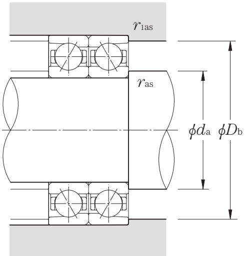
ULTAGE Standard angular contact ball bearings (ceramic ball type) 5S-70 series

Contact angle 30° d 10～130mm

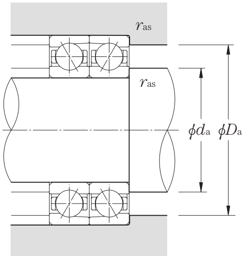


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-7000U	10	26	8	0.3	0.15	5.00	1.62	510	165	2.54	259	52 600	70 100
5S-7001U	12	28	8	0.3	0.15	5.45	1.90	555	193	2.84	289	45 700	60 900
5S-7002U	15	32	9	0.3	0.15	6.15	2.38	625	242	3.40	350	39 900	53 100
5S-7003U	17	35	10	0.3	0.15	7.65	2.92	780	298	4.45	455	36 000	48 000
5S-7004U	20	42	12	0.6	0.3	10.3	4.25	1 050	430	6.55	670	29 700	39 600
5S-7005U	25	47	12	0.6	0.3	11.3	5.10	1 150	520	7.65	780	26 000	34 700
5S-7006U	30	55	13	1	0.6	14.5	7.05	1 480	715	10.7	1 090	21 800	29 000
5S-7007U	35	62	14	1	0.6	18.3	9.30	1 870	950	13.2	1 340	19 300	25 700
5S-7008U	40	68	15	1	0.6	19.5	10.7	1 990	1 090	14.8	1 510	17 400	23 100
5S-7009U	45	75	16	1	0.6	23.1	13.0	2 360	1 320	18.4	1 870	15 600	20 800
5S-7010U	50	80	16	1	0.6	24.5	14.6	2 500	1 490	20.5	2 090	14 400	19 200
5S-7011U	55	90	18	1.1	0.6	32.5	19.2	3 300	1 960	26.3	2 680	12 900	17 200
5S-7012U	60	95	18	1.1	0.6	33.0	20.5	3 350	2 090	27.7	2 830	12 100	16 100
5S-7013U	65	100	18	1.1	0.6	35.0	22.8	3 550	2 320	30.5	3 100	11 400	15 100
5S-7014U	70	110	20	1.1	0.6	44.0	28.6	4 500	2 920	40.0	4 100	10 400	13 900
5S-7015U	75	115	20	1.1	0.6	45.0	30.5	4 600	3 100	42.0	4 300	9 900	13 100
5S-7016U	80	125	22	1.1	0.6	55.0	37.0	5 600	3 750	50.5	5 150	9 100	12 200
5S-7017U	85	130	22	1.1	0.6	56.5	39.0	5 750	3 950	53.0	5 400	8 700	11 600
5S-7018U	90	140	24	1.5	1	67.5	46.0	6 850	4 700	64.5	6 600	8 200	10 900
5S-7019U	95	145	24	1.5	1	69.0	48.5	7 050	4 950	68.0	6 900	7 800	10 400
5S-7020U	100	150	24	1.5	1	70.5	51.0	7 200	5 200	71.0	7 250	7 500	10 000
5S-7021U	105	160	26	2	1	82.5	59.5	8 400	6 050	81.0	8 300	7 100	9 400
5S-7022U	110	170	28	2	1	95.0	67.5	9 650	6 900	95.0	9 700	6 700	8 900
5S-7024U	120	180	28	2	1	96.5	71.5	9 850	7 300	99.5	10 200	6 200	8 300
5S-7026U	130	200	33	2	1	121	91.0	12 300	9 300	126	12 900	5 700	7 600
5S-7028U	140	210	33	2	1	123	96.0	12 600	9 800	130	13 300	5 300	7 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.8	1	0	0.39	0.76	1	0.78	0.63	1.24

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

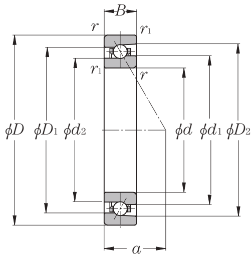
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.33	1	0.66

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
9.2	0.9	0.017	15.2	14.0	20.4	22.7	12.5	23.5	24.8	0.3	0.15	**5S-7000U**
10.0	1.0	0.018	17.9	16.7	23.1	25.5	14.5	25.5	26.8	0.3	0.15	**5S-7001U**
11.3	1.3	0.027	20.9	19.7	26.1	28.6	17.5	29.5	30.8	0.3	0.15	**5S-7002U**
12.6	1.8	0.033	23.0	21.6	29.0	31.9	19.5	32.5	33.8	0.3	0.15	**5S-7003U**
15.2	2.9	0.060	28.1	26.4	34.9	38.3	24.5	37.5	39.5	0.6	0.3	**5S-7004U**
16.5	3.3	0.071	32.6	30.9	39.4	42.8	29.5	42.5	44.5	0.6	0.3	**5S-7005U**
19.0	4.8	0.10	39.2	37.3	46.9	50.6	35.5	49.5	50.5	1	0.6	**5S-7006U**
21.1	6.3	0.13	44.2	42.2	52.8	56.9	40.5	56.5	57.5	1	0.6	**5S-7007U**
23.2	7.4	0.17	49.7	47.7	58.3	62.4	45.5	62.5	63.5	1	0.6	**5S-7008U**
25.4	9.4	0.21	55.3	53.0	64.7	69.3	50.5	69.5	70.5	1	0.6	**5S-7009U**
26.9	11	0.23	60.3	58.0	69.7	74.3	55.5	74.5	75.5	1	0.6	**5S-7010U**
30.1	16	0.33	66.9	64.3	78.1	83.5	62	83	85.5	1	0.6	**5S-7011U**
31.5	17	0.36	71.9	69.3	83.1	88.5	67	88	90.5	1	0.6	**5S-7012U**
32.9	18	0.38	76.9	74.3	88.1	93.4	72	93	95.5	1	0.6	**5S-7013U**
36.1	24	0.53	83.6	80.5	96.4	102.6	77	103	105.5	1	0.6	**5S-7014U**
37.6	26	0.56	88.6	85.5	101.4	107.6	82	108	110.5	1	0.6	**5S-7015U**
40.8	34	0.74	95.2	91.7	109.8	116.8	87	118	120.5	1	0.6	**5S-7016U**
42.2	36	0.78	100.2	96.7	114.8	121.8	92	123	125.5	1	0.6	**5S-7017U**
45.4	47	1.00	106.9	103.0	123.2	131.0	98.5	131.5	134.5	1.5	1	**5S-7018U**
46.8	49	1.04	111.9	108.0	128.2	136.0	103.5	136.5	139.5	1.5	1	**5S-7019U**
48.3	51	1.09	116.9	113.0	133.2	141.0	108.5	141.5	144.5	1.5	1	**5S-7020U**
51.5	70	1.34	123.5	119.2	141.5	150.1	115	150	154.5	2	1	**5S-7021U**
54.6	83	1.69	130.2	125.4	149.9	159.3	120	160	164.5	2	1	**5S-7022U**
57.5	90	1.80	140.2	135.4	159.9	169.2	130	170	174.5	2	1	**5S-7024U**
64.4	131	2.80	153.9	148.5	176.2	186.9	140	190	194.5	2	1	**5S-7026U**
67.3	144	2.90	164.0	158.7	186.3	197.0	150	200	204.5	2	1	**5S-7028U**

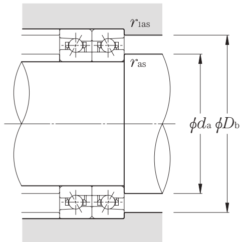
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE9U series

Contact angle 15° d 50～170mm

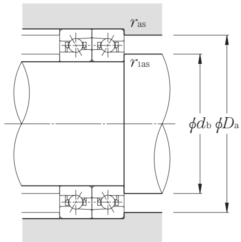


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed (min⁻¹) grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
2LA-HSE910UC	50	72	12	0.6	0.3	11.0	8.1	1 120	830	11.8	1 210	10.9	21 800	34 600
2LA-HSE911UC	55	80	13	1	0.6	13.7	10.1	1 390	1 030	14.8	1 510	10.8	19 700	31 300
2LA-HSE912UC	60	85	13	1	0.6	14.2	11.1	1 450	1 130	16.2	1 660	10.9	18 300	29 100
2LA-HSE913UC	65	90	13	1	0.6	14.3	11.6	1 460	1 180	17.0	1 740	11.0	17 200	27 200
2LA-HSE914UC	70	100	16	1	0.6	20.9	16.5	2 140	1 680	24.2	2 470	10.9	15 600	24 800
2LA-HSE915UC	75	105	16	1	0.6	21.8	18.0	2 220	1 830	26.3	2 690	10.9	14 800	23 400
2LA-HSE916UC	80	110	16	1	0.6	22.0	18.8	2 240	1 910	27.5	2 810	11.0	14 000	22 200
2LA-HSE917UC	85	120	18	1.1	0.6	29.8	24.8	3 050	2 520	36.0	3 700	10.9	13 000	20 600
2LA-HSE918UC	90	125	18	1.1	0.6	31.0	26.8	3 150	2 740	39.0	4 000	10.9	12 400	19 600
2LA-HSE919UC	95	130	18	1.1	0.6	31.5	27.9	3 200	2 850	40.5	4 150	11.0	11 800	18 800
2LA-HSE920UC	100	140	20	1.1	0.6	36.5	32.5	3 700	3 350	48.0	4 900	11.0	11 100	17 600
2LA-HSE921UC	105	145	20	1.1	0.6	37.0	34.0	3 750	3 450	50.0	5 100	11.0	10 600	16 900
2LA-HSE922UC	110	150	20	1.1	0.6	37.5	35.5	3 800	3 600	51.0	5 250	11.1	10 200	16 200
2LA-HSE924UC	120	165	22	1.1	0.6	48.0	45.0	4 850	4 600	66.0	6 750	11.0	9 300	14 800
2LA-HSE926UC	130	180	24	1.5	1	59.0	56.0	6 050	5 700	81.5	8 350	11.0	8 600	13 600
2LA-HSE928UC	140	190	24	1.5	1	59.5	58.0	6 050	5 950	85.0	8 700	11.0	8 100	12 800
2LA-HSE930UC	150	210	28	2	1	79.5	77.0	8 100	7 850	112	11 500	10.9	7 400	11 700
2LA-HSE932UC	160	220	28	2	1	80.0	80.5	8 200	8 200	117	12 000	11.0	7 000	11 100
2LA-HSE934UC	170	230	28	2	1	81.0	83.5	8 250	8 500	122	12 500	11.1	6 700	10 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

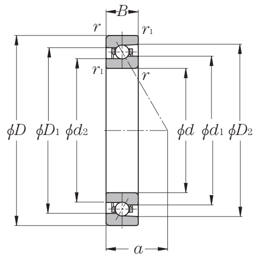
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
14.2	6.0	0.13	57.6	56.6	64.4	66.8	54.5	52.5	67.5	69.5	0.6	0.3
15.6	7.7	0.18	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
16.3	8.3	0.20	68.6	67.4	76.4	79.1	65.5	64.5	79.5	80.5	1	0.6
17.0	8.9	0.21	73.6	72.4	81.4	84.1	70.5	69.5	84.5	85.5	1	0.6
19.5	14	0.34	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
20.1	15	0.36	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
20.8	16	0.38	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
22.8	22	0.54	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
23.5	23	0.56	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
24.2	24	0.59	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
26.2	32	0.82	113.8	111.7	126.2	130.7	107	104.5	133	135.5	1	0.6
26.9	33	0.85	118.8	116.7	131.2	135.7	112	109.5	138	140.5	1	0.6
27.5	35	0.88	123.8	121.7	136.2	140.7	117	114.5	143	145.5	1	0.6
30.2	47	1.20	135.4	133.0	149.6	154.8	127	124.5	158	160.5	1	0.6
32.9	62	1.56	146.9	144.2	163.1	168.9	138.5	135.5	171.5	174.5	1.5	1
34.3	66	1.66	156.9	154.2	173.1	178.9	148.5	145.5	181.5	184.5	1.5	1
38.3	99	2.58	170.5	167.3	189.5	196.4	160	155.5	200	204.5	2	1
39.6	105	2.71	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
41.0	111	2.84	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

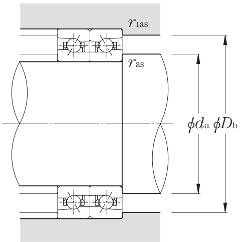
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE9U series

Contact angle 20° d 50～170mm

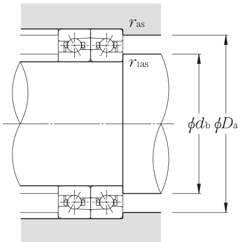


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
2LA-HSE910U	50	72	12	0.6	0.3	10.7	7.95	1 090	810	13.2	1 350	23 100	37 200
2LA-HSE911U	55	80	13	1	0.6	13.3	9.90	1 360	1 010	16.5	1 690	20 800	33 600
2LA-HSE912U	60	85	13	1	0.6	13.8	10.8	1 410	1 100	18.1	1 850	19 400	31 300
2LA-HSE913U	65	90	13	1	0.6	13.9	11.3	1 420	1 150	18.9	1 930	18 200	29 300
2LA-HSE914U	70	100	16	1	0.6	20.4	16.1	2 080	1 640	26.9	2 750	16 600	26 700
2LA-HSE915U	75	105	16	1	0.6	21.2	17.5	2 160	1 790	29.4	3 000	15 600	25 200
2LA-HSE916U	80	110	16	1	0.6	21.4	18.3	2 190	1 870	30.0	3 100	14 800	23 900
2LA-HSE917U	85	120	18	1.1	0.6	29.1	24.2	2 960	2 470	40.0	4 100	13 700	22 100
2LA-HSE918U	90	125	18	1.1	0.6	30.0	26.2	3 100	2 670	43.5	4 450	13 100	21 100
2LA-HSE919U	95	130	18	1.1	0.6	30.5	27.3	3 100	2 780	45.5	4 650	12 500	20 200
2LA-HSE920U	100	140	20	1.1	0.6	35.5	32.0	3 600	3 250	53.0	5 450	11 700	18 900
2LA-HSE921U	105	145	20	1.1	0.6	36.0	33.0	3 650	3 400	55.0	5 650	11 300	18 200
2LA-HSE922U	110	150	20	1.1	0.6	36.5	34.5	3 700	3 500	57.0	5 850	10 800	17 500
2LA-HSE924U	120	165	22	1.1	0.6	46.5	44.0	4 750	4 500	74.0	7 550	9 900	15 900
2LA-HSE926U	130	180	24	1.5	1	57.5	54.5	5 850	5 550	91.0	9 300	9 100	14 600
2LA-HSE928U	140	190	24	1.5	1	58.0	57.0	5 900	5 800	95.0	9 700	8 500	13 800
2LA-HSE930U	150	210	28	2	1	77.5	75.5	7 900	7 700	125	12 800	7 800	12 600
2LA-HSE932U	160	220	28	2	1	78.0	78.5	7 950	8 000	131	13 400	7 400	11 900
2LA-HSE934U	170	230	28	2	1	79.0	81.5	8 050	8 300	136	13 900	7 000	11 300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

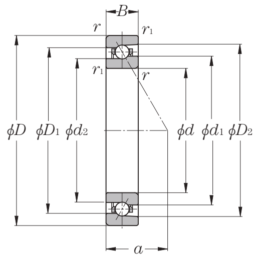
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
17.2	6.0	0.13	57.6	56.6	64.4	66.8	54.5	52.5	67.5	69.5	0.6	0.3
18.9	7.7	0.18	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
19.8	8.3	0.20	68.6	67.4	76.4	79.1	65.5	64.5	79.5	80.5	1	0.6
20.7	8.9	0.21	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
23.6	14	0.34	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
24.5	15	0.36	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
25.4	16	0.38	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
27.8	22	0.54	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
28.7	23	0.56	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
29.6	24	0.59	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
32.0	32	0.82	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6
32.9	33	0.85	118.8	116.7	131.2	135.6	112	109.5	138	140.5	1	0.6
33.8	35	0.88	123.8	121.7	136.2	140.6	117	114.5	143	145.5	1	0.6
37.1	47	1.20	135.4	133.0	149.6	154.7	127	124.5	158	160.5	1	0.6
40.4	62	1.56	146.9	144.2	163.1	168.9	138.5	135.5	171.5	174.5	1.5	1
42.2	66	1.66	156.9	154.2	173.1	178.8	148.5	145.5	181.5	184.5	1.5	1
47.0	99	2.58	170.5	167.3	189.5	196.3	160	155.5	200	204.5	2	1
48.8	105	2.71	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
50.6	111	2.84	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

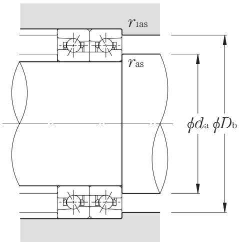
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE9U series

Contact angle 25° d 50～170mm

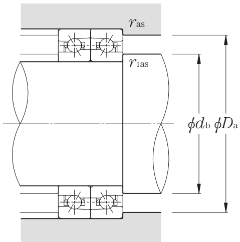


Part number	Boundary dimensions (mm)					Basic load ratings				Static axial load capacity		Limiting speed (min^{-1})	
						dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	kN	kgf	grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
2LA-HSE910UAD	50	72	12	0.6	0.3	10.3	7.70	1 050	785	14.8	1 510	20 500	32 100
2LA-HSE911UAD	55	80	13	1	0.6	12.9	9.60	1 310	980	18.4	1 880	18 500	29 000
2LA-HSE912UAD	60	85	13	1	0.6	13.3	10.5	1 360	1 070	20.2	2 060	17 200	27 000
2LA-HSE913UAD	65	90	13	1	0.6	13.5	11.0	1 370	1 120	21.1	2 160	16 100	25 300
2LA-HSE914UAD	70	100	16	1	0.6	19.7	15.6	2 010	1 590	29.9	3 050	14 700	23 000
2LA-HSE915UAD	75	105	16	1	0.6	20.5	17.0	2 090	1 730	32.0	3 300	13 900	21 700
2LA-HSE916UAD	80	110	16	1	0.6	20.7	17.7	2 110	1 810	33.5	3 450	13 200	20 600
2LA-HSE917UAD	85	120	18	1.1	0.6	28.1	23.4	2 860	2 390	45.0	4 600	12 200	19 100
2LA-HSE918UAD	90	125	18	1.1	0.6	29.2	25.4	2 980	2 590	48.5	4 950	11 600	18 200
2LA-HSE919UAD	95	130	18	1.1	0.6	29.5	26.4	3 000	2 690	50.5	5 200	11 100	17 400
2LA-HSE920UAD	100	140	20	1.1	0.6	34.5	31.0	3 500	3 150	59.0	6 050	10 400	16 300
2LA-HSE921UAD	105	145	20	1.1	0.6	34.5	32.0	3 550	3 300	61.5	6 300	10 000	15 700
2LA-HSE922UAD	110	150	20	1.1	0.6	35.0	33.5	3 600	3 400	64.0	6 550	9 600	15 100
2LA-HSE924UAD	120	165	22	1.1	0.6	45.0	42.5	4 600	4 350	82.0	8 400	8 800	13 700
2LA-HSE926UAD	130	180	24	1.5	1	55.5	53.0	5 700	5 400	101	10 400	8 100	12 600
2LA-HSE928UAD	140	190	24	1.5	1	56.0	55.0	5 700	5 600	105	10 800	7 600	11 900
2LA-HSE930UAD	150	210	28	2	1	75.0	73.0	7 650	7 450	140	14 300	6 900	10 900
2LA-HSE932UAD	160	220	28	2	1	75.5	76.0	7 700	7 750	146	14 900	6 600	10 300
2LA-HSE934UAD	170	230	28	2	1	76.0	79.0	7 750	8 050	152	15 500	6 200	9 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

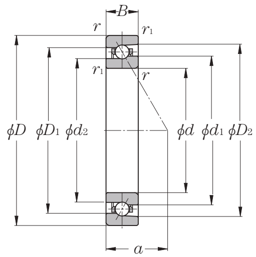
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
20.3	6.0	0.13	57.6	56.6	64.4	66.7	54.5	52.5	67.5	69.5	0.6	0.3
22.4	7.7	0.18	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
23.5	8.3	0.20	68.6	67.4	76.4	79.0	65.5	64.5	79.5	80.5	1	0.6
24.7	8.9	0.21	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
28.0	14	0.34	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
29.1	15	0.36	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
30.3	16	0.38	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
33.1	22	0.54	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
34.2	23	0.56	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
35.4	24	0.59	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
38.2	32	0.82	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6
39.3	33	0.85	118.8	116.7	131.2	135.6	112	109.5	138	140.5	1	0.6
40.5	35	0.88	123.8	121.7	136.2	140.6	117	114.5	143	145.5	1	0.6
44.4	47	1.20	135.4	133.0	149.6	154.7	127	124.5	158	160.5	1	0.6
48.4	62	1.56	146.9	144.2	163.1	168.8	138.5	135.5	171.5	174.5	1.5	1
50.7	66	1.66	156.9	154.2	173.1	178.8	148.5	145.5	181.5	184.5	1.5	1
56.3	99	2.58	170.5	167.3	189.5	196.3	160	155.5	200	204.5	2	1
58.6	105	2.71	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
60.9	111	2.84	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

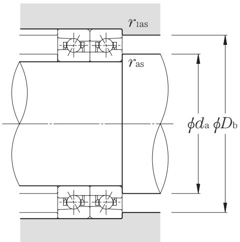
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE0 series

Contact angle 15° d 50～170mm

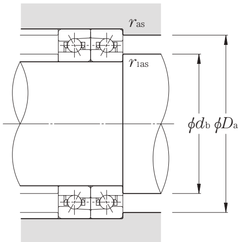


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
2LA-HSE010C	50	80	16	1	0.6	15.9	11.4	1 620	1 160	16.7	1 700	10.4	20 500	32 500
2LA-HSE011C	55	90	18	1.1	0.6	17.3	13.6	1 760	1 380	19.9	2 030	10.6	18 300	29 100
2LA-HSE012C	60	95	18	1.1	0.6	18.1	15.0	1 850	1 530	22.0	2 240	10.7	17 200	27 200
2LA-HSE013C	65	100	18	1.1	0.6	18.4	15.8	1 870	1 610	23.2	2 360	10.8	16 100	25 600
2LA-HSE014C	70	110	20	1.1	0.6	22.5	19.9	2 290	2 030	29.2	2 980	10.8	14 800	23 400
2LA-HSE015C	75	115	20	1.1	0.6	23.9	22.4	2 440	2 290	33.0	3 350	10.9	14 000	22 200
2LA-HSE016C	80	125	22	1.1	0.6	27.4	25.7	2 790	2 620	38.0	3 850	10.9	13 000	20 600
2LA-HSE017C	85	130	22	1.1	0.6	27.7	26.8	2 830	2 740	39.5	4 000	10.9	12 400	19 600
2LA-HSE018C	90	140	24	1.5	1	32.0	31.5	3 300	3 200	46.0	4 700	10.9	11 600	18 300
2LA-HSE019C	95	145	24	1.5	1	32.5	32.5	3 300	3 350	48.0	4 900	11.0	11 100	17 600
2LA-HSE020C	100	150	24	1.5	1	33.5	35.0	3 450	3 600	51.5	5 250	11.0	10 600	16 900
2LA-HSE021C	105	160	26	2	1	38.5	40.5	3 950	4 150	60.0	6 100	11.0	10 000	15 900
2LA-HSE022C	110	170	28	2	1	48.0	49.5	4 900	5 000	72.5	7 400	10.9	9 500	15 100
2LA-HSE024C	120	180	28	2	1	48.0	51.5	4 900	5 250	75.5	7 700	11.0	8 900	14 100
2LA-HSE026C	130	200	33	2	1	69.0	71.0	7 050	7 250	104	10 600	10.8	8 100	12 800
2LA-HSE028C	140	210	33	2	1	71.5	77.0	7 300	7 850	113	11 500	10.9	7 600	12 100
2LA-HSE030C	150	225	35	2.1	1.1	73.5	83.0	7 500	8 450	122	12 400	11.0	7 100	11 300
2LA-HSE032C	160	240	38	2.1	1.1	86.0	97.0	8 800	9 850	142	14 500	11.0	6 700	10 600
2LA-HSE034C	170	260	42	2.1	1.1	99.0	111	10 100	11 300	163	16 700	10.9	6 200	9 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

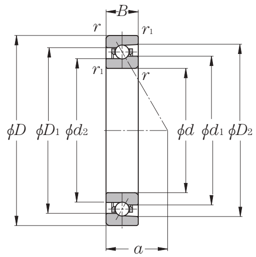
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
16.8	12	0.26	60.1	58.6	69.9	73.3	55.5	54.5	74.5	75.5	1	0.6
18.8	16	0.40	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
19.5	17	0.42	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
20.1	18	0.45	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
22.2	24	0.64	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
22.8	25	0.68	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
24.8	34	0.91	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
25.5	35	0.96	101.8	99.9	113.2	117.5	92	89.5	123	125.5	1	0.6
27.5	45	1.25	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
28.2	47	1.30	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
28.9	49	1.36	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
30.9	61	1.73	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
32.9	77	2.13	132.4	129.8	147.6	153.3	120	115.5	160	164.5	2	1
34.2	82	2.28	142.4	139.8	157.6	163.3	130	125.5	170	174.5	2	1
38.8	130	3.40	155.5	152.3	174.5	181.6	140	135.5	190	194.5	2	1
40.1	129	3.68	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
42.8	163	4.46	178.0	174.8	197.0	204.1	162	157	213	218	2	1
46.0	206	5.46	189.5	186.0	210.5	218.2	172	167	228	233	2	1
50.0	272	7.37	203.6	199.8	226.4	234.9	182	177	248	253	2	1

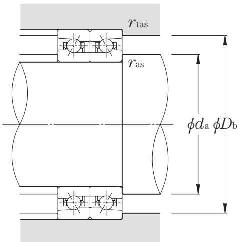
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE0 series

Contact angle 20° d 50～170mm

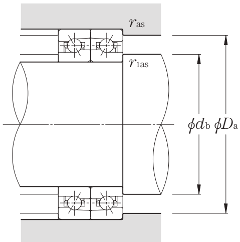


Part number	Boundary dimensions mm					Basic load ratings dynamic static dynamic static kN kgf				Static axial load capacity		Limiting speed min⁻¹	
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r (kN)	C_{or} (kN)	C_r (kgf)	C_{or} (kgf)	kN	kgf	grease lubrication	oil lubrication
2LA-HSE010	50	80	16	1	0.6	15.5	11.2	1 580	1 140	18.7	1 900	21 600	34 900
2LA-HSE011	55	90	18	1.1	0.6	16.8	13.3	1 720	1 350	22.2	2 260	19 400	31 300
2LA-HSE012	60	95	18	1.1	0.6	17.6	14.7	1 800	1 490	24.6	2 500	18 200	29 300
2LA-HSE013	65	100	18	1.1	0.6	17.9	15.4	1 830	1 570	25.9	2 640	17 100	27 500
2LA-HSE014	70	110	20	1.1	0.6	21.9	19.4	2 230	1 980	32.5	3 300	15 600	25 200
2LA-HSE015	75	115	20	1.1	0.6	23.3	21.9	2 380	2 230	36.5	3 750	14 800	23 900
2LA-HSE016	80	125	22	1.1	0.6	26.7	25.1	2 720	2 560	42.0	4 300	13 700	22 100
2LA-HSE017	85	130	22	1.1	0.6	27.0	26.2	2 760	2 670	44.0	4 500	13 100	21 100
2LA-HSE018	90	140	24	1.5	1	31.5	30.5	3 200	3 150	51.5	5 250	12 200	19 700
2LA-HSE019	95	145	24	1.5	1	31.5	32.0	3 250	3 250	53.5	5 450	11 700	18 900
2LA-HSE020	100	150	24	1.5	1	33.0	34.5	3 350	3 500	57.5	5 850	11 300	18 200
2LA-HSE021	105	160	26	2	1	37.5	39.5	3 850	4 050	66.5	6 800	10 600	17 100
2LA-HSE022	110	170	28	2	1	46.5	48.0	4 750	4 900	80.5	8 200	10 000	16 200
2LA-HSE024	120	180	28	2	1	47.0	50.0	4 800	5 100	84.0	8 600	9 400	15 100
2LA-HSE026	130	200	33	2	1	67.5	69.5	6 900	7 100	116	11 900	8 500	13 800
2LA-HSE028	140	210	33	2	1	70.0	75.0	7 100	7 650	126	12 800	8 000	13 000
2LA-HSE030	150	225	35	2.1	1.1	72.0	81.0	7 300	8 250	136	13 900	7 500	12 100
2LA-HSE032	160	240	38	2.1	1.1	84.0	94.5	8 550	9 650	159	16 200	7 000	11 300
2LA-HSE034	170	260	42	2.1	1.1	96.5	108	9 850	11 100	182	18 600	6 500	10 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

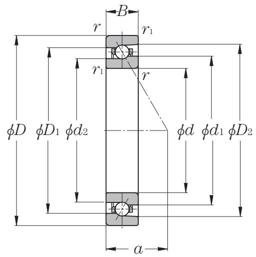
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm				Abutment and fillet dimensions mm					
a			d_1	d_2	D_1	D_2	d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
19.9	12	0.26	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
22.3	16	0.40	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
23.2	17	0.42	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
24.1	18	0.45	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
26.5	24	0.64	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
27.4	25	0.68	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
29.8	34	0.91	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
30.7	35	0.96	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
33.1	45	1.25	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
34.0	47	1.30	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
34.9	49	1.36	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
37.3	61	1.73	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
39.7	77	2.13	132.4	129.8	147.6	153.2	120	115.5	160	164.5	2	1
41.5	82	2.28	142.4	139.8	157.6	163.2	130	125.5	170	174.5	2	1
46.8	130	3.40	155.5	152.3	174.5	181.5	140	135.5	190	194.5	2	1
48.6	129	3.68	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
51.9	163	4.46	178.0	174.8	197.0	204.0	162	157	213	218	2	1
55.7	206	5.46	189.5	186.0	210.5	218.2	172	167	228	233	2	1
60.4	272	7.37	203.6	199.8	226.4	234.9	182	177	248	253	2	1

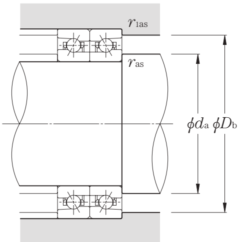
ULTAGE High-speed angular contact ball bearings (steel ball type) 2LA-HSE0 series

Contact angle 25° d 50～170mm

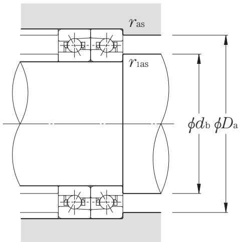


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
2LA-HSE010AD	50	80	16	1	0.6	15.0	10.8	1 530	1 100	20.9	2 130	19 200	30 100
2LA-HSE011AD	55	90	18	1.1	0.6	16.3	12.9	1 660	1 310	24.8	2 530	17 200	27 000
2LA-HSE012AD	60	95	18	1.1	0.6	17.1	14.2	1 740	1 450	27.4	2 800	16 100	25 300
2LA-HSE013AD	65	100	18	1.1	0.6	17.3	14.9	1 770	1 520	28.9	2 940	15 100	23 700
2LA-HSE014AD	70	110	20	1.1	0.6	21.2	18.8	2 160	1 920	36.5	3 700	13 900	21 700
2LA-HSE015AD	75	115	20	1.1	0.6	22.5	21.2	2 300	2 160	41.0	4 200	13 200	20 600
2LA-HSE016AD	80	125	22	1.1	0.6	25.8	24.3	2 630	2 480	47.0	4 800	12 200	19 100
2LA-HSE017AD	85	130	22	1.1	0.6	26.1	25.4	2 660	2 590	49.0	5 000	11 600	18 200
2LA-HSE018AD	90	140	24	1.5	1	30.5	29.7	3 100	3 050	57.5	5 850	10 900	17 000
2LA-HSE019AD	95	145	24	1.5	1	30.5	31.0	3 150	3 150	60.0	6 100	10 400	16 300
2LA-HSE020AD	100	150	24	1.5	1	31.5	33.0	3 250	3 400	64.0	6 550	10 000	15 700
2LA-HSE021AD	105	160	26	2	1	36.5	38.5	3 700	3 900	74.5	7 600	9 400	14 800
2LA-HSE022AD	110	170	28	2	1	45.0	46.5	4 600	4 750	90.0	9 150	8 900	14 000
2LA-HSE024AD	120	180	28	2	1	45.5	48.5	4 650	4 950	94.0	9 550	8 300	13 000
2LA-HSE026AD	130	200	33	2	1	65.0	67.5	6 650	6 850	130	13 200	7 600	11 900
2LA-HSE028AD	140	210	33	2	1	67.5	73.0	6 900	7 400	141	14 300	7 100	11 200
2LA-HSE030AD	150	225	35	2.1	1.1	69.5	78.5	7 050	8 000	151	15 400	6 700	10 400
2LA-HSE032AD	160	240	38	2.1	1.1	81.0	91.5	8 300	9 350	177	18 000	6 200	9 800
2LA-HSE034AD	170	260	42	2.1	1.1	93.0	105	9 500	10 700	203	20 700	5 800	9 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

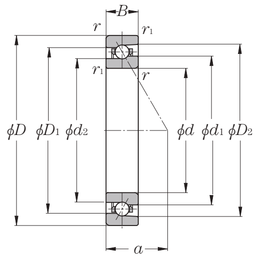
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
23.3	12	0.26	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
26.1	16	0.40	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
27.2	17	0.42	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
28.4	18	0.45	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
31.1	24	0.64	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
32.3	25	0.68	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
35.1	34	0.91	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
36.2	35	0.96	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
39.0	45	1.25	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
40.2	47	1.30	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
41.3	49	1.36	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
44.1	61	1.73	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
46.9	77	2.13	132.4	129.8	147.6	153.2	120	115.5	160	164.5	2	1
49.2	82	2.28	142.4	139.8	157.6	163.2	130	125.5	170	174.5	2	1
55.3	130	3.40	155.5	152.3	174.5	181.5	140	135.5	190	194.5	2	1
57.6	129	3.68	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
61.5	163	4.46	178.0	174.8	197.0	204.0	162	157	213	218	2	1
66.0	206	5.46	189.5	186.0	210.5	218.2	172	167	228	233	2	1
71.5	272	7.37	203.6	199.8	226.4	234.9	182	177	248	253	2	1

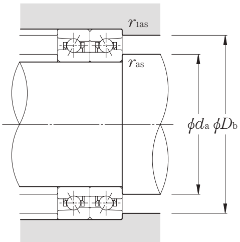
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE9U series

Contact angle 15° d 50～170mm

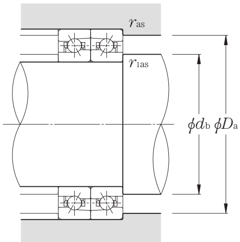


Part number	Boundary dimensions mm					Basic load ratings				Static axial load capacity		Factor	Limiting speed min⁻¹	
						dynamic kN	static kN	dynamic kgf	static kgf	kN	kgf		grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
5S-2LA-HSE910UC	50	72	12	0.6	0.3	11.0	5.65	1 120	575	7.45	760	7.6	25 600	42 400
5S-2LA-HSE911UC	55	80	13	1	0.6	13.7	7.05	1 390	715	9.30	950	7.5	23 100	38 300
5S-2LA-HSE912UC	60	85	13	1	0.6	14.2	7.70	1 450	785	10.1	1 040	7.6	21 500	35 700
5S-2LA-HSE913UC	65	90	13	1	0.6	14.3	8.05	1 460	820	10.6	1 090	7.6	20 100	33 400
5S-2LA-HSE914UC	70	100	16	1	0.6	20.9	11.5	2 140	1 170	15.2	1 560	7.5	18 400	30 400
5S-2LA-HSE915UC	75	105	16	1	0.6	21.8	12.5	2 220	1 270	16.6	1 700	7.6	17 300	28 700
5S-2LA-HSE916UC	80	110	16	1	0.6	22.0	13.0	2 240	1 330	17.3	1 770	7.6	16 400	27 200
5S-2LA-HSE917UC	85	120	18	1.1	0.6	29.8	17.2	3 050	1 750	22.9	2 340	7.5	15 200	25 200
5S-2LA-HSE918UC	90	125	18	1.1	0.6	31.0	18.6	3 150	1 900	24.8	2 530	7.6	14 500	24 100
5S-2LA-HSE919UC	95	130	18	1.1	0.6	31.5	19.4	3 200	1 970	25.8	2 640	7.6	13 900	23 000
5S-2LA-HSE920UC	100	140	20	1.1	0.6	36.5	22.7	3 700	2 310	29.9	3 050	7.6	13 000	21 600
5S-2LA-HSE921UC	105	145	20	1.1	0.6	37.0	23.6	3 750	2 400	31.0	3 200	7.6	12 500	20 700
5S-2LA-HSE922UC	110	150	20	1.1	0.6	37.5	24.5	3 800	2 500	32.0	3 300	7.7	12 000	19 900
5S-2LA-HSE924UC	120	165	22	1.1	0.6	48.0	31.5	4 850	3 200	41.5	4 250	7.6	10 900	18 200
5S-2LA-HSE926UC	130	180	24	1.5	1	59.0	38.5	6 050	3 950	51.0	5 250	7.6	10 100	16 700
5S-2LA-HSE928UC	140	190	24	1.5	1	59.5	40.5	6 050	4 100	53.5	5 500	7.6	9 500	15 700
5S-2LA-HSE930UC	150	210	28	2	1	79.5	53.5	8 100	5 450	71.5	7 300	7.6	8 700	14 400
5S-2LA-HSE932UC	160	220	28	2	1	80.0	55.5	8 200	5 700	74.5	7 600	7.6	8 200	13 600
5S-2LA-HSE934UC	170	230	28	2	1	81.0	58.0	8 250	5 900	77.0	7 900	7.7	7 800	12 900

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35	1	0	0.44	1.57	1	1.76	0.72	2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41				1.38		1.55		2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

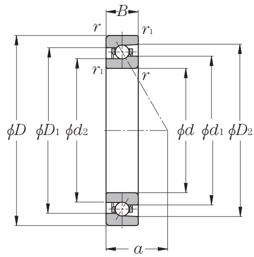
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
14.2	6.0	0.12	57.6	56.6	64.4	66.8	54.5	52.5	67.5	69.5	0.6	0.3
15.6	7.7	0.17	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
16.3	8.3	0.18	68.6	67.4	76.4	79.1	65.5	64.5	79.5	80.5	1	0.6
17.0	8.9	0.19	73.6	72.4	81.4	84.1	70.5	69.5	84.5	85.5	1	0.6
19.5	14	0.31	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
20.1	15	0.33	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
20.8	16	0.34	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
22.8	22	0.48	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
23.5	23	0.51	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
24.2	24	0.53	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
26.2	32	0.74	113.8	111.7	126.2	130.7	107	104.5	133	135.5	1	0.6
26.9	33	0.77	118.8	116.7	131.2	135.7	112	109.5	138	140.5	1	0.6
27.5	35	0.80	123.8	121.7	136.2	140.7	117	114.5	143	145.5	1	0.6
30.2	47	1.08	135.4	133.0	149.6	154.8	127	124.5	158	160.5	1	0.6
32.9	62	1.40	146.9	144.2	163.1	168.9	138.5	135.5	171.5	174.5	1.5	1
34.3	66	1.48	156.9	154.2	173.1	178.9	148.5	145.5	181.5	184.5	1.5	1
38.3	99	2.30	170.5	167.3	189.5	196.4	160	155.5	200	204.5	2	1
39.6	105	2.42	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
41.0	111	2.55	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

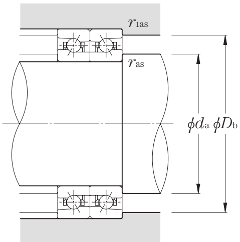
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE9U series

Contact angle 20° d 50～170mm

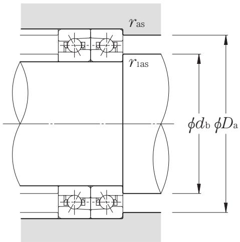


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-2LA-HSE910U	50	72	12	0.6	0.3	10.7	5.50	1 090	560	8.55	875	28 200	46 100
5S-2LA-HSE911U	55	80	13	1	0.6	13.3	6.85	1 360	700	10.7	1 090	25 500	41 700
5S-2LA-HSE912U	60	85	13	1	0.6	13.8	7.50	1 410	765	11.6	1 190	23700	38 800
5S-2LA-HSE913U	65	90	13	1	0.6	13.9	7.85	1 420	800	12.2	1 250	22 200	36 300
5S-2LA-HSE914U	70	100	16	1	0.6	20.4	11.2	2 080	1 140	17.4	1 780	20 200	33 100
5S-2LA-HSE915U	75	105	16	1	0.6	21.2	12.2	2 160	1 240	19.0	1 940	19 100	31 300
5S-2LA-HSE916U	80	110	16	1	0.6	21.4	12.7	2 190	1 290	19.8	2 020	18 100	29 600
5S-2LA-HSE917U	85	120	18	1.1	0.6	29.1	16.8	2 960	1 710	26.1	2 670	16 800	27 400
5S-2LA-HSE918U	90	125	18	1.1	0.6	30.0	18.1	3 100	1 850	28.3	2 890	16 000	26 200
5S-2LA-HSE919U	95	130	18	1.1	0.6	30.5	18.9	3 100	1 930	29.4	3 000	15 300	25 000
5S-2LA-HSE920U	100	140	20	1.1	0.6	35.5	22.1	3 600	2 260	34.0	3 500	14 300	23 400
5S-2LA-HSE921U	105	145	20	1.1	0.6	36.0	23.0	3 650	2 350	35.5	3 650	13 800	22 500
5S-2LA-HSE922U	110	150	20	1.1	0.6	36.5	23.9	3 700	2 430	37.0	3 800	13 200	21 600
5S-2LA-HSE924U	120	165	22	1.1	0.6	46.5	30.5	4 750	3 100	47.5	4 850	12 100	19 700
5S-2LA-HSE926U	130	180	24	1.5	1	57.5	38.0	5 850	3 850	58.5	6 000	11 100	18 100
5S-2LA-HSE928U	140	190	24	1.5	1	58.0	39.5	5 900	4 000	61.0	6 250	10 400	17 000
5S-2LA-HSE930U	150	210	28	2	1	77.5	52.0	7 900	5 350	81.0	8 300	9 600	15 600
5S-2LA-HSE932U	160	220	28	2	1	78.0	54.5	7 950	5 550	84.5	8 650	9 100	14 800
5S-2LA-HSE934U	170	230	28	2	1	79.0	56.5	8 050	5 750	88.0	9 000	8 600	14 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

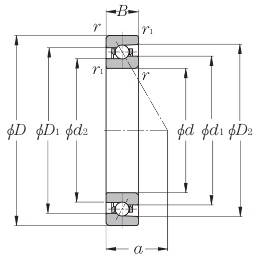
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
17.2	6.0	0.12	57.6	56.6	64.4	66.8	54.5	52.5	67.5	69.5	0.6	0.3
18.9	7.7	0.17	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
19.8	8.3	0.18	68.6	67.4	76.4	79.1	65.5	64.5	79.5	80.5	1	0.6
20.7	8.9	0.19	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
23.6	14	0.31	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
24.5	15	0.33	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
25.4	16	0.34	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
27.8	22	0.48	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
28.7	23	0.51	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
29.6	24	0.53	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
32.0	32	0.74	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6
32.9	33	0.77	118.8	116.7	131.2	135.6	112	109.5	138	140.5	1	0.6
33.8	35	0.80	123.8	121.7	136.2	140.6	117	114.5	143	145.5	1	0.6
37.1	47	1.08	135.4	133.0	149.6	154.7	127	124.5	158	160.5	1	0.6
40.4	62	1.40	146.9	144.2	163.1	168.9	138.5	135.5	171.5	174.5	1.5	1
42.2	66	1.48	156.9	154.2	173.1	178.8	148.5	145.5	181.5	184.5	1.5	1
47.0	99	2.30	170.5	167.3	189.5	196.3	160	155.5	200	204.5	2	1
48.8	105	2.42	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
50.6	111	2.55	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

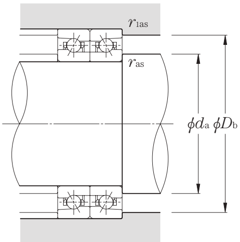
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE9U series

Contact angle 25° d 50～170mm

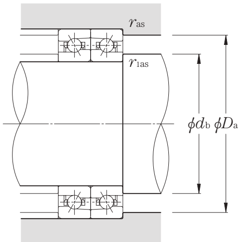


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-2LA-HSE910UAD	50	72	12	0.6	0.3	10.3	5.30	1 050	545	9.75	995	24 300	41 000
5S-2LA-HSE911UAD	55	80	13	1	0.6	12.9	6.65	1 310	680	12.1	1 240	22 000	37 000
5S-2LA-HSE912UAD	60	85	13	1	0.6	13.3	7.3	1 360	740	13.3	1 360	20 500	34 500
5S-2LA-HSE913UAD	65	90	13	1	0.6	13.5	7.6	1 370	775	13.9	1 420	19 200	32 300
5S-2LA-HSE914UAD	70	100	16	1	0.6	19.7	10.8	2 010	1 100	19.9	2 030	17 500	29 400
5S-2LA-HSE915UAD	75	105	16	1	0.6	20.5	11.8	2 090	1 200	21.5	2 200	16 500	27 800
5S-2LA-HSE916UAD	80	110	16	1	0.6	20.7	12.3	2 110	1 250	22.5	2 300	15 600	26 300
5S-2LA-HSE917UAD	85	120	18	1.1	0.6	28.1	16.2	2 860	1 660	29.4	3 000	14 500	24 400
5S-2LA-HSE918UAD	90	125	18	1.1	0.6	29.2	17.6	2 980	1 790	31.5	3 250	13 800	23 300
5S-2LA-HSE919UAD	95	130	18	1.1	0.6	29.5	18.3	3 000	1 870	33.0	3 400	13 200	22 200
5S-2LA-HSE920UAD	100	140	20	1.1	0.6	34.5	21.4	3 500	2 190	39.0	4 000	12 400	20 800
5S-2LA-HSE921UAD	105	145	20	1.1	0.6	34.5	22.3	3 550	2 270	40.5	4 150	11 900	20 000
5S-2LA-HSE922UAD	110	150	20	1.1	0.6	35.0	23.1	3 600	2 360	42.0	4 300	11 400	19 200
5S-2LA-HSE924UAD	120	165	22	1.1	0.6	45.0	29.6	4 600	3 000	54.0	5 550	10 400	17 500
5S-2LA-HSE926UAD	130	180	24	1.5	1	55.5	36.5	5 700	3 750	67.0	6 850	9 600	16 100
5S-2LA-HSE928UAD	140	190	24	1.5	1	56.0	38.0	5 700	3 900	70.0	7 150	9 000	15 200
5S-2LA-HSE930UAD	150	210	28	2	1	75.0	50.5	7 650	5 150	92.5	9 450	8 200	13 900
5S-2LA-HSE932UAD	160	220	28	2	1	75.5	52.5	7 700	5 350	96.5	9 850	7 800	13 200
5S-2LA-HSE934UAD	170	230	28	2	1	76.0	54.5	7 750	5 600	100	10 200	7 400	12 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

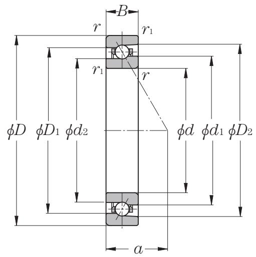
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
20.3	6.0	0.12	57.6	56.6	64.4	66.7	54.5	52.5	67.5	69.5	0.6	0.3
22.4	7.7	0.17	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
23.5	8.3	0.18	68.6	67.4	76.4	79.0	65.5	64.5	79.5	80.5	1	0.6
24.7	8.9	0.19	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
28.0	14	0.31	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
29.1	15	0.33	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
30.3	16	0.34	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
33.1	22	0.48	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
34.2	23	0.51	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
35.4	24	0.53	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
38.2	32	0.74	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6
39.3	33	0.77	118.8	116.7	131.2	135.6	112	109.5	138	140.5	1	0.6
40.5	35	0.80	123.8	121.7	136.2	140.6	117	114.5	143	145.5	1	0.6
44.4	47	1.08	135.4	133.0	149.6	154.7	127	124.5	158	160.5	1	0.6
48.4	62	1.40	146.9	144.2	163.1	168.8	138.5	135.5	171.5	174.5	1.5	1
50.7	66	1.48	156.9	154.2	173.1	178.8	148.5	145.5	181.5	184.5	1.5	1
56.3	99	2.30	170.5	167.3	189.5	196.3	160	155.5	200	204.5	2	1
58.6	105	2.42	180.5	177.3	199.5	206.3	170	165.5	210	214.5	2	1
60.9	111	2.55	190.5	187.3	209.5	216.3	180	175.5	220	224.5	2	1

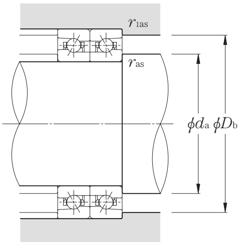
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE0 series

Contact angle 15° d 50～170mm

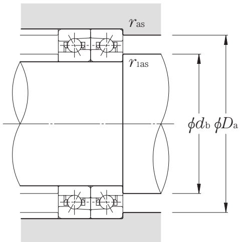


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed (min⁻¹)	
	d	D	B	$r_{s\ min}$ ❶	$r_{1s\ min}$ ❶	C_r	C_{or}	C_r	C_{or}	kN	kgf	f_o	grease lubrication	oil lubrication
5S-2LA-HSE010C	50	80	16	1	0.6	15.9	7.90	1 620	805	10.5	1 070	7.2	24 000	39 800
5S-2LA-HSE011C	55	90	18	1.1	0.6	17.3	9.40	1 760	960	12.5	1 280	7.4	21 500	35 700
5S-2LA-HSE012C	60	95	18	1.1	0.6	18.1	10.4	1 850	1 060	13.9	1 420	7.4	20 100	33 400
5S-2LA-HSE013C	65	100	18	1.1	0.6	18.4	10.9	1 870	1 120	14.6	1 490	7.5	18 900	31 400
5S-2LA-HSE014C	70	110	20	1.1	0.6	22.5	13.8	2 290	1 410	18.4	1 880	7.5	17 300	28 700
5S-2LA-HSE015C	75	115	20	1.1	0.6	23.9	15.5	2 440	1 590	20.8	2 120	7.5	16 400	27 200
5S-2LA-HSE016C	80	125	22	1.1	0.6	27.4	17.8	2 790	1 820	23.8	2 430	7.5	15 200	25 200
5S-2LA-HSE017C	85	130	22	1.1	0.6	27.7	18.6	2 830	1 900	24.9	2 540	7.6	14 500	24 100
5S-2LA-HSE018C	90	140	24	1.5	1	32.0	21.8	3 300	2 220	29.2	2 970	7.6	13 600	22 500
5S-2LA-HSE019C	95	145	24	1.5	1	32.5	22.7	3 300	2 310	30.5	3 100	7.6	13 000	21 600
5S-2LA-HSE020C	100	150	24	1.5	1	33.5	24.4	3 450	2 480	32.5	3 350	7.6	12 500	20 700
5S-2LA-HSE021C	105	160	26	2	1	38.5	28.2	3 950	2 880	38.0	3 850	7.6	11 800	19 500
5S-2LA-HSE022C	110	170	28	2	1	48.0	34.0	4 900	3 500	45.5	4 650	7.6	11 100	18 500
5S-2LA-HSE024C	120	180	28	2	1	48.0	35.5	4 900	3 650	47.5	4 850	7.6	10 400	17 200
5S-2LA-HSE026C	130	200	33	2	1	69.0	49.5	7 050	5 000	66.0	6 700	7.5	9 500	15 700
5S-2LA-HSE028C	140	210	33	2	1	71.5	53.5	7 300	5 450	71.5	7 300	7.6	8 900	14 800
5S-2LA-HSE030C	150	225	35	2.1	1.1	73.5	57.5	7 500	5 850	77.0	7 850	7.6	8 300	13 800
5S-2LA-HSE032C	160	240	38	2.1	1.1	86.0	67.0	8 800	6 850	90.0	9 150	7.6	7 800	12 900
5S-2LA-HSE034C	170	260	42	2.1	1.1	99.0	77.0	10 100	7 850	103	10 500	7.6	7 300	12 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

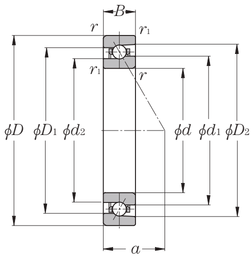
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm				Abutment and fillet dimensions mm					
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	D_2	d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
16.8	12	0.23	60.1	58.6	69.9	73.3	55.5	54.5	74.5	75.5	1	0.6
18.8	16	0.37	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
19.5	17	0.40	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
20.1	18	0.42	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
22.2	24	0.60	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
22.8	25	0.64	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
24.8	34	0.86	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
25.5	35	0.90	101.8	99.9	113.2	117.5	92	89.5	123	125.5	1	0.6
27.5	45	1.18	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
28.2	47	1.23	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
28.9	49	1.28	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
30.9	61	1.63	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
32.9	77	1.99	132.4	129.8	147.6	153.3	120	115.5	160	164.5	2	1
34.2	82	2.14	142.4	139.8	157.6	163.3	130	125.5	170	174.5	2	1
38.8	130	3.18	155.5	152.3	174.5	181.6	140	135.5	190	194.5	2	1
40.1	129	3.41	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
42.8	163	4.17	178.0	174.8	197.0	204.1	162	157	213	218	2	1
46.0	206	5.09	189.5	186.0	210.5	218.2	172	167	228	233	2	1
50.0	272	6.90	203.6	199.8	226.4	234.9	182	177	248	253	2	1

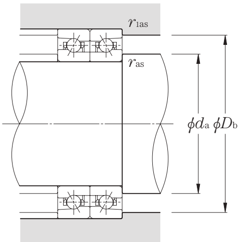
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE0 series

Contact angle 20° d 50～170mm

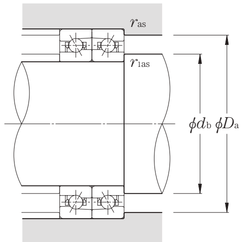


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-2LA-HSE010	50	80	16	1	0.6	15.5	7.75	1 580	790	12.1	1 230	26 500	43 300
5S-2LA-HSE011	55	90	18	1.1	0.6	16.8	9.20	1 720	935	14.4	1 460	23 700	38 800
5S-2LA-HSE012	60	95	18	1.1	0.6	17.6	10.2	1 800	1 040	15.9	1 620	22 200	36 300
5S-2LA-HSE013	65	100	18	1.1	0.6	17.9	10.7	1 830	1 090	16.7	1 710	20 800	34 100
5S-2LA-HSE014	70	110	20	1.1	0.6	21.9	13.5	2 230	1 370	21.1	2 150	19 100	31 200
5S-2LA-HSE015	75	115	20	1.1	0.6	23.3	15.2	2 380	1 550	23.8	2 420	18 100	29 600
5S-2LA-HSE016	80	125	22	1.1	0.6	26.7	17.4	2 720	1 770	27.2	2 780	16 800	27 400
5S-2LA-HSE017	85	130	22	1.1	0.6	27.0	18.1	2 760	1 850	28.4	2 900	16 000	26 200
5S-2LA-HSE018	90	140	24	1.5	1	31.5	21.3	3 200	2 170	33.5	3 400	15 000	24 500
5S-2LA-HSE019	95	145	24	1.5	1	31.5	22.1	3 250	2 260	34.5	3 550	14 300	23 400
5S-2LA-HSE020	100	150	24	1.5	1	33.0	23.8	3 350	2 420	37.5	3 800	13 800	22 500
5S-2LA-HSE021	105	160	26	2	1	37.5	27.5	3 850	2 810	43.0	4 400	13 000	21 200
5S-2LA-HSE022	110	170	28	2	1	46.5	33.5	4 750	3 400	52.0	5 300	12 300	20 100
5S-2LA-HSE024	120	180	28	2	1	47.0	35.0	4 800	3 550	54.5	5 550	11 500	18 700
5S-2LA-HSE026	130	200	33	2	1	67.5	48.0	6 900	4 900	75.5	7 700	10 400	17 000
5S-2LA-HSE028	140	210	33	2	1	70.0	52.0	7 100	5 300	81.5	8 300	9 800	16 100
5S-2LA-HSE030	150	225	35	2.1	1.1	72.0	56.0	7 300	5 700	88.0	8 950	9 200	15 000
5S-2LA-HSE032	160	240	38	2.1	1.1	84.0	65.5	8 550	6 700	103	10 500	8 600	14 100
5S-2LA-HSE034	170	260	42	2.1	1.1	96.5	75.0	9 850	7 650	118	12 000	8 000	13 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

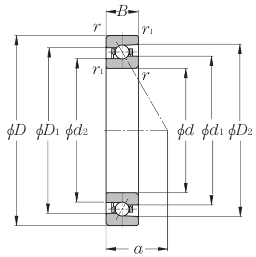
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
19.9	12	0.23	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
22.3	16	0.37	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
23.2	17	0.40	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
24.1	18	0.42	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
26.5	24	0.60	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
27.4	25	0.64	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
29.8	34	0.86	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
30.7	35	0.90	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
33.1	45	1.18	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
34.0	47	1.23	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
34.9	49	1.28	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
37.3	61	1.63	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
39.7	77	1.99	132.4	129.8	147.6	153.2	120	115.5	160	164.5	2	1
41.5	82	2.14	142.4	139.8	157.6	163.2	130	125.5	170	174.5	2	1
46.8	130	3.18	155.5	152.3	174.5	181.5	140	135.5	190	194.5	2	1
48.6	129	3.41	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
51.9	163	4.17	178.0	174.8	197.0	204.0	162	157	213	218	2	1
55.7	206	5.09	189.5	186.0	210.5	218.2	172	167	228	233	2	1
60.4	272	6.90	203.6	199.8	226.4	234.9	182	177	248	253	2	1

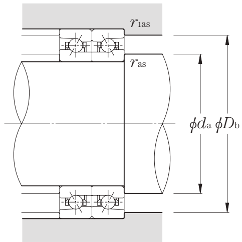
ULTAGE High-speed angular contact ball bearings (ceramic ball type) 5S-2LA-HSE0 series

Contact angle 25° d 50～170mm

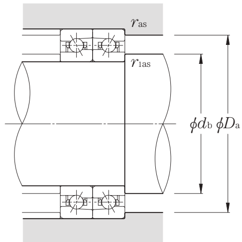


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	Static axial load capacity kgf	Limiting speed min⁻¹ grease lubrication	Limiting speed min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}				
5S-2LA-HSE010AD	50	80	16	1	0.6	15.0	7.50	1 530	765	13.8	1 400	22 800	38 500
5S-2LA-HSE011AD	55	90	18	1.1	0.6	16.3	8.90	1 660	910	16.4	1 670	20 500	34 500
5S-2LA-HSE012AD	60	95	18	1.1	0.6	17.1	9.85	1 740	1 000	18.1	1 850	19 200	32 300
5S-2LA-HSE013AD	65	100	18	1.1	0.6	17.3	10.4	1 770	1 060	19.0	1 940	18 000	30 300
5S-2LA-HSE014AD	70	110	20	1.1	0.6	21.2	13.0	2 160	1 330	24.0	2 440	16 500	27 800
5S-2LA-HSE015AD	75	115	20	1.1	0.6	22.5	14.7	2 300	1 500	27.0	2 760	15 600	26 300
5S-2LA-HSE016AD	80	125	22	1.1	0.6	25.8	16.9	2 630	1 720	31.0	3 150	14 500	24 400
5S-2LA-HSE017AD	85	130	22	1.1	0.6	26.1	17.6	2 660	1 790	32.5	3 300	13 800	23 300
5S-2LA-HSE018AD	90	140	24	1.5	1	30.5	20.6	3 100	2 100	38.0	3 850	12 900	21 700
5S-2LA-HSE019AD	95	145	24	1.5	1	30.5	21.4	3 150	2 190	39.5	4 000	12 400	20 800
5S-2LA-HSE020AD	100	150	24	1.5	1	31.5	23.0	3 250	2 350	42.5	4 300	11 900	20 000
5S-2LA-HSE021AD	105	160	26	2	1	36.5	26.7	3 700	2 720	49.0	5 000	11 200	18 900
5S-2LA-HSE022AD	110	170	28	2	1	45.0	32.5	4 600	3 300	59.5	6 050	10 600	17 900
5S-2LA-HSE024AD	120	180	28	2	1	45.5	33.5	4 650	3 450	62.0	6 300	9 900	16 700
5S-2LA-HSE026AD	130	200	33	2	1	65.0	46.5	6 650	4 750	85.5	8 750	9 000	15 200
5S-2LA-HSE028AD	140	210	33	2	1	67.5	50.5	6 900	5 150	92.5	9 450	8 500	14 300
5S-2LA-HSE030AD	150	225	35	2.1	1.1	69.5	54.5	7 050	5 550	100	10 200	7 900	13 300
5S-2LA-HSE032AD	160	240	38	2.1	1.1	81.0	63.5	8 300	6 450	117	11 900	7 400	12 500
5S-2LA-HSE034AD	170	260	42	2.1	1.1	93.0	73.0	9 500	7 450	134	13 700	6 900	11 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

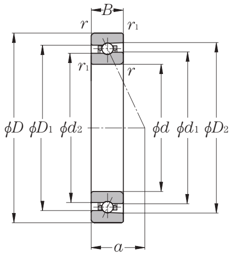
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm				Abutment and fillet dimensions mm					
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	D_2	d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
23.3	12	0.23	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
26.1	16	0.37	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
27.2	17	0.40	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
28.4	18	0.40	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
31.1	24	0.60	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
32.3	25	0.64	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
35.1	34	0.86	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
36.2	35	0.90	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
39.0	45	1.18	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
40.2	47	1.23	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
41.3	49	1.28	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1
44.1	61	1.63	125.8	123.6	139.2	144.1	115	110.5	150	154.5	2	1
46.9	77	1.99	132.4	129.8	147.6	153.2	120	115.5	160	164.5	2	1
49.2	82	2.14	142.4	139.8	157.6	163.2	130	125.5	170	174.5	2	1
55.3	130	3.18	155.5	152.3	174.5	181.5	140	135.5	190	194.5	2	1
57.6	129	3.41	165.5	162.4	184.5	191.5	150	145.5	200	204.5	2	1
61.5	163	4.17	178.0	174.8	197.0	204.0	162	157	213	218	2	1
66.0	206	5.09	189.5	186.0	210.5	218.2	172	167	228	233	2	1
71.5	272	6.90	203.6	199.8	226.4	234.9	182	177	248	253	2	1

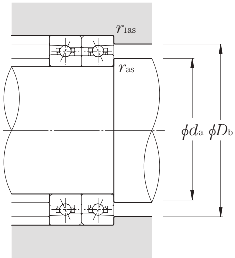
ULTAGE Super high-speed angular contact ball bearings 5S-2LA-HSF0 series

Contact angle 25° d 50～100mm

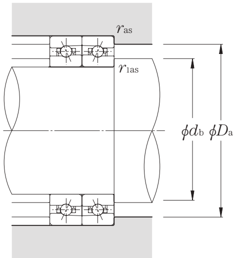


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSF010AD	50	80	16	1	0.6	10.1	6.20	1 030	635	11.4	1 170	50 000
5S-2LA-HSF011AD	55	90	18	1.1	0.6	12.6	7.80	1 280	800	14.4	1 470	44 800
5S-2LA-HSF012AD	60	95	18	1.1	0.6	12.9	8.45	1 320	860	15.5	1 580	41 900
5S-2LA-HSF013AD	65	100	18	1.1	0.6	13.3	9.05	1 360	925	16.7	1 700	39 400
5S-2LA-HSF014AD	70	110	20	1.1	0.6	16.2	11.1	1 650	1 130	20.4	2 080	36 100
5S-2LA-HSF015AD	75	115	20	1.1	0.6	16.7	11.9	1 700	1 210	21.8	2 220	34 200
5S-2LA-HSF016AD	80	125	22	1.1	0.6	19.9	14.2	2 030	1 440	26.0	2 660	31 700
5S-2LA-HSF017AD	85	130	22	1.1	0.6	20.1	14.7	2 050	1 500	27.0	2 750	30 200
5S-2LA-HSF018AD	90	140	24	1.5	1	24.5	18.2	2 500	1 860	33.5	3 400	28 300
5S-2LA-HSF019AD	95	145	24	1.5	1	24.7	18.8	2 520	1 920	34.5	3 550	27 100
5S-2LA-HSF020AD	100	150	24	1.5	1	25.3	20.0	2 580	2 040	37.0	3 750	26 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

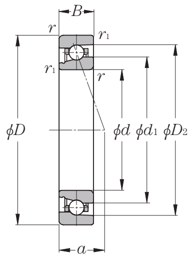
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm				Abutment and fillet dimensions mm					
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	D_2	d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
23.3	10	0.29	61.6	60.6	68.4	70.9	55.5	54.5	74.5	75.5	1	0.6
26.0	14	0.42	68.6	67.4	76.4	79.2	62	59.5	83	85.5	1	0.6
27.2	15	0.45	73.6	72.4	81.4	84.2	67	64.5	88	90.5	1	0.6
28.3	16	0.48	78.6	77.4	86.4	89.2	72	69.5	93	95.5	1	0.6
31.1	22	0.67	85.6	84.3	94.4	97.5	77	74.5	103	105.5	1	0.6
32.3	24	0.71	90.6	89.3	99.4	102.5	82	79.5	108	110.5	1	0.6
35.0	31	0.95	97.6	96.2	107.4	110.8	87	84.5	118	120.5	1	0.6
36.2	33	1.00	102.6	101.2	112.4	115.8	92	89.5	123	125.5	1	0.6
39.0	41	1.31	109.8	108.0	120.2	124.2	98.5	95.5	131.5	134.5	1.5	1
40.1	43	1.36	114.8	113.0	125.2	129.2	103.5	100.5	136.5	139.5	1.5	1
41.3	45	1.42	119.8	118.0	130.2	134.2	108.5	105.5	141.5	144.5	1.5	1

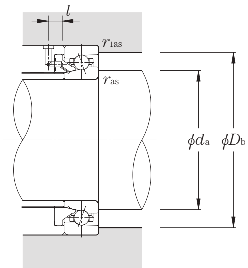
ULTAGE Eco-friendly angular contact ball bearings (ceramic ball type) 5S-2LA-HSL9U series

Contact angle 20° d 50～130mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSL910U	50	72	12	0.6	0.3	10.7	5.50	1 090	560	8.55	875	46 100
5S-2LA-HSL911U	55	80	13	1	0.6	13.3	6.85	1 360	700	10.6	1 090	41 700
5S-2LA-HSL912U	60	85	13	1	0.6	13.8	7.50	1 410	765	11.6	1 190	38 800
5S-2LA-HSL913U	65	90	13	1	0.6	13.9	7.85	1 420	800	12.2	1 250	36 300
5S-2LA-HSL914U	70	100	16	1	0.6	20.4	11.2	2 080	1 140	17.4	1 780	33 100
5S-2LA-HSL915U	75	105	16	1	0.6	21.2	12.2	2 160	1 240	19.0	1 940	31 300
5S-2LA-HSL916U	80	110	16	1	0.6	21.4	12.7	2 190	1 290	19.8	2 020	29 600
5S-2LA-HSL917U	85	120	18	1.1	0.6	29.1	16.8	2 960	1 710	26.1	2 670	27 400
5S-2LA-HSL918U	90	125	18	1.1	0.6	30.0	18.1	3 100	1 850	28.3	2 890	26 200
5S-2LA-HSL919U	95	130	18	1.1	0.6	30.5	18.9	3 100	1 930	29.4	3 000	25 000
5S-2LA-HSL920U	100	140	20	1.1	0.6	35.5	22.1	3 600	2 260	34.0	3 500	23 400
5S-2LA-HSL921U	105	145	20	1.1	0.6	36.0	23.0	3 650	2 350	35.5	3 650	22 500
5S-2LA-HSL922U	110	150	20	1.1	0.6	36.5	23.9	3 700	2 430	37.0	3 800	21 600
5S-2LA-HSL924U	120	165	22	1.1	0.6	46.5	30.5	4 750	3 100	47.5	4 850	19 700
5S-2LA-HSL926U	130	180	24	1.5	1	57.5	38.0	5 850	3 850	58.5	6 000	18 100

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

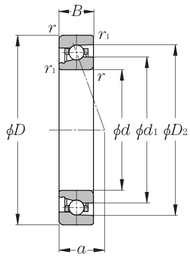
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm				Part number
a	Single-row (approx.)	d_1	D_2	d_a min	D_b max	r_{1as} max	l ❷ min	
17.2	0.11	57.6	66.8	54.5	69.5	0.3	8.5	**5S-2LA-HSL910U**
18.9	0.16	63.6	74.1	60.5	75.5	0.6	8.5	**5S-2LA-HSL911U**
19.8	0.17	68.6	79.1	65.5	80.5	0.6	8.5	**5S-2LA-HSL912U**
20.7	0.17	73.6	84.0	70.5	85.5	0.6	8.5	**5S-2LA-HSL913U**
23.6	0.29	80.1	93.2	75.5	95.5	0.6	8.5	**5S-2LA-HSL914U**
24.5	0.31	85.1	98.2	80.5	100.5	0.6	9	**5S-2LA-HSL915U**
25.4	0.32	90.1	103.2	85.5	105.5	0.6	9	**5S-2LA-HSL916U**
27.8	0.45	96.8	112.3	92	115.5	0.6	9	**5S-2LA-HSL917U**
28.7	0.48	101.8	117.3	97	120.5	0.6	9	**5S-2LA-HSL918U**
29.6	0.50	106.8	122.3	102	125.5	0.6	9	**5S-2LA-HSL919U**
32.0	0.69	113.8	130.6	107	135.5	0.6	9	**5S-2LA-HSL920U**
32.9	0.72	118.8	135.6	112	140.5	0.6	9	**5S-2LA-HSL921U**
33.8	0.75	123.8	140.6	117	145.5	0.6	9	**5S-2LA-HSL922U**
37.1	1.01	135.4	154.7	127	160.5	0.6	9	**5S-2LA-HSL924U**
40.4	1.32	146.9	168.9	138.5	174.5	1	9	**5S-2LA-HSL926U**

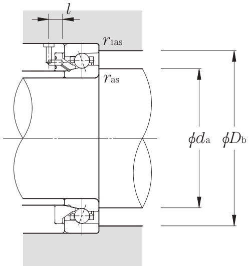
ULTAGE Eco-friendly angular contact ball bearings (ceramic ball type) 5S-2LA-HSL9U series

Contact angle 25° d 50～130mm



Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Limiting speed min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSL910UAD	50	72	12	0.6	0.3	10.3	5.30	1 050	545	9.75	995	41 000
5S-2LA-HSL911UAD	55	80	13	1	0.6	12.9	6.65	1 310	680	12.1	1 240	37 000
5S-2LA-HSL912UAD	60	85	13	1	0.6	13.3	7.3	1 360	740	13.3	1 360	34 500
5S-2LA-HSL913UAD	65	90	13	1	0.6	13.5	7.6	1 370	775	13.9	1 420	32 300
5S-2LA-HSL914UAD	70	100	16	1	0.6	19.7	10.8	2 010	1 100	19.9	2 030	29 400
5S-2LA-HSL915UAD	75	105	16	1	0.6	20.5	11.8	2 090	1 200	21.5	2 200	27 800
5S-2LA-HSL916UAD	80	110	16	1	0.6	20.7	12.3	2 110	1 250	22.5	2 300	26 300
5S-2LA-HSL917UAD	85	120	18	1.1	0.6	28.1	16.2	2 860	1 660	29.4	3 000	24 400
5S-2LA-HSL918UAD	90	125	18	1.1	0.6	29.2	17.6	2 980	1 790	31.5	3 250	23 300
5S-2LA-HSL919UAD	95	130	18	1.1	0.6	29.5	18.3	3 000	1 870	33.0	3 400	22 200
5S-2LA-HSL920UAD	100	140	20	1.1	0.6	34.5	21.4	3 500	2 190	39.0	4 000	20 800
5S-2LA-HSL921UAD	105	145	20	1.1	0.6	34.5	22.3	3 550	2 270	40.5	4 150	20 000
5S-2LA-HSL922UAD	110	150	20	1.1	0.6	35.0	23.1	3 600	2 360	42.0	4 300	19 200
5S-2LA-HSL924UAD	120	165	22	1.1	0.6	45.0	29.6	4 600	3 000	54.0	5 550	17 500
5S-2LA-HSL926UAD	130	180	24	1.5	1	55.5	36.5	5 700	3 750	67.0	6 850	16 100

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

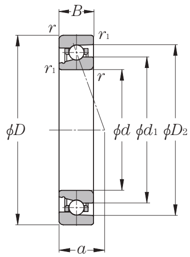
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm				Part number
a	Single-row (approx.)	d_1	D_2	d_a min	D_b max	r_{1as} max	l [2] min	
20.3	0.11	57.6	66.7	54.5	69.5	0.3	8.5	**5S-2LA-HSL910UAD**
22.4	0.16	63.6	74.1	60.5	75.5	0.6	8.5	**5S-2LA-HSL911UAD**
23.5	0.17	68.6	79.0	65.5	80.5	0.6	8.5	**5S-2LA-HSL912UAD**
24.7	0.17	73.6	84.0	70.5	85.5	0.6	8.5	**5S-2LA-HSL913UAD**
28.0	0.29	80.1	93.2	75.5	95.5	0.6	8.5	**5S-2LA-HSL914UAD**
29.1	0.31	85.1	98.2	80.5	100.5	0.6	9	**5S-2LA-HSL915UAD**
30.3	0.32	90.1	103.2	85.5	105.5	0.6	9	**5S-2LA-HSL916UAD**
33.1	0.45	96.8	112.3	92	115.5	0.6	9	**5S-2LA-HSL917UAD**
34.2	0.48	101.8	117.3	97	120.5	0.6	9	**5S-2LA-HSL918UAD**
35.4	0.50	106.8	122.3	102	125.5	0.6	9	**5S-2LA-HSL919UAD**
38.2	0.69	113.8	130.6	107	135.5	0.6	9	**5S-2LA-HSL920UAD**
39.3	0.72	118.8	135.6	112	140.5	0.6	9	**5S-2LA-HSL921UAD**
40.5	0.75	123.8	140.6	117	145.5	0.6	9	**5S-2LA-HSL922UAD**
44.4	1.01	135.4	154.7	127	160.5	0.6	9	**5S-2LA-HSL924UAD**
48.4	1.32	146.9	168.8	138.5	174.5	1	9	**5S-2LA-HSL926UAD**

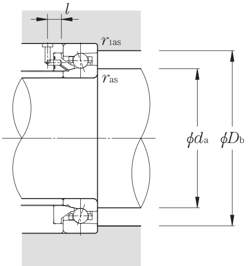
ULTAGE Eco-friendly angular contact ball bearings (ceramic ball type) 5S-2LA-HSL0 series

Contact angle 20° d 50～130mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSL010	50	80	16	1	0.6	15.5	7.75	1 580	790	12.1	1 230	43 300
5S-2LA-HSL011	55	90	18	1.1	0.6	16.8	9.20	1 720	935	14.4	1 460	38 800
5S-2LA-HSL012	60	95	18	1.1	0.6	17.6	10.2	1 800	1 040	15.9	1 620	36 300
5S-2LA-HSL013	65	100	18	1.1	0.6	17.9	10.7	1 830	1 090	16.7	1 710	34 100
5S-2LA-HSL014	70	110	20	1.1	0.6	21.9	13.5	2 230	1 370	21.1	2 150	31 200
5S-2LA-HSL015	75	115	20	1.1	0.6	23.3	15.2	2 380	1 550	23.8	2 420	29 600
5S-2LA-HSL016	80	125	22	1.1	0.6	26.7	17.4	2 720	1 770	27.2	2 780	27 400
5S-2LA-HSL017	85	130	22	1.1	0.6	27.0	18.1	2 760	1 850	28.4	2 900	26 200
5S-2LA-HSL018	90	140	24	1.5	1	31.5	21.3	3 200	2 170	33.5	3 400	24 500
5S-2LA-HSL019	95	145	24	1.5	1	31.5	22.1	3 250	2 260	34.5	3 550	23 400
5S-2LA-HSL020	100	150	24	1.5	1	33.0	23.8	3 350	2 420	37.5	3 800	22 500
5S-2LA-HSL021	105	160	26	2	1	37.5	27.5	3 850	2 810	43.0	4 400	21 200
5S-2LA-HSL022	110	170	28	2	1	46.5	33.5	4 750	3 400	52.0	5 300	20 100
5S-2LA-HSL024	120	180	28	2	1	47.0	35.0	4 800	3 550	54.5	5 550	18 700
5S-2LA-HSL026	130	200	33	2	1	67.5	48.0	6 900	4 900	75.5	7 700	17 000

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

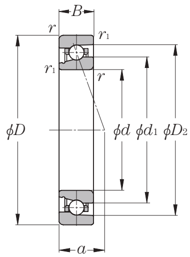
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{1as} max	l ❷ min	Part number
19.9	0.22	60.1	73.2	55.5	75.5	0.6	8.5	**5S-2LA-HSL010**
22.3	0.35	67.6	80.8	62	85.5	0.6	8.5	**5S-2LA-HSL011**
23.2	0.38	72.6	85.8	67	90.5	0.6	8.5	**5S-2LA-HSL012**
24.1	0.40	77.6	90.8	72	95.5	0.6	9	**5S-2LA-HSL013**
26.5	0.57	84.8	99.1	77	105.5	0.6	9	**5S-2LA-HSL014**
27.4	0.60	89.8	104.1	82	110.5	0.6	9	**5S-2LA-HSL015**
29.8	0.82	96.8	112.5	87	120.5	0.6	9	**5S-2LA-HSL016**
30.7	0.85	101.8	117.4	92	125.5	0.6	9	**5S-2LA-HSL017**
33.1	1.12	108.8	125.8	98.5	134.5	1	9	**5S-2LA-HSL018**
34.0	1.17	113.8	130.8	103.5	139.5	1	9	**5S-2LA-HSL019**
34.9	1.22	118.8	135.8	108.5	144.5	1	9	**5S-2LA-HSL020**
37.3	1.55	125.8	144.1	115	154.5	1	9	**5S-2LA-HSL021**
39.7	1.89	132.4	153.2	120	164.5	1	9	**5S-2LA-HSL022**
41.5	2.03	142.4	163.2	130	174.5	1	9	**5S-2LA-HSL024**
46.8	2.98	155.5	181.5	140	194.5	1	9	**5S-2LA-HSL026**

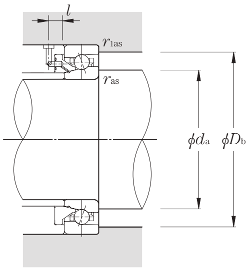
ULTAGE Eco-friendly angular contact ball bearings (ceramic ball type) 5S-2LA-HSL0 series

Contact angle 25° d 50～130mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSL010AD	50	80	16	1	0.6	15.0	7.50	1 530	765	13.8	1 400	38 500
5S-2LA-HSL011AD	55	90	18	1.1	0.6	16.3	8.90	1 660	910	16.4	1 670	34 500
5S-2LA-HSL012AD	60	95	18	1.1	0.6	17.1	9.85	1 740	1 000	18.1	1 850	32 300
5S-2LA-HSL013AD	65	100	18	1.1	0.6	17.3	10.4	1 770	1 060	19.0	1 940	30 300
5S-2LA-HSL014AD	70	110	20	1.1	0.6	21.2	13.0	2 160	1 330	24.0	2 440	27 800
5S-2LA-HSL015AD	75	115	20	1.1	0.6	22.5	14.7	2 300	1 500	27.0	2 760	26 300
5S-2LA-HSL016AD	80	125	22	1.1	0.6	25.8	16.9	2 630	1 720	31.0	3 150	24 400
5S-2LA-HSL017AD	85	130	22	1.1	0.6	26.1	17.6	2 660	1 790	32.5	3 300	23 300
5S-2LA-HSL018AD	90	140	24	1.5	1	30.5	20.6	3 100	2 100	38.0	3 850	21 700
5S-2LA-HSL019AD	95	145	24	1.5	1	30.5	21.4	3 150	2 190	39.5	4 000	20 800
5S-2LA-HSL020AD	100	150	24	1.5	1	31.5	23.0	3 250	2 350	42.5	4 300	20 000
5S-2LA-HSL021AD	105	160	26	2	1	36.5	26.7	3 700	2 720	49.0	5 000	18 900
5S-2LA-HSL022AD	110	170	28	2	1	45.0	32.5	4 600	3 300	59.5	6 050	17 700
5S-2LA-HSL024AD	120	180	28	2	1	45.5	33.5	4 650	3 450	62.0	6 300	16 700
5S-2LA-HSL026AD	130	200	33	2	1	65.0	46.5	6 650	4 750	85.5	8 750	15 200

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

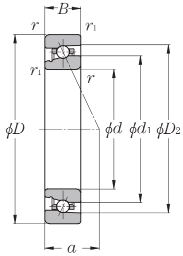
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm				Part number
a	Single-row (approx.)	d_1	D_2	d_a min	D_b max	r_{1as} max	l ❷ min	
23.3	0.22	60.1	73.2	55.5	75.5	0.6	8.5	**5S-2LA-HSL010AD**
26.1	0.35	67.6	80.8	62	85.5	0.6	8.5	**5S-2LA-HSL011AD**
27.2	0.38	72.6	85.8	67	90.5	0.6	8.5	**5S-2LA-HSL012AD**
28.4	0.40	77.6	90.8	72	95.5	0.6	9	**5S-2LA-HSL013AD**
31.1	0.57	84.8	99.1	77	105.5	0.6	9	**5S-2LA-HSL014AD**
32.3	0.60	89.8	104.1	82	110.5	0.6	9	**5S-2LA-HSL015AD**
35.1	0.82	96.8	112.5	87	120.5	0.6	9	**5S-2LA-HSL016AD**
36.2	0.85	101.8	117.4	92	125.5	0.6	9	**5S-2LA-HSL017AD**
39.0	1.12	108.8	125.8	98.5	134.5	1	9	**5S-2LA-HSL018AD**
40.2	1.17	113.8	130.8	103.5	139.5	1	9	**5S-2LA-HSL019AD**
41.3	1.22	118.8	135.8	108.5	144.5	1	9	**5S-2LA-HSL020AD**
44.1	1.55	125.8	144.1	115	154.5	1	9	**5S-2LA-HSL021AD**
46.9	1.89	132.4	153.2	120	164.5	1	9	**5S-2LA-HSL022AD**
49.2	2.03	142.4	163.2	130	174.5	1	9	**5S-2LA-HSL024AD**
55.3	2.98	155.5	181.5	140	194.5	1	9	**5S-2LA-HSL026AD**

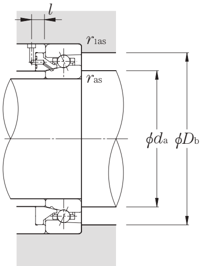
ULTAGE Eco-friendly angular contact ball bearings (ceramic ball type) 5S-2LA-HSFL0 series

Contact angle 25° d 50～100mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSFL010AD	50	80	16	1	0.6	10.1	6.20	1 030	635	11.4	1 170	50 000
5S-2LA-HSFL011AD	55	90	18	1.1	0.6	12.6	7.80	1 280	800	14.4	1 470	44 800
5S-2LA-HSFL012AD	60	95	18	1.1	0.6	12.9	8.45	1 320	860	15.5	1 580	41 900
5S-2LA-HSFL013AD	65	100	18	1.1	0.6	13.3	9.05	1 360	925	16.7	1 700	39 400
5S-2LA-HSFL014AD	70	110	20	1.1	0.6	16.2	11.1	1 650	1 130	20.4	2 080	36 100
5S-2LA-HSFL015AD	75	115	20	1.1	0.6	16.7	11.9	1 700	1 210	21.8	2 220	34 200
5S-2LA-HSFL016AD	80	125	22	1.1	0.6	19.9	14.2	2 030	1 440	26.0	2 660	31 700
5S-2LA-HSFL017AD	85	130	22	1.1	0.6	20.1	14.7	2 050	1 500	27.0	2 750	30 200
5S-2LA-HSFL018AD	90	140	24	1.5	1	24.5	18.2	2 500	1 860	33.5	3 400	28 300
5S-2LA-HSFL019AD	95	145	24	1.5	1	24.7	18.8	2 520	1 920	34.5	3 550	27 100
5S-2LA-HSFL020AD	100	150	24	1.5	1	25.3	20.0	2 580	2 040	37.0	3 750	26 000

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

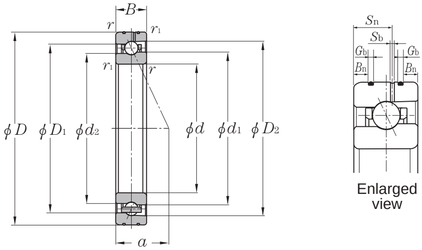
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm				Part number
a	Single-row (approx.)	d_1	D_2	d_a min	D_b max	r_{1as} max	l ❷ min	
23.3	0.27	61.6	70.9	55.5	75.5	0.6	8.5	**5S-2LA-HSFL010AD**
26.0	0.40	68.6	79.2	62	85.5	0.6	8.5	**5S-2LA-HSFL011AD**
27.2	0.43	73.6	84.2	67	90.5	0.6	8.5	**5S-2LA-HSFL012AD**
28.3	0.46	78.6	89.2	72	95.5	0.6	9	**5S-2LA-HSFL013AD**
31.1	0.64	85.6	97.5	77	105.5	0.6	9	**5S-2LA-HSFL014AD**
32.3	0.68	90.6	102.5	82	110.5	0.6	9	**5S-2LA-HSFL015AD**
35.0	0.91	97.6	110.8	87	120.5	0.6	9	**5S-2LA-HSFL016AD**
36.2	0.95	102.6	115.8	92	125.5	0.6	9	**5S-2LA-HSFL017AD**
39.0	1.25	109.8	124.2	98.5	134.5	1	9	**5S-2LA-HSFL018AD**
40.1	1.30	114.8	129.2	103.5	139.5	1	9	**5S-2LA-HSFL019AD**
41.3	1.36	119.8	134.2	108.5	144.5	1	9	**5S-2LA-HSFL020AD**

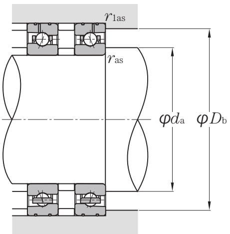
ULTAGE Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring 5S-2LA-HSEW9U type

Contact angle 20° d 50～100mm

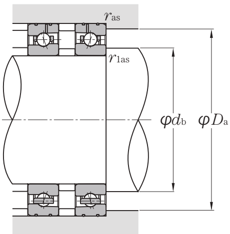


Part number	Boundary dimensions mm									Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN (Static)	kgf	Limiting speed min⁻¹ oil lubrication
	d	D	B	B_n	S_n	S_b	G_b	r min ❶	r_1 min ❶							
5S-2LA-HSEW910U	50	72	12	2.2	6.6	1.2	1.3	0.6	0.3	10.7	5.50	1 090	560	8.55	875	46 100
5S-2LA-HSEW911U	55	80	13	2.8	7.2	1.2	1.3	1	0.6	13.3	6.85	1 360	700	10.6	1 090	41 700
5S-2LA-HSEW912U	60	85	13	2.8	7.2	1.2	1.3	1	0.6	13.8	7.50	1 410	765	11.6	1 190	38 800
5S-2LA-HSEW913U	65	90	13	2.8	7.2	1.2	1.3	1	0.6	13.9	7.85	1 420	800	12.2	1 250	36 300
5S-2LA-HSEW914U	70	100	16	3.1	9.3	1.4	1.9	1	0.6	20.4	11.2	2 080	1 140	17.4	1 780	33 100
5S-2LA-HSEW915U	75	105	16	3.1	9.3	1.4	1.9	1	0.6	21.2	12.2	2 160	1 240	19.0	1 940	31 300
5S-2LA-HSEW916U	80	110	16	3.1	9.3	1.4	1.9	1	0.6	21.4	12.7	2 190	1 290	19.8	2 020	29 600
5S-2LA-HSEW917U	85	120	18	4	10.4	1.6	1.9	1.1	0.6	29.1	16.8	2 960	1 710	26.1	2 670	27 400
5S-2LA-HSEW918U	90	125	18	4	10.4	1.6	1.9	1.1	0.6	30.0	18.1	3 100	1 850	28.3	2 890	26 200
5S-2LA-HSEW919U	95	130	18	4	10.4	1.6	1.9	1.1	0.6	30.5	18.9	3 100	1 930	29.4	3 000	25 000
5S-2LA-HSEW920U	100	140	20	4	12	1.6	1.9	1.1	0.6	35.5	22.1	3 600	2 260	34.0	3 500	23 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

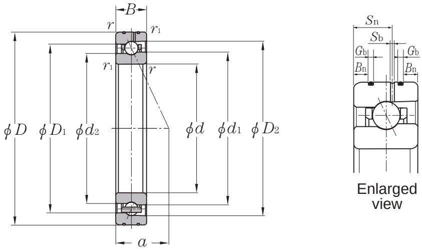
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm				Abutment and fillet dimensions mm					
a			d_1	d_2	D_1	D_2	d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
17.2	6.0	0.12	57.6	56.6	64.4	66.8	54.5	52.5	67.5	69.5	0.6	0.3
18.9	7.7	0.17	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
19.8	8.3	0.18	68.6	67.4	76.4	79.1	65.5	64.5	79.5	80.5	1	0.6
20.7	8.9	0.19	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
23.6	14	0.31	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
24.5	15	0.33	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
25.4	16	0.34	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
27.8	22	0.48	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
28.7	23	0.51	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
29.6	24	0.53	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
32.0	32	0.74	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6

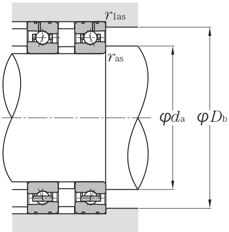
ULTAGE Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring 5S-2LA-HSEW9U type

Contact angle 25° d 50～100mm

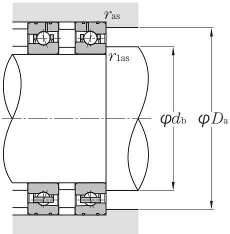


Part number	Boundary dimensions mm									Basic load ratings dynamic static kN		dynamic static kgf		Static axial load capacity kN	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	B_n	S_n	S_b	G_b	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	(Static)		
5S-2LA-HSEW910UAD	50	72	12	2.2	6.6	1.2	1.3	0.6	0.3	10.3	5.30	1 050	545	9.75	995	41 000
5S-2LA-HSEW911UAD	55	80	13	2.8	7.2	1.2	1.3	1	0.6	12.9	6.65	1 310	680	12.1	1 240	37 000
5S-2LA-HSEW912UAD	60	85	13	2.8	7.2	1.2	1.3	1	0.6	13.3	7.3	1 360	740	13.3	1 360	34 500
5S-2LA-HSEW913UAD	65	90	13	2.8	7.2	1.2	1.3	1	0.6	13.5	7.6	1 370	775	13.9	1 420	32 300
5S-2LA-HSEW914UAD	70	100	16	3.1	9.3	1.4	1.9	1	0.6	19.7	10.8	2 010	1 100	19.9	2 030	29 400
5S-2LA-HSEW915UAD	75	105	16	3.1	9.3	1.4	1.9	1	0.6	20.5	11.8	2 090	1 200	21.5	2 200	27 800
5S-2LA-HSEW916UAD	80	110	16	3.1	9.3	1.4	1.9	1	0.6	20.7	12.3	2 110	1 250	22.5	2 300	26 300
5S-2LA-HSEW917UAD	85	120	18	4	10.4	1.6	1.9	1.1	0.6	28.1	16.2	2 860	1 660	29.4	3 000	24 400
5S-2LA-HSEW918UAD	90	125	18	4	10.4	1.6	1.9	1.1	0.6	29.2	17.6	2 980	1 790	31.5	3 250	23 300
5S-2LA-HSEW919UAD	95	130	18	4	10.4	1.6	1.9	1.1	0.6	29.5	18.3	3 000	1 870	33.0	3 400	22 200
5S-2LA-HSEW920UAD	100	140	20	4	12	1.6	1.9	1.1	0.6	34.5	21.4	3 500	2 190	39.0	4 000	20 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

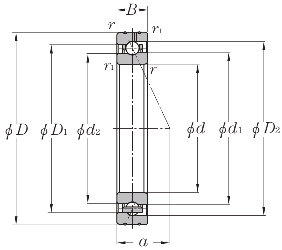
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

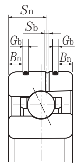
When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
20.3	6.0	0.12	57.6	56.6	64.4	66.7	54.5	52.5	67.5	69.5	0.6	0.3
22.4	7.7	0.17	63.6	62.4	71.4	74.1	60.5	59.5	74.5	75.5	1	0.6
23.5	8.3	0.18	68.6	67.4	76.4	79.0	65.5	64.5	79.5	80.5	1	0.6
24.7	8.9	0.19	73.6	72.4	81.4	84.0	70.5	69.5	84.5	85.5	1	0.6
28.0	14	0.31	80.1	78.6	89.8	93.2	75.5	74.5	94.5	95.5	1	0.6
29.1	15	0.33	85.1	83.6	94.8	98.2	80.5	79.5	99.5	100.5	1	0.6
30.3	16	0.34	90.1	88.6	99.8	103.2	85.5	84.5	104.5	105.5	1	0.6
33.1	22	0.48	96.8	94.9	108.2	112.3	92	89.5	113	115.5	1	0.6
34.2	23	0.51	101.8	99.9	113.2	117.3	97	94.5	118	120.5	1	0.6
35.4	24	0.53	106.8	104.9	118.2	122.3	102	99.5	123	125.5	1	0.6
38.2	32	0.74	113.8	111.7	126.2	130.6	107	104.5	133	135.5	1	0.6

ULTAGE Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring 5S-2LA-HSEW0 type

Contact angle 20° d 50～100mm

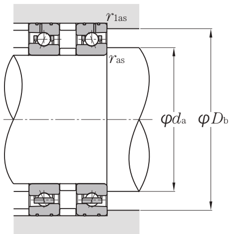




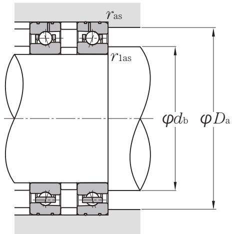
Enlarged view

Part number	Boundary dimensions mm									Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN (Static)	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	B_n	S_n	S_b	G_b	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-HSEW010	50	80	16	3.4	9.3	1.4	1.3	1	0.6	15.5	7.75	1 580	790	12.1	1 230	43 300
5S-2LA-HSEW011	55	90	18	4.3	9.7	1.4	1.9	1.1	0.6	16.8	9.20	1 720	935	14.4	1 460	38 800
5S-2LA-HSEW012	60	95	18	4.3	9.7	1.4	1.9	1.1	0.6	17.6	10.2	1 800	1 040	15.9	1 620	36 300
5S-2LA-HSEW013	65	100	18	4	10.4	1.6	1.9	1.1	0.6	17.9	10.7	1 830	1 090	16.7	1 710	34 100
5S-2LA-HSEW014	70	110	20	4	11.6	1.6	1.9	1.1	0.6	21.9	13.5	2 230	1 370	21.1	2 150	31 200
5S-2LA-HSEW015	75	115	20	4	11.6	1.6	2.4	1.1	0.6	23.3	15.2	2 380	1 550	23.8	2 420	29 600
5S-2LA-HSEW016	80	125	22	4.7	12.2	1.6	2.4	1.1	0.6	26.7	17.4	2 720	1 770	27.2	2 780	27 400
5S-2LA-HSEW017	85	130	22	4.7	12.2	1.6	2.4	1.1	0.6	27.0	18.1	2 760	1 850	28.4	2 900	26 200
5S-2LA-HSEW018	90	140	24	5.5	14.5	1.6	1.9	1.5	1	31.5	21.3	3 200	2 170	33.5	3 400	24 500
5S-2LA-HSEW019	95	145	24	5.5	14.5	1.6	2.4	1.5	1	31.5	22.1	3 250	2 260	34.5	3 550	23 400
5S-2LA-HSEW020	100	150	24	5.5	14.5	1.6	1.9	1.5	1	33.0	23.8	3 350	2 420	37.5	3 800	22 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

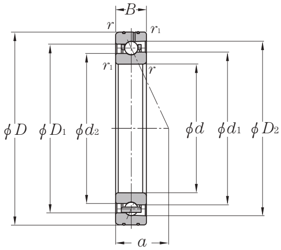
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

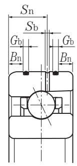
When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
19.9	12	0.23	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
22.3	16	0.37	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
23.2	17	0.40	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
24.1	18	0.42	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
26.5	24	0.60	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
27.4	25	0.64	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
29.8	34	0.86	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
30.7	35	0.90	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
33.1	45	1.18	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
34.0	47	1.23	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
34.9	49	1.28	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1

ULTAGE Air-oil lubricated high-speed angular ball bearings with re-lubricating hole on the outer ring 5S-2LA-HSEW0 type

Contact angle 25° *d* 50〜100mm

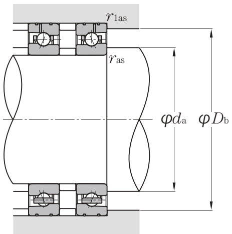




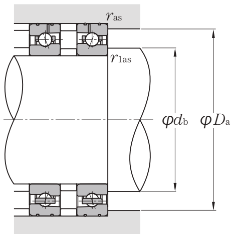
Enlarged view

Part number	Boundary dimensions mm									Basic load ratings dynamic / static kN		dynamic / static kgf		Static axial load capacity kN	kgf	Limiting speed min^{-1} oil lubrication
	d	D	B	B_n	S_n	S_b	G_b	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	(Static)		
5S-2LA-HSEW010AD	50	80	16	3.4	9.3	1.4	1.3	1	0.6	15.0	7.50	1 530	765	13.8	1 400	38 500
5S-2LA-HSEW011AD	55	90	18	4.3	9.7	1.4	1.9	1.1	0.6	16.3	8.90	1 660	910	16.4	1 670	34 500
5S-2LA-HSEW012AD	60	95	18	4.3	9.7	1.4	1.9	1.1	0.6	17.1	9.85	1 740	1 000	18.1	1 850	32 300
5S-2LA-HSEW013AD	65	100	18	4	10.4	1.6	1.9	1.1	0.6	17.3	10.4	1 770	1 060	19.0	1 940	30 300
5S-2LA-HSEW014AD	70	110	20	4	11.6	1.6	1.9	1.1	0.6	21.2	13.0	2 160	1 330	24.0	2 440	27 800
5S-2LA-HSEW015AD	75	115	20	4	11.6	1.6	2.4	1.1	0.6	22.5	14.7	2 300	1 500	27.0	2 760	26 300
5S-2LA-HSEW016AD	80	125	22	4.7	12.2	1.6	2.4	1.1	0.6	25.8	16.9	2 630	1 720	31.0	3 150	24 400
5S-2LA-HSEW017AD	85	130	22	4.7	12.2	1.6	2.4	1.1	0.6	26.1	17.6	2 660	1 790	32.5	3 300	23 300
5S-2LA-HSEW018AD	90	140	24	5.5	14.5	1.6	1.9	1.5	1	30.5	20.6	3 100	2 100	38.0	3 850	21 700
5S-2LA-HSEW019AD	95	145	24	5.5	14.5	1.6	2.4	1.5	1	30.5	21.4	3 150	2 190	39.5	4 000	20 800
5S-2LA-HSEW020AD	100	150	24	5.5	14.5	1.6	1.9	1.5	1	31.5	23.0	3 250	2 350	42.5	4 300	20 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

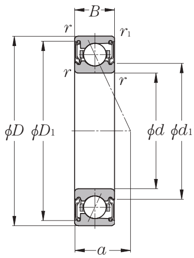
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	D_2	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	D_b max	r_{as} max	r_{1as} max
23.3	12	0.23	60.1	58.6	69.9	73.2	55.5	54.5	74.5	75.5	1	0.6
26.1	16	0.37	67.6	66.2	77.4	80.8	62	59.5	83	85.5	1	0.6
27.2	17	0.40	72.6	71.2	82.4	85.8	67	64.5	88	90.5	1	0.6
28.4	18	0.40	77.6	76.2	87.4	90.8	72	69.5	93	95.5	1	0.6
31.1	24	0.60	84.8	83.0	95.2	99.1	77	74.5	103	105.5	1	0.6
32.3	25	0.64	89.8	88.0	100.2	104.1	82	79.5	108	110.5	1	0.6
35.1	34	0.86	96.8	94.9	108.2	112.5	87	84.5	118	120.5	1	0.6
36.2	35	0.90	101.8	99.9	113.2	117.4	92	89.5	123	125.5	1	0.6
39.0	45	1.18	108.8	106.7	121.2	125.8	98.5	95.5	131.5	134.5	1.5	1
40.2	47	1.23	113.8	111.7	126.2	130.8	103.5	100.5	136.5	139.5	1.5	1
41.3	49	1.28	118.8	116.7	131.2	135.8	108.5	105.5	141.5	144.5	1.5	1

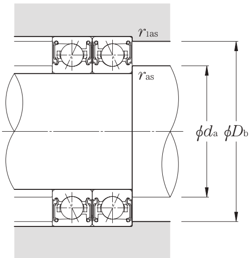
ULTAGE Sealed standard angular contact ball bearings (steel ball type) 79 LLB series

Contact angle 15° d 10～50mm

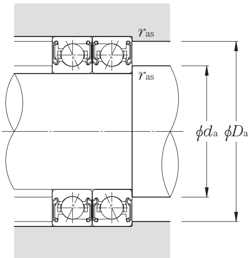


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
7900CDLLB	10	22	6	0.3	0.15	3.00	1.52	305	155	1.91	194	14.1	75 700
7901CDLLB	12	24	6	0.3	0.15	3.35	1.86	340	189	2.34	239	14.7	67 300
7902CDLLB	15	28	7	0.3	0.15	5.05	2.86	515	292	3.60	370	14.5	56 300
7903CDLLB	17	30	7	0.3	0.15	5.25	3.15	535	320	4.00	405	14.8	51 500
7904CDLLB	20	37	9	0.3	0.15	7.30	4.55	745	465	5.75	590	14.9	42 500
7905CDLLB	25	42	9	0.3	0.15	8.15	5.75	835	585	7.30	745	15.5	36 100
7906CDLLB	30	47	9	0.3	0.15	8.60	6.60	880	675	8.40	860	15.9	31 400
7907CDLLB	35	55	10	0.6	0.3	11.8	9.50	1 200	970	12.1	1 230	15.9	26 900
7908CDLLB	40	62	12	0.6	0.3	17.6	13.8	1 790	1 400	17.5	1 780	15.5	23 700
7909CDLLB	45	68	12	0.6	0.3	18.6	15.6	1 890	1 590	19.8	2 020	15.8	21 400
7910CDLLB	50	72	12	0.6	0.3	15.9	14.7	1 620	1 490	18.6	1 900	16.4	20 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

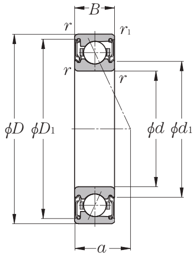
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
5.2	0.010	12.9	19.7	12.5	19.7	20.8	0.3	0.15	**7900CDLLB**
5.4	0.012	15.2	21.7	14.5	21.7	22.8	0.3	0.15	**7901CDLLB**
6.4	0.017	18.5	26.0	17.5	26.0	26.8	0.3	0.15	**7902CDLLB**
6.7	0.019	20.2	28.0	19.5	28.0	28.8	0.3	0.15	**7903CDLLB**
8.4	0.039	23.9	33.9	22.5	34.5	35.8	0.3	0.15	**7904CDLLB**
9.0	0.046	29.1	38.9	27.5	39.5	40.8	0.3	0.15	**7905CDLLB**
9.7	0.053	34.6	43.9	32.5	44.5	45.8	0.3	0.15	**7906CDLLB**
11.1	0.081	40.2	51.2	39.5	51.2	52.5	0.6	0.3	**7907CDLLB**
12.9	0.11	45.3	58.8	44.5	58.8	59.5	0.6	0.3	**7908CDLLB**
13.6	0.13	50.8	64.3	49.5	64.3	65.5	0.6	0.3	**7909CDLLB**
14.2	0.14	55.2	67.5	54.5	67.5	69.5	0.6	0.3	**7910CDLLB**

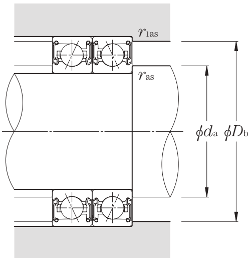
ULTAGE Sealed standard angular contact ball bearings (steel ball type) 79 LLB series

Contact angle 25° d 10～50mm

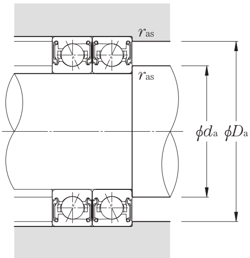


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
7900ADLLB	10	22	6	0.3	0.15	2.88	1.45	294	148	2.20	225	65 600
7901ADLLB	12	24	6	0.3	0.15	3.20	1.77	325	181	2.61	267	58 300
7902ADLLB	15	28	7	0.3	0.15	4.80	2.74	490	279	4.40	450	48 800
7903ADLLB	17	30	7	0.3	0.15	5.00	3.00	510	305	4.75	485	44 700
7904ADLLB	20	37	9	0.3	0.15	6.95	4.35	710	445	6.35	645	36 800
7905ADLLB	25	42	9	0.3	0.15	7.75	5.50	790	560	7.75	790	31 300
7906ADLLB	30	47	9	0.3	0.15	8.15	6.30	830	640	8.65	885	27 300
7907ADLLB	35	55	10	0.6	0.3	11.1	9.00	1 130	920	13.1	1 340	23 300
7908ADLLB	40	62	12	0.6	0.3	16.7	13.1	1 700	1 330	19.3	1 960	20 600
7909ADLLB	45	68	12	0.6	0.3	17.6	14.8	1 790	1 510	21.5	2 190	18 600
7910ADLLB	50	72	12	0.6	0.3	15.0	13.9	1 530	1 420	13.6	1 380	17 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

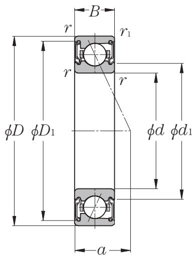
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.8	0.010	12.9	19.7	12.5	19.7	20.8	0.3	0.15	**7900ADLLB**
7.2	0.012	15.2	21.7	14.5	21.7	22.8	0.3	0.15	**7901ADLLB**
8.6	0.017	18.5	26.0	17.5	26.0	26.8	0.3	0.15	**7902ADLLB**
9.0	0.019	20.2	28.0	19.5	28.0	28.8	0.3	0.15	**7903ADLLB**
11.2	0.039	23.9	33.9	22.5	34.5	35.8	0.3	0.15	**7904ADLLB**
12.4	0.046	29.1	38.9	27.5	39.5	40.8	0.3	0.15	**7905ADLLB**
13.5	0.053	34.6	43.9	32.5	44.5	45.8	0.3	0.15	**7906ADLLB**
15.6	0.081	40.2	51.2	39.5	51.2	52.5	0.6	0.3	**7907ADLLB**
18.0	0.11	45.3	58.8	44.5	58.8	59.5	0.6	0.3	**7908ADLLB**
19.3	0.13	50.8	64.3	49.5	64.3	65.5	0.6	0.3	**7909ADLLB**
20.2	0.14	55.2	67.5	54.5	67.5	69.5	0.6	0.3	**7910ADLLB**

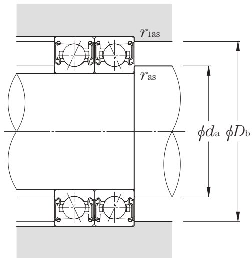
ULTAGE Sealed standard angular contact ball bearings (steel ball type) 70 LLB series

Contact angle 15° d 10～50mm

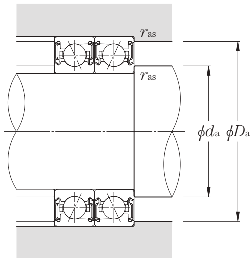


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Factor	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
7000CDLLB	10	26	8	0.3	0.15	5.30	2.49	540	254	3.10	315	12.6	67 300
7001CDLLB	12	28	8	0.3	0.15	5.80	2.90	590	296	3.65	370	13.2	60 600
7002CDLLB	15	32	9	0.3	0.15	6.25	3.40	635	345	4.25	435	14.0	51 500
7003CDLLB	17	35	10	0.3	0.15	8.25	4.50	840	460	5.70	580	13.8	46 600
7004CDLLB	20	42	12	0.6	0.3	10.5	6.00	1 070	610	7.55	770	14.0	39 100
7005CDLLB	25	47	12	0.6	0.3	12.3	8.00	1 250	815	10.1	1 030	14.7	33 600
7006CDLLB	30	55	13	1	0.6	15.1	10.3	1 540	1 050	13.0	1 320	14.9	28 500
7007CDLLB	35	62	14	1	0.6	19.1	13.7	1 950	1 390	17.3	1 760	15.0	25 000
7008CDLLB	40	68	15	1	0.6	20.6	15.9	2 100	1 620	20.1	2 050	15.4	22 400
7009CDLLB	45	75	16	1	0.6	27.7	21.1	2 820	2 160	26.7	2 730	15.1	20 200
7010CDLLB	50	80	16	1	0.6	28.6	22.9	2 910	2 330	29.0	2 960	15.4	18 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

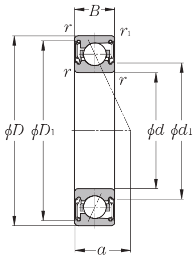
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.4	0.018	14.5	23.4	12.5	23.5	24.8	0.3	0.15	**7000CDLLB**
6.7	0.022	16.5	25.4	14.5	25.5	26.8	0.3	0.15	**7001CDLLB**
7.7	0.032	19.5	28.8	17.5	29.5	30.8	0.3	0.15	**7002CDLLB**
8.5	0.040	21.6	32.2	19.5	32.5	33.8	0.3	0.15	**7003CDLLB**
10.2	0.070	26.0	38.0	24.5	38.0	39.5	0.6	0.3	**7004CDLLB**
10.9	0.083	30.4	43.1	29.5	43.1	44.5	0.6	0.3	**7005CDLLB**
12.2	0.11	36.4	50.4	35.5	50.4	50.5	1	0.6	**7006CDLLB**
13.6	0.16	41.9	57.2	40.5	57.2	57.5	1	0.6	**7007CDLLB**
14.8	0.19	47.9	62.7	45.5	62.7	63.5	1	0.6	**7008CDLLB**
16.1	0.24	53.0	70.3	50.5	70.3	70.5	1	0.6	**7009CDLLB**
16.8	0.26	58.0	75.3	55.5	75.3	75.5	1	0.6	**7010CDLLB**

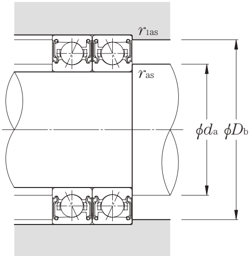
ULTAGE Sealed standard angular contact ball bearings (steel ball type) 70 LLB series

Contact angle 25° d 10～50mm

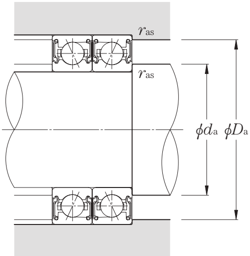


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min-1 grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
7000ADLLB	10	26	8	0.3	0.15	5.15	2.41	525	245	3.85	395	58 300
7001ADLLB	12	28	8	0.3	0.15	5.60	2.79	570	285	4.50	455	52 500
7002ADLLB	15	32	9	0.3	0.15	5.95	3.25	610	330	4.95	505	44 700
7003ADLLB	17	35	10	0.3	0.15	7.90	4.35	805	445	6.95	710	40 400
7004ADLLB	20	42	12	0.6	0.3	10.0	5.75	1 020	585	8.80	900	33 900
7005ADLLB	25	47	12	0.6	0.3	11.7	7.65	1 190	780	11.3	1 150	29 200
7006ADLLB	30	55	13	1	0.6	14.4	9.80	1 470	995	14.9	1 520	24 700
7007ADLLB	35	62	14	1	0.6	18.2	13.0	1 850	1 330	20.4	2 080	21 600
7008ADLLB	40	68	15	1	0.6	19.5	15.1	1 990	1 540	23.2	2 370	19 400
7009ADLLB	45	75	16	1	0.6	26.3	20.1	2 680	2 050	31.0	3 150	17 500
7010ADLLB	50	80	16	1	0.6	27.1	21.8	2 760	2 220	33.0	3 350	16 200

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

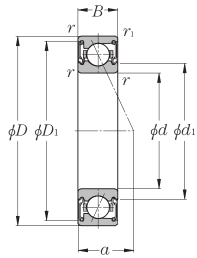
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	D_1	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
8.3	0.018	14.5	23.4	12.5	23.5	24.8	0.3	0.15	**7000ADLLB**
8.7	0.022	16.5	25.4	14.5	25.5	26.8	0.3	0.15	**7001ADLLB**
10.0	0.032	19.5	28.8	17.5	29.5	30.8	0.3	0.15	**7002ADLLB**
11.1	0.040	21.6	32.2	19.5	32.5	33.8	0.3	0.15	**7003ADLLB**
13.3	0.070	26.0	38.0	24.5	38.0	39.5	0.6	0.3	**7004ADLLB**
14.5	0.083	30.4	43.1	29.5	43.1	44.5	0.6	0.3	**7005ADLLB**
16.5	0.11	36.4	50.4	35.5	50.4	50.5	1	0.6	**7006ADLLB**
18.4	0.16	41.9	57.2	40.5	57.2	57.5	1	0.6	**7007ADLLB**
20.2	0.19	47.9	62.7	45.5	62.7	63.5	1	0.6	**7008ADLLB**
22.1	0.24	53.0	70.3	50.5	70.3	70.5	1	0.6	**7009ADLLB**
23.3	0.26	58.0	75.3	55.5	75.3	75.5	1	0.6	**7010ADLLB**

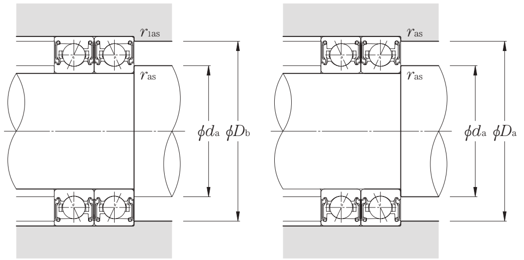
ULTAGE Sealed standard angular contact ball bearings (ceramic ball type) 5S-79 LLB series

Contact angle 15° d 10～50mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
5S-7900CDLLB	10	22	6	0.3	0.15	3.00	1.05	305	107	1.19	121	9.8	89 800
5S-7901CDLLB	12	24	6	0.3	0.15	3.35	1.29	340	131	1.46	149	10.2	79 800
5S-7902CDLLB	15	28	7	0.3	0.15	5.05	1.98	515	202	2.25	230	10.0	66 800
5S-7903CDLLB	17	30	7	0.3	0.15	5.25	2.19	535	223	2.49	254	10.3	61 100
5S-7904CDLLB	20	37	9	0.3	0.15	7.30	3.15	745	325	3.60	365	10.3	50 400
5S-7905CDLLB	25	42	9	0.3	0.15	8.15	4.00	835	405	4.55	465	10.7	42 900
5S-7906CDLLB	30	47	9	0.3	0.15	8.60	4.60	880	470	5.25	535	11.0	37 300
5S-7907CDLLB	35	55	10	0.6	0.3	11.8	6.60	1 200	670	7.55	770	11.0	31 900
5S-7908CDLLB	40	62	12	0.6	0.3	17.6	9.55	1 790	975	10.9	1 110	10.8	28 200
5S-7909CDLLB	45	68	12	0.6	0.3	18.6	10.8	1 890	1 100	12.4	1 260	11.0	24 100
5S-7910CDLLB	50	72	12	0.6	0.3	15.9	10.2	1 620	1 040	11.7	1 190	11.3	22 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back (DB) Face-to-face (DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

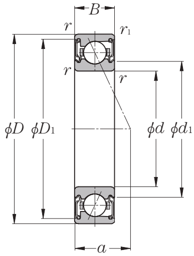
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	D_1	d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	
5.2	0.009	12.9	19.7	12.5	19.7	20.8	0.3	0.15	**5S-7900CDLLB**
5.4	0.011	15.2	21.7	14.5	21.7	22.8	0.3	0.15	**5S-7901CDLLB**
6.4	0.015	18.5	26.0	17.5	26.0	26.8	0.3	0.15	**5S-7902CDLLB**
6.7	0.017	20.2	28.0	19.5	28.0	28.8	0.3	0.15	**5S-7903CDLLB**
8.4	0.036	23.9	33.9	22.5	34.5	35.8	0.3	0.15	**5S-7904CDLLB**
9.0	0.042	29.1	38.9	27.5	39.5	40.8	0.3	0.15	**5S-7905CDLLB**
9.7	0.048	34.6	43.9	32.5	44.5	45.8	0.3	0.15	**5S-7906CDLLB**
11.1	0.073	40.2	51.2	39.5	51.2	52.5	0.6	0.3	**5S-7907CDLLB**
12.9	0.099	45.3	58.8	44.5	58.8	59.5	0.6	0.3	**5S-7908CDLLB**
13.6	0.12	50.8	64.3	49.5	64.3	65.5	0.6	0.3	**5S-7909CDLLB**
14.2	0.12	55.2	67.5	54.5	67.5	69.5	0.6	0.3	**5S-7910CDLLB**

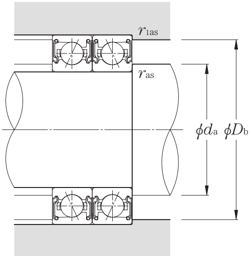
ULTAGE Sealed standard angular contact ball bearings (ceramic ball type) 5S-79 LLB series

Contact angle 25° d 10～50mm

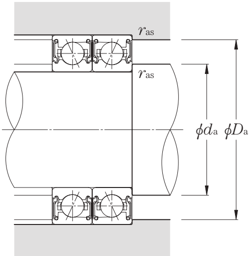


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-7900ADLLB	10	22	6	0.3	0.15	2.88	1.01	294	103	1.52	155	79 700
5S-7901ADLLB	12	24	6	0.3	0.15	3.20	1.23	325	125	1.86	189	70 800
5S-7902ADLLB	15	28	7	0.3	0.15	4.80	1.90	490	193	2.86	292	59 300
5S-7903ADLLB	17	30	7	0.3	0.15	5.00	2.09	510	213	3.15	320	54 300
5S-7904ADLLB	20	37	9	0.3	0.15	6.95	3.00	710	310	4.55	465	44 700
5S-7905ADLLB	25	42	9	0.3	0.15	7.75	3.80	790	385	5.75	585	38 100
5S-7906ADLLB	30	47	9	0.3	0.15	8.15	4.35	830	445	6.60	670	33 100
5S-7907ADLLB	35	55	10	0.6	0.3	11.1	6.25	1 130	635	9.45	965	28 300
5S-7908ADLLB	40	62	12	0.6	0.3	16.7	9.05	1 700	925	13.7	1 400	25 000
5S-7909ADLLB	45	68	12	0.6	0.3	17.6	10.3	1 790	1 050	15.6	1 590	21 400
5S-7910ADLLB	50	72	12	0.6	0.3	15.0	9.60	1 530	980	14.6	1 490	20 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

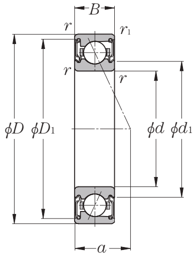
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.8	0.009	12.9	19.7	12.5	19.7	20.8	0.3	0.15	**5S-7900ADLLB**
7.2	0.011	15.2	21.7	14.5	21.7	22.8	0.3	0.15	**5S-7901ADLLB**
8.6	0.015	18.5	26.0	17.5	26.0	26.8	0.3	0.15	**5S-7902ADLLB**
9.0	0.017	20.2	28.0	19.5	28.0	28.8	0.3	0.15	**5S-7903ADLLB**
11.2	0.036	23.9	33.9	22.5	34.5	35.8	0.3	0.15	**5S-7904ADLLB**
12.4	0.042	29.1	38.9	27.5	39.5	40.8	0.3	0.15	**5S-7905ADLLB**
13.5	0.048	34.6	43.9	32.5	44.5	45.8	0.3	0.15	**5S-7906ADLLB**
15.6	0.073	40.2	51.2	39.5	51.2	52.5	0.6	0.3	**5S-7907ADLLB**
18.0	0.099	45.3	58.8	44.5	58.8	59.5	0.6	0.3	**5S-7908ADLLB**
19.3	0.12	50.8	64.3	49.5	64.3	65.5	0.6	0.3	**5S-7909ADLLB**
20.2	0.12	55.2	67.5	54.5	67.5	69.5	0.6	0.3	**5S-7910ADLLB**

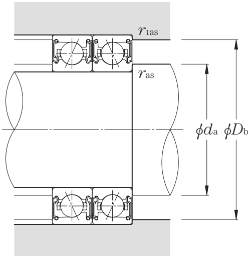
ULTAGE Sealed standard angular contact ball bearings (ceramic ball type) 5S-70 LLB series

Contact angle 15° d 10～50mm

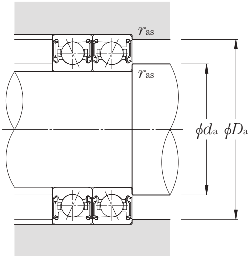


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
5S-7000CDLLB	10	26	8	0.3	0.15	5.30	1.73	540	176	1.93	197	8.8	80 600
5S-7001CDLLB	12	28	8	0.3	0.15	5.80	2.01	590	205	2.26	231	9.2	72 600
5S-7002CDLLB	15	32	9	0.3	0.15	6.25	2.35	635	239	2.66	271	9.7	61 800
5S-7003CDLLB	17	35	10	0.3	0.15	8.25	3.15	840	320	3.55	360	9.6	55 800
5S-7004CDLLB	20	42	12	0.6	0.3	10.5	4.15	1 070	425	4.70	480	9.7	46 800
5S-7005CDLLB	25	47	12	0.6	0.3	12.3	5.55	1 250	565	6.30	640	10.2	40 300
5S-7006CDLLB	30	55	13	1	0.6	15.1	7.10	1 540	725	8.10	825	10.3	34 100
5S-7007CDLLB	35	62	14	1	0.6	19.1	9.45	1 950	965	10.8	1 100	10.4	29 900
5S-7008CDLLB	40	68	15	1	0.6	20.6	11.0	2 100	1 120	12.6	1 280	10.6	26 900
5S-7009CDLLB	45	75	16	1	0.6	27.7	14.6	2 820	1 490	16.7	1 700	10.4	23 300
5S-7010CDLLB	50	80	16	1	0.6	28.6	15.9	2 910	1 620	18.1	1 850	10.6	21 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.38				1.47		1.65		2.39
0.357	0.4				1.4		1.57		2.28
0.714	0.43				1.3		1.46		2.11
1.07	0.46				1.23		1.38		2
1.43	0.47	1	0	0.44	1.19	1	1.34	0.72	1.93
2.14	0.5				1.12		1.26		1.82
3.57	0.55				1.02		1.14		1.66
5.35	0.56				1		1.12		1.63
7.14	0.56				1		1.12		1.63

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

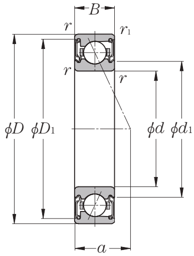
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.46	1	0.92

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
6.4	0.014	14.5	23.4	12.5	23.5	24.8	0.3	0.15	**5S-7000CDLLB**
6.7	0.020	16.5	25.4	14.5	25.5	26.8	0.3	0.15	**5S-7001CDLLB**
7.7	0.029	19.5	28.8	17.5	29.5	30.8	0.3	0.15	**5S-7002CDLLB**
8.5	0.035	21.6	32.2	19.5	32.5	33.8	0.3	0.15	**5S-7003CDLLB**
10.2	0.064	26.0	38.0	24.5	38.0	39.5	0.6	0.3	**5S-7004CDLLB**
10.9	0.075	30.4	43.1	29.5	43.1	44.5	0.6	0.3	**5S-7005CDLLB**
12.2	0.096	36.4	50.4	35.5	50.4	50.5	1	0.6	**5S-7006CDLLB**
13.6	0.14	41.9	57.2	40.5	57.2	57.5	1	0.6	**5S-7007CDLLB**
14.8	0.17	47.9	62.7	45.5	62.7	63.5	1	0.6	**5S-7008CDLLB**
16.1	0.21	53.0	70.3	50.5	70.3	70.5	1	0.6	**5S-7009CDLLB**
16.8	0.23	58.0	75.3	55.5	75.3	75.5	1	0.6	**5S-7010CDLLB**

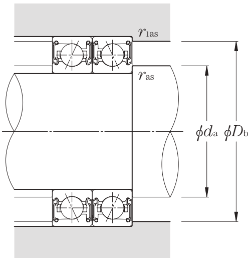
ULTAGE **Sealed standard angular contact ball bearings (ceramic ball type)**
5S-70 LLB series

Contact angle 25° d 10～50mm

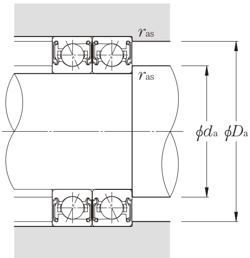


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	Static axial load capacity kgf	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-7000ADLLB	10	26	8	0.3	0.15	5.15	1.67	525	170	2.51	256	70 600
5S-7001ADLLB	12	28	8	0.3	0.15	5.60	1.93	570	197	2.92	297	63 500
5S-7002ADLLB	15	32	9	0.3	0.15	5.95	2.25	610	229	3.40	345	54 000
5S-7003ADLLB	17	35	10	0.3	0.15	7.90	3.00	805	305	4.55	465	48 800
5S-7004ADLLB	20	42	12	0.6	0.3	10.0	4.00	1 020	405	6.00	615	41 000
5S-7005ADLLB	25	47	12	0.6	0.3	11.7	5.30	1 190	540	8.00	815	35 300
5S-7006ADLLB	30	55	13	1	0.6	14.4	6.80	1 470	690	10.2	1 040	29 900
5S-7007ADLLB	35	62	14	1	0.6	18.2	9.00	1 850	920	13.6	1 390	26 200
5S-7008ADLLB	40	68	15	1	0.6	19.5	10.5	1 990	1 070	15.8	1 620	23 500
5S-7009ADLLB	45	75	16	1	0.6	26.3	14.0	2 680	1 420	21.1	2 150	20 300
5S-7010ADLLB	50	80	16	1	0.6	27.1	15.1	2 760	1 540	22.8	2 330	18 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

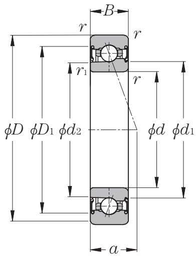
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	D_1	Abutment and fillet dimensions mm d_a min	D_a max	D_b max	r_{as} max	r_{1as} max	Part number
8.3	0.014	14.5	23.4	12.5	23.5	24.8	0.3	0.15	**5S-7000ADLLB**
8.7	0.020	16.5	25.4	14.5	25.5	26.8	0.3	0.15	**5S-7001ADLLB**
10.0	0.029	19.5	28.8	17.5	29.5	30.8	0.3	0.15	**5S-7002ADLLB**
11.1	0.035	21.6	32.2	19.5	32.5	33.8	0.3	0.15	**5S-7003ADLLB**
13.3	0.064	26.0	38.0	24.5	38.0	39.5	0.6	0.3	**5S-7004ADLLB**
14.5	0.075	30.4	43.1	29.5	43.1	44.5	0.6	0.3	**5S-7005ADLLB**
16.5	0.096	36.4	50.4	35.5	50.4	50.5	1	0.6	**5S-7006ADLLB**
18.4	0.14	41.9	57.2	40.5	57.2	57.5	1	0.6	**5S-7007ADLLB**
20.2	0.17	47.9	62.7	45.5	62.7	63.5	1	0.6	**5S-7008ADLLB**
22.1	0.21	53.0	70.3	50.5	70.3	70.5	1	0.6	**5S-7009ADLLB**
23.3	0.23	58.0	75.3	55.5	75.3	75.5	1	0.6	**5S-7010ADLLB**

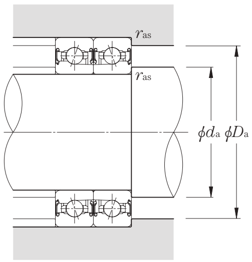
ULTAGE Sealed high-speed angular contact ball bearings (steel ball type) 2LA-BNS9 LLB series

Contact angle 15° d 50～100mm

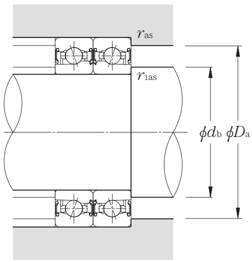


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
2LA-BNS910CLLB	50	72	12	0.6	0.3	8.10	7.30	825	745	10.7	1 090	11.1	21 800
2LA-BNS911CLLB	55	80	13	1	0.6	10.3	9.20	1 050	940	13.5	1 380	11.0	19 700
2LA-BNS912CLLB	60	85	13	1	0.6	10.6	10.0	1 080	1 010	14.6	1 490	11.1	18 300
2LA-BNS913CLLB	65	90	13	1	0.6	10.9	10.7	1 110	1 090	15.7	1 600	11.2	17 200
2LA-BNS914CLLB	70	100	16	1	0.6	13.7	13.5	1 400	1 370	19.8	2 020	11.1	15 600
2LA-BNS915CLLB	75	105	16	1	0.6	14.1	14.4	1 440	1 470	21.2	2 170	11.2	14 800
2LA-BNS916CLLB	80	110	16	1	0.6	14.5	15.4	1 480	1 570	22.6	2 310	11.3	14 000
2LA-BNS917CLLB	85	120	18	1.1	0.6	17.4	18.3	1 770	1 860	26.9	2 740	11.2	13 000
2LA-BNS918CLLB	90	125	18	1.1	0.6	17.9	19.5	1 820	1 980	28.7	2 920	11.3	12 400
2LA-BNS919CLLB	95	130	18	1.1	0.6	18.3	20.6	1 870	2 110	30.5	3 100	11.3	11 800
2LA-BNS920CLLB	100	140	20	1.1	0.6	25.7	28.0	2 620	2 850	41.0	4 200	11.2	11 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

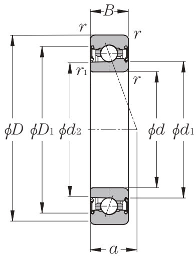
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
14.2	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**2LA-BNS910CLLB**
15.6	0.19	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**2LA-BNS911CLLB**
16.3	0.21	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**2LA-BNS912CLLB**
16.9	0.22	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**2LA-BNS913CLLB**
19.5	0.38	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**2LA-BNS914CLLB**
20.1	0.39	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**2LA-BNS915CLLB**
20.8	0.41	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**2LA-BNS916CLLB**
22.8	0.59	96.0	95.0	108.6	92	89.5	113	1	0.6	**2LA-BNS917CLLB**
23.5	0.62	100.9	100.0	113.6	97	94.5	118	1	0.6	**2LA-BNS918CLLB**
24.2	0.65	105.9	105.0	118.6	102	99.5	123	1	0.6	**2LA-BNS919CLLB**
26.2	0.87	111.9	110.9	127.3	107	104.5	133	1	0.6	**2LA-BNS920CLLB**

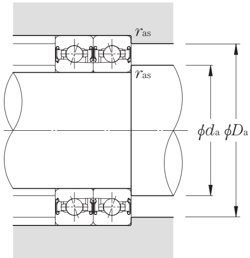
ULTAGE **Sealed high-speed angular contact ball bearings (steel ball type)**
2LA-BNS9 LLB series

Contact angle 20° d 50～100mm

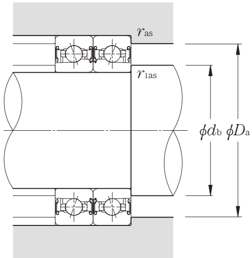


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	Static axial load capacity kgf	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
2LA-BNS910LLB	50	72	12	0.6	0.3	7.90	7.10	805	725	11.9	1 220	23 100
2LA-BNS911LLB	55	80	13	1	0.6	10.1	9.00	1 030	915	15.1	1 540	20 800
2LA-BNS912LLB	60	85	13	1	0.6	10.4	9.70	1 060	990	16.3	1 660	19 400
2LA-BNS913LLB	65	90	13	1	0.6	10.6	10.4	1 080	1 060	17.5	1 790	18 200
2LA-BNS914LLB	70	100	16	1	0.6	13.4	13.1	1 360	1 340	22.1	2 250	16 600
2LA-BNS915LLB	75	105	16	1	0.6	13.7	14.1	1 400	1 430	23.6	2 410	15 600
2LA-BNS916LLB	80	110	16	1	0.6	14.1	15.0	1 440	1 530	25.2	2 570	14 800
2LA-BNS917LLB	85	120	18	1.1	0.6	16.9	17.8	1 730	1 820	29.9	3 050	13 700
2LA-BNS918LLB	90	125	18	1.1	0.6	17.4	19.0	1 770	1 930	32.0	3 250	13 100
2LA-BNS919LLB	95	130	18	1.1	0.6	17.8	20.1	1 820	2 050	34.0	3 450	12 500
2LA-BNS920LLB	100	140	20	1.1	0.6	25.1	27.3	2 560	2 780	46.0	4 700	11 700

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

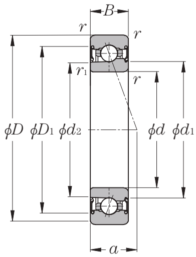
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
17.2	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**2LA-BNS910LLB**
18.9	0.19	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**2LA-BNS911LLB**
19.8	0.21	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**2LA-BNS912LLB**
20.7	0.22	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**2LA-BNS913LLB**
23.6	0.38	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**2LA-BNS914LLB**
24.5	0.39	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**2LA-BNS915LLB**
25.4	0.41	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**2LA-BNS916LLB**
27.8	0.59	96.0	95.0	108.6	92	89.5	113	1	0.6	**2LA-BNS917LLB**
28.7	0.62	100.9	100.0	113.6	97	94.5	118	1	0.6	**2LA-BNS918LLB**
29.6	0.65	105.9	105.0	118.6	102	99.5	123	1	0.6	**2LA-BNS919LLB**
32.0	0.87	111.9	110.9	127.3	107	104.5	133	1	0.6	**2LA-BNS920LLB**

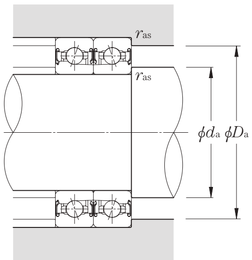
ULTAGE Sealed high-speed angular contact ball bearings (steel ball type) 2LA-BNS9 LLB series

Contact angle 25° d 50～100mm

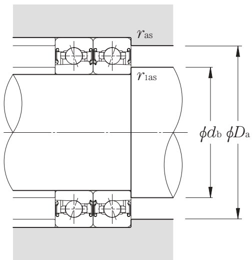


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
2LA-BNS910ADLLB	50	72	12	0.6	0.3	7.60	6.90	775	700	12.4	1 270	20 500
2LA-BNS911ADLLB	55	80	13	1	0.6	9.75	8.70	990	885	16.8	1 710	18 500
2LA-BNS912ADLLB	60	85	13	1	0.6	10.0	9.40	1 020	960	18.1	1 850	17 200
2LA-BNS913ADLLB	65	90	13	1	0.6	10.3	10.1	1 050	1 030	19.5	1 990	16 100
2LA-BNS914ADLLB	70	100	16	1	0.6	12.9	12.7	1 320	1 300	24.6	2 500	14 700
2LA-BNS915ADLLB	75	105	16	1	0.6	13.3	13.6	1 350	1 390	26.3	2 680	13 900
2LA-BNS916ADLLB	80	110	16	1	0.6	13.6	14.5	1 390	1 480	28.0	2 860	13 200
2LA-BNS917ADLLB	85	120	18	1.1	0.6	16.4	17.2	1 670	1 760	33.5	3 400	12 200
2LA-BNS918ADLLB	90	125	18	1.1	0.6	16.8	18.4	1 710	1 870	35.5	3 600	11 600
2LA-BNS919ADLLB	95	130	18	1.1	0.6	17.2	19.5	1 760	1 990	37.5	3 850	11 100
2LA-BNS920ADLLB	100	140	20	1.1	0.6	24.2	26.4	2 470	2 690	51.0	5 200	10 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

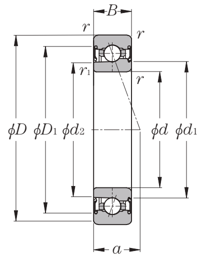
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
20.3	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**2LA-BNS910ADLLB**
22.3	0.19	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**2LA-BNS911ADLLB**
23.5	0.21	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**2LA-BNS912ADLLB**
24.7	0.22	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**2LA-BNS913ADLLB**
27.9	0.38	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**2LA-BNS914ADLLB**
29.1	0.39	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**2LA-BNS915ADLLB**
30.3	0.41	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**2LA-BNS916ADLLB**
33.0	0.59	96.0	95.0	108.6	92	89.5	113	1	0.6	**2LA-BNS917ADLLB**
34.2	0.62	100.9	100.0	113.6	97	94.5	118	1	0.6	**2LA-BNS918ADLLB**
35.4	0.65	105.9	105.0	118.6	102	99.5	123	1	0.6	**2LA-BNS919ADLLB**
38.1	0.87	111.9	110.9	127.3	107	104.5	133	1	0.6	**2LA-BNS920ADLLB**

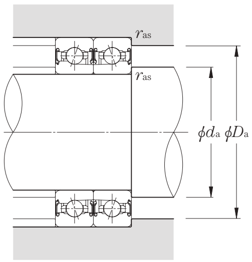
ULTAGE **Sealed high-speed angular contact ball bearings (steel ball type)**
2LA-BNS0 LLB series

Contact angle 15° *d* 45～100mm

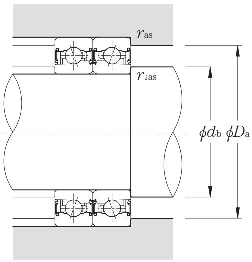


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
2LA-BNS009CLLB	45	75	16	1	0.6	11.8	9.15	1 210	930	13.4	1 370	10.7	22 200
2LA-BNS010CLLB	50	80	16	1	0.6	14.7	11.5	1 500	1 170	16.8	1 720	10.7	20 500
2LA-BNS011CLLB	55	90	18	1.1	0.6	17.3	13.6	1 760	1 380	19.9	2 030	10.6	18 300
2LA-BNS012CLLB	60	95	18	1.1	0.6	18.1	15.0	1 850	1 530	22.0	2 240	10.7	17 200
2LA-BNS013CLLB	65	100	18	1.1	0.6	18.4	15.8	1 870	1 610	23.2	2 360	10.8	16 100
2LA-BNS014CLLB	70	110	20	1.1	0.6	22.4	19.9	2 290	2 030	29.2	2 980	10.8	14 800
2LA-BNS015CLLB	75	115	20	1.1	0.6	23.9	22.4	2 440	2 290	33.0	3 350	10.9	14 000
2LA-BNS016CLLB	80	125	22	1.1	0.6	27.4	25.7	2 790	2 620	38.0	3 850	10.9	13 000
2LA-BNS017CLLB	85	130	22	1.1	0.6	27.7	26.8	2 830	2 740	39.5	4 000	10.9	12 400
2LA-BNS018CLLB	90	140	24	1.5	1	32.0	31.5	3 300	3 200	46.0	4 700	10.9	11 600
2LA-BNS019CLLB	95	145	24	1.5	1	32.5	32.5	3 300	3 350	48.0	4 900	11.0	11 100
2LA-BNS020CLLB	100	150	24	1.5	1	33.5	35.0	3 450	3 600	51.5	5 250	11.0	10 600

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

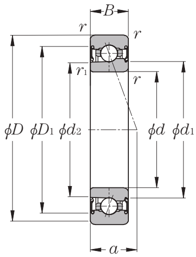
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
16.1	0.26	54.1	53.3	65.0	50.5	49.5	69.5	1	0.6	**2LA-BNS009CLLB**
16.8	0.28	58.4	57.5	70.5	55.5	54.5	74.5	1	0.6	**2LA-BNS010CLLB**
18.8	0.41	65.2	64.1	78.7	62	59.5	83	1	0.6	**2LA-BNS011CLLB**
19.5	0.44	70.1	69.1	83.5	67	64.5	88	1	0.6	**2LA-BNS012CLLB**
20.1	0.47	75.2	74.2	88.2	72	69.5	93	1	0.6	**2LA-BNS013CLLB**
22.2	0.66	81.9	80.8	96.8	77	74.5	103	1	0.6	**2LA-BNS014CLLB**
22.8	0.69	86.8	85.8	102.2	82	79.5	108	1	0.6	**2LA-BNS015CLLB**
24.8	0.94	93.7	92.5	110.2	87	84.5	118	1	0.6	**2LA-BNS016CLLB**
25.5	0.98	98.6	97.5	115.4	92	89.5	123	1	0.6	**2LA-BNS017CLLB**
27.5	1.29	105.3	104.1	123.2	98.5	95.5	131.5	1.5	1	**2LA-BNS018CLLB**
28.2	1.34	110.4	109.1	128.1	103.5	100.5	136.5	1.5	1	**2LA-BNS019CLLB**
28.9	1.40	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	**2LA-BNS020CLLB**

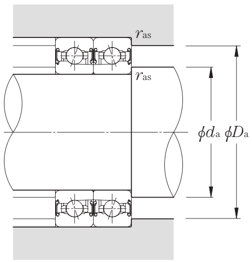
ULTAGE Sealed high-speed angular contact ball bearings (steel ball type) 2LA-BNS0 LLB series

Contact angle 20° d 45～100mm

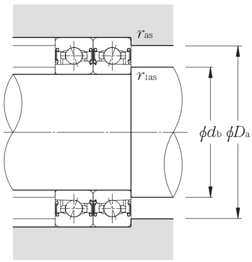


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Limiting speed (min^{-1}) grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
2LA-BNS009LLB	45	75	16	1	0.6	11.5	8.95	1 180	910	15.0	1 530	23 500
2LA-BNS010LLB	50	80	16	1	0.6	14.4	11.2	1 470	1 150	18.8	1 920	21 600
2LA-BNS011LLB	55	90	18	1.1	0.6	16.8	13.3	1 720	1 350	22.2	2 260	19 400
2LA-BNS012LLB	60	95	18	1.1	0.6	17.6	14.7	1 800	1 490	24.6	2 500	18 200
2LA-BNS013LLB	65	100	18	1.1	0.6	17.9	15.4	1 830	1 570	25.9	2 640	17 100
2LA-BNS014LLB	70	110	20	1.1	0.6	21.9	19.4	2 230	1 980	32.5	3 300	15 600
2LA-BNS015LLB	75	115	20	1.1	0.6	23.3	21.9	2 380	2 230	36.5	3 750	14 800
2LA-BNS016LLB	80	125	22	1.1	0.6	26.7	25.1	2 720	2 560	42.0	4 300	13 700
2LA-BNS017LLB	85	130	22	1.1	0.6	27.0	26.2	2 760	2 670	44.0	4 500	13 100
2LA-BNS018LLB	90	140	24	1.5	1	31.5	30.5	3 200	3 150	51.5	5 250	12 200
2LA-BNS019LLB	95	145	24	1.5	1	31.5	32.0	3 250	3 250	53.5	5 450	11 700
2LA-BNS020LLB	100	150	24	1.5	1	33.0	34.5	3 350	3 500	57.5	5 850	11 300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

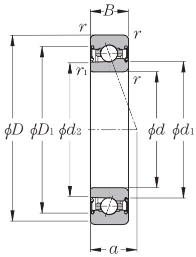
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
19.0	0.26	54.1	53.3	65.0	50.5	49.5	69.5	1	0.6	**2LA-BNS009LLB**
19.9	0.28	58.4	57.5	70.5	55.5	54.5	74.5	1	0.6	**2LA-BNS010LLB**
22.3	0.41	65.2	64.2	78.7	62	59.5	83	1	0.6	**2LA-BNS011LLB**
23.2	0.44	70.1	69.2	83.5	67	64.5	88	1	0.6	**2LA-BNS012LLB**
24.1	0.47	75.2	74.2	88.2	72	69.5	93	1	0.6	**2LA-BNS013LLB**
26.5	0.66	81.9	80.8	96.8	77	74.5	103	1	0.6	**2LA-BNS014LLB**
27.4	0.69	86.8	85.8	102.2	82	79.5	108	1	0.6	**2LA-BNS015LLB**
29.8	0.94	93.7	92.5	110.2	87	84.5	118	1	0.6	**2LA-BNS016LLB**
30.7	0.98	98.6	97.5	115.4	92	89.5	123	1	0.6	**2LA-BNS017LLB**
33.1	1.29	105.3	104.2	123.2	98.5	95.5	131.5	1.5	1	**2LA-BNS018LLB**
34.0	1.34	110.4	109.2	128.1	103.5	100.5	136.5	1.5	1	**2LA-BNS019LLB**
34.9	1.40	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	**2LA-BNS020LLB**

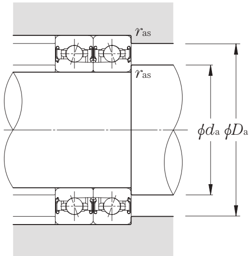
ULTAGE Sealed high-speed angular contact ball bearings (steel ball type) 2LA-BNS0 LLB series

Contact angle 25° d 45～100mm

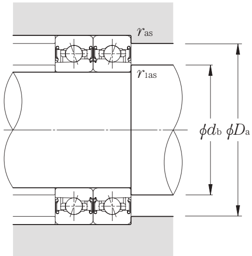


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
2LA-BNS009ADLLB	45	75	16	1	0.6	11.2	8.65	1 140	885	16.7	1 700	20 800
2LA-BNS010ADLLB	50	80	16	1	0.6	13.9	10.9	1 420	1 110	21.0	2 140	19 200
2LA-BNS011ADLLB	55	90	18	1.1	0.6	16.3	12.9	1 660	1 310	24.8	2 530	17 200
2LA-BNS012ADLLB	60	95	18	1.1	0.6	17.1	14.2	1 740	1 450	27.4	2 800	16 100
2LA-BNS013ADLLB	65	100	18	1.1	0.6	17.3	14.9	1 770	1 520	28.9	2 940	15 200
2LA-BNS014ADLLB	70	110	20	1.1	0.6	21.2	18.8	2 160	1 920	36.5	3 700	13 900
2LA-BNS015ADLLB	75	115	20	1.1	0.6	22.5	21.2	2 300	2 160	41.0	4 200	13 200
2LA-BNS016ADLLB	80	125	22	1.1	0.6	25.8	24.3	2 630	2 480	47.0	4 800	12 200
2LA-BNS017ADLLB	85	130	22	1.1	0.6	26.1	25.4	2 670	2 590	49.0	5 000	11 600
2LA-BNS018ADLLB	90	140	24	1.5	1	30.5	29.7	3 100	3 050	57.5	5 850	10 900
2LA-BNS019ADLLB	95	145	24	1.5	1	30.5	31.0	3 150	3 150	60.0	6 100	10 400
2LA-BNS020ADLLB	100	150	24	1.5	1	32.0	33.0	3 250	3 400	64.0	6 550	10 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

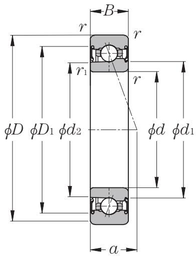
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
22.1	0.26	54.1	53.3	65.0	50.5	49.5	69.5	1	0.6	**2LA-BNS009ADLLB**
23.3	0.28	58.4	57.6	70.5	55.5	54.5	74.5	1	0.6	**2LA-BNS010ADLLB**
26.0	0.41	65.2	64.2	78.7	62	59.5	83	1	0.6	**2LA-BNS011ADLLB**
27.2	0.44	70.1	69.2	83.5	67	64.5	88	1	0.6	**2LA-BNS012ADLLB**
28.4	0.47	75.2	74.2	88.2	72	69.5	93	1	0.6	**2LA-BNS013ADLLB**
31.1	0.66	81.9	80.9	96.8	77	74.5	103	1	0.6	**2LA-BNS014ADLLB**
32.3	0.69	86.8	85.9	102.2	82	79.5	108	1	0.6	**2LA-BNS015ADLLB**
35.1	0.94	93.7	92.6	110.2	87	84.5	118	1	0.6	**2LA-BNS016ADLLB**
36.2	0.98	98.6	97.6	115.4	92	89.5	123	1	0.6	**2LA-BNS017ADLLB**
39.0	1.29	105.3	104.2	123.2	98.5	95.5	131.5	1.5	1	**2LA-BNS018ADLLB**
40.2	1.34	110.4	109.2	128.1	103.5	100.5	136.5	1.5	1	**2LA-BNS019ADLLB**
41.3	1.40	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	**2LA-BNS020ADLLB**

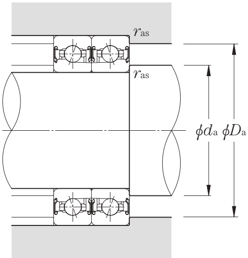
ULTAGE **Sealed high-speed angular contact ball bearings (ceramic ball type)**
5S-2LA-BNS9 LLB series

Contact angle 15° d 50～100mm

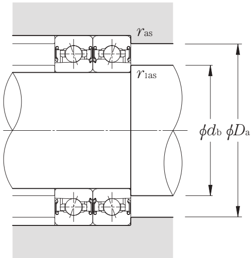


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
5S-2LA-BNS910CLLB	50	72	12	0.6	0.3	8.10	5.05	825	515	6.80	690	7.7	25 600
5S-2LA-BNS911CLLB	55	80	13	1	0.6	10.3	6.40	1 050	650	8.55	870	7.6	23 100
5S-2LA-BNS912CLLB	60	85	13	1	0.6	10.6	6.90	1 080	705	9.25	945	7.7	21 500
5S-2LA-BNS913CLLB	65	90	13	1	0.6	10.9	7.40	1 110	755	9.95	1 010	7.8	20 100
5S-2LA-BNS914CLLB	70	100	16	1	0.6	13.7	9.35	1 400	950	12.5	1 280	7.7	18 300
5S-2LA-BNS915CLLB	75	105	16	1	0.6	14.1	10.0	1 440	1 020	13.4	1 370	7.8	17 300
5S-2LA-BNS916CLLB	80	110	16	1	0.6	14.5	10.6	1 480	1 090	14.3	1 460	7.8	16 400
5S-2LA-BNS917CLLB	85	120	18	1.1	0.6	17.4	12.7	1 770	1 290	17.0	1 730	7.8	15 200
5S-2LA-BNS918CLLB	90	125	18	1.1	0.6	17.9	13.5	1 820	1 370	18.1	1 850	7.8	14 500
5S-2LA-BNS919CLLB	95	130	18	1.1	0.6	18.3	14.3	1 870	1 460	19.2	1 960	7.8	13 900
5S-2LA-BNS920CLLB	100	140	20	1.1	0.6	25.7	19.4	2 620	1 980	26.0	2 650	7.7	13 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

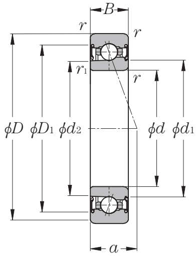
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
14.2	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**5S-2LA-BNS910CLLB**
15.6	0.18	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**5S-2LA-BNS911CLLB**
16.3	0.20	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**5S-2LA-BNS912CLLB**
16.9	0.21	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**5S-2LA-BNS913CLLB**
19.5	0.36	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**5S-2LA-BNS914CLLB**
20.1	0.37	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**5S-2LA-BNS915CLLB**
20.8	0.39	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**5S-2LA-BNS916CLLB**
22.8	0.57	96.0	95.0	108.6	92	89.5	113	1	0.6	**5S-2LA-BNS917CLLB**
23.5	0.59	100.9	100.0	113.6	97	94.5	118	1	0.6	**5S-2LA-BNS918CLLB**
24.2	0.62	105.9	105.0	118.6	102	99.5	123	1	0.6	**5S-2LA-BNS919CLLB**
26.2	0.82	111.9	110.9	127.3	107	104.5	133	1	0.6	**5S-2LA-BNS920CLLB**

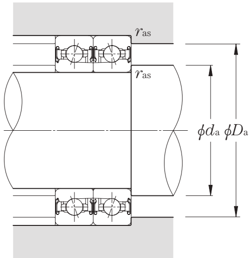
ULTAGE **Sealed high-speed angular contact ball bearings (ceramic ball type)**
5S-2LA-BNS9 LLB series

Contact angle 20° d 50～100mm

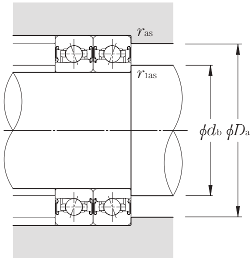


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	Static axial load capacity (kgf)	Limiting speed (min⁻¹) grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-BNS910LLB	50	72	12	0.6	0.3	7.90	4.95	805	505	7.75	790	28 200
5S-2LA-BNS911LLB	55	80	13	1	0.6	10.1	6.25	1 030	635	9.75	995	25 500
5S-2LA-BNS912LLB	60	85	13	1	0.6	10.4	6.70	1 060	685	10.5	1 080	23 700
5S-2LA-BNS913LLB	65	90	13	1	0.6	10.6	7.20	1 080	735	11.3	1 160	22 200
5S-2LA-BNS914LLB	70	100	16	1	0.6	13.4	9.10	1 360	930	14.3	1 460	20 200
5S-2LA-BNS915LLB	75	105	16	1	0.6	13.7	9.75	1 400	995	15.3	1 560	19 100
5S-2LA-BNS916LLB	80	110	16	1	0.6	14.1	10.4	1 440	1 060	16.3	1 660	18 100
5S-2LA-BNS917LLB	85	120	18	1.1	0.6	16.9	12.3	1 730	1 260	19.4	1 980	16 800
5S-2LA-BNS918LLB	90	125	18	1.1	0.6	17.4	13.1	1 770	1 340	20.6	2 100	16 000
5S-2LA-BNS919LLB	95	130	18	1.1	0.6	17.8	14.0	1 820	1 420	21.9	2 230	15 300
5S-2LA-BNS920LLB	100	140	20	1.1	0.6	25.1	18.9	2 560	1 930	29.7	3 050	14 300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

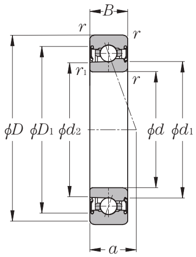
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
17.2	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**5S-2LA-BNS910LLB**
18.9	0.18	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**5S-2LA-BNS911LLB**
19.8	0.20	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**5S-2LA-BNS912LLB**
20.7	0.21	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**5S-2LA-BNS913LLB**
23.6	0.36	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**5S-2LA-BNS914LLB**
24.5	0.37	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**5S-2LA-BNS915LLB**
25.4	0.39	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**5S-2LA-BNS916LLB**
27.8	0.57	96.0	95.0	108.6	92	89.5	113	1	0.6	**5S-2LA-BNS917LLB**
28.7	0.59	100.9	100.0	113.6	97	94.5	118	1	0.6	**5S-2LA-BNS918LLB**
29.6	0.62	105.9	105.0	118.6	102	99.5	123	1	0.6	**5S-2LA-BNS919LLB**
32.0	0.82	111.9	110.9	127.3	107	104.5	133	1	0.6	**5S-2LA-BNS920LLB**

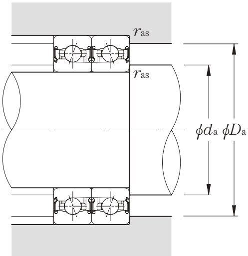
ULTAGE Sealed high-speed angular contact ball bearings (ceramic ball type 5S-2LA-BNS9 LLB series

Contact angle 25° d 50~100mm

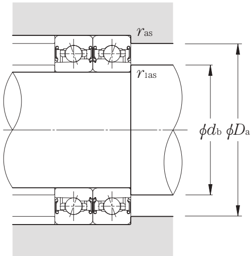


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Limiting speed min^{-1} grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-BNS910ADLLB	50	72	12	0.6	0.3	7.60	4.75	775	485	8.80	895	25 600
5S-2LA-BNS911ADLLB	55	80	13	1	0.6	9.75	6.05	990	615	11.1	1 130	23 200
5S-2LA-BNS912ADLLB	60	85	13	1	0.6	10.0	6.50	1 020	665	12.0	1 220	21 600
5S-2LA-BNS913ADLLB	65	90	13	1	0.6	10.3	7.00	1 050	715	12.9	1 310	20 200
5S-2LA-BNS914ADLLB	70	100	16	1	0.6	12.9	8.80	1 320	900	16.2	1 650	18 400
5S-2LA-BNS915ADLLB	75	105	16	1	0.6	13.3	9.45	1 350	960	17.3	1 770	17 400
5S-2LA-BNS916ADLLB	80	110	16	1	0.6	13.6	10.0	1 390	1 020	18.5	1 890	16 500
5S-2LA-BNS917ADLLB	85	120	18	1.1	0.6	16.4	11.9	1 670	1 220	22.0	2 240	15 300
5S-2LA-BNS918ADLLB	90	125	18	1.1	0.6	16.8	12.7	1 710	1 300	23.4	2 390	14 500
5S-2LA-BNS919ADLLB	95	130	18	1.1	0.6	17.2	13.5	1 760	1 380	24.8	2 530	13 900
5S-2LA-BNS920ADLLB	100	140	20	1.1	0.6	24.2	18.3	2 470	1 870	33.5	3 450	13 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

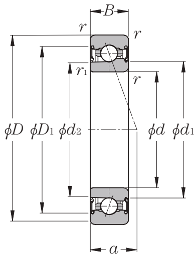
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
20.3	0.14	56.9	56.0	65.0	54.5	52.5	67.5	0.6	0.3	**5S-2LA-BNS910ADLLB**
22.3	0.18	62.6	61.7	72.1	60.5	59.5	74.5	1	0.6	**5S-2LA-BNS911ADLLB**
23.5	0.20	67.6	66.7	77.1	65.5	64.5	79.5	1	0.6	**5S-2LA-BNS912ADLLB**
24.7	0.21	72.6	71.7	82.1	70.5	69.5	84.5	1	0.6	**5S-2LA-BNS913ADLLB**
27.9	0.36	79.2	78.3	90.2	75.5	74.5	94.5	1	0.6	**5S-2LA-BNS914ADLLB**
29.1	0.37	84.2	83.3	95.2	80.5	79.5	99.5	1	0.6	**5S-2LA-BNS915ADLLB**
30.3	0.39	89.2	88.3	100.2	85.5	84.5	104.5	1	0.6	**5S-2LA-BNS916ADLLB**
33.0	0.57	96.0	95.0	108.6	92	89.5	113	1	0.6	**5S-2LA-BNS917ADLLB**
34.2	0.59	100.9	100.0	113.6	97	94.5	118	1	0.6	**5S-2LA-BNS918ADLLB**
35.4	0.62	105.9	105.0	118.6	102	99.5	123	1	0.6	**5S-2LA-BNS919ADLLB**
38.1	0.82	111.9	110.9	127.3	107	104.5	133	1	0.6	**5S-2LA-BNS920ADLLB**

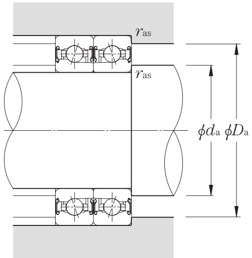
ULTAGE Sealed high-speed angular contact ball bearings (ceramic ball type) 5S-2LA-BNS0 LLB series

Contact angle 15° d 45～100mm

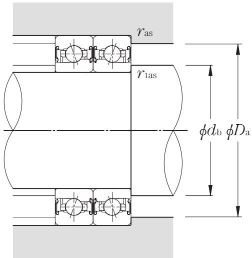


Part number	Boundary dimensions mm					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o	
5S-2LA-BNS009CLLB	45	75	16	1	0.6	11.8	6.20	1 210	645	8.45	860	7.4	26 000
5S-2LA-BNS010CLLB	50	80	16	1	0.6	14.7	7.50	1 500	815	10.6	1 080	7.4	24 000
5S-2LA-BNS011CLLB	55	90	18	1.1	0.6	17.3	9.40	1 760	960	12.5	1 280	7.4	21 500
5S-2LA-BNS012CLLB	60	95	18	1.1	0.6	18.1	10.4	1 850	1 060	13.9	1 420	7.4	20 100
5S-2LA-BNS013CLLB	65	100	18	1.1	0.6	18.4	10.9	1 870	1 120	14.6	1 490	7.5	18 900
5S-2LA-BNS014CLLB	70	110	20	1.1	0.6	22.4	13.8	2 290	1 410	18.4	1 880	7.5	17 300
5S-2LA-BNS015CLLB	75	115	20	1.1	0.6	23.9	15.5	2 440	1 590	20.8	2 120	7.5	16 400
5S-2LA-BNS016CLLB	80	125	22	1.1	0.6	27.4	17.8	2 790	1 820	23.8	2 430	7.5	15 200
5S-2LA-BNS017CLLB	85	130	22	1.1	0.6	27.7	18.6	2 830	1 900	24.9	2 540	7.6	14 500
5S-2LA-BNS018CLLB	90	140	24	1.5	1	32.0	21.8	3 300	2 220	29.2	2 970	7.6	13 600
5S-2LA-BNS019CLLB	95	145	24	1.5	1	32.5	22.7	3 300	2 310	30.5	3 100	7.6	13 000
5S-2LA-BNS020CLLB	100	150	24	1.5	1	33.5	24.4	3 450	2 480	32.5	3 350	7.6	12 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

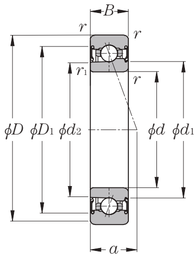
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
16.1	0.25	54.1	53.3	65.0	50.5	49.5	69.5	1	0.6	**5S-2LA-BNS009CLLB**
16.8	0.26	58.4	57.5	70.5	55.5	54.5	74.5	1	0.6	**5S-2LA-BNS010CLLB**
18.8	0.38	65.2	64.1	78.7	62	59.5	83	1	0.6	**5S-2LA-BNS011CLLB**
19.5	0.41	70.1	69.1	83.5	67	64.5	88	1	0.6	**5S-2LA-BNS012CLLB**
20.1	0.44	75.2	74.2	88.2	72	69.5	93	1	0.6	**5S-2LA-BNS013CLLB**
22.2	0.62	81.9	80.8	96.8	77	74.5	103	1	0.6	**5S-2LA-BNS014CLLB**
22.8	0.65	86.8	85.8	102.2	82	79.5	108	1	0.6	**5S-2LA-BNS015CLLB**
24.8	0.88	93.7	92.5	110.2	87	84.5	118	1	0.6	**5S-2LA-BNS016CLLB**
25.5	0.93	98.6	97.5	115.4	92	89.5	123	1	0.6	**5S-2LA-BNS017CLLB**
27.5	1.22	105.3	104.1	123.2	98.5	95.5	131.5	1.5	1	**5S-2LA-BNS018CLLB**
28.2	1.27	110.4	109.1	128.1	103.5	100.5	136.5	1.5	1	**5S-2LA-BNS019CLLB**
28.9	1.32	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	**5S-2LA-BNS020CLLB**

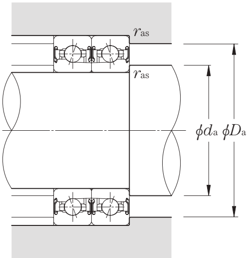
ULTAGE Sealed high-speed angular contact ball bearings (ceramic ball type) 5S-2LA-BNS0 LLB series

Contact angle 20° d 45～100mm

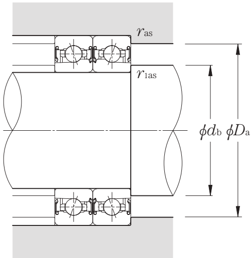


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-BNS009LLB	45	75	16	1	0.6	11.5	6.2	1 180	630	9.70	985	28 700
5S-2LA-BNS010LLB	50	80	16	1	0.6	14.4	7.8	1 470	795	12.2	1 240	26 500
5S-2LA-BNS011LLB	55	90	18	1.1	0.6	16.8	9.2	1 720	935	14.4	1 460	23 700
5S-2LA-BNS012LLB	60	95	18	1.1	0.6	17.6	10.2	1 800	1 040	15.9	1 620	22 200
5S-2LA-BNS013LLB	65	100	18	1.1	0.6	17.9	10.7	1 830	1 090	16.7	1 710	20 800
5S-2LA-BNS014LLB	70	110	20	1.1	0.6	21.9	13.5	2 230	1 370	21.1	2 150	19 100
5S-2LA-BNS015LLB	75	115	20	1.1	0.6	23.3	15.2	2 380	1 550	23.8	2 420	18 100
5S-2LA-BNS016LLB	80	125	22	1.1	0.6	26.7	17.4	2 720	1 770	27.2	2 780	16 800
5S-2LA-BNS017LLB	85	130	22	1.1	0.6	27.0	18.1	2 760	1 850	28.4	2 900	16 000
5S-2LA-BNS018LLB	90	140	24	1.5	1	31.5	21.3	3 200	2 170	33.5	3 400	15 000
5S-2LA-BNS019LLB	95	145	24	1.5	1	31.5	22.1	3 250	2 260	34.5	3 550	14 300
5S-2LA-BNS020LLB	100	150	24	1.5	1	33.0	23.8	3 350	2 420	37.5	3 800	13 800

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.57	1	0	0.43	1	1	1.09	0.7	1.63

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

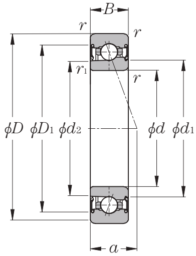
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.42	1	0.84

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
19.0	0.25	54.1	53.3	65.0	50.5	49.5	69.5	1	0.6	**5S-2LA-BNS009LLB**
19.9	0.26	58.4	57.5	70.5	55.5	54.5	74.5	1	0.6	**5S-2LA-BNS010LLB**
22.3	0.38	65.2	64.2	78.7	62	59.5	83	1	0.6	**5S-2LA-BNS011LLB**
23.2	0.41	70.1	69.2	83.5	67	64.5	88	1	0.6	**5S-2LA-BNS012LLB**
24.1	0.44	75.2	74.2	88.2	72	69.5	93	1	0.6	**5S-2LA-BNS013LLB**
26.5	0.62	81.9	80.8	96.8	77	74.5	103	1	0.6	**5S-2LA-BNS014LLB**
27.4	0.65	86.8	85.8	102.2	82	79.5	108	1	0.6	**5S-2LA-BNS015LLB**
29.8	0.88	93.7	92.5	110.2	87	84.5	118	1	0.6	**5S-2LA-BNS016LLB**
30.7	0.93	98.6	97.5	115.4	92	89.5	123	1	0.6	**5S-2LA-BNS017LLB**
33.1	1.22	105.3	104.2	123.2	98.5	95.5	131.5	1.5	1	**5S-2LA-BNS018LLB**
34.0	1.27	110.4	109.2	128.1	103.5	100.5	136.5	1.5	1	**5S-2LA-BNS019LLB**
34.9	1.32	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	**5S-2LA-BNS020LLB**

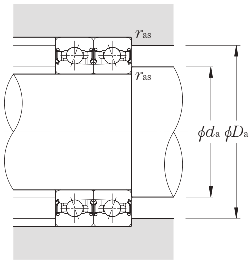
ULTAGE Sealed high-speed angular contact ball bearings (ceramic ball type) 5S-2LA-BNS0 LLB series

Contact angle 25° d 45～100mm

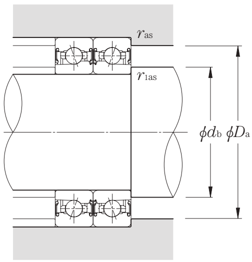


Part number	Boundary dimensions (mm)					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static axial load capacity (kN)	(kgf)	Limiting speed min⁻¹ grease lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			
5S-2LA-BNS009ADLLB	45	75	16	1	0.6	11.2	6.00	1 140	610	11.0	1 120	26 100
5S-2LA-BNS010ADLLB	50	80	16	1	0.6	13.9	7.55	1 420	770	13.9	1 410	24 100
5S-2LA-BNS011ADLLB	55	90	18	1.1	0.6	16.3	8.90	1 660	910	16.4	1 670	21 600
5S-2LA-BNS012ADLLB	60	95	18	1.1	0.6	17.1	9.85	1 740	1 000	18.1	1 840	20 200
5S-2LA-BNS013ADLLB	65	100	18	1.1	0.6	17.3	10.4	1 770	1 060	19.0	1 940	19 000
5S-2LA-BNS014ADLLB	70	110	20	1.1	0.6	21.2	13.0	2 160	1 330	24.0	2 440	17 400
5S-2LA-BNS015ADLLB	75	115	20	1.1	0.6	22.5	14.7	2 300	1 500	27.0	2 760	16 500
5S-2LA-BNS016ADLLB	80	125	22	1.1	0.6	25.8	16.9	2 630	1 720	31.0	3 150	15 300
5S-2LA-BNS017ADLLB	85	130	22	1.1	0.6	26.1	17.6	2 670	1 790	32.5	3 300	14 500
5S-2LA-BNS018ADLLB	90	140	24	1.5	1	30.5	20.6	3 100	2 100	38.0	3 850	13 600
5S-2LA-BNS019ADLLB	95	145	24	1.5	1	30.5	21.4	3 150	2 190	39.5	4 000	13 000
5S-2LA-BNS020ADLLB	100	150	24	1.5	1	32.0	23.0	3 250	2 350	42.5	4 300	12 500

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load $P_r = XF_r + YF_a$

e	Single row / Tandem				Back-to-back / Face-to-face			
	$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y	X	Y	X	Y
0.68	1	0	0.41	0.87	1	0.92	0.67	1.41

Static equivalent radial load $P_{or} = X_o F_r + Y_o F_a$

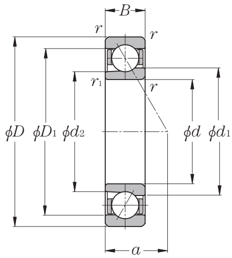
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.5	0.38	1	0.76

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
22.1	0.25	54.1	53.3	65	50.5	49.5	69.5	1	0.6	5S-2LA-BNS009ADLLB
23.3	0.26	58.4	57.6	70.5	55.5	54.5	74.5	1	0.6	5S-2LA-BNS010ADLLB
26.0	0.38	65.2	64.2	78.7	62	59.5	83	1	0.6	5S-2LA-BNS011ADLLB
27.2	0.41	70.1	69.2	83.5	67	64.5	88	1	0.6	5S-2LA-BNS012ADLLB
28.4	0.44	75.2	74.2	88.2	72	69.5	93	1	0.6	5S-2LA-BNS013ADLLB
31.1	0.62	81.9	80.9	96.8	77	74.5	103	1	0.6	5S-2LA-BNS014ADLLB
32.3	0.65	86.8	85.9	102.2	82	79.5	108	1	0.6	5S-2LA-BNS015ADLLB
35.1	0.88	93.7	92.6	110.2	87	84.5	118	1	0.6	5S-2LA-BNS016ADLLB
36.2	0.93	98.6	97.6	115.4	92	89.5	123	1	0.6	5S-2LA-BNS017ADLLB
39.0	1.22	105.3	104.2	123.2	98.5	95.5	131.5	1.5	1	5S-2LA-BNS018ADLLB
40.2	1.27	110.4	109.2	128.1	103.5	100.5	136.5	1.5	1	5S-2LA-BNS019ADLLB
41.3	1.32	115.4	114.2	132.7	108.5	105.5	141.5	1.5	1	5S-2LA-BNS020ADLLB

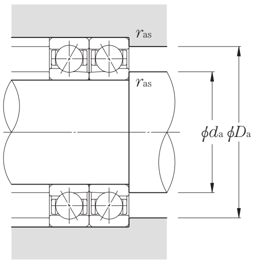
Angular contact ball bearings for motors and lathes (steel ball type) BNT9 series

Contact angle 15° d 10～65mm

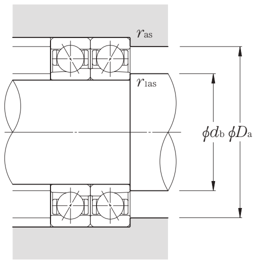


Part number	Boundary dimensions (mm)					Basic load ratings				Static axial load capacity		Factor	Limiting speed (min⁻¹)	
						dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	kN	kgf		grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}			f_0		
BNT900	10	22	6	0.3	0.15	2.30	1.00	235	101	1.43	146	9.3	62 200	125 600
BNT901	12	24	6	0.3	0.15	2.57	1.22	262	124	1.76	180	9.6	55 300	111 700
BNT902	15	28	7	0.3	0.15	3.70	1.75	375	179	2.54	259	9.5	46 300	93 500
BNT903	17	30	7	0.3	0.15	3.90	1.95	395	199	2.82	288	9.7	42 300	85 500
BNT904	20	37	9	0.3	0.15	5.60	2.99	570	305	4.35	440	9.7	34 900	70 500
BNT905	25	42	9	0.3	0.15	6.00	3.55	610	360	5.15	525	10.1	29 700	60 000
BNT906	30	47	9	0.3	0.15	6.35	4.10	650	420	6.00	610	10.4	25 800	52 200
BNT907	35	55	10	0.6	0.3	10.1	6.30	1 030	645	9.20	940	10.1	21 000	42 400
BNT908	40	62	12	0.6	0.3	10.7	7.30	1 090	740	10.6	1 080	10.4	18 500	37 500
BNT909	45	68	12	0.6	0.3	13.2	9.20	1 350	935	13.4	1 370	10.4	16 700	33 800
BNT910	50	72	12	0.6	0.3	14.0	10.3	1 430	1 060	15.1	1 540	10.5	15 500	31 300
BNT911	55	80	13	1	0.6	14.6	11.6	1 490	1 180	17.0	1 730	10.7	13 800	27 600
BNT912	60	85	13	1	0.6	15.3	12.8	1 560	1 300	18.7	1 910	10.8	12 800	25 700
BNT913	65	90	13	1	0.6	15.5	13.4	1 580	1 370	19.7	2 010	10.9	12 000	24 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

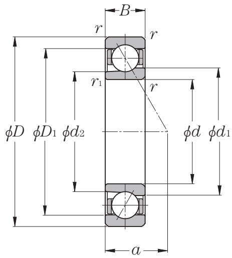
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
5.2	0.3	0.010	14.0	12.7	18.0	12.2	11.2	20	0.3	0.15	**BNT900**
5.4	0.4	0.011	16.0	14.7	20.0	14.2	13.2	22	0.3	0.15	**BNT901**
6.4	0.6	0.016	19.0	17.4	24.0	17.2	16.2	26	0.3	0.15	**BNT902**
6.7	0.8	0.017	21.0	19.4	26.0	19.2	18.2	28	0.3	0.15	**BNT903**
8.4	1.4	0.037	25.5	23.5	31.4	22.5	21.5	34.5	0.3	0.15	**BNT904**
9.0	1.7	0.043	30.5	28.5	36.5	27.5	26.5	39.5	0.3	0.15	**BNT905**
9.7	1.9	0.049	35.5	33.5	41.5	32.5	31.5	44.5	0.3	0.15	**BNT906**
11.1	2.8	0.073	41.2	38.5	48.8	39.5	37.5	50.5	0.6	0.3	**BNT907**
12.9	4.5	0.11	47.0	44.4	55.0	44.5	42.5	57.5	0.6	0.3	**BNT908**
13.6	5.2	0.13	52.1	49.1	60.9	49.5	48	63.5	0.6	0.3	**BNT909**
14.2	6.2	0.13	56.6	53.6	65.4	54.5	52.5	67.5	0.6	0.3	**BNT910**
15.6	7.8	0.18	63.2	60.1	71.8	60.5	59.5	74.5	1	0.6	**BNT911**
16.3	8.3	0.20	68.1	65.1	76.9	65.5	64.5	79.5	1	0.6	**BNT912**
17.0	8.9	0.21	73.1	70.1	81.9	70.5	69.5	84.5	1	0.6	**BNT913**

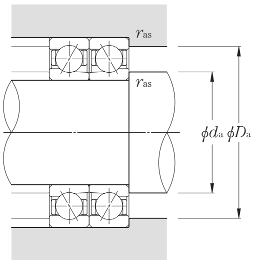
Angular contact ball bearings for motors and lathes (steel ball type) BNT0 series

Contact angle 15° d 10～70mm

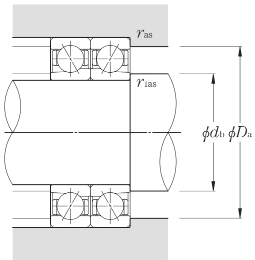


Part number	Boundary dimensions mm					Basic load ratings dynamic	static	dynamic	static	Static axial load capacity		Factor	Limiting speed min⁻¹	
						kN		kgf		kN	kgf		grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
BNT000	10	26	8	0.3	0.15	3.75	1.45	385	148	2.07	211	8.3	60 300	120 100
BNT001	12	28	8	0.3	0.15	4.15	1.73	420	176	2.48	253	8.8	52 700	104 900
BNT002	15	32	9	0.3	0.15	4.75	2.22	485	226	3.20	325	9.2	46 000	91 500
BNT003	17	35	10	0.3	0.15	5.90	2.70	600	275	3.90	395	9.0	41 500	82 700
BNT004	20	42	12	0.6	0.3	8.00	3.95	815	405	5.70	580	9.2	34 300	68 300
BNT005	25	47	12	0.6	0.3	8.95	4.85	910	495	7.05	720	9.6	30 000	59 700
BNT006	30	55	13	1	0.6	11.6	6.75	1 180	685	9.75	995	9.8	25 100	50 000
BNT007	35	62	14	1	0.6	14.6	8.95	1 490	910	13.0	1 320	9.8	20 100	40 200
BNT008	40	68	15	1	0.6	15.7	10.4	1 600	1 060	15.1	1 540	10.0	18 100	36 100
BNT009	45	75	16	1	0.6	18.6	12.6	1 900	1 290	18.4	1 870	10.1	16 300	32 500
BNT010	50	80	16	1	0.6	19.9	14.3	2 030	1 460	20.9	2 130	10.2	15 000	30 000
BNT011	55	90	18	1.1	0.6	26.1	18.7	2 660	1 910	27.3	2 780	10.1	13 200	26 400
BNT012	60	95	18	1.1	0.6	26.8	20.0	2 730	2 040	29.2	2 980	10.3	12 300	24 700
BNT013	65	100	18	1.1	0.6	28.4	22.4	2 890	2 290	32.5	3 350	10.4	11 600	23 200
BNT014	70	110	20	1.1	0.6	36.0	28.1	3 650	2 870	41.0	4 200	10.3	10 600	21 300

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35	1	0	0.44	1.57	1	1.76	0.72	2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41				1.38		1.55		2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

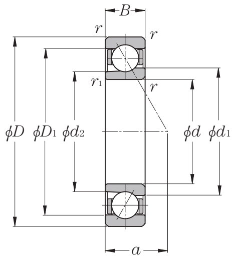
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
6.5	0.9	0.015	14.6	13.0	21.0	12.5	11.2	23.5	0.3	0.15	**BNT000**
6.8	1.0	0.020	17.4	15.6	23.5	14.5	13.2	25.5	0.3	0.15	**BNT001**
7.7	1.3	0.029	20.4	18.5	26.5	17.5	16.2	29.5	0.3	0.15	**BNT002**
8.5	1.8	0.033	22.2	20.2	29.6	19.5	18.2	32.5	0.3	0.15	**BNT003**
10.3	3.0	0.057	27.4	24.9	35.5	24.5	22.5	37.5	0.6	0.3	**BNT004**
10.9	3.5	0.067	31.8	29.4	40.6	29.5	27.5	42.5	0.6	0.3	**BNT005**
12.3	4.3	0.11	38.4	35.5	47.8	35.5	34.5	49.5	1	0.6	**BNT006**
13.6	6.5	0.15	43.4	40.2	53.8	40.5	39.5	56.5	1	0.6	**BNT007**
14.8	8.0	0.18	48.8	45.7	59.4	45.5	44.5	62.5	1	0.6	**BNT008**
16.1	9.6	0.23	54.2	50.9	65.6	50.5	49.5	69.5	1	0.6	**BNT009**
16.8	11	0.26	59.6	55.9	70.2	55.5	54.5	74.5	1	0.6	**BNT010**
18.8	16	0.38	66.1	61.8	79.1	62	59.5	83	1	0.6	**BNT011**
19.5	19	0.40	71.1	66.8	84.1	67	64.5	88	1	0.6	**BNT012**
20.2	20	0.42	75.2	71.8	89.8	72	69.5	93	1	0.6	**BNT013**
22.2	27	0.56	82.3	77.7	97.9	77	74.5	103	1	0.6	**BNT014**

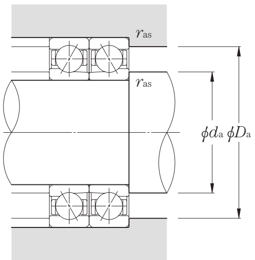
Angular contact ball bearings for motors and lathes (steel ball type) BNT2 series

Contact angle 15° d 10～80mm

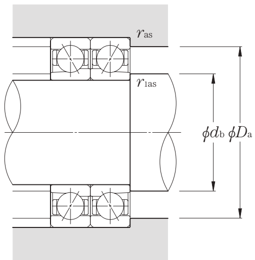


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
BNT200	10	30	9	0.6	0.3	4.15	1.71	420	175	2.46	250	8.7	53 300	106 800
BNT201	12	32	10	0.6	0.3	5.40	2.28	550	232	3.25	330	8.5	48 400	97 000
BNT202	15	35	11	0.6	0.3	6.85	2.97	700	300	4.25	430	8.5	42 600	85 400
BNT203	17	40	12	0.6	0.3	8.55	3.80	870	385	5.40	555	8.5	37 000	74 100
BNT204	20	47	14	1	0.6	11.2	5.35	1 140	545	7.70	785	8.8	30 900	61 900
BNT205	25	52	15	1	0.6	12.7	6.70	1 290	685	9.70	990	9.2	27 300	54 700
BNT206	30	62	16	1	0.6	17.6	9.60	1 800	980	13.9	1 420	9.2	22 900	45 900
BNT207	35	72	17	1.1	0.6	23.2	13.1	2 370	1 330	18.8	1 920	9.1	18 100	36 000
BNT208	40	80	18	1.1	0.6	27.8	16.5	2 830	1 680	23.8	2 430	9.3	16 200	32 100
BNT209	45	85	19	1.1	0.6	31.0	18.9	3 200	1 920	27.3	2 780	9.3	14 900	29 600
BNT210	50	90	20	1.1	0.6	32.5	20.8	3 350	2 120	30.0	3 050	9.5	13 900	27 500
BNT211	55	100	21	1.5	1	40.5	26.2	4 150	2 670	38.0	3 850	9.5	12 300	24 400
BNT212	60	110	22	1.5	1	49.0	32.5	5 000	3 300	47.0	4 800	9.5	11 000	21 800
BNT213	65	120	23	1.5	1	53.5	36.0	5 450	3 650	52.0	5 300	9.5	10 300	20 400
BNT214	70	125	24	1.5	1	58.0	39.5	5 900	4 000	57.0	5 800	9.6	9 700	19 400
BNT215	75	130	25	1.5	1	60.5	43.0	6 200	4 400	62.5	6 350	9.7	9 200	18 300
BNT216	80	140	26	2	1	71.0	50.5	7 250	5 150	73.5	7 500	9.7	8 600	17 200

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

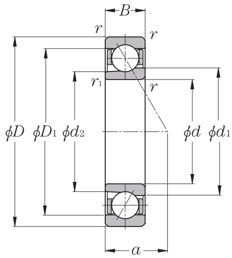
Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a			d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
7.2	1.1	0.019	17.0	15.0	23.0	14.5	12.5	25.5	0.6	0.3	**BNT200**
8.0	1.5	0.025	18.4	16.2	26.0	16.5	14.5	27.5	0.6	0.3	**BNT201**
8.9	2.2	0.035	20.8	18.4	29.4	19.5	17.5	30.5	0.6	0.3	**BNT202**
9.9	2.9	0.054	24.2	21.4	33.6	21.5	19.5	35.5	0.6	0.3	**BNT203**
11.7	4.6	0.092	29.4	26.2	39.4	25.5	24.5	41.5	1	0.6	**BNT204**
12.8	6.1	0.13	33.8	30.7	44.2	30.5	29.5	46.5	1	0.6	**BNT205**
14.3	8.3	0.20	40.6	36.6	52.6	35.5	34.5	56.5	1	0.6	**BNT206**
15.8	10	0.29	46.8	42.0	60.6	42	39.5	65	1	0.6	**BNT207**
17.2	13	0.38	53.0	47.7	67.0	47	44.5	73	1	0.6	**BNT208**
18.3	16	0.44	57.3	51.9	73.0	52	49.5	78	1	0.6	**BNT209**
19.5	20	0.46	62.2	56.8	78.0	57	54.5	83	1	0.6	**BNT210**
21.0	25	0.61	69.0	62.8	86.4	63.5	60.5	91.5	1.5	1	**BNT211**
22.8	32	0.78	77.0	70.2	96.4	68.5	65.5	101.5	1.5	1	**BNT212**
24.1	37	1.01	82.5	75.3	102.5	73.5	70.5	111.5	1.5	1	**BNT213**
25.2	47	1.08	87.0	79.5	108.0	78.5	75.5	116.5	1.5	1	**BNT214**
26.6	54	1.17	93.0	85.5	114.5	83.5	80.5	121.5	1.5	1	**BNT215**
27.9	58	1.45	98.1	90.4	122.0	90	85.5	130	2	1	**BNT216**

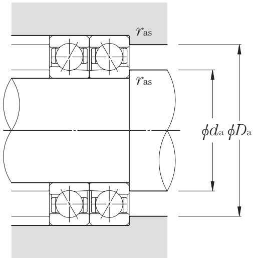
Angular contact ball bearings for motors and lathes (ceramic ball type) 5S-BNT9 series

Contact angle 15° d 10～65mm

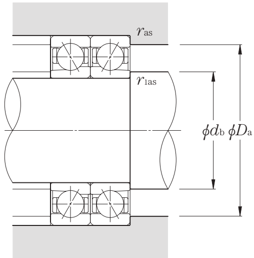


Part number	Boundary dimensions mm					Basic load ratings dynamic static (kN)		dynamic static (kgf)		Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}			f_0		
5S-BNT900	10	22	6	0.3	0.15	2.30	0.69	235	70	0.905	92	6.4	72 500	145 600
5S-BNT901	12	24	6	0.3	0.15	2.57	0.84	262	86	1.11	113	6.7	64 400	129 400
5S-BNT902	15	28	7	0.3	0.15	3.70	1.22	375	124	1.60	163	6.6	54 000	108 400
5S-BNT903	17	30	7	0.3	0.15	3.90	1.35	395	138	1.78	182	6.7	49 400	99 100
5S-BNT904	20	37	9	0.3	0.15	5.60	2.07	570	211	2.74	279	6.8	40 700	81 800
5S-BNT905	25	42	9	0.3	0.15	6.00	2.46	610	251	3.25	330	7.0	34 600	69 600
5S-BNT906	30	47	9	0.3	0.15	6.35	2.84	650	290	3.80	385	7.2	30 100	60 500
5S-BNT907	35	55	10	0.6	0.3	10.1	4.40	1 030	445	5.80	590	7.0	24 400	49 300
5S-BNT908	40	62	12	0.6	0.3	10.7	5.05	1 090	515	6.70	685	7.2	21 600	43 500
5S-BNT909	45	68	12	0.6	0.3	13.2	6.35	1 350	650	8.45	865	7.2	19 500	39 300
5S-BNT910	50	72	12	0.6	0.3	14.0	7.15	1 430	730	9.55	975	7.3	18 000	36 400
5S-BNT911	55	80	13	1	0.6	14.6	8.00	1 490	820	10.7	1 090	7.4	16 000	32 000
5S-BNT912	60	85	13	1	0.6	15.3	8.85	1 560	900	11.8	1 200	7.5	14 900	29 800
5S-BNT913	65	90	13	1	0.6	15.5	9.30	1 580	945	12.4	1 270	7.5	13 900	27 900

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_o F_r + Y_o F_a$

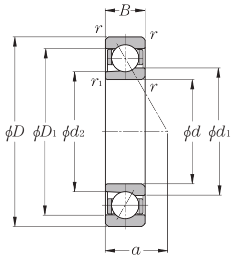
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a			d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
5.2	0.3	0.009	14.0	12.7	18.0	12.2	11.2	20	0.3	0.15	**5S-BNT900**
5.4	0.4	0.010	16.0	14.7	20.0	14.2	13.2	22	0.3	0.15	**5S-BNT901**
6.4	0.6	0.014	19.0	17.4	24.0	17.2	16.2	26	0.3	0.15	**5S-BNT902**
6.7	0.8	0.015	21.0	19.4	26.0	19.2	18.2	28	0.3	0.15	**5S-BNT903**
8.4	1.4	0.033	25.5	23.5	31.4	22.5	21.5	34.5	0.3	0.15	**5S-BNT904**
9.0	1.7	0.039	30.5	28.5	36.5	27.5	26.5	39.5	0.3	0.15	**5S-BNT905**
9.7	1.9	0.044	35.5	33.5	41.5	32.5	31.5	44.5	0.3	0.15	**5S-BNT906**
11.1	2.8	0.063	41.2	38.5	48.8	39.5	37.5	50.5	0.6	0.3	**5S-BNT907**
12.9	4.5	0.100	47.0	44.4	55.0	44.5	42.5	57.5	0.6	0.3	**5S-BNT908**
13.6	5.2	0.110	52.1	49.1	60.9	49.5	48	63.5	0.6	0.3	**5S-BNT909**
14.2	6.2	0.110	56.6	53.6	65.4	54.5	52.5	67.5	0.6	0.3	**5S-BNT910**
15.6	7.8	0.160	63.2	60.1	71.8	60.5	59.5	74.5	1	0.6	**5S-BNT911**
16.3	8.3	0.170	68.1	65.1	76.9	65.5	64.5	79.5	1	0.6	**5S-BNT912**
17.0	8.9	0.190	73.1	70.1	81.9	70.5	69.5	84.5	1	0.6	**5S-BNT913**

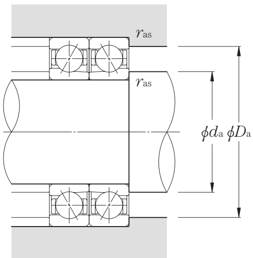
Angular contact ball bearings for motors and lathes (ceramic ball type) 5S-BNT0 series

Contact angle 15° d 10～70mm

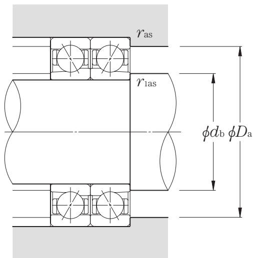


Part number	Boundary dimensions mm					Basic load ratings dynamic static kN		dynamic static kgf		Static axial load capacity kN	kgf	Factor	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}			f_0		
5S-BNT000	10	26	8	0.3	0.15	3.75	1.01	385	103	1.31	133	5.7	70 100	140 200
5S-BNT001	12	28	8	0.3	0.15	4.15	1.20	420	122	1.57	160	6.1	61 200	122 400
5S-BNT002	15	32	9	0.3	0.15	4.75	1.54	485	157	2.02	206	6.4	53 400	106 800
5S-BNT003	17	35	10	0.3	0.15	5.90	1.87	600	191	2.45	250	6.3	48 300	96 500
5S-BNT004	20	42	12	0.6	0.3	8.00	2.74	815	279	3.60	365	6.4	39 800	79 700
5S-BNT005	25	47	12	0.6	0.3	8.95	3.35	910	345	4.45	455	6.7	34 900	69 700
5S-BNT006	30	55	13	1	0.6	11.6	4.65	1 180	475	6.15	630	6.8	29 200	58 400
5S-BNT007	35	62	14	1	0.6	14.6	6.20	1 490	630	8.20	835	6.8	23 500	46 900
5S-BNT008	40	68	15	1	0.6	15.7	7.20	1 600	735	9.55	975	7.0	21 100	42 100
5S-BNT009	45	75	16	1	0.6	18.6	8.75	1 900	890	11.6	1 180	7.0	19 000	37 900
5S-BNT010	50	80	16	1	0.6	19.9	9.90	2 030	1 010	13.2	1 340	7.1	17 500	35 000
5S-BNT011	55	90	18	1.1	0.6	26.1	13.0	2 660	1 320	17.2	1 760	7.0	15 500	31 000
5S-BNT012	60	95	18	1.1	0.6	26.8	13.9	2 730	1 420	18.4	1 880	7.1	14 500	29 000
5S-BNT013	65	100	18	1.1	0.6	28.4	15.5	2 890	1 580	20.7	2 110	7.2	13 600	27 300
5S-BNT014	70	110	20	1.1	0.6	36.0	19.5	3 650	1 990	25.9	2 640	7.1	12 500	25 000

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35	1	0	0.44	1.57	1	1.76	0.72	2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41				1.38		1.55		2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load
$P_{or} = X_o F_r + Y_o F_a$

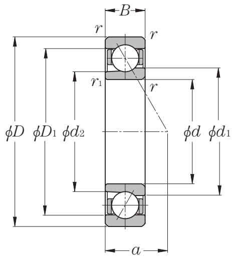
Single row / Tandem		Back-to-back / Face-to-face	
X_o	Y_o	X_o	Y_o
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm a	Internal free space cm³ Single-row (approx.)	Mass kg Single-row (approx.)	Reference dimensions mm d_1	d_2	D_1	Abutment and fillet dimensions mm d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	Part number
6.5	0.9	0.013	14.6	13.0	21.0	12.5	11.2	23.5	0.3	0.15	**5S-BNT000**
6.8	1.0	0.018	17.4	15.6	23.5	14.5	13.2	25.5	0.3	0.15	**5S-BNT001**
7.7	1.3	0.026	20.4	18.5	26.5	17.5	16.2	29.5	0.3	0.15	**5S-BNT002**
8.5	1.8	0.029	22.2	20.2	29.6	19.5	18.2	32.5	0.3	0.15	**5S-BNT003**
10.3	3.0	0.050	27.4	24.9	35.5	24.5	22.5	37.5	0.6	0.3	**5S-BNT004**
10.9	3.5	0.060	31.8	29.4	40.6	29.5	27.5	42.5	0.6	0.3	**5S-BNT005**
12.3	4.3	0.10	38.4	35.5	47.8	35.5	34.5	49.5	1	0.6	**5S-BNT006**
13.6	6.5	0.13	43.4	40.2	53.8	40.5	39.5	56.5	1	0.6	**5S-BNT007**
14.8	8.0	0.16	48.8	45.7	59.4	45.5	44.5	62.5	1	0.6	**5S-BNT008**
16.1	9.6	0.21	54.2	50.9	65.6	50.5	49.5	69.5	1	0.6	**5S-BNT009**
16.8	11	0.24	59.6	55.9	70.2	55.5	54.5	74.5	1	0.6	**5S-BNT010**
18.8	16	0.35	66.1	61.8	79.1	62	59.5	83	1	0.6	**5S-BNT011**
19.5	19	0.36	71.1	66.8	84.1	67	64.5	88	1	0.6	**5S-BNT012**
20.2	20	0.37	75.2	71.8	89.8	72	69.5	93	1	0.6	**5S-BNT013**
22.2	27	0.50	82.3	77.7	97.9	77	74.5	103	1	0.6	**5S-BNT014**

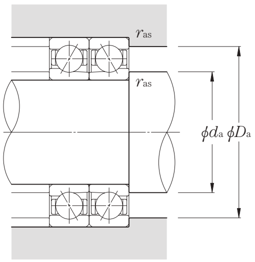
Angular contact ball bearings for motors and lathes (ceramic ball type) 5S-BNT2 series

Contact angle 15° d 10～80mm

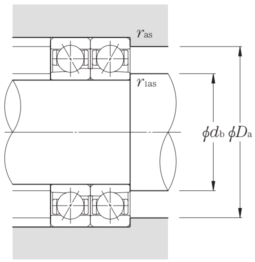


Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static axial load capacity kN	kgf	Factor	Limiting speed min^{-1} grease lubrication	oil lubrication
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}			f_o		
5S-BNT200	10	30	9	0.6	0.3	4.15	1.19	420	121	1.55	158	6.0	63 000	126 000
5S-BNT201	12	32	10	0.6	0.3	5.40	1.58	550	161	2.05	209	5.9	57 300	114 500
5S-BNT202	15	35	11	0.6	0.3	6.85	2.05	700	210	2.67	272	5.9	50 400	100 800
5S-BNT203	17	40	12	0.6	0.3	8.55	2.63	870	268	3.40	350	5.9	43 800	87 500
5S-BNT204	20	47	14	1	0.6	11.2	3.70	1 140	380	4.85	495	6.1	36 500	73 000
5S-BNT205	25	52	15	1	0.6	12.7	4.65	1 290	475	6.10	625	6.4	32 300	64 600
5S-BNT206	30	62	16	1	0.6	17.6	6.70	1 800	680	8.80	895	6.4	27 100	54 200
5S-BNT207	35	72	17	1.1	0.6	23.2	9.05	2 370	925	11.9	1 210	6.3	21 300	42 500
5S-BNT208	40	80	18	1.1	0.6	27.8	11.4	2 830	1 170	15.0	1 530	6.4	19 000	37 900
5S-BNT209	45	85	19	1.1	0.6	31.0	13.1	3 200	1 330	17.2	1 750	6.5	17 500	35 000
5S-BNT210	50	90	20	1.1	0.6	32.5	14.4	3 350	1 470	19.0	1 940	6.6	16 300	32 500
5S-BNT211	55	100	21	1.5	1	40.5	18.1	4 150	1 850	23.9	2 440	6.6	14 500	28 900
5S-BNT212	60	110	22	1.5	1	49.0	22.4	5 000	2 290	29.5	3 000	6.6	12 900	25 900
5S-BNT213	65	120	23	1.5	1	53.5	24.9	5 450	2 530	33.0	3 350	6.6	12 100	24 200
5S-BNT214	70	125	24	1.5	1	58.0	27.3	5 900	2 790	36.0	3 650	6.6	11 500	23 000
5S-BNT215	75	130	25	1.5	1	60.5	29.8	6 200	3 050	39.5	4 000	6.7	10 800	21 600
5S-BNT216	80	140	26	2	1	71.0	35.0	7 250	3 600	46.5	4 750	6.7	10 200	20 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Back-to-back
(DB)



Face-to-face
(DF)

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{i \cdot f_0 \cdot F_a}{C_{or}}$	e	Single row / Tandem				Back-to-back / Face-to-face			
		$F_a/F_r \leqq e$		$F_a/F_r > e$		$F_a/F_r \leqq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
0.178	0.35				1.57		1.76		2.56
0.357	0.36				1.53		1.71		2.48
0.714	0.38				1.46		1.64		2.38
1.07	0.4				1.42		1.59		2.31
1.43	0.41	1	0	0.44	1.38	1	1.55	0.72	2.25
2.14	0.43				1.33		1.49		2.16
3.57	0.44				1.25		1.4		2.03
5.35	0.47				1.18		1.32		1.92
7.14	0.49				1.13		1.26		1.83

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

Single row / Tandem		Back-to-back / Face-to-face	
X_0	Y_0	X_0	Y_0
0.52	0.54	1.04	1.08

When $P_{or} < F_r$ with single-row or tandem arrangement, $P_{or} = F_r$.

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm			Abutment and fillet dimensions mm					Part number
a	Single-row (approx.)	Single-row (approx.)	d_1	d_2	D_1	d_a min	d_b min	D_a max	r_{as} max	r_{1as} max	
7.2	1.1	0.017	17.0	15.0	23.0	14.5	12.5	25.5	0.6	0.3	**5S-BNT200**
8.0	1.5	0.021	18.4	16.2	26.0	16.5	14.5	27.5	0.6	0.3	**5S-BNT201**
8.9	2.2	0.030	20.8	18.4	29.4	19.5	17.5	30.5	0.6	0.3	**5S-BNT202**
9.9	2.9	0.046	24.2	21.4	33.6	21.5	19.5	35.5	0.6	0.3	**5S-BNT203**
11.7	4.6	0.080	29.4	26.2	39.4	25.5	24.5	41.5	1	0.6	**5S-BNT204**
12.8	6.1	0.11	33.8	30.7	44.2	30.5	29.5	46.5	1	0.6	**5S-BNT205**
14.3	8.3	0.18	40.6	36.6	52.6	35.5	34.5	56.5	1	0.6	**5S-BNT206**
15.8	10	0.25	46.8	42.0	60.6	42	39.5	65	1	0.6	**5S-BNT207**
17.2	13	0.33	53.0	47.7	67.0	47	44.5	73	1	0.6	**5S-BNT208**
18.3	16	0.37	57.3	51.9	73.0	52	49.5	78	1	0.6	**5S-BNT209**
19.5	20	0.39	62.2	56.8	78.0	57	54.5	83	1	0.6	**5S-BNT210**
21.0	25	0.52	69.0	62.8	86.4	63.5	60.5	91.5	1.5	1	**5S-BNT211**
22.8	32	0.65	77.0	70.2	96.4	68.5	65.5	101.5	1.5	1	**5S-BNT212**
24.1	37	0.86	82.5	75.3	102.5	73.5	70.5	111.5	1.5	1	**5S-BNT213**
25.2	47	0.91	87.0	79.5	108.0	78.5	75.5	116.5	1.5	1	**5S-BNT214**
26.6	54	0.98	93.0	85.5	114.5	83.5	80.5	121.5	1.5	1	**5S-BNT215**
27.9	58	1.21	98.1	90.4	122.0	90	85.5	130	2	1	**5S-BNT216**

Main Spindle Bearings

10. Cylindrical Roller Bearings CONTENTS

10. Cylindrical Roller Bearings

In a cylindrical roller bearing, the rollers and raceways are in line contact. Consequently this type of bearing can support a larger radial load than a point-contact ball bearing. Also, its design is suitable for high-speed operation.

A cylindrical roller bearing used for the main spindle of a machine tool can have either a double- or single-row configuration, and certain variants have a tapered bore so the radial internal clearance can be adjusted.

① Double-row cylindrical roller bearings

Double-row cylindrical roller bearings are available in two types, NN and NNU, and two series, 30 and 49. The rollers in the NN type bearing are guided by the ribs of the inner ring. The rollers in the NNU type bearing are guided by the ribs of the outer ring. Bearings are available with either a tapered bore (which allows adjustment of radial internal clearance of bearing) or a standard cylindrical bore.

The bearings come in two types, standard type and high-speed HS type. Standard cage is machined brass.

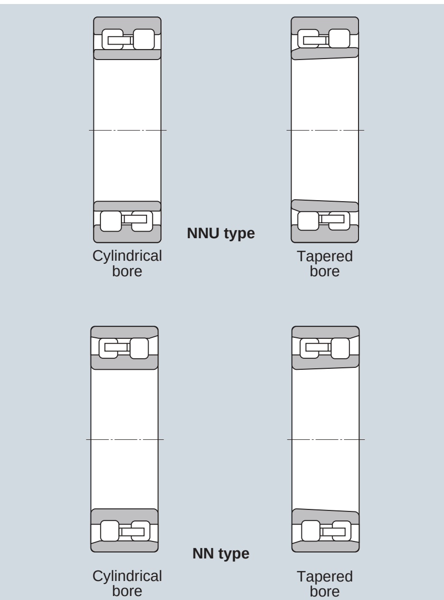


Fig. 10.1

② Single-row cylindrical roller bearings

Single-row cylindrical roller bearings are available in two types, high-speed N10HS type and ultra high-speed N10HSRT6 type. The N10HS type bearings have high-strength machined brass cages, while the N10HSR type bearings have special molded resin cages, which can be used for both grease lubrication and air-oil lubrication. The eco-friendly N10HSLT6 type is a variation from the high-speed N10HSRT6 type bearing and can be used with air-oil lubrication only.

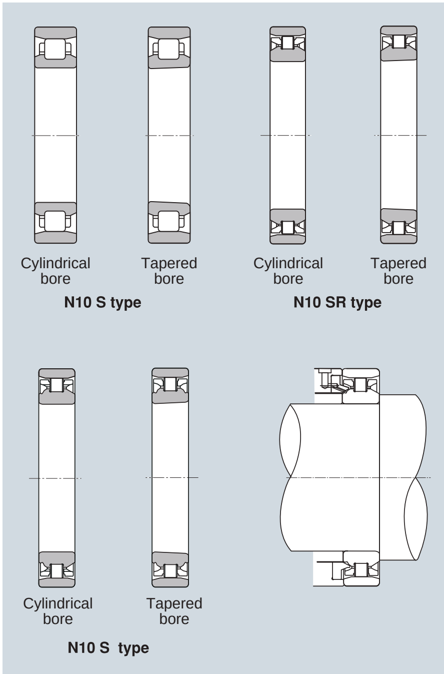


Fig. 10.2

③ Bearing designations

NN49, 30, NNU49 type

NN 30 20 HS RT6 K C0NA P4

- **Precision class** P5：JIS class 5 P2：JIS class 2
  P4：JIS class 4 UP：Special high precision
- **Internal clearance code** See **Table 10.4～10.6**
- **External configuration code** K：Tapered inner ring bore, taper ratio1/12
  No code：Cylindrical inner ring bore
- No code：Machined brass bore
  T6：Molded PEEK cage.
- **Internal modification code** No code：Standard specification
  HS：High speed specification
  HSR：Ultra High speed specification
- **Bore diameter code**
- **Dimension series code**
- **Bearing type code** NN：Double row with ribbed inner ring
  NNU：Double row with ribbed outer ring

N10HS, N10HSR type

N 10 20 HSR T6 K C0NA P4

- **Cage code**
  T6：Molded PEEK cage
  (HSR type)
  No code：High strength machined brass cage
- **Internal modification code**
  HS：High speed specification
  HSR：Ultra high speed specification
- **Bearing type code**
  N：Single row with ribbed inner ring

N10HSL type

N 10 20 HSL T6 K C0NA P4 +TKZ

- **Spacer code**
  (Eco- friendly nozzle)
- **Cage code**
  T6：PEEK resin mold cage
- **Internal modification code**

④ Accuracy of tapered bore

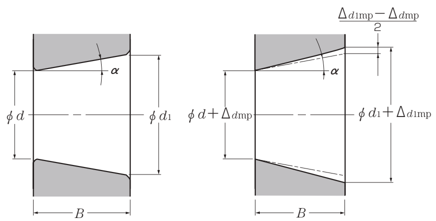
NTN specifies the accuracies of tapered bores conforming with JIS Classes 4 and 2 as shown below. Poor accuracies of the tapered bore lead to misalignment of the inner ring, causing poor performance, premature seizure and flaking. Use of a taper gauge is recommended for higher accuracy of the main spindle. Refer to "6 Handling of Bearings, ⑧ Tapered bore cylindrical roller bearing and main spindle taper angle" in the Technical Data section for more information on taper angle.

Table 10.1 Tolerance of taper-bored bearings

Unit: μm

d mm		Δ_{dmp} Class 4		Δ_{dmp} Class 2		$\Delta_{d1mp}-\Delta_{dmp}$ (approx.) Class 4		$\Delta_{d1mp}-\Delta_{dmp}$ (approx.) Class 2		V_{dp} Class 4	V_{dp} Class 2
over	incl.	high	low	high	low	high	low	high	low	max	max
18	30	+10	0	+ 6	0	+ 4	0	+3	0	2.5	1.5
30	50	+12	0	+ 7	0	+ 5	0	+3.5	0	2.5	1.5
50	80	+15	0	+ 8	0	+ 6	0	+4	0	3	2
80	120	+20	0	+10	0	+ 7	0	+5	0	4	2.5
120	180	+25	0	+12	0	+ 8	0	+6	0	5	3.5
180	250	+29	0	+14	0	+ 9	0	+7	0	7	4.5
250	315	+32	0	−	−	+10	0	−	−	8	−
315	400	+36	0	−	−	+12	0	−	−	9	−
400	500	+40	0	−	−	+14	0	−	−	10	−

Note: **NTN** specification



Theoretical tapered bore   Tapered bore having single plane mean bore diameter deviation

Tolerance of 1/12 taper angle $4^\circ 46'18.8''\ ^{+24''}_{0}$

$\alpha = 2^\circ 23'9.4''$

$d_1 = d + \frac{1}{12}B$

V_{dp}：Single radial plane bore diameter variation
Δ_{dmp}：Single plane mean bore diameter deviation (at theoretical small end on tapered bore)
Δ_{d1mp}：Single plane mean bore diameter deviation (at theoretical large end on tapered bore)
B：Nominal inner ring width

Fig. 10.3

⑤ Accuracy of cylindrical roller bearings

Table 10.2 Inner rings

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane $_{dmp}$						Variation of bore diameter in a single plane V_{dsp}						Variation of mean bore diameter V_{dmp}			Inner ring radial runout K_{ia}		
		Class 5		Class 4 ❶		Class 2 ❶		Diameter series 9			Diameter series 0								
								Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
18	30	0	−6	0	−5	0	−2.5	6	5	2.5	5	4	2.5	3	2.5	1.5	4	3	2.5
30	50	0	−8	0	−6	0	−2.5	8	6	2.5	6	5	2.5	4	3	1.5	5	4	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	5	4	2.5
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	6	5	2.5
120	150	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	8	6	2.5
150	180	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	8	6	5
180	250	0	−15	0	−12	0	−8	15	12	8	12	9	8	8	6	4	10	8	5
250	315	0	−18	—	—	—	—	18	—	—	14	—	—	9	—	—	13	—	—
315	400	0	−23	—	—	—	—	23	—	—	18	—	—	12	—	—	15	—	—
400	500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

❶ The tolerance of bore diameter deviation $_{ds}$ applicable to classes 4 and 2 is the same as the tolerance of single plane mean bore diameter deviation $_{dmp}$.

Table 10.3 Outer rings

Nominal bore diameter D mm		Deviation of mean outside diameter in a single plane $_{Dmp}$						Variation of outside diameter in a single plane V_{Dsp}						Variation of mean outside diameter V_{Dmp}			Outer ring radial runout K_{ea}		
		Class 5		Class 4 ❷		Class 2 ❷		Diameter series 9			Diameter series 0								
								Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
30	50	0	−7	0	−6	0	−4	7	6	4	5	5	4	4	3	2	7	5	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	8	5	4
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	10	6	5
120	150	0	−11	0	−9	0	−5	11	9	5	8	7	5	6	5	2.5	11	7	5
150	180	0	−13	0	−10	0	−7	13	10	7	10	8	7	7	5	3.5	13	8	5
180	250	0	−15	0	−11	0	−8	15	11	8	11	8	8	8	6	4	15	10	7
250	315	0	−18	0	−13	0	−8	18	13	8	14	10	8	9	7	4	18	11	7
315	400	0	−20	0	−15	0	−10	20	15	10	15	11	10	10	8	5	20	13	8
400	500	0	−23	—	—	—	—	23	—	—	17	—	—	12	—	—	23	—	—
500	630	0	−28	—	—	—	—	28	—	—	21	—	—	14	—	—	25	—	—
630	800	0	−35	—	—	—	—	35	—	—	26	—	—	18	—	—	30	—	—

❷ The tolerance of outside diameter deviation $_{Ds}$ applicable to classes 4 and 2 is the same as the tolerance of mean single plane outside diameter deviation $_{Dmp}$.

Unit: μm

Perpendicularity of inner ring face with respect to the bore S_d			Width deviation B_s Single bearing				Width variation V_{Bs}		
Class 5	Class 4	Class 2	Class 5 Class 4		Class 2		Class 5	Class 4	Class 2
max			high	low	high	low	max		
8	4	1.5	0	−120	0	−120	5	2.5	1.5
8	4	1.5	0	−120	0	−120	5	3	1.5
8	5	1.5	0	−150	0	−150	6	4	1.5
9	5	2.5	0	−200	0	−200	7	4	2.5
10	6	2.5	0	−250	0	−250	8	5	2.5
10	6	4	0	−250	0	−300	8	5	4
11	7	5	0	−300	0	−350	10	6	5
13	—	—	0	−350	—	—	13	—	—
15	—	—	0	−400	—	—	15	—	—
—	—	—	—	—	—	—	—	—	—

Unit: μm

Perpendicularity of outer ring outside surface with respect to the face S_D			Width deviation C_s	Width variation V_{Cs}		
Class 5	Class 4	Class 2	All classes	Class 5	Class 4	Class 2
max				max		
8	4	1.5	Identical to B_s relative to d on the same bearing.	5	2.5	1.5
8	4	1.5		6	3	1.5
9	5	2.5		8	4	2.5
10	5	2.5		8	5	2.5
10	5	2.5		8	5	2.5
11	7	4		10	7	4
13	8	5		11	7	5
13	10	7		13	8	7
15	—	—		15	—	—
18	—	—		18	—	—
20	—	—		20	—	—

⑥ Radial internal clearance of cylindrical roller bearings

■Non-interchangeable radial internal clearance

Two types of radial internal clearance are available: non-interchangeable radial internal clearance for which the combination of outer ring and inner ring cannot be changed; and interchangeable radial internal clearance that allows for different outer ring and inner ring combinations. The clearances listed are common to both double-row and the single-row cylindrical roller bearings. For machine components including high-precision machine tool main spindle, bearings with non-interchangeable radial internal clearance and a small clearance range are used. If a double-row tapered bore bearing is used and the desired mounted internal clearance is close to zero, use of clearance in the range between C9NA and C1NA is recommended. Cylindrical bore bearings with non-interchangeable radial internal clearance are also available. For details, contact **NTN** Engineering.

Table 10.4 Cylindrical bore bearings

Unit: μm

Nominal bore diameter *d* mm		Cylindrical bore bearing					
		C1NA		C2NA		NA ❶	
over	incl.	min	max	min	max	min	max
24	30	5	10	10	25	25	35
30	40	5	12	12	25	25	40
40	50	5	15	15	30	30	45
50	65	5	15	15	35	35	50
65	80	10	20	20	40	40	60
80	100	10	25	25	45	45	70
100	120	10	25	25	50	50	80
120	140	15	30	30	60	60	90
140	160	15	35	35	65	65	100
160	180	15	35	35	75	75	110
180	200	20	40	40	80	80	120
200	225	20	45	45	90	90	135
225	250	25	50	50	100	100	150
250	280	25	55	55	110	110	165
280	315	30	60	60	120	120	180
315	355	30	65	65	135	135	200
355	400	35	75	75	150	150	225
400	450	45	85	85	170	170	255
450	500	50	95	95	190	190	285

❶ The code for normal internal clearance is “NA”. Ex: N1006HSNA

Table 10.5 Tapered bore bearings

Unit: μm

Nominal bore diameter *d* mm		Tapered bore bearing									
		C9NA ❷		C0NA ❷		C1NA ❷		C2NA		NA ❶	
over	incl.	min	max	min	max	min	max	min	max	min	max
24	30	5	10	10	20	10	25	25	35	40	50
30	40	5	12	10	20	12	25	25	40	45	55
40	50	5	15	10	20	15	30	30	45	50	65
50	65	5	15	10	20	15	35	35	50	55	75
65	80	10	20	15	30	20	40	40	60	70	90
80	100	10	25	20	35	25	45	45	70	80	105
100	120	10	25	20	35	25	50	50	80	95	120
120	140	15	30	25	40	30	60	60	90	105	135
140	160	15	35	30	45	35	65	65	100	115	150
160	180	15	35	30	45	35	75	75	110	125	165
180	200	20	40	30	50	40	80	80	120	140	180
200	225	20	45	35	55	45	90	90	135	155	200
225	250	25	50	40	65	50	100	100	150	170	215
250	280	25	55	40	65	55	110	110	165	185	240
280	315	30	60	45	75	60	120	120	180	205	265
315	355	30	65	45	75	65	135	135	200	225	295
355	400	35	75	50	90	75	150	150	225	255	330
400	450	45	85	60	100	85	170	170	255	285	370
450	500	50	95	70	115	95	190	190	285	315	410

❶ The code for normal internal clearance is "NA". Ex: N1006HSKNA
❷ Internal clearances C9NA, C0NA and C1NA apply to bearings of JIS class 5 or higher.

■Interchangeable radial internal clearance (cylindrical bore)

Table 10.6

Unit: μm

Nominal bore diameter d mm		C2		CN (Normal)		C3	
over	incl.	min	max	min	max	min	max
24	30	0	25	20	45	35	60
30	40	5	30	25	50	45	70
40	50	5	35	30	60	50	80
50	65	10	40	40	70	60	90
65	80	10	45	40	75	65	100
80	100	15	50	50	85	75	110
100	120	15	55	50	90	85	125
120	140	15	60	60	105	100	145
140	160	20	70	70	120	115	165
160	180	25	75	75	125	120	170
180	200	35	90	90	145	140	195
200	225	45	105	105	165	160	220
225	250	45	110	110	175	170	235
250	280	55	125	125	195	190	260
280	315	55	130	130	205	200	275
315	355	65	145	145	225	225	305
355	400	100	190	190	280	280	370
400	450	110	210	210	310	310	410
450	500	110	220	220	330	330	440

■Adjustment of clearance in tapered bore bearings

Mounted internal clearance of a tapered bore bearing can be adjusted by controlling the drive-up of the tapered bore onto the shaft. Two types of adjusting methods area available: repeated adjustment of spacer width and adjustment with using a mounted internal clearance gauge. The clearance gauge is convenient for mass-production. Refer to "6. Handling of Bearings, ⑦ Clearance adjustment for cylindrical roller bearing, measurement with mounted internal clearance gage" in the Technical Data section.

⑦ Recommended fit of high-precision cylindrical roller bearings

In order to maintain the high precision of the bearing at $d_m n$ values less than 0.75×10[6] the fits listed in **Tables 10.7** and **10.8** are recommended ($d_m n$: pitch circle diameter across rolling elements [mm] multiplied by speed [min^{-1}]).

When the $d_m n$ value is larger than 0.75×10[6] ($d_m n$ value≧0.75×10[6]), consult **NTN** Engineering about the recommended fit. Expansion of the inner ring due to centrifugal force must be considered when determining shaft fit.

Table 10.7 Fit with shaft

Unit: μm

Nominal bore diameter d mm over	Nominal bore diameter d mm incl.	Fit between inner ring and shaft
18	30	0~ 4T
30	50	0~ 5T
50	80	1T~ 6T
80	120	1T~ 6T
120	180	2T~ 8T
180	250	2T~ 8T
250	315	3T~10T
315	400	4T~11T

Note 1: Target the median value.
T: Tight (Interference) fit
Not applicable to tapered bore bearings

Table 10.8 Fit with housing

Unit: μm

Nominal bore diameter D mm over	Nominal bore diameter D mm incl.	Fit between outer ring and housing
30	50	0~3T
50	80	0~4T
80	120	0~4T
120	150	0~5T
150	180	0~5T
180	250	0~6T
250	315	0~7T
315	400	0~8T
400	500	0~9T

Note 1: Target the median value.
T: Tight (Interference) fit

■Fit of tapered bore bearings

When fitting a tapered bore bearing onto a shaft, carefully and thoroughly adjust the fit of the tapered bore to the shaft to maintain high precision of the bearing.

For details of taper angle adjustment refer to "6. Handling of Bearings, ⑧ Cylindrical roller bearing and main spindle taper angle" in the Technical Data section.

⑧ Recommended lubrication specifications

Cylindrical roller bearings are usually used with grease lubrication or air-oil lubrication. Recommended lubrication specifications are described below.

■Grease lubrication

● Recommended brand of grease

Refer to "7. Lubrication of Bearings, ① Grease lubrication" in the Technical Data section.

● Recommended grease fill

10% of the internal free space shown in the dimension tables

● Recommended grease packing method

Refer to "6. Handling of Bearings, ① Cleaning and filling with grease" in the Technical Data section.

■Air-oil lubrication

● Recommended location of nozzle

Refer to "7. Lubrication of Bearings, ② Air-oil lubrication" in the Technical Data section.

● Recommended specifications of nozzle

Nozzle bore diameter.: From 1 to 1.5 mm
Number of nozzles: One nozzle for each bearing, depth of nozzle bore should be four to six times the nozzle diameter.

● Recommended specifications of air-oil

Oil type: Spindle oil
Viscosity grade: ISO VG from 10 to 32 (32 is

Table. 10.9 Air and oil amount

<table>
<tr><th rowspan="2">Bearing type</th><th colspan="2">$d_m n$ value (×10^6)</th><th rowspan="2">Oil amount per shot cm³</th><th rowspan="2">Lubrication interval min</th><th rowspan="2">Oil consumption cm³/h</th><th rowspan="2">Recommended air consumption *Nℓ/min</th></tr>
<tr><th>Over</th><th>Incl.</th></tr>
<tr><td>NN30</td><td></td><td>～ 1.0</td><td rowspan="5">0.02</td><td>8</td><td>0.15</td><td rowspan="4">30～40</td></tr>
<tr><td>NN30HS</td><td>1.0</td><td>～ 1.5</td><td>5</td><td>0.24</td></tr>
<tr><td>N10HS
N10HSRT6</td><td>1.5</td><td>～ 2.3</td><td>5</td><td>0.24</td></tr>
<tr><td>NN30HST6
NN30HSRT6</td><td></td><td>～ 1.7</td><td>15</td><td>0.08</td></tr>
<tr><td>N10HSL</td><td></td><td>～ 2.3</td><td>10</td><td>0.12</td><td>20～40</td></tr>
</table>

*Nℓ/min (Normal liter/minute) ... Nℓ means the volume of air at 0˚C and 1 atmosphere.

⑨ ULTAGE Ultra high speed double row cylindrical roller bearings NN30HSRT6 type

NN30HSRT6 ultra high speed double row cylindrical roller bearings have higher operating speeds with the same level of rigidity and capacity as the conventional series.

Features

1. Optimized internal design to realize high speed and low temperature rise.
2. Molded PEEK cage is used for high speed under grease & air-oil lubrication and grease life.

■Bearing design

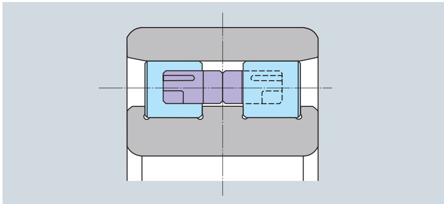
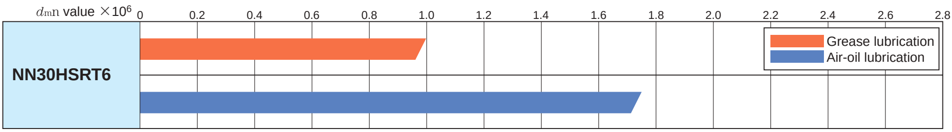


Fig. 10.4 NN30HSRT6 type

■Permissible speed range



Notes) Permissible speed of each bearing (*d*mn value) varies depending on the specifications of the machine for which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline and contact **NTN**.

■Cage design

Cage is made of PEEK which is very light and strong. (**Photo 10.1**)

By using a proven cage design made of PEEK material, less deformation of the cage is seen due to centrifugal force. As a result, the high speed operation of the bearing is improved. The grease life of the bearing is improved by including a pocket for grease in the cage.

Photo 10.1 PEEK cage

■High speed test

$d_m n$ value of 1.0×10^6 under grease lubrication and 1.75×10^6 under air-oil lubrication are realized by the optimized internal design. (**Fig 10.5, 10.6**)

【Test conditions】

Item	Condition
Bearing	NN3020HSRT6K NN3020HST6K NN3020HSK (φ100×φ150×37)
Speed	~8000 min^{-1}
Mounted radial clearance	−5 μm
Lubrication	Grease lubrication
Grease type	MP-1
Jacket cooling	Yes

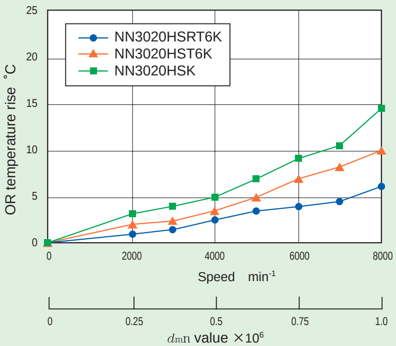


Fig. 10.5 Comparison of temperature rise (grease)

【Test conditions】

Item	Condition
Bearing	NN3020HSRT6K NN3020HST6K NN3020HSK (φ100×φ150×37)
Speed	~15000 min^{-1}
Mounted radial clearance	0 μm
Lubrication	Air- Oil lubrication
Oil	0.02 mL/1shot Oil shot interval: 20min
Air	30 NL/min
Jacket cooling	Yes

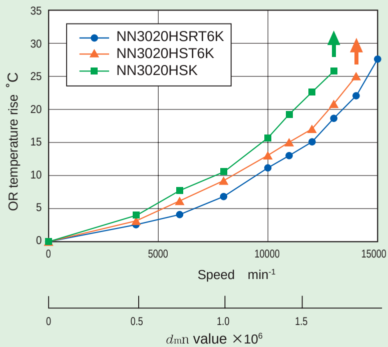
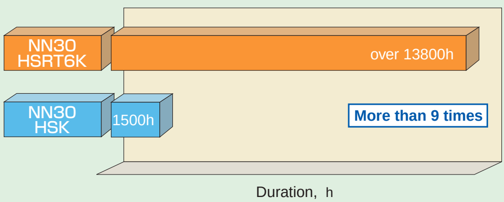


Fig. 10.6 Comparison of temperature rise (air- oil)

■Grease life

Over 13800 hours continuous operation under grease lubrication is realized by the improved cage design at $d_m n$ value of 1.0×10^6. (**Fig. 10.7**)



【Test conditions】

Item	Condition
Bearing	NN3020HSRT6K NN3020HSK (φ100×φ150×37)
Speed	8000 min^{-1}
Mounted radial clearance	−5 μm
Lubrication	Grease lubrication
Grease type	MP-1
Jacket cooling	Yes

Fig. 10.7 Comparison of grease life

⑩ ULTAGE Ultra high-speed single row cylindrical roller bearings N10HSRT6 type

N10HSRT6 type cylindrical roller bearings have been designed for high-speed operation.

Features

1. Optimized internal design allows high speed operation and limits temperature increase.
2. Special resin cage is suitable for high-speed operation.

■Bearing specification

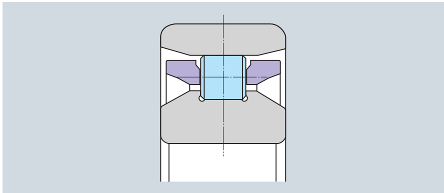
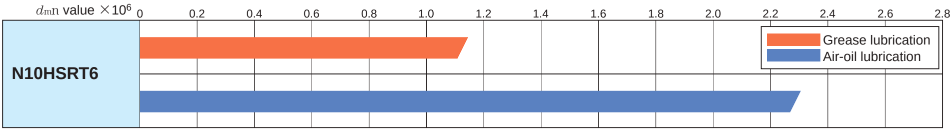


Fig. 10.8 N10HSRT6 type

■Permissible speed range



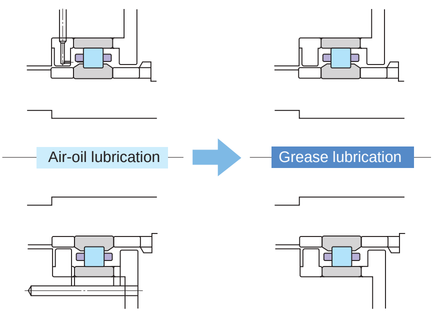
Notes) Permissible speed of each bearing (d_mn value) varies depending on the specifications of the machine for which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline and contact **NTN**.

■Simplified main spindle configuration / adoption of simplified lubrication system

Due to an optimized internal structure, the N10HSR type bearings can reliably run at a higher speed with grease lubrication. The grease lubrication system greatly contributes to reduction in pollution of the surrounding environments by virtually eliminating oil mist (**Fig. 10.9**).

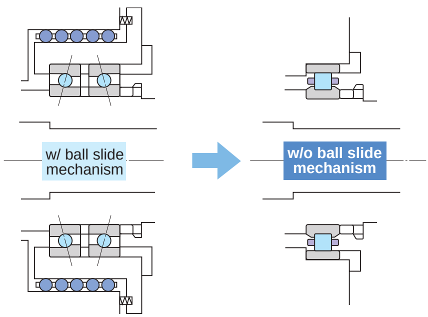
■Simplified main spindle configuration / simplified main spindle rear structure

N10HSR (N10HSL) type high-speed cylindrical roller bearings can replace angular contact ball bearings on the rear side of the main spindle. This arrangement decreases the number of bearing rows (two rows to one row) and eliminates the ball slide mechanism, greatly contributing to simplification of the rear structure (**Fig. 10.10**).



Capable of replacing air-oil lubricated bearings up to d_mn value of 1.15×10^6.

Fig. 10.9 Modification of lubrication system



Capable of replacing angular contact ball bearings up to d_mn value of 2.3×10^6 [air-oil lubrication] or 1.15×10^6 [grease lubrication].

Fig. 10.10 Simplified main spindle rear structure

High-speed operation test with grease lubrication

Due to an optimized internal design, the N10HSR type is capable of high-speed operation with $d_m n$ value of 1.15×10⁶ [grease lubrication] or 2.3×10⁶ [air-oil lubrication] (**Figs. 10.11, 10.12, 10.13, 10.14**).

【Test conditions】

Test bearing	N1011HSRT6 N1011HS (φ55×φ90×18)
Shaft speed	~16000 min⁻¹
Mounted radial clearance	0 μm
Lubrication	Grease
Jacket cooling	No

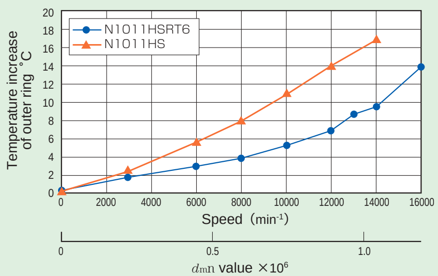


Fig. 10.11 High-speed test results (grease lubrication without outer case cooling)

【Test conditions】

Test bearing	N1011HSRT6 N1011HS (φ55×φ90×18)
Shaft speed	~16000 min⁻¹
Mounted radial clearance	0 μm
Lubrication	Grease
Jacket cooling	Yes

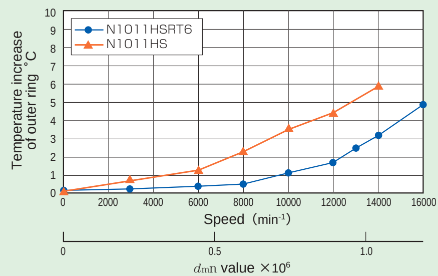


Fig. 10.12 High-speed test results (grease lubrication with outer case cooling)

【Test conditions】

Test bearing	N1016HSRT6 N1016HS (φ80×φ125×22)
Shaft speed	~22000 min⁻¹
Mounted radial clearance	0 μm
Lubrication	Air-oil lubrication
Oil consumption	0.02 mL/shot (oil shot intervals, 5 min)
Air consumption	40 NL/min
Jacket cooling	No

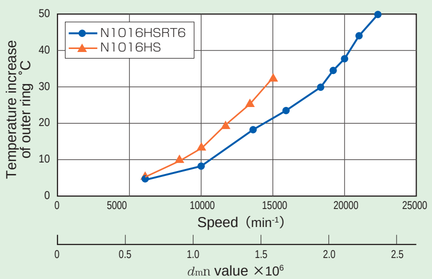


Fig. 10.13 High-speed test results (air-oil lubrication without jacket cooling)

【Test conditions】

Test bearing	N1016HSRT6 N1016HS (φ80×φ125×22)
Shaft speed	~22000 min⁻¹
Mounted radial clearance	0 μm
Lubrication	Air-oil lubrication
Oil consumption	0.02 mL/shot (oil shot intervals, 5 min)
Air consumption	40 NL/min
Jacket cooling	Yes

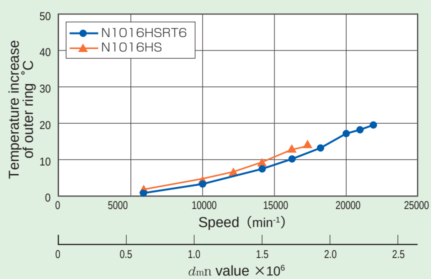


Fig. 10.14 High-speed test results (air-oil lubrication with jacket cooling)

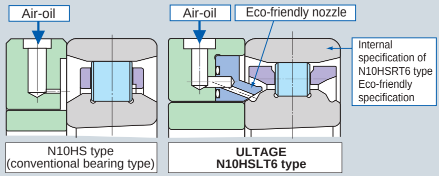
⑪ ULTAGE Eco-friendly air-oil lubricated cylindrical roller bearings N10HSLT6 type

The eco-friendly air-oil lubricated N10HSLT6 type was developed by applying **NTN**'s unique eco-conscious technology to the proven N10HSRT6 type bearing design. The N10HSLT6 type boasts limited emission of oil mist and reduced air and oil consumption. This improves operating environments, saves energy while allowing higher-speed machining operation.

■Features

1. Optimized internal design allows high speed operation and limits temperature increase.
2. Adoption of the eco-friendly nozzle design has led to:
   Lower noise level (up to 7 dBA)
   50% reduction in air consumption
   50% reduction in oil consumption.

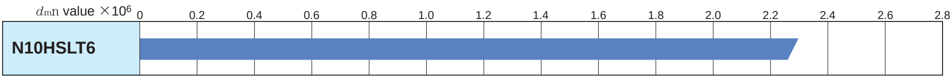
■Bearing specification



NOTE) The N10HSLT6 type is delivered as packed together with the spacer with the eco-friendly nozzle. The bearing type code N10HSLT6 represents the bearing proper, while a spacer code stands for an eco-friendly nozzle proper or a spacer having a built-in nozzle. For more details, see "③ Bearing Designations".

Fig. 10.15 N10HSLT6 type

■Permissible speed range



Notes) Permissible speed of each bearing (dmn value) varies depending on the specifications of the machine for which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline and contact **NTN**.

■High-speed running test

Even with decreased air consumption and oil consumption, the N10HSL type bearings can reliably operate at high speed of dmn 2.3×10⁶ (**Fig. 10.16, 10.17**).

【Test conditions】

Test bearing	N1016HSLT6 N1016HS (φ80×φ125×22)	
Shaft speed	~22000 min⁻¹	
Mounted radial clearance	0 μm	
Oil consumption	0.02 mL/shot	
	N1016HS	5 min intervals
	N1016HSL	10 min intervals
Air consumption	N1016HS	40 NL/min
	N1016HSL	20 NL/min
Jacket cooling	No	

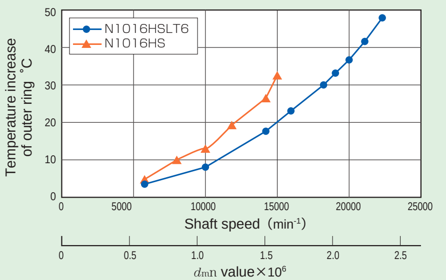


Fig. 10.16 Hgh-speed test results (without Jacket cooling)

【Test conditions】

Test bearing	N1016HSLT6 N1016HS (φ80×φ125×22)	
Shaft speed	~23000 min⁻¹	
Mounted radial clearance	0 μm	
Oil consumption	0.02 mL/shot	
	N1016HS	5 min intervals
	N1016HSL	10 min intervals
Air consumption	N1016HS	40 NL/min
	N1016HSL	20 NL/min
Jacket cooling	Yes	

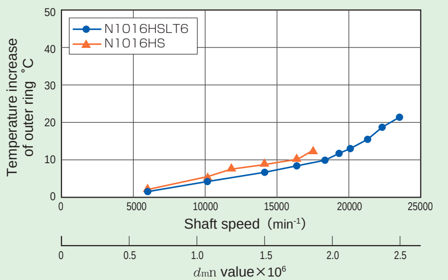
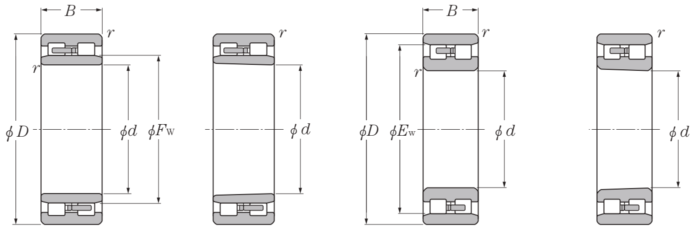


Fig. 10.17 High-speed test results (with Jacket cooling)

⑫ Dimension tables for double row cylindrical roller bearings

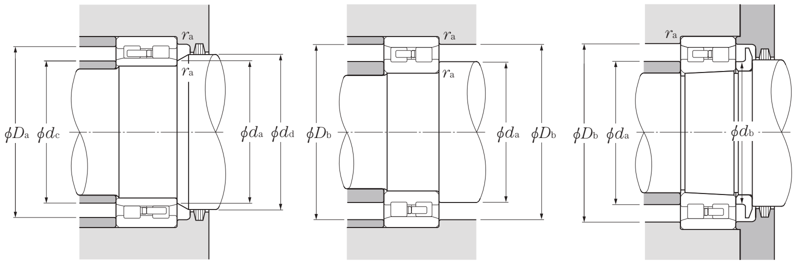
ULTAGE Double row cylindrical roller bearings

d 25～95mm



Part number NNU Type cylindrical bore	NNU Type tapered bore❶	NN Type cylindrical bore	NN Type tapered bore❶	Boundary dimensions mm d	D	B	$r_{s\,min}$❷	Basic load ratings dynamic kN C_r	static kN C_{or}	dynamic kgf C_r	static kgf C_{or}	Limiting speeds min⁻¹ grease lubrication	oil lubrication
—	—	NN3005	NN3005K	25	47	16	0.6	25.8	30.0	2 630	3 050	19 300	23 400
—	—	NN3005HS	NN3005HSK	25	47	16	0.6	25.8	30.0	2 630	3 050	22 600	31 100
—	—	NN3006	NN3006K	30	55	19	1	31.0	37.0	3 150	3 800	16 300	19 800
—	—	NN3006HS	NN3006HSK	30	55	19	1	31.0	37.0	3 150	3 800	19 100	26 300
—	—	NN3007	NN3007K	35	62	20	1	38.0	47.5	3 850	4 850	14 300	17 300
—	—	NN3007HS	NN3007HSK	35	62	20	1	38.0	47.5	3 850	4 850	16 700	23 100
—	—	NN3008	NN3008K	40	68	21	1	43.5	55.5	4 400	5 650	12 800	15 600
—	—	NN3008HS	NN3008HSK	40	68	21	1	43.5	55.5	4 400	5 650	15 000	20 700
—	—	NN3009	NN3009K	45	75	23	1	52.0	68.5	5 300	7 000	11 600	14 000
—	—	NN3009HS	NN3009HSK	45	75	23	1	52.0	68.5	5 300	7 000	13 600	18 700
—	—	NN3010	NN3010K	50	80	23	1	53.0	72.5	5 400	7 400	10 700	13 000
—	—	NN3010HS	NN3010HSK	50	80	23	1	53.0	72.5	5 400	7 400	12 500	17 300
—	—	NN3011	NN3011K	55	90	26	1.1	69.5	96.5	7 050	9 850	9 600	11 600
—	—	NN3011HS	NN3011HSK	55	90	26	1.1	69.5	96.5	7 050	9 850	11 200	15 500
—	—	NN3012	NN3012K	60	95	26	1.1	71.0	102	7 250	10 400	9 000	10 900
—	—	NN3012HS	NN3012HSK	60	95	26	1.1	71.0	102	7 250	10 400	10 500	14 500
—	—	NN3013	NN3013K	65	100	26	1.1	75.0	111	7 650	11 400	8 400	10 200
—	—	NN3013HST6	NN3013HST6K	65	100	26	1.1	72.5	107	7 400	10 900	9 900	13 600
—	—	NN3013HSRT6	NN3013HSRT6K	65	100	26	1.1	72.5	107	7 400	10 900	12 100	21 200
—	—	NN3014	NN3014K	70	110	30	1.1	94.5	143	9 650	14 600	7 700	9 300
—	—	NN3014HST6	NN3014HST6K	70	110	30	1.1	92.0	137	9 350	14 000	9 000	12 400
—	—	NN3014HSRT6	NN3014HSRT6K	70	110	30	1.1	92.0	137	9 350	14 000	11 000	19 300
—	—	NN3015	NN3015K	75	115	30	1.1	96.5	149	9 850	15 200	7 300	8 900
—	—	NN3015HST6	NN3015HST6K	75	115	30	1.1	96.5	149	9 850	15 200	8 500	11 800
—	—	NN3015HSRT6	NN3015HSRT6K	75	115	30	1.1	96.5	149	9 850	15 200	10 400	18 300
—	—	NN3016	NN3016K	80	125	34	1.1	116	179	11 800	18 200	6 800	8 300
—	—	NN3016HST6	NN3016HST6K	80	125	34	1.1	112	172	11 500	17 500	8 000	11 000
—	—	NN3016HSRT6	NN3016HSRT6K	80	125	34	1.1	112	172	11 500	17 500	9 700	17 100
—	—	NN3017	NN3017K	85	130	34	1.1	122	194	12 400	19 800	6 500	7 900
—	—	NN3017HST6	NN3017HST6K	85	130	34	1.1	118	187	12 100	19 100	7 600	10 500
—	—	NN3017HSRT6	NN3017HSRT6K	85	130	34	1.1	118	187	12 100	19 100	9 300	16 300
—	—	NN3018	NN3018K	90	140	37	1.5	143	228	14 600	23 200	6 000	7 300
—	—	NN3018HST6	NN3018HST6K	90	140	37	1.5	143	228	14 600	23 200	7 100	9 700
—	—	NN3018HSRT6	NN3018HSRT6K	90	140	37	1.5	143	228	14 600	23 200	8 600	15 200
—	—	NN3019	NN3019K	95	145	37	1.5	146	238	14 900	24 200	5 800	7 000

❶ A bearing number with suffix **K** indicates a tapered-bore bearing (taper ratio 1/12).
❷ Minimum allowable value for corner radius dimension r.
A part number containing a suffix **T6** means an **ULTAGE Series**.



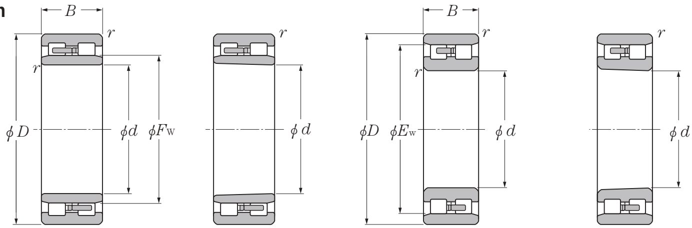
Dynamic equivalent radial load
$P_r=F_r$

Static equivalent radial load
$P_{or}=F_r$

Dimensions mm		Abutment and fillet dimensions mm								Mass kg (approx.)				Internal free space cm³
										NNU Type		NN Type		NN Type
F_w	E_w	d_a min	d_b min	d_c max	d_d min	D_a max	D_b max	D_b min	r_{as} max	cylindrical bore	tapered bore	cylindrical bore	tapered bore	
—	41.3	29	30	—	—	—	43	42	0.6	—	—	0.124	0.121	3.72
—	41.3	29	30	—	—	—	43	42	0.6	—	—	0.124	0.121	3.72
—	48.5	35	36.5	—	—	—	50	49	1	—	—	0.199	0.193	6.38
—	48.5	35	36.5	—	—	—	50	49	1	—	—	0.199	0.193	6.38
—	55	40	41.5	—	—	—	57	56	1	—	—	0.242	0.235	8.09
—	55	40	41.5	—	—	—	57	56	1	—	—	0.242	0.235	8.09
—	61	45	47	—	—	—	63	62	1	—	—	0.312	0.303	9.68
—	61	45	47	—	—	—	63	62	1	—	—	0.312	0.303	9.68
—	67.5	50	52	—	—	—	70	69	1	—	—	0.405	0.393	13.3
—	67.5	50	52	—	—	—	70	69	1	—	—	0.405	0.393	13.3
—	72.5	55	57	—	—	—	75	74	1	—	—	0.433	0.419	14.6
—	72.5	55	57	—	—	—	75	74	1	—	—	0.433	0.419	14.6
—	81	61.5	63.5	—	—	—	83.5	82	1	—	—	0.651	0.631	20.5
—	81	61.5	63.5	—	—	—	83.5	82	1	—	—	0.651	0.631	20.5
—	86.1	66.5	68.5	—	—	—	88.5	87	1	—	—	0.704	0.683	21.1
—	86.1	66.5	68.5	—	—	—	88.5	87	1	—	—	0.704	0.683	21.1
—	91	71.5	73.5	—	—	—	93.5	92	1	—	—	0.76	0.74	22.2
—	91	71.5	73.5	—	—	—	93.5	92	1	—	—	0.69	0.66	21.4
—	91	71.5	73.5	—	—	—	93.5	92	1	—	—	0.69	0.66	21.4
—	100	76.5	79	—	—	—	103.5	101	1	—	—	1.04	1.01	33.0
—	100	76.5	79	—	—	—	103.5	101	1	—	—	0.99	0.96	30.4
—	100	76.5	79	—	—	—	103.5	101	1	—	—	0.99	0.96	30.4
—	105	81.5	84	—	—	—	108.5	106	1	—	—	1.14	1.11	35.0
—	105	81.5	84	—	—	—	108.5	106	1	—	—	1.05	1.02	31.2
—	105	81.5	84	—	—	—	108.5	106	1	—	—	1.05	1.02	31.2
—	113	86.5	89.5	—	—	—	118.5	114	1	—	—	1.52	1.47	45.0
—	113	86.5	89.5	—	—	—	118.5	114	1	—	—	1.43	1.38	43.0
—	113	86.5	89.5	—	—	—	118.5	114	1	—	—	1.43	1.38	43.0
—	118	91.5	84.5	—	—	—	123.5	119	1	—	—	1.61	1.56	48.8
—	118	91.5	84.5	—	—	—	123.5	119	1	—	—	1.51	1.46	44.4
—	118	91.5	84.5	—	—	—	123.5	119	1	—	—	1.51	1.46	44.4
—	127	98	101	—	—	—	132	129	1.5	—	—	2.07	2.01	64.1
—	127	98	101	—	—	—	132	129	1.5	—	—	1.97	1.91	57.6
—	127	98	101	—	—	—	132	129	1.5	—	—	1.97	1.91	57.6
—	132	103	106	—	—	—	137	134	1.5	—	—	2.17	2.10	67.0

ULTAGE Double row cylindrical roller bearings

d 100～190mm

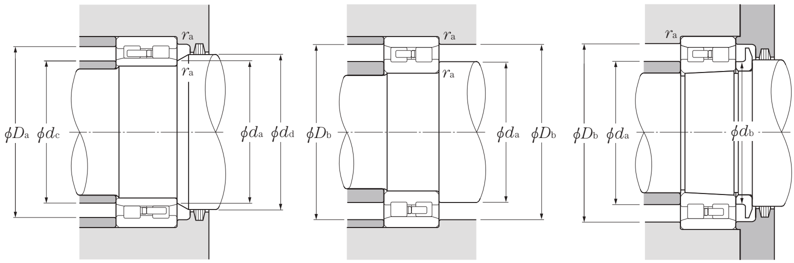


NNU Type: Cylindrical bore, Tapered bore

NN Type: Cylindrical bore, Tapered bore

Part number NNU Type cylindrical bore	NNU Type tapered bore❶	NN Type cylindrical bore	NN Type tapered bore❶	Boundary dimensions (mm) d	D	B	$r_{s\,min}$❷	Basic load ratings dynamic (kN) C_r	static (kN) C_{0r}	dynamic (kgf) C_r	static (kgf) C_{0r}	Limiting speeds (min⁻¹) grease lubrication	oil lubrication
NNU4920	NNU4920K	NN4920	NN4920K	100	140	40	1.1	131	260	13 300	26 500	6 000	7 200
—	—	NN3020	NN3020K	100	150	37	1.5	153	256	15 600	26 100	5 600	6 700
—	—	NN3020HST6	NN3020HST6K	100	150	37	1.5	149	247	15 200	25 200	6 500	9 000
—	—	NN3020HSRT6	NN3020HSRT6K	100	150	37	1.5	149	247	15 200	25 200	8 000	14 000
NNU4921	NNU4921K	NN4921	NN4921K	105	145	40	1.1	133	268	13 500	27 400	5 700	6 900
—	—	NN3021	NN3021K	105	160	41	2	198	320	20 200	33 000	5 300	6 400
—	—	NN3021HST6	NN3021HST6K	105	160	41	2	198	320	20 200	33 000	6 200	8 500
—	—	NN3021HSRT6	NN3021HSRT6K	105	160	41	2	198	320	20 200	33 000	7 100	11 300
NNU4922	NNU4922K	NN4922	NN4922K	110	150	40	1.1	137	284	14 000	28 900	5 500	6 600
—	—	NN3022	NN3022K	110	170	45	2	229	375	23 300	38 000	5 000	6 000
—	—	NN3022HST6	NN3022HST6K	110	170	45	2	229	375	23 300	38 000	5 800	8 000
—	—	NN3022HSRT6	NN3022HSRT6K	110	170	45	2	229	375	23 300	38 000	6 700	10 600
NNU4924	NNU4924K	NN4924	NN4924K	120	165	45	1.1	183	360	18 700	37 000	5 000	6 000
—	—	NN3024	NN3024K	120	180	46	2	233	390	23 700	40 000	4 600	5 600
—	—	NN3024HST6	NN3024HST6K	120	180	46	2	226	380	23 100	38 500	5 400	7 500
—	—	NN3024HSRT6	NN3024HSRT6K	120	180	46	2	226	380	23 100	38 500	6 200	9 900
NNU4926	NNU4926K	NN4926	NN4926K	130	180	50	1.5	220	440	22 400	45 000	4 600	5 500
—	—	NN3026	NN3026K	130	200	52	2	284	475	29 000	48 500	4 200	5 100
—	—	NN3026HST6	NN3026HST6K	130	200	52	2	284	475	29 000	48 500	4 900	6 800
—	—	NN3026HSRT6	NN3026HSRT6K	130	200	52	2	284	475	29 000	48 500	5 700	9 000
NNU4928	NNU4928K	NN4928	NN4928K	140	190	50	1.5	227	470	23 100	48 000	4 300	5 200
—	—	NN3028	NN3028K	140	210	53	2	298	515	30 500	52 500	4 000	4 800
—	—	NN3028HST6	NN3028HST6K	140	210	53	2	298	515	30 500	52 500	4 700	6 400
NNU4930	NNU4930K	NN4930	NN4930K	150	210	60	2	345	690	35 000	70 500	3 900	4 800
—	—	NN3030	NN3030K	150	225	56	2.1	335	585	34 000	60 000	3 700	4 500
—	—	NN3030HS	NN3030HSK	150	225	56	2.1	335	585	34 000	60 000	4 300	6 000
NNU4932	NNU4932K	NN4932	NN4932K	160	220	60	2	355	740	36 500	75 500	3 700	4 500
—	—	NN3032	NN3032K	160	240	60	2.1	375	660	38 000	67 500	3 500	4 200
—	—	NN3032HS	NN3032HSK	160	240	60	2.1	375	660	38 000	67 500	4 100	5 600
NNU4934	NNU4934K	NN4934	NN4934K	170	230	60	2	360	765	37 000	78 000	3 600	4 300
—	—	NN3034	NN3034K	170	260	67	2.1	440	775	45 000	79 000	3 200	3 900
NNU4936	NNU4936K	NN4936	NN4936K	180	250	69	2	460	965	46 500	98 500	3 200	3 800
—	—	NN3036	NN3036K	180	280	74	2.1	565	995	57 500	102 000	3 000	3 600
NNU4938	NNU4938K	NN4938	NN4938K	190	260	69	2	475	1 030	48 500	105 000	3 000	3 600
—	—	NN3038	NN3038K	190	290	75	2.1	580	1 040	59 000	106 000	2 800	3 300

❶ A bearing number with suffix **K** indicates a tapered-bore bearing (taper ratio 1/12).
❷ Minimum allowable value for corner radius dimension r.
A part number containing a suffix **T6** means an **ULTAGE Series**



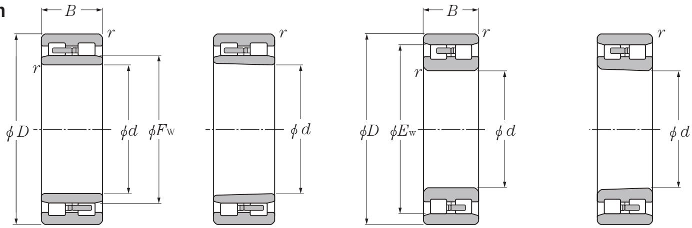
Dynamic equivalent radial load
$P_r = F_r$

Static equivalent radial load
$P_{or} = F_r$

Dimensions mm F_w	E_w	Abutment and fillet dimensions mm d_a min	d_b min	d_c max	d_d min	D_a max	D_b max	D_b min	r_{as} max	Mass kg (approx.) NNU Type cylindrical bore	NNU Type tapered bore	NN Type cylindrical bore	NN Type tapered bore	Internal free space cm³ NN Type
113	129	106.5	110	111	115	133.5	133.5	131	1	1.83	1.75	1.75	1.67	49.8
—	137	108	111	—	—	—	142	139	1.5	—	—	2.26	2.19	67.5
—	137	108	111	—	—	—	142	139	1.5	—	—	2.14	2.07	61.6
—	137	108	111	—	—	—	142	139	1.5	—	—	2.14	2.07	61.6
118	134	111.5	115	116	120	138.5	138.5	136	1	1.91	1.82	1.82	1.73	50.2
—	146	114	117	—	—	—	151	148	2	—	—	2.89	2.80	91.9
—	146	114	117	—	—	—	151	148	2	—	—	2.75	2.66	82.7
—	146	114	117	—	—	—	151	148	2	—	—	2.75	2.66	82.7
123	139	116.5	120	121	125	143.5	143.5	141	1	1.99	1.90	1.90	1.81	53.9
—	155	119	123	—	—	—	161	157	2	—	—	3.69	3.56	115
—	155	119	123	—	—	—	161	157	2	—	—	3.50	3.37	103
—	155	119	123	—	—	—	161	157	2	—	—	3.50	3.37	103
134.5	154.5	126.5	130	133	137	158.5	158.5	156.5	1	2.75	2.62	2.63	2.51	82.5
—	165	129	133	—	—	—	171	167	2	—	—	3.98	3.83	130
—	165	129	133	—	—	—	171	167	2	—	—	3.76	3.61	117
—	165	129	133	—	—	—	171	167	2	—	—	3.76	3.61	117
146	168	138	142	144	148	172	172	170	1.5	3.69	3.52	3.52	3.35	112
—	182	139	143	—	—	—	191	183	2	—	—	5.92	5.71	182
—	182	139	143	—	—	—	191	183	2	—	—	5.55	5.34	164
—	182	139	143	—	—	—	191	183	2	—	—	5.55	5.34	164
156	178	148	152	154	158	182	182	180	1.5	3.94	3.76	3.76	3.58	117
—	192	149	153	—	—	—	201	194	2	—	—	6.44	6.21	199
—	192	149	153	—	—	—	201	194	2	—	—	6.11	5.91	176
168.5	196.5	159	164	166	171	201	201	198.5	2	6.18	5.90	5.90	5.62	192
—	206	161	166	—	—	—	214	208	2	—	—	7.81	7.53	237
—	206	161	166	—	—	—	214	208	2	—	—	7.81	7.53	237
178.5	206.5	169	174	176	182	211	211	208.5	2	6.53	6.23	6.24	5.94	199
—	219	171	176	—	—	—	229	221	2	—	—	8.92	8.59	287
—	219	171	176	—	—	—	229	221	2	—	—	8.92	8.59	287
188.5	216.5	179	184	186	192	221	221	218.5	2	6.87	6.55	6.56	6.24	212
—	236	181	187	—	—	—	249	238	2	—	—	12.6	12.2	379
202	234	189	195	199	205	241	241	236	2	9.90	9.46	9.45	9.01	299
—	255	191	197	—	—	—	269	257	2	—	—	16.6	16.0	478
212	244	199	205	209	215	251	251	246	2	10.4	9.94	9.93	9.47	303
—	265	201	207	—	—	—	279	267	2	—	—	18.0	17.4	504

Double row cylindrical roller bearings

d 200～500mm



NNU Type

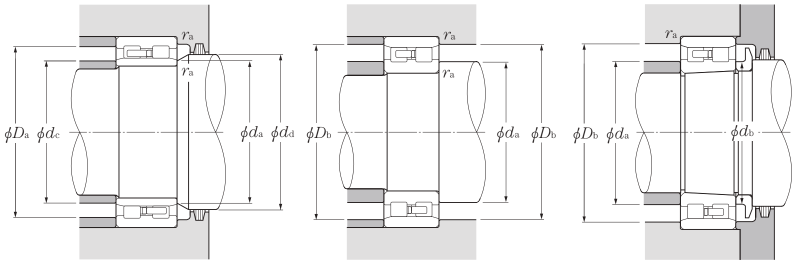
Cylindrical bore　　Tapered bore

NN Type

Cylindrical bore　　Tapered bore

Part number				Boundary dimensions mm				Basic load ratings				Limiting speeds min⁻¹	
NNU Type		NN Type						dynamic kN	static kN	dynamic kgf	static kgf		
cylindrical bore	tapered bore❶	cylindrical bore	tapered bore❶	*d*	*D*	*B*	$r_{s\,min}$❷	C_r	C_{or}	C_r	C_{or}	grease lubrication	oil lubrication
NNU4940	NNU4940K	NN4940	NN4940K	200	280	80	2.1	555	1 180	56 500	120 000	2 900	3 500
—	—	NN3040	NN3040K	200	310	82	2.1	655	1 170	66 500	119 000	2 600	3 100
NNU4944	NNU4944K	NN4944	NN4944K	220	300	80	2.1	585	1 300	59 500	132 000	2 600	3 100
—	—	NN3044	NN3044K	220	340	90	3	815	1 480	83 000	151 000	2 300	2 800
NNU4948	NNU4948K	NN4948	NN4948K	240	320	80	2.1	610	1 410	62 500	144 000	2 300	2 800
—	—	NN3048	NN3048K	240	360	92	3	855	1 600	87 000	163 000	2 200	2 600
NNU4952	NNU4952K	NN4952	NN4952K	260	360	100	2.1	900	2 070	92 000	211 000	2 200	2 600
—	—	NN3052	NN3052K	260	400	104	4	1 060	1 990	108 000	203 000	2 100	2 500
NNU4956	NNU4956K	NN4956	NN4956K	280	380	100	2.1	925	2 200	94 500	224 000	1 900	2 300
—	—	NN3056	NN3056K	280	420	106	4	1 080	2 080	110 000	212 000	1 800	2 100
NNU4960	NNU4960K	NN4960	NN4960K	300	420	118	3	1 200	2 800	122 000	285 000	1 800	2 100
—	—	NN3060	NN3060K	300	460	118	4	1 330	2 560	135 000	261 000	1 600	2 000
NNU4964	NNU4964K	NN4964	NN4964K	320	440	118	3	1 240	2 970	126 000	305 000	1 600	2 000
—	—	NN3064	NN3064K	320	480	121	4	1 350	2 670	138 000	272 000	1 500	1 800
NNU4968	NNU4968K	—	—	340	460	118	3	1 270	3 150	130 000	320 000	1 500	1 800
—	—	NN3068	NN3068K	340	520	133	5	1 620	3 200	165 000	325 000	1 500	1 800
NNU4972	NNU4972K	—	—	360	480	118	3	1 290	3 250	131 000	330 000	1 500	1 800
—	—	NN3072	NN3072K	360	540	134	5	1 650	3 300	169 000	340 000	1 400	1 600
NNU4976	NNU4976K	—	—	380	520	140	4	1 630	4 050	167 000	415 000	1 400	1 600
—	—	NN3076	NN3076K	380	560	135	5	1 690	3 450	172 000	355 000	1 300	1 500
NNU4980	NNU4980K	—	—	400	540	140	4	1 690	4 300	172 000	435 000	1 300	1 500
—	—	NN3080	NN3080K	400	600	148	5	2 040	4 150	208 000	420 000	1 200	1 400
NNU4984	NNU4984K	—	—	420	560	140	4	1 740	4 500	177 000	460 000	1 200	1 500
—	—	NN3084	NN3084K	420	620	150	5	2 080	4 300	212 000	440 000	1 100	1 400
NNU4988	NNU4988K	—	—	440	600	160	4	2 150	5 550	219 000	565 000	1 100	1 400
—	—	NN3088	NN3088K	440	650	157	6	2 420	5 100	247 000	520 000	1 100	1 300
NNU4992	NNU4992K	—	—	460	620	160	4	2 220	5 850	226 000	595 000	1 100	1 300
—	—	NN3092	NN3092K	460	680	163	6	2 550	5 350	260 000	545 000	1 000	1 200
NNU4996	NNU4996K	—	—	480	650	170	5	2 280	5 900	233 000	600 000	1 000	1 200
NNU49/500	NNU49/500K	—	—	500	670	170	5	2 360	6 200	240 000	635 000	1 000	1 200

❶ A bearing number with suffix **K** indicates a tapered-bore bearing (taper ratio 1/12).
❷ Minimum allowable value for corner radius dimension *r*.



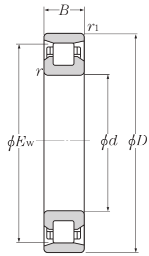
Dynamic equivalent radial load
$P_r = F_r$

Static equivalent radial load
$P_{or} = F_r$

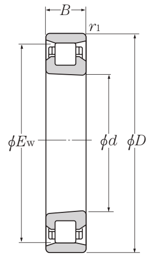
Dimensions mm		Abutment and fillet dimensions mm								Mass kg (approx.)				Internal free space cm³
										NNU Type		NN Type		NN Type
F_w	E_w	d_a min	d_b min	d_c max	d_d min	D_a max	D_b max	D_b min	r_{as} max	cylindrical bore	tapered bore	cylindrical bore	tapered bore	
225	261	211	218	222	228	269	269	264	2	14.7	14.0	14.0	13.3	437
—	282	211	218	—	—	—	299	285	2	—	—	21.6	20.8	649
245	281	231	238	242	248	289	289	284	2	15.9	15.2	15.2	14.5	485
—	310	233	240	—	—	—	327	313	2.5	—	—	29.3	28.2	877
265	301	251	258	262	269	309	309	304	2	17.2	16.4	16.4	15.6	518
—	330	253	261	—	—	—	347	333	2.5	—	—	32.8	31.6	973
292	336	271	279	288	296	349	349	339	2	29.6	28.3	28.3	27.0	850
—	364	276	285	—	—	—	384	367	3	—	—	47.4	45.8	1 370
312	356	291	299	308	316	369	369	359	2	31.6	30.2	30.2	28.8	897
—	384	296	305	—	—	—	404	387	3	—	—	51.1	49.3	1 500
339	391	313	323	335	343	407	407	394	2.5	48.6	46.4	46.4	44.2	1 360
—	418	316	326	—	—	—	444	421	3	—	—	70.8	68.6	2 000
359	411	333	343	355	363	427	427	414	2.5	51.4	49.1	49.0	46.7	1 450
—	438	336	346	—	—	—	464	441	3	—	—	76.2	73.5	2 200
379	—	353	363	375	383	447	—	—	2.5	54.2	51.7	—	—	—
—	473	360	371	—	—	—	500	477	4	—	—	102	98.5	2 950
398	—	373	383	394	402	467	—	—	2.5	57.0	54.4	—	—	—
—	493	380	391	—	—	—	520	497	4	—	—	107	103	3 600
425	—	396	408	420	430	504	—	—	3	84.5	80.6	—	—	—
—	512	400	411	—	—	—	540	516	4	—	—	113	109	3 340
445	—	416	428	440	450	524	—	—	3	88.2	84.1	—	—	—
—	547	420	432	—	—	—	580	551	4	—	—	146	141	4 230
465	—	436	448	460	470	544	—	—	3	92.0	87.7	—	—	—
—	567	440	452	—	—	—	600	571	4	—	—	154	148	4 520
492	—	456	469	487	497	584	—	—	3	127	121	—	—	—
—	596	464	477	—	—	—	626	601	5	—	—	178	172	5 000
512	—	476	489	507	517	604	—	—	3	132	126	—	—	—
—	622	484	498	—	—	—	656	627	5	—	—	202	195	6 030
534	—	500	514	531	541	630	—	—	4	156	149	—	—	—
556	—	520	534	551	561	650	—	—	4	162	155	—	—	—

High speed single row cylindrical roller bearings

d 30～80mm



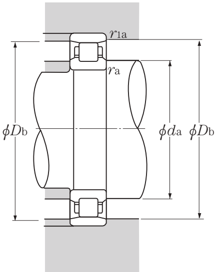
Cylindrical bore



Tapered bore

Part number ❶ ❸		Boundary dimensions						Basic load ratings				Limiting speeds	
								dynamic	static	dynamic	static		
								kN		kgf		min^{-1}	
cylindrical bore	tapered bore	d	D	B	$r_{s\,min}$ ❷	$r_{1s\,min}$ ❷	E_w	C_r	C_{or}	C_r	C_{or}	grease lubrication	oil lubrication
N1006HS	N1006HSK	30	55	13	1	0.6	48.5	17.2	17.6	1 750	1 790	20 500	32 100
N1007HS	N1007HSK	35	62	14	1	0.6	55	21.2	22.5	2 160	2 300	18 000	28 200
N1008HS	N1008HSK	40	68	15	1	0.6	61	24.3	26.3	2 480	2 680	16 100	25 300
N1009HS	N1009HSK	45	75	16	1	0.6	67.5	29.1	32.5	2 970	3 350	14 500	22 800
N1010HS	N1010HSK	50	80	16	1	0.6	72.5	29.9	34.5	3 050	3 550	13 400	21 100
N1011HS	N1011HSK	55	90	18	1.1	1	81	39.0	46.0	4 000	4 700	12 100	18 900
N1012HS	N1012HSK	60	95	18	1.1	1	86.1	40.0	48.5	4 100	4 950	11 300	17 700
N1013HS	N1013HSK	65	100	18	1.1	1	91	42.5	53.5	4 300	5 450	10 600	16 600
N1014HS	N1014HSK	70	110	20	1.1	1	100	52.0	65.5	5 300	6 700	9 700	15 200
N1015HS	N1015HSK	75	115	20	1.1	1	105	53.0	69.0	5 400	7 050	9 200	14 400
N1016HS	N1016HSK	80	125	22	1.1	1	113	63.5	82.0	6 450	8 400	8 500	13 400

❶ A bearing number with suffix **K** indicates a tapered-bore bearing (taper ratio 1/12).
❷ Minimum allowable value for chamfer dimension r or r_1.
❸ N10HS differs from standard N10 in internal construction.



Dynamic equivalent radial load

$P_r = F_r$

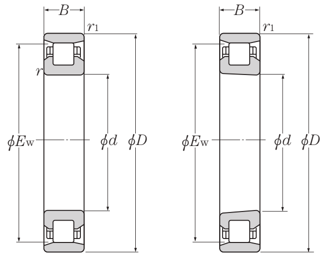
Static equivalent radial load

$P_{or} = F_r$

Abutment and fillet dimensions mm					Mass cylindrical bore kg (approx.)	Internal free space cm³	Part number	
d_a min	D_b max	D_b min	r_{as} max	r_{1as} max			cylindrical bore	tapered bore
35	50	49	1	0.6	0.143	4.33	**N1006HS**	**N1006HSK**
40	57	56	1	0.6	0.190	5.06	**N1007HS**	**N1007HSK**
45	63	62	1	0.6	0.235	7.10	**N1008HS**	**N1008HSK**
50	70	69	1	0.6	0.298	8.85	**N1009HS**	**N1009HSK**
55	75	74	1	0.6	0.323	10.8	**N1010HS**	**N1010HSK**
61.5	83.5	82	1	1	0.473	15.0	**N1011HS**	**N1011HSK**
66.5	88.5	87	1	1	0.505	15.3	**N1012HS**	**N1012HSK**
71.5	93.5	92	1	1	0.538	19.0	**N1013HS**	**N1013HSK**
76.5	103.5	101	1	1	0.745	22.0	**N1014HS**	**N1014HSK**
81.5	108.5	106	1	1	0.787	26.5	**N1015HS**	**N1015HSK**
86.5	118.5	114	1	1	1.05	31.1	**N1016HS**	**N1016HSK**

High speed single row cylindrical roller bearings

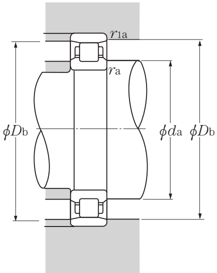
d 85～160mm



Cylindrical bore Tapered bore

Part number ❶ ❸		Boundary dimensions						Basic load ratings				Limiting speeds	
								dynamic	static	dynamic	static		
								kN		kgf		min^{-1}	
cylindrical bore	tapered bore	d	D	B	$r_{s\,min}$ ❷	$r_{1s\,min}$ ❷	E_w	C_r	C_{or}	C_r	C_{or}	grease lubrication	oil lubrication
N1017HS	N1017HSK	85	130	22	1.1	1	118	65.0	86.0	6 650	8 800	8 100	12 800
N1018HS	N1018HSK	90	140	24	1.5	1.1	127	78.5	105	8 000	10 700	7 600	11 900
N1019HS	N1019HSK	95	145	24	1.5	1.1	132	80.5	110	8 200	11 200	7 300	11 400
N1020HS	N1020HSK	100	150	24	1.5	1.1	137	82.0	115	8 400	11 700	7 000	11 000
N1021HS	N1021HSK	105	160	26	2	1.1	146	109	149	11 100	15 200	6 600	10 400
N1022HS	N1022HSK	110	170	28	2	1.1	155	126	173	12 800	17 700	6 200	9 800
N1024HS	N1024HSK	120	180	28	2	1.1	165	128	182	13 100	18 500	5 800	9 100
N1026HS	N1026HSK	130	200	33	2	1.1	182	156	220	15 900	22 400	5 300	8 300
N1028HS	N1028HSK	140	210	33	2	1.1	192	164	240	16 800	24 400	5 000	7 800
N1030HS	N1030HSK	150	225	35	2.1	1.5	206	185	273	18 800	27 800	4 700	7 300
N1032HS	N1032HSK	160	240	38	2.1	1.5	219	206	305	21 000	31 500	4 400	6 900

❶ A bearing number with suffix **K** indicates a tapered-bore bearing (taper ratio 1/12).
❷ Minimum allowable value for chamfer dimension r or r_1.
❸ N10HS differs from standard N10 in internal construction.



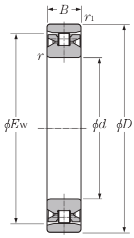
Dynamic equivalent radial load
$P_r=F_r$

Static equivalent radial load
$P_{or}=F_r$

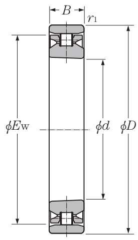
Abutment and fillet dimensions mm					**Mass** cylindrical bore kg (approx.)	**Internal free space** cm^3	**Part number**	
d_a min	D_b max	D_b min	r_{as} max	r_{1as} max			cylindrical bore	tapered bore
91.5	123.5	119	1	1	1.10	33.4	**N1017HS**	**N1017HSK**
98	132	129	1.5	1	1.43	40.0	**N1018HS**	**N1018HSK**
103	137	134	1.5	1	1.50	46.5	**N1019HS**	**N1019HSK**
108	142	139	1.5	1	1.55	53.5	**N1020HS**	**N1020HSK**
114	151	148	2	1	1.96	56.2	**N1021HS**	**N1021HSK**
119	161	157	2	1	2.44	68.8	**N1022HS**	**N1022HSK**
129	171	167	2	1	2.61	87.5	**N1024HS**	**N1024HSK**
139	191	183	2	1	3.95	118	**N1026HS**	**N1026HSK**
149	201	194	2	1	4.19	130	**N1028HS**	**N1028HSK**
161	214	208	2	1.5	5.10	151	**N1030HS**	**N1030HSK**
171	229	221	2	1.5	6.30	172	**N1032HS**	**N1032HSK**

ULTAGE Ultra high-speed single row cylindrical roller bearings

d 45～100mm



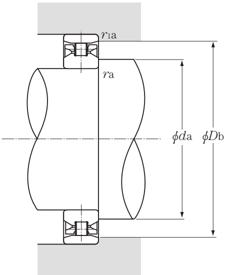
Cylindrical bore



Tapered bore

Part number ❶ ❸		Boundary dimensions						Basic load ratings				Limiting speeds	
								dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	min⁻¹	
cylindrical bore	tapered bore	d	D	B	$r_{s\,min}$ ❷	$r_{1s\,min}$ ❷	E_w	C_r	C_{or}	C_r	C_{or}	grease lubrication	oil lubrication
N1009HSRT6	**N1009HSRT6K**	45	75	16	1	0.6	67.5	21	22.5	2 150	2 290	18 900	37 500
N1011HSRT6	**N1011HSRT6K**	55	90	18	1.1	1	81	24.1	28.7	2 460	2 930	15 400	30 900
N1012HSRT6	**N1012HSRT6K**	60	95	18	1.1	1	86.1	23.8	28.9	2 430	2 950	14 400	28 900
N1013HSRT6	**N1013HSRT6K**	65	100	18	1.1	1	91	25.3	32	2 580	3 250	13 600	27 200
N1014HSRT6	**N1014HSRT6K**	70	110	20	1.1	1	100	29.2	37.5	2 980	3 850	12 400	24 700
N1016HSRT6	**N1016HSRT6K**	80	125	22	1.1	1	113	38	50	3 900	5 100	11 000	21 900
N1018HSRT6	**N1018HSRT6K**	90	140	24	1.5	1.1	127	48	64.5	4 900	6 550	9 700	19 500
N1020HSRT6	**N1020HSRT6K**	100	150	24	1.5	1.1	137	50.5	70.5	5 150	7 200	9 000	18 000

❶ Minimum allowable value for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = F_r$

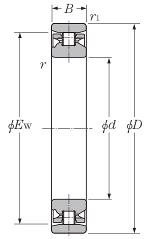
Static equivalent radial load

$P_{or} = F_r$

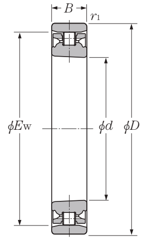
Abutment and fillet dimensions mm					Internal free space cm³	Part number	
d_a min	D_b max	D_b min	r_{as} max	r_{1as} max		cylindrical bore	tapered bore
50	70	69	1	0.6	9.2	**N1009HSRT6**	**N1009HSRT6K**
61.5	83.5	82	1	1	15.7	**N1011HSRT6**	**N1011HSRT6K**
66.5	88.5	87	1	1	17.0	**N1012HSRT6**	**N1012HSRT6K**
71.5	93.5	92	1	1	17.9	**N1013HSRT6**	**N1013HSRT6K**
76.5	103.5	101	1	1	23.3	**N1014HSRT6**	**N1014HSRT6K**
86.5	118.5	114	1	1	31.6	**N1016HSRT6**	**N1016HSRT6K**
98	132	129	1.5	1	41.1	**N1018HSRT6**	**N1018HSRT6K**
108	142	139	1.5	1	45.1	**N1020HSRT6**	**N1020HSRT6K**

ULTAGE Eco-friendly ultra high-speed single row cylindrical roller bearings
Air-oil lubrication only

d 55～100mm



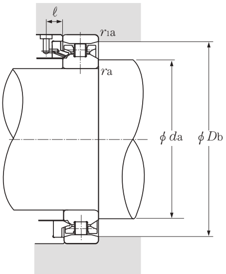
Cylindrical bore



Tapered bore

Part number		Boundary dimensions						Basic load ratings				Limiting speeds
								dynamic	static	dynamic	static	
								kN		kgf		min^{-1}
cylindrical bore	tapered bore	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	E_w	C_r	C_{or}	C_r	C_{or}	grease lubrication
N1011HSLT6	N1011HSLT6K	55	90	18	1.1	1	81	24.1	28.7	2 460	2 930	30 900
N1012HSLT6	N1012HSLT6K	60	95	18	1.1	1	86.1	23.8	28.9	2 430	2 950	28 900
N1013HSLT6	N1013HSLT6K	65	100	18	1.1	1	91	25.3	32	2 580	3 250	27 200
N1014HSLT6	N1014HSLT6K	70	110	20	1.1	1	100	29.2	37.5	2 980	3 850	24 700
N1016HSLT6	N1016HSLT6K	80	125	22	1.1	1	113	38	50	3 900	5 100	21 900
N1018HSLT6	N1018HSLT6K	90	140	24	1.5	1.1	127	48	64.5	4 900	6 550	19 500
N1020HSLT6	N1020HSLT6K	100	150	24	1.5	1.1	137	50.5	70.5	5 150	7 200	18 000

❶ Minimum allowable value for chamfer dimension r or $r1$.
❷ For the details of spacer dimensions, please contact **NTN** Engineering.



Dynamic equivalent radial load

$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Abutment and fillet dimensions mm						Part number	
d_a min	D_b max	D_b min	r_{as} max	r_{1as} max	ℓ ❷ min	cylindrical bore	tapered bore
61.5	83.5	82	1	1	8.5	**N1011HSLT6**	**N1011HSLT6K**
66.5	88.5	87	1	1	8.5	**N1012HSLT6**	**N1012HSLT6K**
71.5	93.5	92	1	1	8.5	**N1013HSLT6**	**N1013HSLT6K**
76.5	103.5	101	1	1	10	**N1014HSLT6**	**N1014HSLT6K**
86.5	118.5	114	1	1	10	**N1016HSLT6**	**N1016HSLT6K**
98	132	129	1.5	1	10	**N1018HSLT6**	**N1018HSLT6K**
108	142	139	1.5	1	10	**N1020HSLT6**	**N1020HSLT6K**

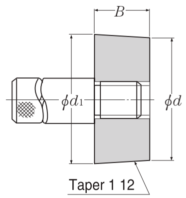
⑬ Taper gage and internal clearance adjustment gage for NTN precision cylindrical roller bearings

As the need increases for machine tools of higher speed and precision, a higher degree of precision is required of machine tool bearings. For a precision bearing to exhibit its full performance, it must be installed correctly. In particular, when a tapered bore bearing is used, the corresponding taper on the shaft must be finished to a high degree of precision. **NTN** recommends the ring gage for the tapered shaft be finished to the same precision as for bearings. Note that the contact area between tapered faces should be 80% or greater.

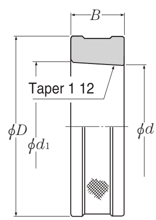
NTN also offers a plug gage that permits verification of the precision of the ring gage. Remember that the radial internal clearance of a cylindrical roller bearing needs to be correctly adjusted. Too large a radial clearance can diminish the precision of the main spindle, while too small a radial clearance can lead to abnormal heat generation and premature flaking of the bearing. To ensure adequate internal clearance, use a mounted internal clearance adjustment gage.

⑭ Dimension table for taper gage

Part number Plug gage	Part number Ring gage	Applicable bearing		Boundary dimensions mm d	d_1	D	B	Mass (approx.) kg type TB	type TA
TANN3006K	**TBNN3006K**	N1006HS	NN3006K	30	31.583	70	19	0.5	0.2
TANN3007K	**TBNN3007K**	N1007HS	NN3007K	35	36.667	75	20	0.6	0.3
TANN3008K	**TBNN3008K**	N1008HS	NN3008K	40	41.750	80	21	0.7	0.3
TANN3009K	**TBNN3009K**	N1009HS	NN3009K	45	46.917	85	23	0.7	0.4
TANN3010K	**TBNN3010K**	N1010HS	NN3010K	50	51.917	90	23	0.8	0.5
TANN3011K	**TBNN3011K**	N1011HS	NN3011K	55	57.167	95	26	0.9	0.7
TANN3012K	**TBNN3012K**	N1012HS	NN3012K	60	62.167	100	26	1.0	0.8
TANN3013K	**TBNN3013K**	N1013HS	NN3013K	65	67.167	105	26	1.1	0.9
TANN3014K	**TBNN3014K**	N1014HS	NN3014K	70	72.500	110	30	1.3	1.3
TANN3015K	**TBNN3015K**	N1015HS	NN3015K	75	77.500	115	30	1.4	1.4
TANN3016K	**TBNN3016K**	N1016HS	NN3016K	80	82.833	125	34	1.9	1.7
TANN3017K	**TBNN3017K**	N1017HS	NN3017K	85	87.833	130	34	2.0	1.9
TANN3018K	**TBNN3018K**	N1018HS	NN3018K	90	93.083	140	37	2.6	2.4
TANN3019K	**TBNN3019K**	N1019HS	NN3019K	95	98.083	145	37	2.7	2.6
TANN3020K	**TBNN3020K**	N1020HS	NN3020K	100	103.083	150	37	2.8	2.8
TANN3021K	**TBNN3021K**	N1021HS	NN3021K	105	108.417	160	41	3.6	3.5
TANN3022K	**TBNN3022K**	N1022HS	NN3022K	110	113.750	165	45	4.1	4.0
TANN3024K	**TBNN3024K**	N1024HS	NN3024K	120	123.833	170	46	4.1	4.7
TANN3026K	**TBNN3026K**	N1026HS	NN3026K	130	134.333	180	52	4.8	6.4
TANN3028K	**TBNN3028K**	N1028HS	NN3028K	140	144.417	190	53	5.2	7.4
TANN3030K	**TBNN3030K**	N1030HS	NN3030K	150	154.667	210	56	7.2	8.4
TANN3032K	**TBNN3032K**	N1032HS	NN3032K	160	165.000	220	60	8.1	10

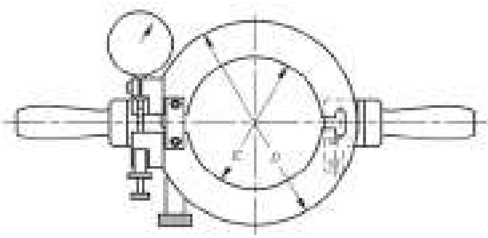


Plug gage (TA)



Ring gage (TB)

⑮ Dimension table for mounted internal clearance adjustment gage



Part number	Applicable bearing		Boundary dimensions mm		
			E	D	width B
SBNN3007-2	N1007HSK	NN3007K	55	101	23
SBNN3008-2	N1008HSK	NN3008K	61	107	23
SBNN3009-2	N1009HSK	NN3009K	67.5	114	23
SBNN3010-2	N1010HSK	NN3010K	72.5	120	23
SBNN3011-2	N1011HSK	NN3011K	81	131	25
SBNN3012-2	N1012HSK	NN3012K	86.1	138	25
SBNN3013-2	N1013HSK	NN3013K	91	145	25
SBNN3014-2	N1014HSK	NN3014K	100	156	28
SBNN3015-2	N1015HSK	NN3015K	105	161	28
SBNN3016-2	N1016HSK	NN3016K	113	175	30
SBNN3017-2	N1017HSK	NN3017K	118	185	30
SBNN3018-2	N1018HSK	NN3018K	127	195	33
SBNN3019-2	N1019HSK	NN3019K	132	204	33
SBNN3020-2	N1020HSK	NN3020K	137	210	33
SBNN3021-2	N1021HSK	NN3021K	146	220	36
SBNN3022-2	N1022HSK	NN3022K	155	235	40
SBNN3024-2	N1024HSK	NN3024K	165	250	40
SBNN3026-2	N1026HSK	NN3026K	182	275	45
SBNN3028-2	N1028HSK	NN3028K	192	285	45
SBNN3030-2	N1030HSK	NN3030K	206	305	50
SBNN3032-2	N1032HSK	NN3032K	219	320	50

Main Spindle Bearings

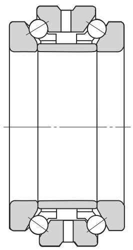
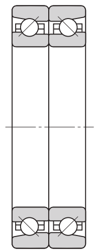
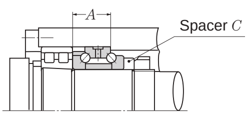
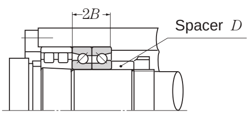
11. Angular Contact Ball Bearings for Axial Loads CONTENTS

11. Angular Contact Ball Bearings for Axial Loads

① Features and types

NTN provides a range of thrust bearings for the main spindles. This includes 5629 and 5620 series for high axial rigidity (contact angle 60˚) and HTA U(A) series high-speed duplex angular contact ball bearings for axial loads with optimized internal design (contact angle 40˚, 30˚). These bearings are used in conjunction with NN30, NN49, or NNU49 series double-row cylindrical roller bearings (matched bearings must have the same bore and outside diameter).

Table 11.1 Types of angular contact ball bearings for axial loads

	5629 and 5620 series	HTA0U (A)..DB, HTA9U (A)..DB series
Bearing type		
Initial contact angle	60˚	40˚, 30˚
Cage material	High-strength machined brass cage	Molded resin, machined phenolic, high-strength machined copper alloy cage
Features	These series can withstand axial loads in both directions. Due to a larger contact angle, rigidity in axial directions is enhanced. The structure of these bearings limits them to grease-lubricated vertical shaft applications.	These duplex angular contact ball bearing series have similar design to the double-row thrust angular contact ball bearing series, but are different in terms of their widths (see the diagrams below). Since their contact angles are lower at 40° and 30°, the series boast high-speed capability. However, their axial rigidity is less than double-row thrust angular contact ball bearings with 60° contact angle.
Interchangeability	A double-direction thrust angular contact ball bearing can be readily interchanged with a duplex angular contact ball bearing simply by replacing spacer C with spacer D; the dimensions of the shaft and housing remain unchanged. Dimension *A* = Dimension 2*B*  Double-direction thrust angular contact ball bearing 5629 series 5620 series  High-speed duplex angular contact ball bearing for axial loads HTA9UDB series HTB0UDB series	

② Standard cage types

Table 11.2 Standard cage of angular contact ball bearing for axial loads

Bearing series	Machined phenol cage	Machined brass cage
5629 **5620**	— —	562920～562964 562005～562064
HTA9U (A) **HTA0U (A)**	HTA920U～HTA938U HTA010U～HTA038U	HTA940U～HTA964U HTA040U～HTA064U

Notes: Cage types may be subjected to change without notice. For details, contact **NTN** Engineering.

③ Bearing designations

562 0 20M / GN P4

- P4 — **Tolerance class code** P5: **NTN** Class 5, P4: **NTN** Class 4
- GN — **Internal clearance code** GN: Normal preload, GM: Medium preload
- 20M — **Bore code (refer to the dimensions tables)**
  without M: Tapered shaft small side diameter type (Ex.: 562020→ϕ100 mm bore)
  with M: Tapered shaft large side diameter type (Ex.: 562020→ϕ103 mm bore)
- 0 — **Dimension series code**
- 562 — **Bearing type**

5S - HTA 0 20 U A T2 DB / GN P4L

- P4L — **Tolerance class code** P5: JIS Class 5 P4: JIS Class 4
  L: Outer ring outside diameter tolerance for axial load
- GN — **Internal clearance code** GN: Normal preload, GM: Medium preload
- DB — **Duplex arrangement code** DB: back-to-back (double-row), DTBT: tandem back-to-back (four-row)
- T2 — **Cage code** No code: Standard cage, T2: Molded resin, L1: Machined brass cage
- A — **Contact angle code** No code: 40˚, A: 30˚
- U — **Bearing series: ULTAGE**
- 20 — **Nominal bore diameter (see the dimensions tables)**
- 0 — **Dimension series code**
- HTA — **Bearing type**
- 5S — **Material code** 5S: Material of rolling element is ceramics, No code: Bearing steel

④ Accuracy of double-direction angular contact thrust ball bearings

Table 11.3 Inner rings

Unit: μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation d_{mp} or bore diameter deviation d_s				Perpendicularity of inner ring face with respect to the bore S_d		Axial runout S_{ia}		Width variation V_{Bs}		Bearing height deviation T_s	
		Class 5		Class 4		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4
over	incl.	high	low	high	low	max		max		max		high	low
18	30	0	− 6	0	− 5	8	4	5	3	5	2.5	0	− 300
30	50	0	− 8	0	− 6	8	4	5	3	5	3	0	− 400
50	80	0	− 9	0	− 7	8	5	6	5	6	4	0	− 500
80	120	0	−10	0	− 8	9	5	6	5	7	4	0	− 600
120	180	0	−13	0	−10	10	6	8	6	8	5	0	− 700
180	250	0	−15	0	−12	11	7	8	6	10	6	0	− 800
250	315	0	−18	0	−15	13	8	10	8	13	7	0	− 900
315	400	0	−23	0	−18	15	9	13	10	15	9	0	−1 000

Table 11.4 Outer rings

Unit: μm

Nominal bore diameter D mm		Single plane mean outside diameter deviation D_{mp} or outside diameter deviation D_s		Perpendicularity of outer ring outside surface with respect to the face S_D		Axial runout S_{ea}		Width variation V_{Cs}	
		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4
over	incl.	high	low	max		max		max	
30	50	−30	−40	8	4	Identical to ΔS_{ia} relative to d of the same bearing.		5	2.5
50	80	−40	−50	8	4			6	3
80	120	−50	−60	9	5			8	4
120	150	−60	−75	10	5			8	5
150	180	−60	−75	10	5			8	5
180	250	−75	−90	11	7			10	7
250	315	−90	−105	13	8			11	7
315	400	−110	−125	13	10			13	8
400	500	−120	−140	15	13			15	10

⑤ Accuracy of high-speed duplex angular contact ball bearings for axial loads

Table 11.5 Inner rings

Unit: μm

Nominal bore diameter d mm over	incl.	Single plane mean bore diameter deviation $_{dmp}$ Class 5 high	Class 5 low	Class 4❶ high	Class 4❶ low	Single radial plane bore diameter variation V_{dsp} Diameter series 9 Class 5 max	Diameter series 9 Class 4 max	Diameter series 0 Class 5 max	Diameter series 0 Class 4 max	Mean bore diameter deviation V_{dmp} Class 5 max	Class 4 max	Perpendicularity of inner ring face with respect to the bore S_d Class 5 max	Class 4 max	Axial runout S_{ia} Class 5 max	Class 4 max
18	30	0	−6	0	−5	6	5	5	4	3	2.5	8	4	5	3
30	50	0	−8	0	−6	8	6	6	5	4	3	8	4	5	3
50	80	0	−9	0	−7	9	7	7	5	5	3.5	8	5	6	5
80	120	0	−10	0	−8	10	8	8	6	5	4	9	5	6	5
120	150	0	−13	0	−10	13	10	10	8	7	5	10	6	8	6
150	180	0	−13	0	−10	13	10	10	8	7	5	10	6	8	6
180	250	0	−15	0	−12	15	12	12	9	8	6	11	7	8	6
250	315	0	−18	0	−14	18	14	14	11	9	8	13	8	10	8
315	400	0	−23	0	−16	23	17	18	12	12	9	15	10	13	10

❶The tolerance of bore diameter deviation $_{ds}$ is the same as the tolerance of single plane mean bore diameter deviation $_{dmp}$.

Unit: μm

Overall width variation of assembled bearing B_s Class 5 high	Class 4 low	Width variation V_{Bs} Class 5 max	Class 4 max	Nominal bore diameter d mm over	incl.
0	−240	5	2.5	18	30
0	−240	5	3	30	50
0	−300	6	4	50	80
0	−400	7	4	80	120
0	−500	8	5	120	150
0	−500	8	5	150	180
0	−600	10	6	180	250
0	−700	13	8	250	315
0	−800	15	10	315	400

Table 11.6 Outer rings

Unit: μm

Nominal bore diameter D mm over	incl.	Single plane mean outside diameter deviation $_{Dmp}$ and outside diameter deviation $_{Ds}$ Class 5L or Class 4L❷ high	Class 5L or Class 4L❷ low	Class 5 high	Class 5 low	Class 4❷ high	Class 4❷ low	Axial runout S_{ea} Class 5 All classes	Class 4 All classes	Overall width variation of assembled bearing C_s All classes	Width variation V_{Cs} Class 5 max	Class 4 max
30	50	−25	−36	0	−7	0	−6	8	5	Identical to B_s relative to d on the same bearing.	5	2.5
50	80	−30	−43	0	−9	0	−7	10	5		6	3
80	120	−36	−51	0	−10	0	−8	11	6		8	4
120	150	−43	−61	0	−11	0	−9	13	7		8	5
150	180	−43	−61	0	−13	0	−10	14	8		8	5
180	250	−50	−70	0	−15	0	−11	15	10		10	7
250	315	−56	−79	0	−18	0	−13	18	10		11	7
315	400	−62	−87	0	−20	0	−15	20	13		13	8
400	500	−68	−95	0	−23	—	—	23	15		15	10

❷ The tolerance of outside diameter deviation $_{Ds}$ to be applied to the Class 4 and Class 2 is same as the tolerance of the mean outside diameter deviation $_{dmp}$.
Note that the Class 4 is applicable to diameter series 0 and 2, and the Class 2 is applicable to all the diameter series.
Note: This standard is the **NTN** standard.

⑥ Basic preload

The initial internal clearance or initial preload must be selected with consideration of the lubricating method, maximum speed, and required axial rigidity. Although usage with normal preload (GN) within the allowable speed range is possible for both grease lubrication and air-oil lubrication, ask **NTN** Engineering to recommend the appropriate preload if axial rigidity is required and you want to inhibit temperature rise of the main spindle. The standard preloads are summarized in **Table 11.7**.

Table 11.7 Basic preload

Unit: : N {kgf}

<table>
<tr><th rowspan="2">Bore number</th><th colspan="2">5629</th><th colspan="2">5620</th><th colspan="2">HTA9UDB</th><th colspan="2">HTA9UADB</th><th colspan="2">HTA0UDB</th><th colspan="2">HTA0UADB</th><th rowspan="2">Bore number</th></tr>
<tr><th>Normal GN
GN</th><th>Medium GM
GM</th><th>Normal GN
GN</th><th>Medium GM
GM</th><th>Normal GN
GN</th><th>Medium GM
GM</th><th>Normal GN
GN</th><th>Medium GM
GM</th><th>Normal GN
GN</th><th>Medium GM
GM</th><th>Normal GN
GN</th><th>Medium GM
GM</th></tr>
<tr><td>05</td><td rowspan="15">—</td><td rowspan="15">—</td><td>294 {30}</td><td>685 {70}</td><td rowspan="15">—</td><td rowspan="15">—</td><td rowspan="15">—</td><td rowspan="15">—</td><td rowspan="5">—</td><td rowspan="5">—</td><td rowspan="5">—</td><td rowspan="5">—</td><td>05</td></tr>
<tr><td>06</td><td rowspan="4">490 {50}</td><td rowspan="4">785 {80}</td><td>06</td></tr>
<tr><td>07</td><td>07</td></tr>
<tr><td>08</td><td>08</td></tr>
<tr><td>09</td><td>09</td></tr>
<tr><td>10</td><td rowspan="4">980 {100}</td><td rowspan="4">1 670 {170}</td><td rowspan="4">685 {70}</td><td rowspan="4">1 270 {130}</td><td rowspan="4">490 {50}</td><td rowspan="4">885 {90}</td><td>10</td></tr>
<tr><td>11</td><td>11</td></tr>
<tr><td>12</td><td>12</td></tr>
<tr><td>13</td><td>13</td></tr>
<tr><td>14</td><td rowspan="6">1 470 {150}</td><td rowspan="6">2 450 {250}</td><td rowspan="4">980 {100}</td><td rowspan="2">1 570 {160}</td><td rowspan="3">590 {60}</td><td rowspan="3">1 470 {150}</td><td>14</td></tr>
<tr><td>15</td><td>15</td></tr>
<tr><td>16</td><td rowspan="2">1 960 {200}</td><td>16</td></tr>
<tr><td>17</td><td rowspan="4">885 {90}</td><td rowspan="4">1 960 {200}</td><td>17</td></tr>
<tr><td>18</td><td rowspan="4">1 470 {150}</td><td rowspan="4">2 450 {250}</td><td>18</td></tr>
<tr><td>19</td><td>19</td></tr>
<tr><td>20</td><td rowspan="3">1 470 {150}</td><td rowspan="3">2 450 {250}</td><td rowspan="9">1 960 {200}</td><td rowspan="9">3 250 {330}</td><td rowspan="3">980 {100}</td><td rowspan="3">1 670 {170}</td><td rowspan="3">685 {70}</td><td rowspan="3">1 270 {130}</td><td>20</td></tr>
<tr><td>21</td><td rowspan="3">980 {100}</td><td rowspan="3">2 450 {250}</td><td>21</td></tr>
<tr><td>22</td><td rowspan="2">1 960 {200}</td><td rowspan="2">3 450 {350}</td><td>22</td></tr>
<tr><td>24</td><td rowspan="6">1 960 {200}</td><td rowspan="6">2 940 {300}</td><td rowspan="3">1 270 {130}</td><td rowspan="3">2 450 {250}</td><td>885 {90}</td><td>1 770 {180}</td><td>24</td></tr>
<tr><td>26</td><td rowspan="2">980 {100}</td><td rowspan="2">1 960 {200}</td><td rowspan="3">2 940 {300}</td><td rowspan="3">5 400 {550}</td><td rowspan="3">1 470 {150}</td><td rowspan="3">3 450 {350}</td><td>26</td></tr>
<tr><td>28</td><td>28</td></tr>
<tr><td>30</td><td rowspan="3">1 960 {200}</td><td rowspan="3">3 450 {350}</td><td rowspan="3">1 270 {130}</td><td rowspan="3">2 450 {250}</td><td>30</td></tr>
<tr><td>32</td><td rowspan="2">3 900 {400}</td><td rowspan="2">7 350 {750}</td><td rowspan="3">2 450 {250}</td><td rowspan="3">4 900 {500}</td><td>32</td></tr>
<tr><td>34</td><td>34</td></tr>
<tr><td>36</td><td rowspan="3">2 450 {250}</td><td rowspan="3">3 900 {400}</td><td rowspan="3">2 450 {250}</td><td rowspan="3">3 900 {400}</td><td rowspan="2">3 450 {350}</td><td rowspan="2">5 900 {600}</td><td rowspan="2">1 770 {180}</td><td rowspan="2">3 450 {350}</td><td rowspan="3">4 900 {500}</td><td rowspan="3">9 300 {950}</td><td>36</td></tr>
<tr><td>38</td><td rowspan="2">3 450 {350}</td><td rowspan="2">6 850 {700}</td><td>38</td></tr>
<tr><td>40</td><td rowspan="3">3 900 {400}</td><td rowspan="3">6 850 {700}</td><td>2 450 {250}</td><td>4 900 {500}</td><td>40</td></tr>
<tr><td>44</td><td rowspan="2">2 940 {300}</td><td rowspan="2">4 400 {450}</td><td rowspan="4">2 940 {300}</td><td rowspan="4">4 400 {450}</td><td rowspan="6">—</td><td rowspan="6">—</td><td rowspan="2">6 850 {700}</td><td rowspan="2">12 700 {1 300}</td><td rowspan="3">3 900 {400}</td><td rowspan="3">7 850 {800}</td><td>44</td></tr>
<tr><td>48</td><td>48</td></tr>
<tr><td>52</td><td rowspan="3">3 900 {400}</td><td rowspan="3">5 900 {600}</td><td rowspan="2">4 900 {500}</td><td rowspan="2">8 850 {900}</td><td rowspan="2">8 850 {900}</td><td rowspan="2">15 700 {1 600}</td><td>52</td></tr>
<tr><td>56</td><td rowspan="3">5 900 {600}</td><td rowspan="3">11 800 {1 200}</td><td>56</td></tr>
<tr><td>60</td><td rowspan="2">3 900 {400}</td><td rowspan="2">5 900 {600}</td><td rowspan="2">5 900 {600}</td><td rowspan="2">11 800 {1 200}</td><td rowspan="2">10 800 {1 100}</td><td rowspan="2">17 700 {1 800}</td><td>60</td></tr>
<tr><td>64</td><td>4 900 {500}</td><td>7 350 {750}</td><td>64</td></tr>
</table>

⑦ Shaft and housing fits

Fits given in **Table 11.8** are recommended for angular contact ball bearings for axial loads. To maintain high accuracy, provision of interference between the shaft and the bore of inner ring is essential. The fit of the housing and bearing should be same as that for cylindrical roller bearings, since an angular contact ball bearing is normally used together with a cylindrical roller bearing.

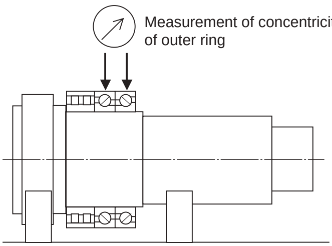


Fig. 11.1 Concentricity

■Checking concentricity of outside diameter of outer ring after bearing

Controlling concentricity of outer ring assembly is necessary for reduction of axial runout of the main spindle. Measure and control the concentricity of outer ring shown in **Fig. 11.1** and "6. Handling of Bearings, ② Mounting" in the Technical Data section.

Table 11.8 Fit to shaft

Unit: μm

Nominal bore diameter d mm over	incl.	Fit of inner ring to shaft
2.5	10	0～2T
10	18	0～2T
18	30	0～2.5T
30	50	0～3T
50	80	0～3.5T
80	120	0～4T
120	180	0～5T
180	250	0～6T

Note 1: Target the median value.
2: For high-speed applications where $d_m n$ value exceeds 0.75 ×10[6], the fit should be increased.For such an arrangement, consult **NTN** Engineering.
T: Tight (Interference) fit

⑧ Recommended lubrication specifications

Angular contact ball bearings for axial loads are usually used with grease lubrication or air-oil lubrication. Recommended specifications of the lubrication methods are described below.

■Grease lubrication

● Recommended brand of grease

Refer to "7. Lubrication of Bearings, ① Grease lubrication" in the Technical Data section.

● Recommended grease filling amount

$d_m n$ value ≦0.65×10[6]
15% of the capacity shown in the dimensions tables
$d_m n$ value ＞0.65×10[6]
12% of the capacity shown in the dimensions tables

● Recommended grease filling method

Refer to "6. Handling of Bearings, ① Cleaning and filling with grease" in the Technical Data section.

Notes: High-strength machined brass cages are used for 5629/5620 series. Thus, if they are used for grease-lubricated vertical shafts, the cage on one side may hang onto the rolling elements, possibly causing seizure. Use of the HTA series with resin cages or oil lubrication (including feeding of lubricating oil) is recommended.

■Air-oil lubrication

● Recommended location of nozzle

Refer to "7. Lubrication of Bearings ② Recommended location of nozzle for air-oil lubrication" in the Technical Data section.

● Recommended specifications of nozzle

Nozzle bore diameter : From 1 to 1.5 mm
Number of nozzles: One nozzle for each bearing, depth of nozzle bore should be four to six times of nozzle bore diameter.

● Recommended specifications of air-oil

Oil type: Spindle oil
Viscosity grade: ISO VG from 10 to 32 (32 is preferable)

Table. 11.9 Air and oil amount

Bearing types	$d_m n$ value (×10[6]) Over	Incl.	Oil amount per shot mL	Lubrication intervals min	Oil consumption mL/h	Recommended air consumption *NL/min
HTA9 (A)	～	1.0	0.03	8	0.23	20～40
HTA0 (A)	1.0 ～	1.2		5	0.36	
5S-HTA0 (A)						

＊NL/min (Normal liter/minute) … NL means the volume of air at 0˚C and 1 atmosphere.

⑨ ULTAGE Angular contact ball bearings for axial loads HTA U type

HTA U type angular contact ball bearing has a higher limiting speed with the same rigidity and loading capability as the conventional HTA series.

■Features

1. Optimized internal design to minimize the temperature rise especially at high speed range.
2. Improved molded nylon cage pocket design where the ball contacts to have improved lubrication performance under grease or air-oil lubrication.

■Bearings design

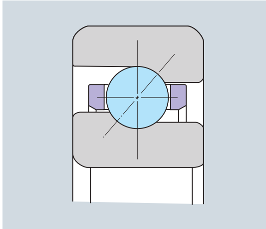
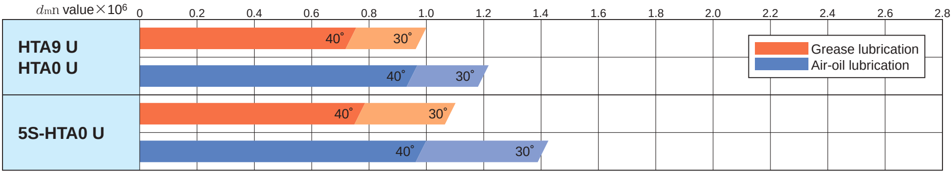


Fig. 11.2 HTA U type

■Permissible speed range



Notes) Permissible speed of each bearing (d_mn value) varies depending on the specifications of the machine for which the bearing is used (motor drive system, cooling system, and construction around the bearing). Consider the optimal choice referring to the above guideline and contact **NTN**.

■Axial rigidity

Axial rigidity is at the same level as the conventional design.

【Calculation conditions】

Bearing	HTA020UA B , HTA020A B HTA020U B , HTA020 B (φ100×φ1 0 ×22. ×2 row)
ounted preload	α 30° 880 N α 40° 14 0 N

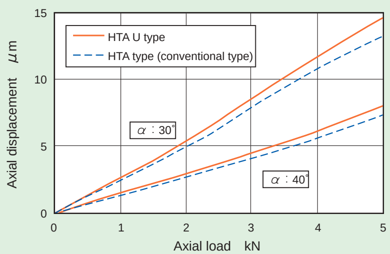


Fig. 11.3 Axial load and rigidity

■Data/Allowable axial load

By reviewing the internal structure, the allowable axial load has improved over HTA types by about 1.3 times with the contact angle of 30° and by about 1.2 times with the contact angle of 40°.

【Calculation conditions】

Bearing	HTA020UADB, HTA020ADB HTA020UDB, HTA020DB (φ100×φ150×22.5×2 row)

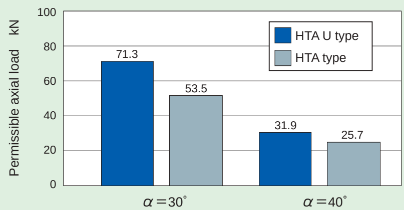


Fig. 11.4 Comparison of permissible axial load

■High speed test

d_mn value of 1.0×10⁶ under grease lubrication and 1.25×10⁶ under air-oil lubrication are realized by the optimized internal design. (**Fig.11.5～11.8**)

【Test condition】

Bearing [α:30°]	HTA020UADB HTA020ADB (φ100×φ150×22.5×2 rows)
Speed	～8000 min⁻¹
Mounted preload	880 N
Lubrication	Grease
Grease type	MP-1
Jacket coating	w/, w/o

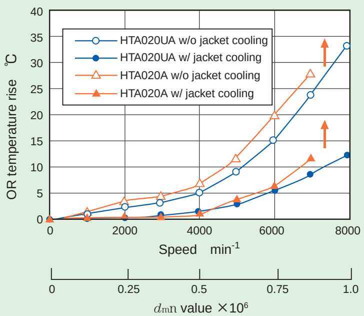


Fig. 11.5 Comparison of temperature rise (Grease, α=30°)

【Test condition】

Bearing [α:30°]	HTA020UADB HTA020ADB (φ100×φ150×22.5×2 rows)
Speed	～10000 min⁻¹
Mounted preload	880 N
Lubrication	Air- oil
Oil	0.03 mL/1shot Oil shot interval 5 min
Air	40 NL/min
Jacket cooling	w/, w/o

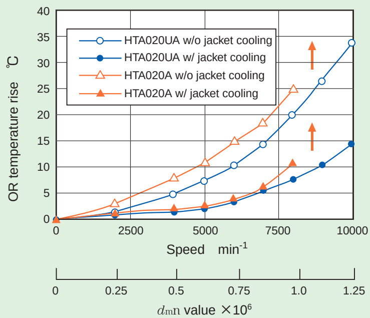


Fig. 11.6 Comparison of temperature rise (Air-oil, α=30°)

【Test condition】

Bearing [α:40°]	HTA020UDB HTA020DB (φ100×φ150×22.5×2 rows)
Speed	～6000 min⁻¹
Mounted preload	1470 N
Lubrication	Grease
Grease type	MP-1
Jacket coating	w/, w/o

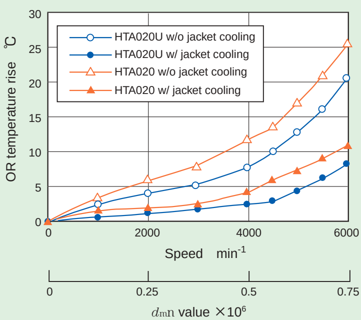


Fig. 11.7 Comparison of temperature rise (Grease, α=40°)

【Test condition】

Bearing [α:40°]	HTA020UDB HTA020DB (φ100×φ150×22.5×2 rows)
Speed	～7500 min⁻¹
Mounted preload	1470 N
Lubrication	Air- oil
Oil	0.03 mL/1shot Oil shot interval 5 min
Air	40 NL/min
Jacket cooling	w/, w/o

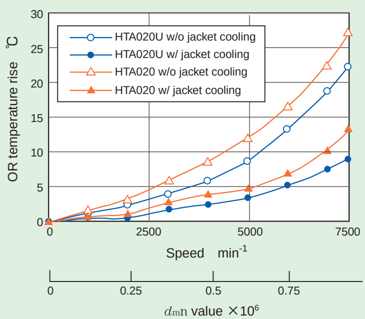
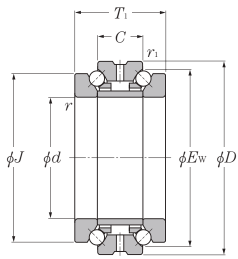


Fig. 11.8 Comparison of temperature rise (Air-oil, α=40°)

⑩ Dimension tables for angular contact ball bearings

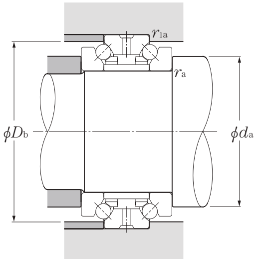
Double-direction angular contact thrust ball bearings 5629 series

Contact angle 60° d 100〜320mm



Part number		Boundary dimensions mm							Basic load ratings kN		kgf		Limiting speed min^{-1}		Mass (approx.) kg	
		d							dynamic	static	dynamic	static				
small size	large size	small size	large size	D	T_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{0a}	C_a	C_{0a}	grease lubrication	oil lubrication	small size	large size
562920	**562920M**	100	104	140	48	24	1.1	0.6	52.0	179	5 300	18 200	3 200	4 200	2.04	1.8
562921	**562921M**	105	109	145	48	24	1.1	0.6	53.5	188	5 450	19 200	3 000	4 100	2.12	1.87
562922	**562922M**	110	114	150	48	24	1.1	0.6	54.0	193	5 500	19 700	2 900	3 900	2.21	1.95
562924	**562924M**	120	124	165	54	27	1.1	0.6	65.0	242	6 600	24 700	2 600	3 500	3.06	2.75
562926	**562926M**	130	134	180	60	30	1.5	1	75.0	284	7 650	28 900	2 400	3 200	4.11	3.7
562928	**562928M**	140	144	190	60	30	1.5	1	76.0	297	7 750	30 500	2 300	3 100	4.38	3.94
562930	**562930M**	150	155	210	72	36	2	1	107	410	10 900	41 500	2 100	2 800	6.88	6.2
562932	**562932M**	160	165	220	72	36	2	1	109	430	11 100	44 000	2 000	2 600	7.26	6.53
562934	**562934M**	170	175	230	72	36	2	1	111	450	11 300	46 000	1 900	2 500	7.64	6.88
562936	**562936M**	180	186	250	84	42	2	1	156	605	15 900	62 000	1 700	2 300	11.2	10
562938	**562938M**	190	196	260	84	42	2	1	157	625	16 000	63 500	1 700	2 200	11.7	10.5
562940	**562940M**	200	207	280	96	48	2.1	1.1	185	735	18 800	75 000	1 600	2 100	16.3	14.7
562944	**562944M**	220	227	300	96	48	2.1	1.1	190	795	19 400	81 000	1 400	1 900	17.7	16
562948	**562948M**	240	247	320	96	48	2.1	1.1	196	850	20 000	87 000	1 300	1 800	19	17
562952	**562952M**	260	269	360	120	60	2.1	1.1	261	1 130	26 600	116 000	1 200	1 600	32.9	29.6
562956	**562956M**	280	289	380	120	60	2.1	1.1	265	1 190	27 000	121 000	1 100	1 500	35	31.5
562960	**562960M**	300	310	420	144	472	3	1.1	335	1 510	34 500	154 000	1 000	1 400	55	49.5
562964	**562964M**	320	330	440	144	72	3	1.1	340	1 580	3 500	161 000	1 000	1 300	58.1	52.3

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ Maximum circumscribed circle diameter of balls.



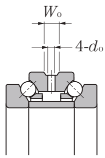
Dynamic equivalent axial load

$P_a = F_a$

Static equivalent axial load

$P_{oa} = F_a$

Reference dimensions mm		Abutment and fillet dimensions mm				Part number	
J	E_W ❷	d_a min	D_b max	r_{as} max	r_{1as} max	small size	large size
126	129	114	134.5	1	0.6	**562920**	**562920M**
131	134	119	139.5	1	0.6	**562921**	**562921M**
136	139	124	144.5	1	0.6	**562922**	**562922M**
150	154.5	138	159.5	1	0.6	**562924**	**562924M**
163	168	150	173.5	1.5	1	**562926**	**562926M**
173	178	160	183.5	1.5	1	**562928**	**562928M**
190	196.5	174	202	2	1	**562930**	**562930M**
200	206.5	184	212	2	1	**562932**	**562932M**
210	216.5	194	222	2	1	**562934**	**562934M**
227	234	207	242	2	1	**562936**	**562936M**
237	344	217	252	2	1	**562938**	**562938M**
252	261	231	270	2	1	**562940**	**562940M**
272	281	251	290	2	1	**562944**	**562944M**
292	301	271	310	2	1	**562948**	**562948M**
328	336	299	350	2	1	**562952**	**562952M**
348	356	319	370	2	1	**562956**	**562956M**
384	391	349	410	2.5	1	**562960**	**562960M**
404	411	369	430	2.5	1	**562964**	**562964M**



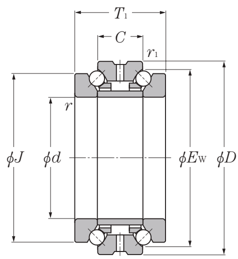
Dimensions of oil hole and oil groove

unit: mm

Nominal outer diameter D		Oil groove width	Oil hole diameter
over	incl.	W_o	d_o
150	200	8	4
200	210	12	6
210	260	12	6
260	320	14	6

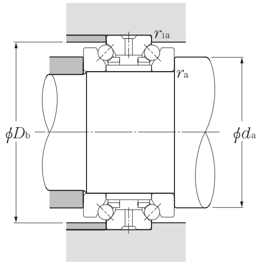
Double-direction angular contact thrust ball bearings 5620 series

Contact angle 60° d 25～320mm



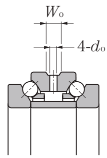
Part number		Boundary dimensions							Basic load ratings				Limiting speed		Mass	
		mm							dynamic kN	static kN	dynamic kgf	static kgf	min⁻¹		(approx.) kg	
small size	large size	d small size	d large size	D	T_1	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{0a}	C_a	C_{0a}	grease lubrication	oil lubrication	small size	large size
562005	562005M	25	27	47	28	14	0.6	0.3	13.2	28.3	1 350	2 890	10 400	14 000	0.197	0.177
562006	562006M	30	32	55	32	16	1	0.6	14.0	32.5	1 420	3 350	8 700	11 700	0.301	0.28
562007	562007M	35	37	62	34	17	1	0.6	19.7	48.5	2 010	4 950	7 700	10 300	0.394	0.35
562008	562008M	40	42	68	36	18	1	0.6	23.8	58.5	2 430	5 950	7 000	9 400	0.482	0.44
562009	562009M	45	47	75	38	19	1	0.6	26.0	69.0	2 650	7 000	6 200	8 300	0.605	0.54
562010	562010M	50	52	80	38	19	1	0.6	26.8	74.0	2 730	7 550	5 700	7 700	0.638	0.59
562011	562011M	55	57	90	44	22	1.1	0.6	37.0	99.0	3 800	10 100	5 200	7 000	0.988	0.9
562012	562012M	60	62	95	44	22	1.1	0.6	37.5	103	3 850	10 500	4 900	6 500	1.06	0.96
562013	562013M	65	67	100	44	22	1.1	0.6	39.0	111	3 950	11 300	4 600	6 100	1.08	1
562014	562014M	70	73	110	48	24	1.1	0.6	47.5	140	4 850	14 300	4 200	5 600	1.53	1.4
562015	562015M	75	78	115	48	24	1.1	0.6	49.0	150	5 000	15 300	3 900	5 300	1.61	1.5
562016	562016M	80	83	125	54	27	1.1	0.6	57.5	178	5 850	18 200	3 700	4 900	2.2	2
562017	562017M	85	88	130	54	27	1.1	0.6	58.0	184	5 950	18 800	3 500	4 700	2.31	2.1
562018	562018M	90	93	140	60	30	1.5	1	67.5	216	6 850	22 000	3 300	4 400	3.05	2.7
562019	562019M	95	98	145	60	30	1.5	1	68.0	223	6 950	22 700	3 100	4 200	3.18	2.9
562020	562020M	100	103	150	60	30	1.5	1	68.5	229	7 000	23 400	3 000	4 000	3.32	3
562021	562021M	105	109	160	66	33	2	1	78.5	266	8 000	27 100	2 800	3 800	4.19	3.7
562022	562022M	110	114	170	72	36	2	1	96.0	315	9 750	32 500	2 700	3 600	5.35	4.9
562024	562024M	120	124	180	72	36	2	1	98.0	335	10 000	34 500	2 500	3 300	5.73	5.2
562026	562026M	130	135	200	84	42	2	1	139	460	14 200	47 000	2 300	3 100	8.58	7.6
562028	562028M	140	144	210	84	42	2	1	144	495	14 600	50 500	2 200	2 900	9.1	8.1
562030	562030M	150	155	225	90	45	2.1	1.1	147	525	15 000	53 500	2 000	2 700	11.2	10
562032	562032M	160	165	240	96	48	2.1	1.1	172	620	17 600	63 000	1 900	2 500	13.6	11.9
562034	562034M	170	175	260	108	54	2.1	1.1	202	735	20 600	75 000	1 800	2 400	18.5	16.5
562036	562036M	180	186	280	120	60	2.1	1.1	234	865	23 900	88 000	1 600	2 200	24.7	21.8
562038	562038M	190	196	290	120	60	2.1	1.1	236	890	24 100	91000	1 600	2 100	25.5	23
562040	562040M	200	207	310	132	66	2.1	1.1	271	1 030	27 700	105 000	1 500	2 000	32.7	29.7
562044	562044M	220	227	340	144	72	3	1.1	335	1 270	34 000	129 000	1 300	1 800	42.8	38.5
562048	562048M	240	247	360	144	72	3	1.1	340	1 350	35 000	137 000	1 300	1 700	45.8	41.2
562052	562052M	260	269	400	164	82	4	1.5	405	1 710	41 500	174 000	1 100	1 500	67	60.3
562056	562056M	280	289	420	164	82	4	1.5	415	1 810	42 500	185 000	1 100	1 500	71.1	64
562060	562060M	300	310	460	190	95	4	1.5	475	2 170	48 500	221 000	1 000	1 300	102	91.8
562964	562964M	320	330	480	190	95	4	1.5	480	2 230	4 900	228 000	1 000	1 300	108	97.2

❶ Minimum allowable value for corner radius dimension r or r_1. ❷ Maximum circumscribed circle diameter of balls.



Dynamic equivalent axial load
$P_a = F_a$

Static equivalent axial load
$P_{0a} = F_a$



Reference dimensions mm		Abutment and fillet dimensions mm				Part number	
J	E_W ❷	d_a min	D_b max	r_{as} max	r_{1as} max	small size	large size
40	41.3	33	44	0.6	0.3	**562005**	**562005M**
47	48.5	40	50.5	1	0.6	**562006**	**562006M**
53	55	45.5	57.5	1	0.6	**562007**	**562007M**
58.5	61	50	63.5	1	0.6	**562008**	**562008M**
65	67.5	56.5	70.5	1	0.6	**562009**	**562009M**
70	72.5	61.5	75.5	1	0.6	**562010**	**562010M**
78	81	67.5	84	1	0.6	**562011**	**562011M**
83	86.1	72.5	89	1	0.6	**562012**	**562012M**
88	91	77.5	94	1	0.6	**562013**	**562013M**
97	100	85	104	1	0.6	**562014**	**562014M**
102	105	90	109	1	0.6	**562015**	**562015M**
110	113	96.5	119	1	0.6	**562016**	**562016M**
115	118	102	124	1	0.6	**562017**	**562017M**
123	127	109	133.5	1.5	1	**562018**	**562018M**
128	132	114	138.5	1.5	1	**562019**	**562019M**
133	137	119	143.5	1.5	1	**562020**	**562020M**
142	146	127	152	2	1	**562021**	**562021M**
150	155	133	162	2	1	**562022**	**562022M**
160	165	143	172	2	1	**562024**	**562024M**
177	182	155	192	2	1	**562026**	**562026M**
187	192	165	202	2	1	**562028**	**562028M**
200	206	178	215	2	1	**562030**	**562030M**
212	219	189	230	2	1	**562032**	**562032M**
230	236	203	250	2	1	**562034**	**562034M**
248	255	219	270	2	1	**562036**	**562036M**
258	265	229	280	2	1	**562038**	**562038M**
274	282	243	300	2	1	**562040**	**562040M**
304	310	267	330	2.5	1	**562044**	**562044M**
322	330	287	350	2.5	1	**562048**	**562048M**
354	364	315	388	3	1.5	**562052**	**562052M**
374	384	335	408	3	1.5	**562056**	**562056M**
406	418	364	448	3	1.5	**562060**	**562060M**
426	438	384	468	3	1.5	**562964**	**562964M**

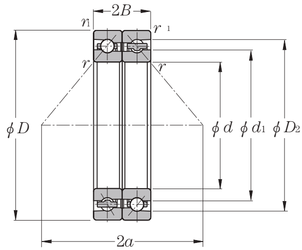
Dimensions of oil hole and oil groove

unit: mm

Nominal outer diameter D		Oil groove width	Oil hole diameter
over	incl.	W_o	d_o
	50	4.5	2
50	80	6	3
80	150	8	4
150	200	12	6
200	210	12	6
210	260	14	6
260	320	16	8

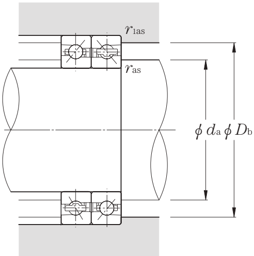
ULTAGE Angular contact ball bearings for axial loads (steel ball type) HTA9UA series

Contact angle 30° d 100～320mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static thrust load capacity kN	Static thrust load capacity kgf	Limiting speed min⁻¹ grease lubrication	Limiting speed min⁻¹ oil lubrication
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}				
HTA920UADB	100	140	36	1.1	0.6	40.0	109	4 050	11 100	66.0	6 750	8 300	10 400
HTA921UADB	105	145	36	1.1	0.6	41.0	115	4 150	11 700	70.0	7 150	8 000	10 000
HTA922UADB	110	150	36	1.1	0.6	41.5	118	4 200	12 000	72.0	7 350	7 700	9 600
HTA924UADB	120	165	40.5	1.1	0.6	48.0	140	4 900	14 300	87.5	8 900	7 000	8 800
HTA926UADB	130	180	45	1.5	1	57.5	173	5 850	17 600	103	10 500	6 500	8 100
HTA928UADB	140	190	45	1.5	1	57.5	177	5 850	18 000	106	10 800	6 100	7 600
HTA930UADB	150	210	54	2	1	80.5	243	8 200	24 800	143	14 600	5 600	6 900
HTA932UADB	160	220	54	2	1	82.0	255	8 350	26 100	151	15 400	5 300	6 600
HTA934UADB	170	230	54	2	1	84.0	268	8 550	27 300	159	16 200	5 000	6 300
HTA936UADB	180	250	63	2	1	127	400	12 900	41 000	239	24 400	4 700	5 800
HTA938UADB	190	260	63	2	1	129	420	13 200	43 000	252	25 700	4 400	5 600
HTA940UADB	200	280	72	2.1	1.1	152	500	15 500	51 000	305	31 000	4 200	5 200
HTA944UADB	220	300	72	2.1	1.1	156	535	15 900	54 500	330	33 500	3 800	4 800
HTA948UADB	240	320	72	2.1	1.1	160	570	16 300	58 000	350	35 500	3 600	4 500
HTA952UADB	260	360	90	2.1	1.1	210	745	21 400	76 000	460	47 000	3 200	4 000
HTA956UADB	280	380	90	2.1	1.1	216	795	22 000	81 000	490	50 000	3 000	3 800
HTA960UADB	300	420	108	3	1.1	276	1 020	28 100	104 000	610	62 000	2 800	3 500
HTA964UADB	320	440	108	3	1.1	280	1 060	28 500	108 000	635	65 000	2 600	3 300

❶ Minimum allowable value for corner radius dimension r or r_1.



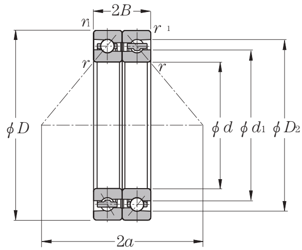
Dynamic equivalent axial load
$P_a = F_a$

Static equivalent axial load
$P_{0a} = F_a$

Load center mm $2a$	Internal free space cm³ Two row (approx.)	Mass kg Two row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{as} max	r_{1as} max	Part number
87.6	24	0.81	115.3	129.1	110	134	1	0.6	**HTA920UADB**
90.5	24	0.85	120.3	134.1	115	139	1	0.6	**HTA921UADB**
93.4	26	0.88	125.3	139.1	120	144	1	0.6	**HTA922UADB**
102.9	36	1.23	137.4	152.4	130	159	1	0.6	**HTA924UADB**
112.4	50	1.65	149.4	165.8	142	172.5	1.5	1	**HTA926UADB**
118.1	53	1.75	159.4	175.8	152	182.5	1.5	1	**HTA928UADB**
131.4	85	2.74	173.1	193.3	164	202.5	2	1	**HTA930UADB**
137.1	90	2.89	183.1	203.3	174	212.5	2	1	**HTA932UADB**
142.9	94	3.05	193.1	213.2	184	222.5	2	1	**HTA934UADB**
156.2	138	4.78	206.4	231.5	194	242.5	2	1	**HTA936UADB**
162.0	144	5.00	216.4	241.5	204	252.5	2	1	**HTA938UADB**
175.2	197	7.00	230.6	258.2	217	270	2	1	**HTA940UADB**
186.7	213	7.60	250.6	277.9	237	290	2	1	**HTA944UADB**
198.3	229	8.15	270.6	297.9	257	310	2	1	**HTA948UADB**
224.7	378	14.3	298.9	331.6	277	350	2	1	**HTA952UADB**
236.3	403	15.2	318.9	351.4	297	370	2	1	**HTA956UADB**
262.7	675	23.5	347.1	385.2	320	410	2.5	1	**HTA960UADB**
274.2	715	24.8	367.1	405.0	340	430	2.5	1	**HTA964UADB**

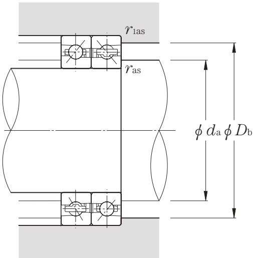
ULTAGE Angular contact ball bearings for axial loads (steel ball type) HTA9U series

Contact angle 40° d 100～320mm



Part number	Boundary dimensions mm					Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Static thrust load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}				
HTA920UDB	100	140	36	1.1	0.6	47.0	121	4 800	12 300	29.3	2 990	6 300	7 900
HTA921UDB	105	145	36	1.1	0.6	48.5	128	4 950	13 000	31.0	3 150	6 000	7 600
HTA922UDB	110	150	36	1.1	0.6	49.0	131	5 000	13 400	32.0	3 250	5 800	7 300
HTA924UDB	120	165	40.5	1.1	0.6	57.0	156	5 800	15 900	39.0	4 000	5 300	6 700
HTA926UDB	130	180	45	1.5	1	68.0	193	6 950	19 600	44.5	4 550	4 800	6 100
HTA928UDB	140	190	45	1.5	1	68.0	197	6 950	20 100	46.0	4 700	4 500	5 800
HTA930UDB	150	210	54	2	1	95.5	270	9 750	27 600	62.5	6 350	4 200	5 300
HTA932UDB	160	220	54	2	1	97.5	284	9 950	29 000	65.5	6 700	3 900	5 000
HTA934UDB	170	230	54	2	1	99.5	298	10 100	30 500	69.0	7 050	3 800	4 800
HTA936UDB	180	250	63	2	1	150	445	15 300	45 500	104	10 600	3 500	4 400
HTA938UDB	190	260	63	2	1	153	470	15 600	48 000	110	11 200	3 300	4 200
HTA940UDB	200	280	72	2.1	1.1	180	555	18 400	56 500	134	13 700	3 100	4 000
HTA944UDB	220	300	72	2.1	1.1	185	595	18 900	60 500	145	14 800	2 900	3 700
HTA948UDB	240	320	72	2.1	1.1	190	635	19 400	64 500	155	15 800	2 700	3 400
HTA952UDB	260	360	90	2.1	1.1	250	830	25 400	84 500	203	20 700	2 400	3 100
HTA956UDB	280	380	90	2.1	1.1	257	885	26 200	90 500	218	22 200	2 300	2 900
HTA960UDB	300	420	108	3	1.1	325	1 130	33 500	115 000	266	27 100	2 100	2 600
HTA964UDB	320	440	108	3	1.1	330	1 180	34 000	120 000	279	28 400	2 000	2 500

❶ Minimum allowable value for corner radius dimension r or r_1.



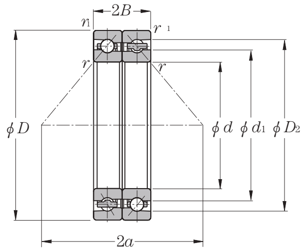
Dynamic equivalent axial load
$P_a=F_a$

Static equivalent axial load
$P_{oa}=F_a$

Load center mm	Internal free space cm³	Mass kg	Reference dimensions mm		Abutment and fillet dimensions mm				Part number
$2a$	Two row (approx.)	Two row (approx.)	d_1	D_2	d_a min	D_b max	r_{as} max	r_{1as} max	
119.1	24	0.81	115.3	129.0	110	134	1	0.6	**HTA920UDB**
123.3	24	0.85	120.3	134.0	115	139	1	0.6	**HTA921UDB**
127.5	26	0.88	125.3	139.0	120	144	1	0.6	**HTA922UDB**
140.3	36	1.23	137.4	152.3	130	159	1	0.6	**HTA924UDB**
153.1	50	1.65	149.4	165.7	142	172.5	1.5	1	**HTA926UDB**
161.5	53	1.75	159.4	175.7	152	182.5	1.5	1	**HTA928UDB**
178.7	85	2.74	173.1	193.2	164	202.5	2	1	**HTA930UDB**
187.1	90	2.89	183.1	203.2	174	212.5	2	1	**HTA932UDB**
195.5	94	3.05	193.1	213.3	184	222.5	2	1	**HTA934UDB**
212.7	138	4.78	206.4	231.5	194	242.5	2	1	**HTA936UDB**
221.1	144	5.00	216.4	241.6	204	252.5	2	1	**HTA938UDB**
238.3	197	7.00	230.6	258.2	217	270	2	1	**HTA940UDB**
255.1	213	7.60	250.6	278.2	237	290	2	1	**HTA944UDB**
271.8	229	8.15	270.6	298.0	257	310	2	1	**HTA948UDB**
306.2	378	14.3	298.9	331.6	277	350	2	1	**HTA952UDB**
323.0	403	15.2	318.9	351.6	297	370	2	1	**HTA956UDB**
357.3	675	23.5	347.1	385.0	320	410	2.5	1	**HTA960UDB**
374.1	715	24.8	367.1	405.2	340	430	2.5	1	**HTA964UDB**

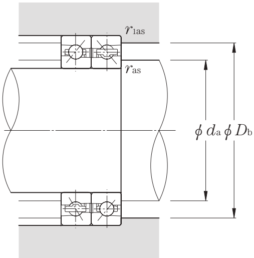
ULTAGE Angular contact ball bearings for axial loads (steel ball type) HTA0UA series

Contact angle 30° d 50～320mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static thrust load capacity kN	kgf	Limiting speed min⁻¹ grease lubrication	oil lubrication
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}				
HTA010UADB	50	80	28.5	1	0.6	24.7	48.5	2 520	4 950	23.2	2 370	15 400	19 200
HTA011UADB	55	90	33	1.1	0.6	26.8	57.5	2 730	5 850	27.7	2 820	13 800	17 200
HTA012UADB	60	95	33	1.1	0.6	28.1	63.0	2 860	6 400	30.5	3 100	12 900	16 100
HTA013UADB	65	100	33	1.1	0.6	28.5	65.0	2 900	6 650	32.0	3 250	12 100	15 200
HTA014UADB	70	110	36	1.1	0.6	35.0	82.0	3 550	8 350	40.0	4 100	11 100	13 900
HTA015UADB	75	115	36	1.1	0.6	37.0	91.5	3 800	9 300	45.5	4 650	10 500	13 200
HTA016UADB	80	125	40.5	1.1	0.6	42.5	105	4 350	10 700	52.0	5 300	9 800	12 200
HTA017UADB	85	130	40.5	1.1	0.6	43.0	108	4 400	11 100	54.5	5 550	9 300	11 600
HTA018UADB	90	140	45	1.5	1	50.0	127	5 100	13 000	63.5	6 500	8 700	10 900
HTA019UADB	95	145	45	1.5	1	50.5	131	5 150	13 400	66.0	6 750	8 300	10 400
HTA020UADB	100	150	45	1.5	1	52.5	140	5 350	14 300	71.0	7 250	8 000	10 000
HTA021UADB	105	160	49.5	2	1	60.0	163	6 100	16 600	82.5	8 400	7 500	9 400
HTA022UADB	110	170	54	2	1	74.5	200	7 600	20 400	100	10 200	7 100	8 900
HTA024UADB	120	180	54	2	1	75.0	206	7 650	21 000	104	10 600	6 700	8 300
HTA026UADB	130	200	63	2	1	108	293	11 000	29 900	144	14 700	6 100	7 600
HTA028UADB	140	210	63	2	1	111	315	11 300	32 000	156	15 900	5 700	7 100
HTA030UADB	150	225	67.5	2.1	1.1	114	330	11 700	34 000	169	17 200	5 300	6 700
HTA032UADB	160	240	72	2.1	1.1	134	390	13 700	40 000	196	20 000	5 000	6 300
HTA034UADB	170	260	81	2.1	1.1	153	450	15 900	46 000	226	23 000	4 700	5 800
HTA036UADB	180	280	90	2.1	1.1	177	530	18 100	54 000	265	27 000	4 300	5 400
HTA038UADB	190	290	91	2.1	1.1	179	545	18 300	55 500	275	28 000	4 200	5 200
HTA040UADB	200	310	99	2.1	1.1	201	610	20 500	62 000	310	31 500	3 900	4 900
HTA044UADB	220	340	108	3	1.1	253	775	25 800	79 000	385	39 500	3 600	4 500
HTA048UADB	240	360	108	3	1.1	261	825	26 600	84 000	415	42 500	3 300	4 200
HTA052UADB	260	400	123	4	1.5	310	1040	31 500	106 000	520	53 500	3 000	3 800
HTA056UADB	280	420	123	4	1.5	315	1110	32 500	113 000	565	57 500	2 900	3 600
HTA060UADB	300	460	142.5	4	1.5	360	1330	37 000	135 000	670	68 500	2 600	3 300
HTA064UADB	320	480	142.5	4	1.5	365	1360	37 000	139 000	700	71 500	2 500	3 100

❶ Minimum allowable value for corner radius dimension r or r_1.



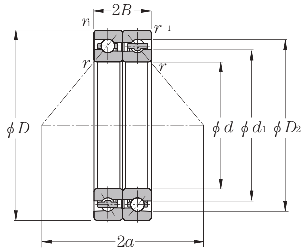
Dynamic equivalent axial load
$P_a = F_a$

Static equivalent axial load
$P_{0a} = F_a$

Load center mm $2a$	Internal free space cm³ Two row (approx.)	Mass kg Two row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{as} max	r_{1as} max	Part number
52.1	9	0.24	60.7	73.2	57.5	74.0	1	0.6	**HTA010UADB**
58.6	13	0.39	68.2	80.8	65.0	84.0	1	0.6	**HTA011UADB**
61.5	13	0.41	73.2	85.8	70.0	89.0	1	0.6	**HTA012UADB**
64.4	14	0.44	78.2	90.8	75.0	94.0	1	0.6	**HTA013UADB**
70.3	18	0.61	85.3	99.1	80.0	104	1	0.6	**HTA014UADB**
73.2	19	0.65	90.3	104.1	85.0	109	1	0.6	**HTA015UADB**
79.8	26	0.88	97.4	112.5	90.0	119	1	0.6	**HTA016UADB**
82.7	28	0.93	102.4	117.5	95.0	124	1	0.6	**HTA017UADB**
89.3	38	1.22	109.4	125.9	102	132.5	1.5	1	**HTA018UADB**
92.1	39	1.27	114.4	130.9	107	137.5	1.5	1	**HTA019UADB**
95.1	39	1.34	119.5	136.0	112	142.5	1.5	1	**HTA020UADB**
101.6	49	1.74	126.5	144.3	119	152.5	2	1	**HTA021UADB**
108.3	66	2.14	133.1	153.4	124	162.5	2	1	**HTA022UADB**
114.1	67	2.32	143.3	163.5	134	172.5	2	1	**HTA024UADB**
127.3	108	3.39	156.4	181.7	144	192.5	2	1	**HTA026UADB**
133.1	114	3.60	166.4	191.7	154	202.5	2	1	**HTA028UADB**
142.6	141	4.46	178.9	204.3	167	215	2	1	**HTA030UADB**
152.1	168	5.40	190.6	218.0	177	230	2	1	**HTA032UADB**
165.3	238	7.20	204.7	235.3	187	250	2	1	**HTA034UADB**
178.5	285	10.6	218.9	251.8	197	270	2	1	**HTA036UADB**
184.3	300	11.0	228.9	261.7	207	280	2	1	**HTA038UADB**
197.5	436	13.8	243.0	278.5	217	300	2	1	**HTA040UADB**
216.6	550	18.1	266.3	306.9	240	330	2.5	1	**HTA044UADB**
228.1	650	18.9	286.3	326.8	260	350	2.5	1	**HTA048UADB**
253.0	850	28.4	314.6	360.3	283	388	3	1.5	**HTA052UADB**
264.6	900	30.2	334.6	380.3	303	408	3	1.5	**HTA056UADB**
291.8	1265	43.6	362.9	414.0	323	448	3	1.5	**HTA060UADB**
303.3	1340	45.8	382.9	433.9	343	468	3	1.5	**HTA064UADB**

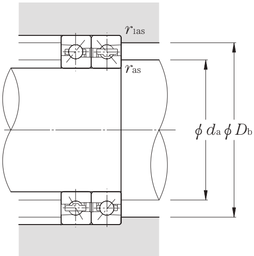
ULTAGE Angular contact ball bearings for axial loads (steel ball type) HTA0U series

Contact angle 40° d 50～320mm



Part number	Boundary dimensions mm					Basic load ratings dynamic static kN		dynamic static kgf		Static thrust load capacity		Limiting speed min⁻¹	
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	kN	kgf	grease lubrication	oil lubrication
HTA010UDB	50	80	28.5	1	0.6	29.6	55.5	3 000	5 650	12.3	1 250	11 500	14 600
HTA011UDB	55	90	33	1.1	0.6	32.0	64.0	3 250	6 500	14.3	1 460	10 300	13 100
HTA012UDB	60	95	33	1.1	0.6	33.5	69.5	3 400	7 100	15.7	1 600	9 700	12 300
HTA013UDB	65	100	33	1.1	0.6	34.0	72.0	3 450	7 350	16.4	1 670	9 100	11 500
HTA014UDB	70	110	36	1.1	0.6	41.5	91.0	4 250	9 300	21.5	2 190	8 300	10 600
HTA015UDB	75	115	36	1.1	0.6	44.0	101.0	4 500	10 300	24.0	2 450	7 900	10 000
HTA016UDB	80	125	40.5	1.1	0.6	50.5	117	5 150	11 900	28.4	2 900	7 300	9 300
HTA017UDB	85	130	40.5	1.1	0.6	51.0	120	5 200	12 300	29.4	3 000	7 000	8 800
HTA018UDB	90	140	45	1.5	1	59.5	141	6 050	14 400	32.0	3 250	6 500	8 300
HTA019UDB	95	145	45	1.5	1	60.0	146	6 100	14 900	33.5	3 400	6 300	7 900
HTA020UDB	100	150	45	1.5	1	62.0	156	6 350	15 900	35.5	3 600	6 000	7 600
HTA021UDB	105	160	49.5	2	1	71.0	181	7 250	18 400	42.5	4 350	5 700	7 200
HTA022UDB	110	170	54	2	1	88.5	222	9 000	22 700	50.0	5 100	5 400	6 800
HTA024UDB	120	180	54	2	1	89.0	228	9 050	23 300	52.0	5 300	5 000	6 300
HTA026UDB	130	200	63	2	1	128	325	13 000	33 000	74.0	7 550	4 500	5 800
HTA028UDB	140	210	63	2	1	132	345	13 500	35 500	79.5	8 100	4 300	5 400
HTA030UDB	150	225	67.5	2.1	1.1	136	370	13 800	37 500	85.0	8 650	4 000	5 200
HTA032UDB	160	240	72	2.1	1.1	159	435	16 200	44 000	103	10 500	3 800	4 800
HTA034UDB	170	260	81	2.1	1.1	182	500	18 600	51 000	116	11 800	3 500	4 400
HTA036UDB	180	280	90	2.1	1.1	211	585	21 500	60 000	140	14 300	3 300	4 100
HTA038UDB	190	290	91	2.1	1.1	214	605	21 800	61 500	145	14 800	3 100	4 000
HTA040UDB	200	310	99	2.1	1.1	240	680	24 400	69 000	159	16 200	2 900	3 700
HTA044UDB	220	340	108	3	1.1	300	860	30 500	87 500	201	20 500	2 700	3 400
HTA048UDB	240	360	108	3	1.1	310	915	31 500	93 000	216	22 000	2 500	3 200
HTA052UDB	260	400	123	4	1.5	365	1160	37 500	118 000	275	28 000	2 300	2 900
HTA056UDB	280	420	123	4	1.5	375	1230	38 500	125 000	293	29 900	2 100	2 700
HTA060UDB	300	460	142.5	4	1.5	430	1470	44 000	150 000	355	36 000	2 000	2 500
HTA064UDB	320	480	142.5	4	1.5	435	1520	44 000	155 000	365	37 000	1 900	2 400

❶ Minimum allowable value for corner radius dimension r or r_1.



Dynamic equivalent axial load

$P_a = F_a$

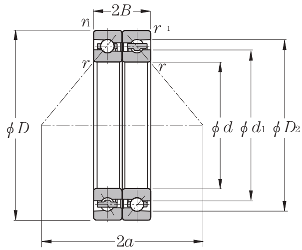
Static equivalent axial load

$P_{0a} = F_a$

Load center mm $2a$	Internal free space cm³ Two row (approx.)	Mass kg Two row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{as} max	r_{1as} max	Part number
69.2	9	0.24	60.7	73.1	57.5	74.0	1	0.6	**HTA010UDB**
77.7	13	0.39	68.2	80.7	65.0	84.0	1	0.6	**HTA011UDB**
81.9	13	0.41	73.2	85.7	70.0	89.0	1	0.6	**HTA012UDB**
86.1	14	0.44	78.2	90.7	75.0	94.0	1	0.6	**HTA013UDB**
94.0	18	0.61	85.3	99.0	80.0	104	1	0.6	**HTA014UDB**
98.2	19	0.65	90.3	104.0	85.0	109	1	0.6	**HTA015UDB**
106.7	26	0.88	97.4	112.4	90.0	119	1	0.6	**HTA016UDB**
110.9	28	0.93	102.4	117.4	95.0	124	1	0.6	**HTA017UDB**
119.5	38	1.22	109.4	125.8	102	132.5	1.5	1	**HTA018UDB**
123.7	39	1.27	114.4	130.8	107	137.5	1.5	1	**HTA019UDB**
128.0	39	1.34	119.5	135.9	112	142.5	1.5	1	**HTA020UDB**
136.5	49	1.74	126.5	144.2	119	152.5	2	1	**HTA021UDB**
145.1	66	2.14	133.1	153.3	124	162.5	2	1	**HTA022UDB**
153.6	67	2.32	143.3	163.4	134	172.5	2	1	**HTA024UDB**
170.8	108	3.39	156.4	181.6	144	192.5	2	1	**HTA026UDB**
179.2	114	3.60	166.4	191.6	154	202.5	2	1	**HTA028UDB**
191.9	141	4.46	178.9	204.2	167	215	2	1	**HTA030UDB**
204.7	168	5.40	190.6	218.4	177	230	2	1	**HTA032UDB**
221.9	238	7.20	204.7	235.2	187	250	2	1	**HTA034UDB**
239.1	285	10.6	218.9	251.6	197	270	2	1	**HTA036UDB**
247.4	300	11.0	228.9	261.6	207	280	2	1	**HTA038UDB**
264.6	436	13.8	243.0	278.4	217	300	2	1	**HTA040UDB**
290.3	550	18.1	266.3	306.7	240	330	2.5	1	**HTA044UDB**
307.0	650	18.9	286.3	326.6	260	350	2.5	1	**HTA048UDB**
339.9	850	28.4	314.6	360.1	283	388	3	1.5	**HTA052UDB**
356.7	900	30.2	334.6	380.1	303	408	3	1.5	**HTA056UDB**
391.7	1265	43.6	362.9	413.7	323	448	3	1.5	**HTA060UDB**
408.5	1340	45.8	382.9	433.7	343	468	3	1.5	**HTA064UDB**

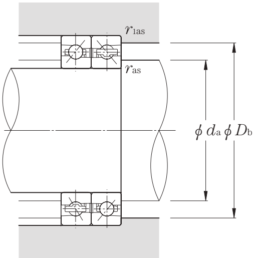
ULTAGE Angular contact ball bearings for axial loads (ceramic ball type) 5S-HTA0UA series

Contact angle 30° d 50～130mm



Part number	Boundary dimensions mm					Basic load ratings dynamic static dynamic static kN kgf				Static thrust load capacity kN kgf		Limiting speed min⁻¹	
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a (kN)	C_{oa} (kN)	C_a (kgf)	C_{oa} (kgf)	kN	kgf	grease lubrication	oil lubrication
5S-HTA010UADB	50	80	28.5	1	0.6	24.7	33.5	2 520	3 400	15.7	1 600	17 300	22 200
5S-HTA011UADB	55	90	33	1.1	0.6	26.8	40.0	2 730	4 050	18.6	1 900	15 500	19 900
5S-HTA012UADB	60	95	33	1.1	0.6	28.1	43.5	2 860	4 450	20.5	2 090	14 500	18 600
5S-HTA013UADB	65	100	33	1.1	0.6	28.5	45.0	2 900	4 600	21.6	2 200	13 600	17 500
5S-HTA014UADB	70	110	36	1.1	0.6	35.0	57.0	3 550	5 800	27.2	2 770	12 500	16 000
5S-HTA015UADB	75	115	36	1.1	0.6	37.0	63.5	3 800	6 450	30.5	3 150	11 800	15 200
5S-HTA016UADB	80	125	40.5	1.1	0.6	42.5	73.0	4 350	7 400	35.0	3 600	11 000	14 100
5S-HTA017UADB	85	130	40.5	1.1	0.6	43.0	75.0	4 400	7 650	36.5	3 750	10 500	13 400
5S-HTA018UADB	90	140	45	1.5	1	49.5	88.5	5 050	9 000	43.0	4 400	9 800	12 500
5S-HTA019UADB	95	145	45	1.5	1	50.5	91.0	5 150	9 300	44.5	4 550	9 400	12 000
5S-HTA020UADB	100	150	45	1.5	1	52.5	97.0	5 350	9 900	48.0	4 900	9 000	11 500
5S-HTA021UADB	105	160	49.5	2	1	60.0	113	6 100	11 500	55.5	5 650	8 500	10 900
5S-HTA022UADB	110	170	54	2	1	74.0	139	7 550	14 100	67.0	6 850	8 000	10 300
5S-HTA024UADB	120	180	54	2	1	75.0	143	7 650	14 500	70.0	7 150	7 500	9 600
5S-HTA026UADB	130	200	63	2	1	108	203	11 000	20 700	97.0	9 900	6 800	8 700

❶ Minimum allowable value for corner radius dimension r or r_1.



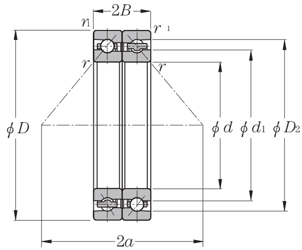
Dynamic equivalent axial load
$P_a=F_a$

Static equivalent axial load
$P_{oa}=F_a$

Load center mm $2a$	Internal free space cm³ Two row (approx.)	Mass kg Two row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{as} max	r_{1as} max	Part number
52.1	9	0.22	60.7	73.2	57.5	74.0	1	0.6	**5S-HTA010UADB**
58.6	13	0.36	68.2	80.8	65.0	84.0	1	0.6	**5S-HTA011UADB**
61.5	13	0.39	73.2	85.8	70.0	89.0	1	0.6	**5S-HTA012UADB**
64.4	14	0.41	78.2	90.8	75.0	94.0	1	0.6	**5S-HTA013UADB**
70.3	18	0.57	85.3	99.1	80.0	104	1	0.6	**5S-HTA014UADB**
73.2	19	0.60	90.3	104.1	85.0	109	1	0.6	**5S-HTA015UADB**
79.8	26	0.83	97.4	112.5	90.0	119	1	0.6	**5S-HTA016UADB**
82.7	28	0.87	102.4	117.5	95.0	124	1	0.6	**5S-HTA017UADB**
89.3	38	1.15	109.4	125.9	102	132.5	1.5	1	**5S-HTA018UADB**
92.1	39	1.20	114.4	130.9	107	137.5	1.5	1	**5S-HTA019UADB**
95.1	39	1.26	119.5	136.0	112	142.5	1.5	1	**5S-HTA020UADB**
101.6	49	1.64	126.5	144.3	119	152.5	2	1	**5S-HTA021UADB**
108.3	66	2.00	133.1	153.4	124	162.5	2	1	**5S-HTA022UADB**
114.1	67	2.17	143.3	163.5	134	172.5	2	1	**5S-HTA024UADB**
127.3	108	3.13	156.4	181.7	144	192.5	2	1	**5S-HTA026UADB**

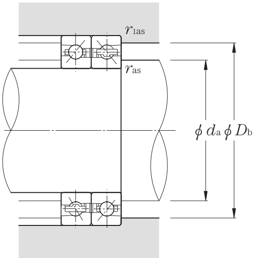
ULTAGE Angular contact ball bearings for axial loads (ceramic ball type) 5S-HTA0U series

Contact angle 40° d 50〜130mm



Part number	Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Static thrust load capacity kN	Static thrust load capacity kgf	Limiting speed min⁻¹ grease lubrication	Limiting speed min⁻¹ oil lubrication
	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}				
5S-HTA010UDB	50	80	28.5	1	0.6	29.6	38.5	3 000	3 900	14.6	1 490	12 200	15 400
5S-HTA011UDB	55	90	33	1.1	0.6	32.0	44.5	3 250	4 500	17.1	1 740	10 900	13 800
5S-HTA012UDB	60	95	33	1.1	0.6	33.5	48.0	3 400	4 900	18.7	1 910	10 200	12 900
5S-HTA013UDB	65	100	33	1.1	0.6	34.0	50.0	3 450	5 100	19.6	2 000	9 600	12 100
5S-HTA014UDB	70	110	36	1.1	0.6	41.5	63.0	4 250	6 450	25.6	2 610	8 800	11 100
5S-HTA015UDB	75	115	36	1.1	0.6	44.0	70.5	4 500	7 150	28.7	2 930	8 300	10 500
5S-HTA016UDB	80	125	40.5	1.1	0.6	50.5	81.0	5 150	8 250	34.0	3 450	7 700	9 800
5S-HTA017UDB	85	130	40.5	1.1	0.6	51.0	83.5	5 200	8 500	35.0	3 600	7 300	9 300
5S-HTA018UDB	90	140	45	1.5	1	59.5	98.0	6 050	10 000	38.0	3 900	6 900	8 700
5S-HTA019UDB	95	145	45	1.5	1	60.0	101	6 100	10 300	39.5	4 050	6 600	8 300
5S-HTA020UDB	100	150	45	1.5	1	62.0	108	6 350	11 000	42.5	4 300	6 300	8 000
5S-HTA021UDB	105	160	49.5	2	1	71.0	125	7 250	12 800	50.5	5 150	6 000	7 500
5S-HTA022UDB	110	170	54	2	1	88.5	154	9 000	15 700	59.5	6 100	5 600	7 100
5S-HTA024UDB	120	180	54	2	1	89.0	158	9 050	16 100	61.5	6 300	5 300	6 700
5S-HTA026UDB	130	200	63	2	1	128	225	13 000	23 000	88.0	9 000	4 800	6 100

❶ Minimum allowable value for corner radius dimension r or r_1.



Dynamic equivalent axial load
$P_a=F_a$

Static equivalent axial load
$P_{oa}=F_a$

Load center mm $2a$	Internal free space cm^3 Two row (approx.)	Mass kg Two row (approx.)	Reference dimensions mm d_1	D_2	Abutment and fillet dimensions mm d_a min	D_b max	r_{as} max	r_{1as} max	Part number
69.2	9	0.22	60.7	73.1	57.5	74.0	1	0.6	**5S-HTA010UDB**
77.7	13	0.36	68.2	80.7	65.0	84.0	1	0.6	**5S-HTA011UDB**
81.9	13	0.39	73.2	85.7	70.0	89.0	1	0.6	**5S-HTA012UDB**
86.1	14	0.41	78.2	90.7	75.0	94.0	1	0.6	**5S-HTA013UDB**
94.0	18	0.57	85.3	99.0	80.0	104	1	0.6	**5S-HTA014UDB**
98.2	19	0.60	90.3	104.0	85.0	109	1	0.6	**5S-HTA015UDB**
106.7	26	0.83	97.4	112.4	90.0	119	1	0.6	**5S-HTA016UDB**
110.9	28	0.87	102.4	117.4	95.0	124	1	0.6	**5S-HTA017UDB**
119.5	38	1.15	109.4	125.8	102	132.5	1.5	1	**5S-HTA018UDB**
123.7	39	1.20	114.4	130.8	107	137.5	1.5	1	**5S-HTA019UDB**
128.0	39	1.26	119.5	135.9	112	142.5	1.5	1	**5S-HTA020UDB**
136.5	49	1.64	126.5	144.2	119	152.5	2	1	**5S-HTA021UDB**
145.1	66	2.00	133.1	153.3	124	162.5	2	1	**5S-HTA022UDB**
153.6	67	2.17	143.3	163.4	134	172.5	2	1	**5S-HTA024UDB**
170.8	108	3.13	156.4	181.6	144	192.5	2	1	**5S-HTA026UDB**

Main Spindle Bearings

12. Tapered Roller Bearings CONTENTS

12. Tapered Roller Bearings

Tapered roller bearings are designed so that the apexes of the inner ring, outer ring, and rollers are located at a common point on the bearing center line. Accordingly, the rollers roll on the raceway surfaces and slide along the back rib of the inner ring cone, guided by the resultant force from the inner ring and outer ring raceways.

This bearing is suitable for handling a radial load, an axial load in one direction, and the resultant load. Also, it has a large load capacity.

In general, the cage of a tapered roller bearing is a punched steel plate type. If P4 or higher is needed for running accuracy, **NTN** recommends that a high-strength machined brass cage to be used.

① Load calculation

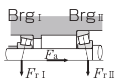
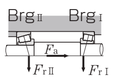
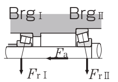
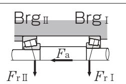
Tapered roller bearings are generally used in pairs, so their dynamic equivalent load can be calculated according to **Table 12.1.**

② Bearing designations

329 18 X U DB +xx P4

- **P4** — **Tolerance class code**
  - P5: JIS class 5
  - P4: JIS class 4
  - UP: **NTN** special high precision
- **+xx** — **Spacer width dimension**
- **DB** — **Duplex arrangement code**
  - DB: Back-to-back
  - DF: Face-to-face
- **U** — **Internal modification code**
- **18 X** — **Nominal bore diameter**
- **329** — **Bearing series code**

Table 12.1 Bearing arrangement and equivalent load

Bearing arrangement		Load condition	Axial load	Equivalent radial load
DB arrangement		$\frac{0.5F_{rI}}{Y_I} \leqq \frac{0.5F_{rII}}{Y_{II}} + F_a$	$F_{aI} = \frac{0.5F_{rII}}{Y_{II}} + F_a$	$P_{rI} = XF_{rI} + Y_I\left(\frac{0.5F_{rII}}{Y_{II}} + F_a\right)$
			$F_{aII} = \frac{0.5F_{rII}}{Y_{II}}$	$P_{rII} = F_{rII}$
DF arrangement		$\frac{0.5F_{rI}}{Y_I} > \frac{0.5F_{rII}}{Y_{II}} + F_a$	$F_{aI} = \frac{0.5F_{rI}}{Y_I}$	$P_{rI} = F_{rI}$
			$F_{aII} = \frac{0.5F_{rI}}{Y_I} - F_a$	$P_{rII} = XF_{rII} + Y_{II}\left(\frac{0.5F_{rI}}{Y_I} - F_a\right)$
DB arrangement		$\frac{0.5F_{rII}}{Y_{II}} \leqq \frac{0.5F_{rI}}{Y_I} + F_a$	$F_{aI} = \frac{0.5F_{rI}}{Y_I}$	$P_{rI} = F_{rI}$
			$F_{aII} = \frac{0.5F_{rI}}{Y_I} + F_a$	$P_{rII} = XF_{rII} + Y_{II}\left(\frac{0.5F_{rI}}{Y_I} + F_a\right)$
DF arrangement		$\frac{0.5F_{rII}}{Y_{II}} > \frac{0.5F_{rI}}{Y_I} + F_a$	$F_{aI} = \frac{0.5F_{rII}}{Y_{II}} - F_a$	$P_{rI} = XF_{rI} + Y_I\left(\frac{0.5F_{rII}}{Y_{II}} - F_a\right)$
			$F_{aII} = \frac{0.5F_{rII}}{Y_{II}}$	$P_{rII} = F_{rII}$

Note 1: The above are valid when the bearing internal clearance and preload are zero.
2: Radial forces in the opposite direction to the arrow in the above illustration are also regarded as positive.

③ Accuracy

Table 12.2 Inner rings

Unit: μm

Nominal bore diameter *d* mm		Deviation of mean bore diameter in a single plane *dmp*				Variation of bore diameter in a single plane *Vdsp*		Mean bore diameter deviation *Vdmp*		Radial runout *Kia*		Perpendicularity of inner ring face with respect to the bore *Sd*		Axial runout *Sia*	Width variation *Bs*		Deviation of the actual bearing width *Ts*	
		Class 5		Class 4 ❶		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 4	Class 5	Class 4	Class 5	Class 4
over	incl.	high	low	high	low	max		max		max		max		max	high	low	high	low
18	30	0	−8	0	−6	6	5	5	4	5	3	8	4	4	0	−200	+200	−200
30	50	0	−10	0	−8	8	6	5	5	6	4	8	4	4	0	−240	+200	−200
50	80	0	−12	0	−9	9	7	6	5	7	4	8	5	4	0	−300	+200	−200
80	120	0	−15	0	−10	11	8	8	5	8	5	9	5	5	0	−400	+200	−200
120	180	0	−18	0	−13	14	10	9	7	11	6	10	6	7	0	−500	+350	−250
180	250	0	−22	0	−15	17	11	11	8	13	8	11	7	8	0	−600	+350	−250

❶ The tolerance of bore diameter deviation *ds* applicable to class 4 is the same as the tolerance of single plane mean bore diameter deviation *dmp*.

Table 12.3 Outer rings

Unit: μm

Nominal bore diameter *D* mm		Deviation of mean outside diameter in a single plane *Dmp*				Variation of outside diameter in a single plane *VDsp*		Mean single plane outside diameter variation *VDmp*		Radial runout *Kea*		Perpendicularity of outer ring outside surface with respect to the face *SD*		Axial runout *Sea*
		Class 5		Class 4 ❷		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 4
over	incl.	high	low	high	low	max		max		max		max		max
30	50	0	−9	0	−7	7	5	5	5	7	5	8	4	5
50	80	0	−11	0	−9	8	7	6	5	8	5	8	4	5
80	120	0	−13	0	−10	10	8	7	5	10	6	9	5	6
120	150	0	−15	0	−11	11	8	8	6	11	7	10	5	7
150	180	0	−18	0	−13	14	10	9	7	13	8	10	5	8
180	250	0	−20	0	−15	15	11	10	8	15	10	11	7	10
250	315	0	−25	0	−18	19	14	13	9	18	11	13	8	10

❷ The tolerance of outside diameter deviation *Ds* applicable to class 4 is the same as the tolerance of single plane mean outside diameter deviation *Dmp*.

④ Recommended fit for high-precision tapered roller bearings

Table 12.4 Fit to shaft

Unit: μm

Nominal bore diameter *d* mm		Fit between inner ring and shaft	
		Fixed side	Floating side
over	incl.	Targeted ❶ interference	Targeted ❶ interference
18	30	0～5T	0～1T
30	50	0～6T	0～2T
50	80	0～7T	0～3T
80	120	0～8T	0～4T
120	180	0～10T	0～5T
180	250	0～13T	0～6T
250	315	0～15T	0～6T
315	400	0～18T	0～8T

❶ Target the median value.
T: Tight (Interference)

Table 12.5 Fit to housing

Unit: μm

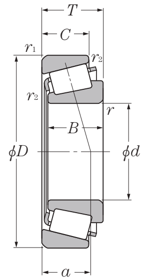
Nominal bore diameter *D* mm		Fit between outer ring and housing
over	incl.	Targeted interference ❶
30	50	3L～3T
50	80	3L～3T
80	120	4L～4T
120	150	5L～5T
150	180	5L～5T
180	250	6L～6T
250	315	7L～7T
315	400	8L～8T
400	500	9L～9T

For precision main spindles, the tight (interference) side of the targeted interference is recommended for the precision tool side.

⑤ Dimension tables for tapered roller bearings

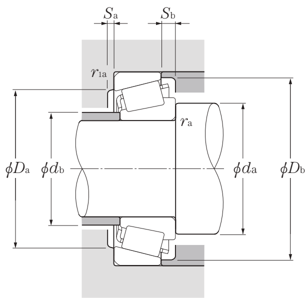
Tapered Roller Bearings

d 20～95mm



part number	Boundary dimensions (mm)								Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Limiting speed (min^{-1})	
	d	D	T	B	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	$r_{2s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	grease lubrication	oil lubrication
4T-32004X	20	42	15	15	12	0.6	0.6	0.15	24.9	27.9	2 540	2 840	9 500	13 000
4T-32005X	25	47	15	15	11.5	0.6	0.6	0.15	27.8	33.5	2 830	3 450	7 900	11 000
4T-32006X	30	55	17	17	13	1	1	0.3	37.5	46.0	3 800	4 700	6 900	9 200
4T-32007X	35	62	18	18	14	1	1	0.3	41.5	52.5	4 250	5 350	6 100	8 100
4T-32008X	40	68	19	19	14.5	1	1	0.3	50.0	65.5	5 100	6 650	5 300	7 100
4T-32009X	45	75	20	20	15.5	1	1	0.3	57.5	76.5	5 850	7 800	4 800	6 400
32910XU	50	72	15	15	12	0.6	0.6	0.15	35.5	57.0	3 650	5 800	4 700	6 300
4T-32010X	50	80	20	20	15.5	1	1	0.3	62.5	88.0	6 400	9 000	4 400	5 800
32911XU	55	80	17	17	14	1	1	0.3	44.5	73.5	4 550	7 500	4 300	5 700
4T-32011X	55	90	23	23	17.5	1.5	1.5	0.6	80.5	118	8 200	12 000	4 000	5 400
32912XA	60	85	17	17	14	1	1	0.3	51.0	83.0	5 200	8 450	4 000	5 300
4T-32012X	60	95	23	23	17.5	1.5	1.5	0.6	82.0	123	8 350	12 500	3 700	4 900
32913XU	65	90	17	17	14	1	1	0.3	48.5	85.0	4 900	8 700	3 700	4 900
4T-32013X	65	100	23	23	17.5	1.5	1.5	0.6	83.0	128	8 450	13 000	3 400	4 600
32914XU	70	100	20	20	16	1	1	0.3	68.5	110	7 000	11 200	3 400	4 600
4T-32014X	70	110	25	25	19	1.5	1.5	0.6	105	160	10 700	16 400	3 200	4 200
32915XU	75	105	20	20	16	1	1	0.3	69.5	114	7 100	11 600	3 200	4 300
32015XU	75	115	25	25	19	1.5	1.5	0.6	106	167	10 800	17 000	3 000	4 000
32916XU	80	110	20	20	16	1	1	0.3	72.0	121	7 350	12 400	3 000	4 000
32016XU	80	125	29	29	22	1.5	1.5	0.6	139	216	14 200	22 000	2 800	3 700
32917XU	85	120	23	23	18	1.5	1.5	0.6	94.0	157	9 600	16 100	2 800	3 800
32017XU	85	130	29	29	22	1.5	1.5	0.6	142	224	14 400	22 900	2 600	3 500
32918XU	90	125	23	23	18	1.5	1.5	0.6	97.5	168	9 950	17 100	2 700	3 600
32018XU	90	140	32	32	24	2	1.5	0.6	168	270	17 200	27 600	2 500	3 300
32919XU	95	130	23	23	18	1.5	1.5	0.6	101	178	10 300	18 200	2 500	3 400
32019XU	95	145	32	32	24	2	1.5	0.6	171	280	17 500	28 600	2 300	3 100

❶ Minimum allowable value for chamfer dimension r, r_1 or r_2.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{or} = 0.5F_r + Y_0F_a$

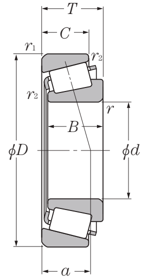
Note that when $P_{or} < F_r$, $P_{or} = F_r$.

The values for e, Y_2 and Y_0 are given in the table below.

Abutment and fillet dimensions mm									Load center mm	Factor	Axial load factor		Mass kg
d_a min	d_b max	D_a max	D_a min	D_b min	S_a min	S_b min	r_{as} max	r_{1as} max	a	e	Y_2	Y_0	(approx.)
24.5	25	37.5	36	39	3	3	0.6	0.6	10.5	0.37	1.60	0.88	0.097
29.5	30	42.5	40	44	3	3.5	0.6	0.6	12	0.43	1.39	0.77	0.114
35.5	35	49.5	48	52	3	4	1	1	13.5	0.43	1.39	0.77	0.166
40.5	40	56.5	54	59	4	4	1	1	15.5	0.45	1.32	0.73	0.224
45.5	46	62.5	60	65	4	4.5	1	1	15	0.38	1.58	0.87	0.273
50.5	51	69.5	67	72	4	4.5	1	1	16.5	0.39	1.53	0.84	0.346
54.5	54	67.5	63.5	69	3	3	0.6	0.6	13.5	0.34	1.76	0.97	1.191
55.5	56	74.5	72	77	4	4.5	1	1	17.5	0.42	1.42	0.78	0.366
60.5	60.5	74.5	70.5	76.5	3	3	1	1	14.5	0.31	1.94	1.07	0.274
63.5	63	81.5	81	86	4	5.5	1.5	1.5	20	0.41	1.48	0.81	0.563
65.5	65.5	79.5	76.5	82	3	3	1	1	15.5	0.33	1.80	0.99	0.296
68.5	67	86.5	85	91	4	5.5	1.5	1.5	21	0.43	1.39	0.77	0.576
70.5	70	84.5	80	86.5	3	3	1	1	16.5	0.35	1.70	0.93	0.315
73.5	72	91.5	90	97	4	5.5	1.5	1.5	22.5	0.46	1.31	0.72	0.63
75.5	75	94.5	90	96	4	4	1	1	18	0.32	1.90	1.05	0.487
78.5	78	101.5	98	105	5	6	1.5	1.5	24	0.43	1.38	0.76	0.848
80.5	80	99.5	94	101.5	4	4	1	1	19	0.33	1.80	0.99	0.511
83.5	83	106.5	103	110	5	6	1.5	1.5	25.5	0.46	1.31	0.72	0.909
85.5	85	104.5	99	106.5	4	4	1	1	20	0.35	1.71	0.94	0.54
88.5	89	116.5	112	120	6	7	1.5	1.5	27	0.42	1.42	0.78	1.28
93.5	92	111.5	111	115	4	5	1.5	1.5	21	0.33	1.83	1.01	0.733
93.5	94	121.5	117	125	6	7	1.5	1.5	28.5	0.44	1.36	0.75	1.35
98.5	96	116.5	112.5	120.5	4	5	1.5	1.5	22	0.34	1.75	0.96	0.817
100	100	131.5	125	134	6	8	2	1.5	30	0.42	1.42	0.78	1.79
103.5	101	121.5	117	125.5	4	5	1.5	1.5	23.5	0.36	1.68	0.92	0.851
105	105	136.5	130	140	6	8	2	1.5	31.5	0.44	1.36	0.75	1.83

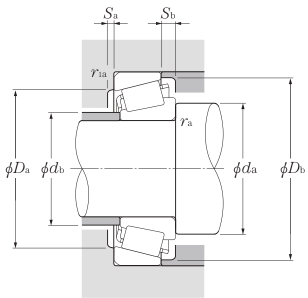
Tapered Roller Bearings

d 100〜190mm



part number	Boundary dimensions mm								Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Limiting speed min^{-1}	
	d	D	T	B	C	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	$r_{2s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}	grease lubrication	oil lubrication
32920XU	100	140	25	25	20	1.5	1.5	0.6	121	206	12 300	21 000	2 400	3 200
32020XU	100	150	32	32	24	2	1.5	0.6	170	281	17 300	28 600	2 200	3 000
32921XA	105	145	25	25	20	1.5	1.5	0.6	126	219	12 800	22 400	2 300	3 000
32021XU	105	160	35	35	26	2.5	2	0.6	201	335	20 500	34 000	2 100	2 800
32922XA	110	150	25	25	20	1.5	1.5	0.6	127	226	13 000	23 100	2 200	2 900
32022XU	110	170	38	38	29	2.5	2	0.6	236	390	24 000	39 500	2 000	2 700
32924XU	120	165	29	29	23	1.5	1.5	0.6	162	294	16 500	30 000	2 000	2 600
32024XU	120	180	38	38	29	2.5	2	0.6	245	420	25 000	43 000	1 800	2 500
32926XU	130	180	32	32	25	2	1.5	0.6	194	350	19 800	36 000	1 800	2 400
32026XU	130	200	45	45	34	2.5	2	0.6	320	545	32 500	55 500	1 700	2 200
32928XU	140	190	32	32	25	2	1.5	0.6	200	375	20 400	38 000	1 700	2 200
32028XU	140	210	45	45	34	2.5	2	0.6	330	580	33 500	59 500	1 600	2 100
32930XU	150	210	38	38	30	2.5	2	0.6	268	490	27 300	50 000	1 600	2 100
32030XU	150	225	48	48	36	3	2.5	1	370	655	37 500	67 000	1 400	1 900
32932XU	160	220	38	38	30	2.5	2	0.6	276	520	28 200	53 000	1 500	1 900
32032XU	160	240	51	51	38	3	2.5	1	435	790	44 500	80 500	1 400	1 800
32934XU	170	230	38	38	30	2.5	2	0.6	286	560	29 200	57 000	1 400	1 800
32034XU	170	260	57	57	43	3	2.5	1	500	895	51 000	91 000	1 300	1 700
32936XU	180	250	45	45	34	2.5	2	0.6	350	700	36 000	71 500	1 300	1 700
32938XU	190	260	45	45	34	2.5	2	0.6	355	710	36 000	72 000	1 200	1 600

❶ Minimum allowable value for chamfer dimension r, r_1 or r_2.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{or} = 0.5F_r + Y_o F_a$

Note that when $P_{or} < F_r$, $P_{or} = F_r$.

The values for e, Y_2 and Y_o are given in the table below.

Abutment and fillet dimensions mm									Load center mm	Factor	Axial load factor		Mass kg
d_a min	d_b max	D_a max	D_a min	D_b min	S_a min	S_b min	r_{as} max	r_{1as} max	a	e	Y_2	Y_0	(approx.)
108.5	107.5	131.5	127.5	135.5	4	5	1.5	1.5	24.5	0.33	1.82	1.00	1.14
110	109	141.5	134	144	6	8	2	1.5	32.5	0.46	1.31	0.72	1.91
113.5	113.5	136.5	131.5	140.5	5	5	1.5	1.5	25	0.34	1.76	0.97	1.2
117	116	150	143	154	6	9	2	2	34.5	0.44	1.35	0.74	2.42
118.5	117.5	141.5	137	145.5	5	5	1.5	1.5	26.5	0.36	1.69	0.93	1.23
122	122	160	152	163	7	9	2	2	36.5	0.43	1.39	0.77	3.07
128.5	128.5	156.5	150	160	6	6	1.5	1.5	29.5	0.35	1.72	0.95	1.77
132	131	170	161	173	7	9	2	2	39	0.46	1.31	0.72	3.25
140	139	171.5	163.5	174	6	7	2	1.5	31.5	0.34	1.77	0.97	2.36
142	144	190	178	192	8	11	2	2	43.5	0.43	1.38	0.76	4.96
150	150	181.5	177	184	6	6	2	1.5	34	0.36	1.67	0.92	2.51
152	153	200	187	202	8	11	2	2	46	0.46	1.31	0.72	5.28
162	162	200	192	202	7	8	2	2	36.5	0.33	1.83	1.01	3.92
164	164	213	200	216	8	12	2.5	2	49.5	0.46	1.31	0.72	6.37
172	170.5	210	199	213.5	7	8	2	2	38.5	0.35	1.73	0.95	4.15
174	175	228	213	231	8	13	2.5	2	52.5	0.46	1.31	0.72	7.8
182	183	220	213	222	7	8	2	2	42.5	0.38	1.57	0.86	4.4
184	187	248	230	249	10	14	2.5	2	56	0.44	1.35	0.74	10.5
192	193	240	225	241	8	11	2	2	54	0.48	1.25	0.69	6.54
202	204	250	235	251	8	11	2	2	55	0.48	1.26	0.69	6.77


JAPAN ZA
NTN

Ball Screw Support Bearings

13. Ball Screw Support Bearings CONTENTS

13. Ball Screw Support Bearings

NTN ballscrew bearings are optimized to support a ballscrew.
These bearings are categorized as shown in **Table 13.1**.

Table 13.1 Bearing types

Type code	Notes	Bore diameter
BST **2A-BST**	Open type thrust angular contact ball bearing with 60˚ contact angle, generally used with grease lubrication	φ17〜φ60
BST LXL/L588 **2A-BST LXL/L588**	Grease-lubricated sealed angular contact ball bearing with 60˚ contact angle	φ17〜φ60
BSTU LLX/L588	Grease-lubricated sealed double row thrust angular contact ball bearing unit with 60˚ contact angle	φ20〜φ100
HT	Duplex angular contact ball bearing with 30˚ contact angle, generally used with grease lubrication	φ6〜φ40
AXN	Needle roller bearing with double-direction thrust needle roller bearing, generally used with oil lubrication	φ20〜φ50
ARN	Needle roller bearing with double-direction thrust cylindrical roller bearing, generally used with oil lubrication	φ20〜φ70

① ULTAGE Angular contact thrust ball bearings BST-1B (LXL/L588), 2A-BST-1B (LXL/L588) series

The 2A-BST type incorporates the maximum possible number of small balls (compared with those of a standard bearing), has thicker inner and outer rings, and a larger contact angle of 60˚. Thus, this type of bearing boasts greater axial rigidity. Additionally, since balls are used as the rolling elements, the starting torque of a angular contact thrust ball bearing is less than that of a roller bearing.

Open (BST and 2A-BST type) and light-contact seals (BST LXL and 2A-BST LXL type) are available and molded resin cages are standard.

Side faces of BST type bearings are flush-ground to provide the same face height difference for both the front and back faces. As a result, bearings of the same part number can be freely combined into DB, DBT, DTBT configurations as illustrated in **Fig. 13.2**, and the adjustment for a relevant preload is no longer necessary.

Every single bearing is machined to the same face height so that when any arrangement is installed on a ballscrew the unit has optimal preload. For this reason, no time-consuming preload adjustment (adjustment with shims or tightening and loosening while measuring the starting torque) is necessary.

■Features 2A-BST-1B (LXL/L588)

1. Unique heat treatment greatly improves resistance against rolling contact fatigue, leading to longer service life (approximately two times that of the conventional type).
2. Both sides are sealed to enhance contamination resistance and to preserve the grease. (Light-contact seal type)
3. Special long-life grease is used. (Light-contact seal type)
4. The combination of a unique heat treatment and special grease reduces fretting (by 80% or more for sliding mode, 90% or more for rolling mode, compared to the conventional type). (Light-contact seal type)
5. Pre-greased bearings eliminate the need for further grease packing and allow easier handling. (Light-contact seal type)

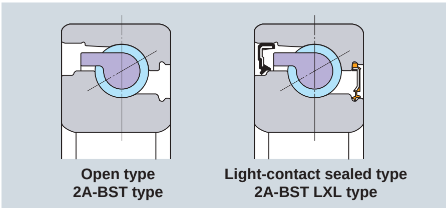


Fig. 13.1

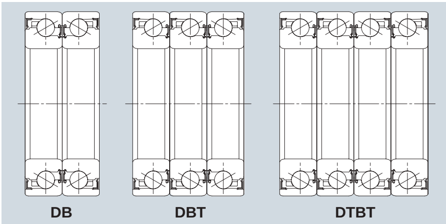


Fig. 13.2 Bearing arrangement

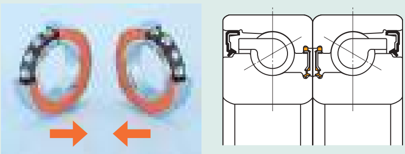
■Easy handling

2A-BST LXL type and BST LXL grease-lubricated sealed angular contact ball bearings eliminate the need for grease filling because they have been packed with grease in advance. You need to only wipe away rust preventive oil before use. Seals in different colors are used for the front and back sides.

The front side (black) and back side (orange) can be identified by the color of a seal, and you can easily check configuration during assembly.

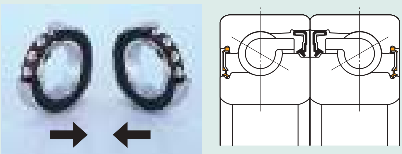
DB set (back faces in combination)

Orange seal + Orange seal



DF set (front faces in combination)

Black seal + Black seal



■Performance tests 2A-BST-1B (LXL/L588)

Ball screw support bearings have a unique internal design in order to lengthen service life and enhance resistance to fretting.

(1) Fretting resistance test (sliding)

Resistance to fretting while sliding is tested by the fretting resistance test. A conceptual drawing of the test is shown in **Fig. 13.3**, and the test conditions are shown in **Table 13.3**. In this test, a fixed ball is pushed against a plate, and reciprocated for a fixed period. The volume of ball and plate wear depth are checked after testing as shown in **Fig. 13.4**.

Due to a unique heat treatment and special grease (light-contact seal type), amount of wear is reduced to 1/5 or less compared to the conventional type consisting of standard SUJ2 plate material and lithium-based general purpose grease. (**Fig. 13.4**)

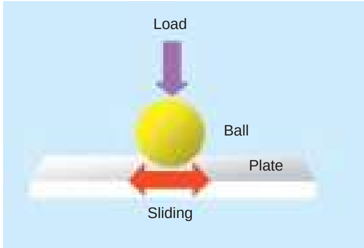


Fig. 13.3 Fretting resistance test (sliding)

Table 13.3 Test conditions

Material	Plate	Conventional type (SUJ2 without special heat treatment)
		ULTAGE series (SUJ2 with special heat treatment)
	Ball	SUJ2
Load (N)		98
Max. contact surface pressure (MPa)		2560
Loading frequency (×10^5cycle)		Test time: 8 h
Sliding cycle (Hz)		30
Amplitude (mm)		0.47
Lubrication		Grease
Temperature		Room temperature

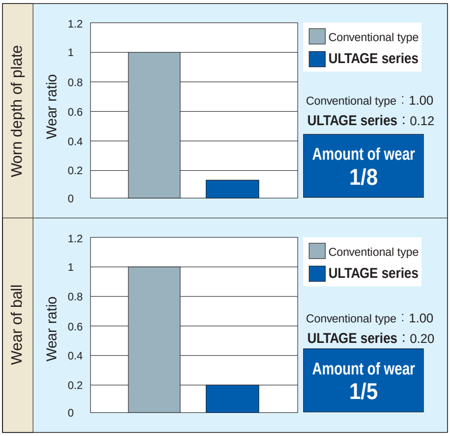


Fig. 13.4 Ratio of fretting corrosion in sliding mode

(2) Fretting resistance test (rolling)

Resistance against fretting while rolling is tested in the rotating and oscillating type fretting corrosion test. A conceptual drawing of the test is shown in **Fig. 13.5**, and the test conditions are shown in **Table 13-4**. In this test, a housing plate is fixed, and the shaft plate oscillates. The decrease in the weight of the bearing plate after the test is shown in **Fig. 13.6**.

Due to the combination of a unique heat treatment and a special grease (light-contact seal type), the amount of wear is reduced to 1/10 or less compared to the conventional type consisting of standard SUJ2 steel rings and lithium based general purpose grease. (**Fig. 13.6**).

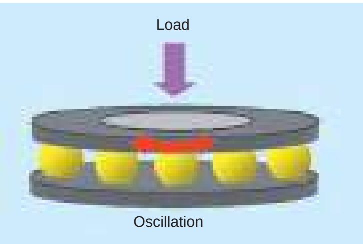


Fig. 13.5 Fretting resistance test (rolling)

Table 13.4 Test conditions

Bearing (mm)	Evaluated with thrust ball bearing 51204 (φ20×φ40×14)
Load (kN)	2.5
Max. contact surface pressure (MPa)	1700
Test time (h)	8
Oscillating cycle (Hz)	30
Oscillating angle (deg)	12
Lubrication	Grease
Temperature	Room temperature

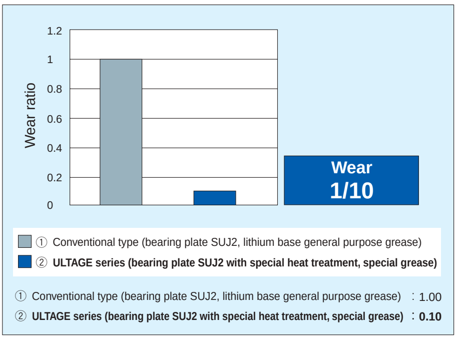


Fig. 13.6 Ratio of fretting corrosion while rolling

(3) Rolling contact fatigue life test

Resistance to rolling contact fatigue is improved as a result of a special heat treatment, leading to a longer service life compared to the standard heat-treated type model in both clean and contaminated oil. (**Fig. 13.7**)

Table 13.5 Test conditions

Bearing (mm)	Evaluated with deep groove ball bearing 6206 (φ30×φ62×16)
Radial load (kN)	6.86
Shaft speed (min^{-1})	2000
Lubrication	VG56 turbine oil
Atmosphere temperature (˚C)	60

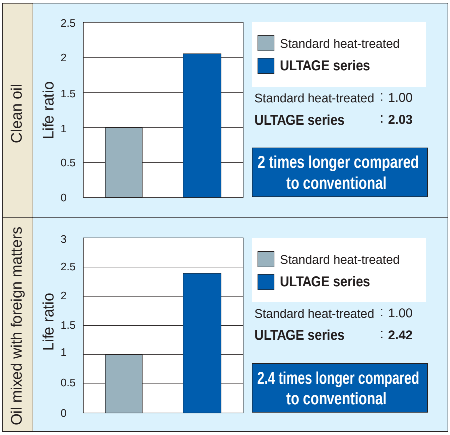


Fig. 13.7 Effect of special heat treatment on rolling contact fatigue life

(4) Grease life test

Service life of the grease has been dramatically extended compared to lithium-base general purpose grease (**Fig. 13.8**).

(Special grease is available for only the light-contact seal type.)

Table 13.6 Test conditions

Bearing (mm)	Evaluated with deep groove ball bearing 6204 (φ20×φ47×14)
Radial load (N)	67
Axial load (N)	67
Shaft speed (min^{-1})	10000
Atmosphere temperature (˚C)	150

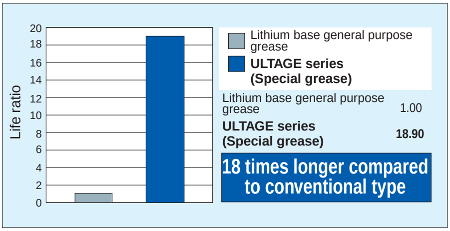


Fig. 13.8 Grease life ratio

(5) Grease leakage test

Light-contact type seals eliminate grease leakage from the bearing. (**Fig. 13.9**)

Table 13.7 Test conditions

Bearing (mm)	2A-BST40×72-1BDFP4 (φ40×φ72×15×2 rows)
Axial load (kN)	3.9
Shaft speed (min^{-1})	1000，2000，3000 running for two hours for each step
Atmosphere	Room temperature

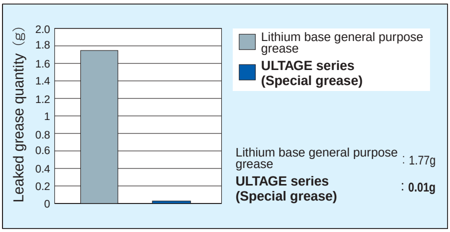


Fig. 13.9 Grease leakage

② *ULTAGE* Double row thrust angular contact ball bearing unit BSTU

The BSTU type is ball screw support bearing unit with two inner rings and one outer ring, in a back-to-back duplex arrangement. The outer ring has mounting holes for the housing for easier handling and the use of a newly developed seal ensures low torque and high dust resistance.

■Features

1. Greater load capacity with optimizations made to the internal bearing design.
2. Use of newly developed light-contact seal to achieve both low torque and high dust resistance.
3. The long operating life of the BST type, and use of special grease with excellent fretting resistance.
4. Outer ring mounting hole, and sealed grease lubrication groove for easier handling.
5. Specifications combining two of these units (D2) are also available for high-load capacity applications.

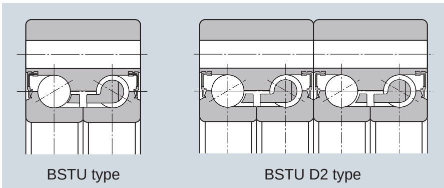


Fig. 13.10 BSTU

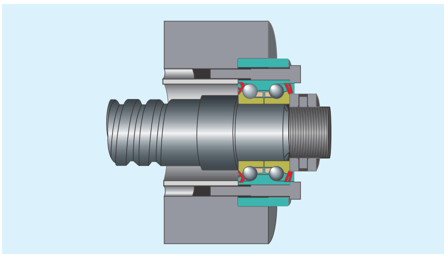


Fig. 13.11 E ample of mounted BSTU type installatio n

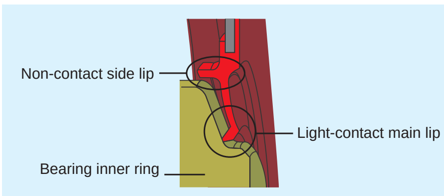


Fig. 13.1 Light-contact seal (code L)

■Performance tests

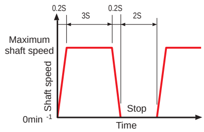
(1) Bearing operating test

The BSTU type exhibit stable temperature rises up to 5000 min^{-1} ($d_m n$ value 0.225×10^6) due to optimizations made to the internal bearing design and the use of a newly developed light-contact seal.(**Fig. 13.13**)

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)
Shaft speed (min^{-1})	Max. 5000

The operating pattern at each shaft speed is shown to the right.



Temperature increase test operating pattern

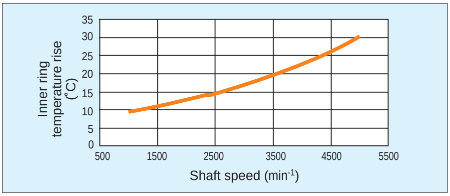


Fig. 13.13 Relation between shaft speed and temperature rise

(2) Torque test, dust test

The BSTU type limits starting torque and has better dust resistance with the use of a newly developed light-contact seal. (**Fig. 13.14**, **Fig. 13.15**)

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)

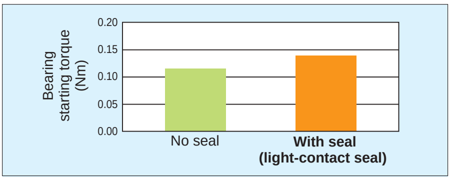
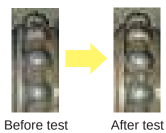


Fig. 13.14 Bearing starting torque

[Test conditions]

Bearing (mm)	BSTU3080LLX/GNP4U/L588 (φ30Xφ80X28)
Shaft speed (min^{-1})	2200
Dust particle diameter	5 to 75 µm (8 types of test powder 1 JIS Z8901)
Dust color phase	Brown
Test time	1 hour



Bearing internal conditions before and after test
(with bearing outer ring removed)
No foreign matter was observed inside the bearing after test.

Fig. 13.15 Dust test results

③ Duplex angular contact ball bearings HT series

HT type duplex angular contact ball bearings feature larger axial load capacity while maintaining the same dimensions as a standard angular contact ball bearing (contact angle: 30˚). Bearings smaller than the BST type are available for use in small products.

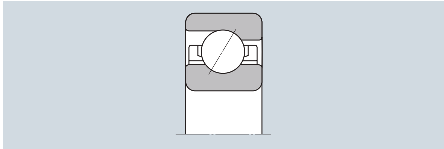


Fig. 13.10 HT

④ Needle roller bearings with double-row thrust needle roller bearings AXN series
Needle roller bearings with double-row thrust cylindrical roller bearings ARN series

AXN and ARN type bearings have thrust needle roller or thrust cylindrical roller bearings on both sides of a radial needle roller bearing. The outer ring side face of the radial needle roller bearing is used as the raceway of both thrust bearings. These bearings can withstand axial loads in both directions while maintaining compact designs. The radial needle roller bearings are suitable for heavy radial loads.

The axial rigidity of the AXN type is extremely enhanced since the thrust needle roller bearings are used for axial loads.

Likewise, the axial rigidity of the ARN type is improved. Since the axial load capacity of this type is larger than the AXN type, this type is suitable for heavy axial loads. Oil lubrication is recommended for the ARN type.

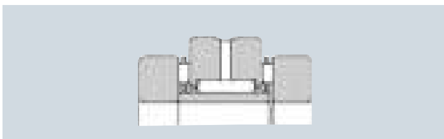


Fig. 13.11 AXN

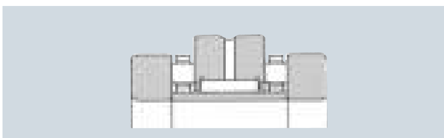


Fig. 13.12 ARN

⑤ Bearing designations

The part number for a ballscrew bearing consists of a type code, dimension code, and various suffixes.

■2A-BST type

2A - BST 20 × 47 −1B LXL DBT P4 / L588

- **Grease code**
  L588: Urea based special grease
- **Tolerance class code**
  P5: JIS Class 5 (equivalent)
  P4: JIS Class 4 (equivalent)
  UP: **NTN** Class
- **Arrangement code**
- **Seal code**
  LXL:Light contact rubber seals
- **Identification code**
  Preload code and added number
  -1B: Standard preload
  -11B: Light preload
- **Outside diameter (mm)**
- **Nominal bore diameter (mm)**
- **Bearing type code**
- **Heat treatment**

■HT type

7 0 04 HT DF / GM P4

- **Tolerance class code**
  P5: JIS class 5
  P4: JIS class 4
- **Internal clearance code**
  GM: Medium preload
  GH: Heavy preload
- **Arrangement code**
- **Internal design code**
- **Nominal bore diameter (See dimension tables.)**
- **Dimension series code**
- **Bearing type code**

■AXN and ARN type

AXN 2052 P4

- **Tolerance class code**
  P5: JIS Class 5
  P4: JIS Class 4
- **Dimension**
  Bore diameter,
  outside diameter (mm)
- **Bearing type code**
  AXN
  ARN

■BSTU type

BSTU 30 80 LLX (N) (DX) (D2) /GN P42U /L588 (P4U)

- **Grease code**
- **Tolerance class code**
- **Preload code**
- **Arrangement code**
- **Outer ring re-lubricating hole**
- **Outer ring pullout groove**
- **Seal code**
- **Outside diameter (mm)**
- **Nominal bore diameter (mm)**
- **Bearing type code**

⑤ Bearing precision

The precision of ballscrew bearings varies depending on the bearing type.

- **2A-BST type**
  Available in **NTN** class 5 (tolerance class code P5), class 4 (tolerance class code P4) each complying with JIS standards, and grade UP (tolerance class code UP). The classes are listed in ascending order.
- **70HT type**
  Same precision as the main spindle angular contact ball bearing. Classes 5 and 4 are available.
- **AXN, ARN types**
  NTN standard classes 4 and 5 complying with the JIS standards.

■Accuracy of 2A-BST type

Table 13.8 Inner rings

Unit: μm

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}						Width variation V_{Bs}			Radial runout K_{ia}			Face runout with bore S_d			Axial runout S_{ia}			Width deviation Δ_{Bs}					
		Class 5		Class 4[1]		Class UP[1]		Class 5	Class 4	Class UP	Class 5	Class 4	Class UP	Class 5	Class 4	Class UP	Class 5	Class 4	Class UP	Class 5		Class 4		Class UP	
over	incl.	high	low	high	low	high	low	max			max			max			max			high	low	high	low	high	low
10	18	0	−5	0	−4	0	−3.5	5	2.5	2	3.5	3	2	7	3	2	5	3	2	0	−120	0	−120	0	−100
18	30	0	−6	0	−5	0	−3.5	5	2.5	2	4	3	2	8	4	3	5	3	2	0	−120	0	−120	0	−100
30	50	0	−8	0	−6	0	−5	5	3	2	5	4	3	8	4	3	6	3	2	0	−120	0	−120	0	−100
50	80	0	−9	0	−7	0	−5	6	4	3	5	4	4	8	5	4	7	4	3	0	−150	0	−150	0	−150

❶ The tolerance of outside diameter deviation Δ_{ds} applicable to classes 4 and UP is the same as the tolerance of single plane mean outside diameter deviation Δ_{dmp}.

Table 13.9 Outer rings

Unit: μm

Nominal bore diameter d mm		Single plane mean outside diameter deviation Δ_{Dmp}						Width variation V_{Cs}			Radial runout K_{ea}			Outside surface inclination S_D			Axial runout S_{ea}	Width deviation Δ_{Cs}
		Class 5		Class 4[1]		Class UP[1]		Class 5	Class 4	Class UP	Class 5	Class 4	Class UP	Class 5	Class 4	Class UP	All classes	All classes
over	incl.	high	low	high	low	high	low	max			max			max				
30	50	0	−7	0	−6	0	−5	5	2.5	2	7	5	4	8	4	3	Identical to S_i relative to d on the same bearing.	Identical to Δ_{Bs} relative to d on the same bearing.
50	80	0	−9	0	−7	0	−5	6	3	2	8	5	4	8	4	3		
80	120	0	−10	0	−8	0	−7	8	4	3	10	6	4	9	5	4		

❷ The tolerance of outside diameter deviation Δ_{Ds} applicable to classes 4 and UP is the same as the tolerance of single plane mean outside diameter deviation Δ_{Dmp}.

■Accuracy of BSTU type (Class P42U)

Table 13.10 Inner rings

Unit: μm

Nominal bore diameter d mm	Single plane mean bore diameter deviation Δdmp high	low	Single radial plane bore diameter variation Vdp max	Mean bore diameter deviation $Vdmp$ max	Radial runout Kia max	Face runout with bore Sd max	Axial runout Sia max	Width deviation ΔBs high	low	Width variation VBs max
20	0	−5	2.5	2.5	3	4	2	0	−125	2
25	0	−5	2.5	2.5	3	4	2	0	−125	2
30	0	−5	2.5	2.5	3	4	2.5	0	−125	2.5
35	0	−5	2.5	2.5	4	4	2.5	0	−125	2.5
40	0	−5	2.5	2.5	4	4	2.5	0	−125	2.5
90	0	−8	4	4	5	5	3	0	−125	3
100	0	−8	4	4	5	5	3	0	−125	3

Table 13.11 Outer rings

Unit: μm

Nominal outside diameter D mm	Single plane mean outside diameter deviation ΔDmp high	low	Single radial plane outside diameter deviation VDp max	Mean single plane outside diameter deviation $VDmp$ max	Radia runout Kea max	Outside surface inclination SD max	Axial runout Sea max	Width variation ΔCs high	low	Width deviation VCs max
68	0	−10	3.5	3.5	5	4	5	0	−250	3
75	0	−10	3.5	3.5	5	4	5	0	−250	3
80	0	−10	3.5	3.5	5	4	5	0	−250	3
90	0	−10	4	4	6	5	6	0	−250	4
100	0	−10	4	4	6	5	6	0	−250	4
190	0	−15	8	6	10	7	10	0	−250	7
200	0	−15	8	6	10	7	10	0	−250	7

■Accuracy of BSTU type (Class P4U)

Table 13.12 Inner rings

Unit: μm

Nominal bore diameter d mm	Single plane mean bore diameter deviation Δdmp high	low	Single radial plane bore diameter variation Vdp max	Mean bore diameter deviation $Vdmp$ max	Radial runout Kia max	Face runout with bore Sd max	Axial runout Sia max	Width deviation ΔBs high	low	Width variation VBs max
20	0	−5	2.5	2.5	3	4	4	0	−125	2.5
25	0	−5	2.5	2.5	3	4	4	0	−125	2.5
30	0	−5	2.5	2.5	3	4	4	0	−125	2.5
35	0	−5	2.5	2.5	4	4	4	0	−125	3
40	0	−5	2.5	2.5	4	4	4	0	−125	3
90	0	−8	4	4	5	5	5	0	−125	4
100	0	−8	4	4	5	5	5	0	−125	4

Table 13.13 Outer rings

Unit: μm

Nominal outside diameter D mm	Single plane mean outside diameter deviation ΔDmp high	low	Single radial plane outside diameter deviation VDp max	Mean single plane outside diameter deviation $VDmp$ max	Radia runout Kea max	Outside surface inclination SD max	Axial runout Sea max	Width variation ΔCs high	low	Width deviation VCs max
68	0	−10	3.5	3.5	5	4	5	0	−250	3
75	0	−10	3.5	3.5	5	4	5	0	−250	3
80	0	−10	3.5	3.5	5	4	5	0	−250	3
90	0	−10	4	4	6	5	6	0	−250	4
100	0	−10	4	4	6	5	6	0	−250	4
190	0	−15	8	6	10	7	10	0	−250	7
200	0	−15	8	6	10	7	10	0	−250	7

■Accuracy of HT type

Table 13.14 Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation dmp						Single radial plane bore diameter variation V_{dp}						Mean bore diameter deviation V_{dmp}			Inner ring radial runout K_{ia}		
		Class 5		Class 4 ❶		Class 2 ❶		Diameter series 9			Diameter series 0,2								
								Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
2.5	10	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
10	18	0	−5	0	−4	0	−2.5	5	4	2.5	4	3	2.5	3	2	1.5	4	2.5	1.5
18	30	0	−6	0	−5	0	−2.5	6	5	2.5	5	4	2.5	3	2.5	1.5	4	3	2.5
30	50	0	−8	0	−6	0	−2.5	8	6	2.5	6	5	2.5	4	3	1.5	5	4	2.5

❶ The tolerance of bore diameter deviation ds, applicable to classes 4 and 2, is the same as the tolerance of mean bore diameter deviation dmp.
This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.
❷ Applicable to individual bearing rings manufactured for duplex bearings.

Table 13.15 Outer rings

Nominal outside diameter D mm		Single plane mean outside diameter deviation Dmp						Single radial plane outside diameter deviation V_{Dp}						Mean single plane outside diameter deviation V_{Dmp}			Outer ring radial runout K_{ea}		
		Class 5		Class 4 ❸		Class 2 ❸		Diameter series 9			Diameter series 0,2								
								Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
over	incl.	high	low	high	low	high	low	max			max			max			max		
18	30	0	−6	0	−5	0	−4	6	5	4	5	4	4	3	2.5	2	6	4	2.5
30	50	0	−7	0	−6	0	−4	7	6	4	5	5	4	4	3	2	7	5	2.5
50	80	0	−9	0	−7	0	−4	9	7	4	7	5	4	5	3.5	2	8	5	4
80	120	0	−10	0	−8	0	−5	10	8	5	8	6	5	5	4	2.5	10	6	5

❸ The tolerance of outside diameter deviation Ds, applicable to classes 4 and 2, is the same as the tolerance of mean outside diameter deviation Dmp.
This applies to the diameter series 0 or 2 for class 4, and all the diameter series for class 2.

■Accuracy of AXN and ARN type

Table 13.16 Inner ring and outer ring

Nominal bearing bore dia. d or nominal bearing outside dia. D mm		Deviation of mean bore ❶ diameter in a single plane dmp				Thrust inner ring bore ❶ dia. deviation dis		Deviation of mean outside ❷ diameter in a single plane Dmp				Bearing height deviation T_s		Outer ring width deviation C_s		Radial inner ring❶ radial runout K_{ia}	
		Class 5		Class 4				Class 5		Class 4						Class 5	
Over	Incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	Max.	
18	30	0	−6	0	−5	+61	+40	−	−	−	−					4	3
30	50	0	−8	0	−6	+75	+50	−	−	−	−					5	4
50	80	0	−9	0	−7	+90	+60	0	−9	0	−7	0	−370	0	−130	5	4
80	120	−	−	−	−	−	−	0	−10	0	−8					−	−
120	150	−	−	−	−	−	−	0	−11	0	−9					−	−

❶ Applicable only to dimension d. ❷ Applicable only to dimension D.

Unit: μm

Face runout with bore S_d			Axial runout S_{ia}			Width variation B_s Single bearing				Width variation B_s Duplex bearing❷		Width variation V_{Bs}		
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5, Class 4		Class 2		Class 5, Class 4		Class 5	Class 4	Class 2
max			max			high	low	high	low	high	low	max		
7	3	1.5	7	3	1.5	0	−40	0	−40	0	−250	5	2.5	1.5
7	3	1.5	7	3	1.5	0	−80	0	−80	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	2.5	1.5
8	4	1.5	8	4	2.5	0	−120	0	−120	0	−250	5	3	1.5

Unit: μm

Outside surface inclination S_D			Axial runout S_{ea}			Width variation C_s	Width variation V_{Cs}		
Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	All classes	Class 5	Class 4	Class 2
max			max				max		
8	4	1.5	8	5	2.5	Identical to B_s relative to d of the same bearing	5	2.5	1.5
8	4	1.5	8	5	2.5		5	2.5	1.5
8	4	1.5	10	5	4		6	3	1.5
9	5	2.5	11	6	5		8	4	2.5

Unit: μm

Outer ring❷ radial runout K_{ea}		Perpendicularity of outer ring❷ outside surface with respect to the face S_D		Thrust inner ring and❶ outer ring thickness variation❷ S_{ia}, S_{ea}	
Class 5	Class 4	Class 5	Class 4	Class 5	Class 4
Max.		Max.		Max.	
—	—	—	—	3	2
—	—	—	—	3	2
8	5	8	4	4	3
10	6	9	5	4	3
11	7	10	5	5	4

⑦ Basic preload and axial rigidity

Basic preloads for each type of ball screw support bearings are shown in the dimension tables. The preloads can be altered depending on the required rigidity. Contact **NTN** in such a case. In the AXN and ARN types, rigidity is normally enhanced by tightening the thrust bearing rings to supply preload. Preloads and torques are shown in the dimensions tables to help control basic preload. A bearing that allows preset preload by tightening the bearing raceways to adjust the clearance A between the thrust bearing ring and radial bearing ring (**Fig. 13.19**) is also available. Ask **NTN** for details.

Axial rigidity of the 2A-BST type DB duplex arrangement and the AXN type at the basic preload are shown in **Figs. 13.20** and **13.21**.

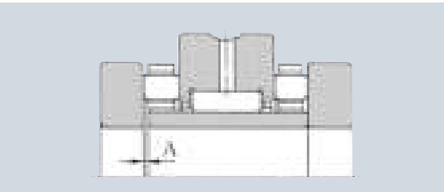


Fig. 13.19

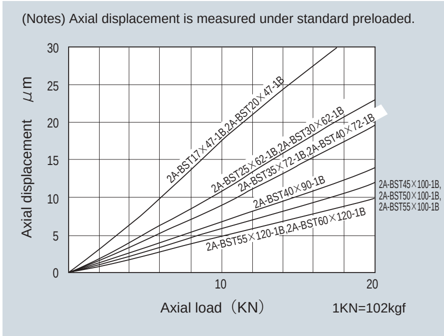


Fig. 13.20 BST type rigidity chart

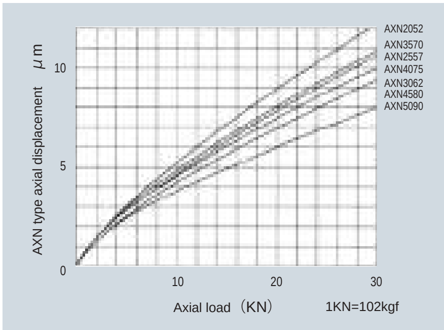


Fig. 13.21 AXN type rigidity chart

⑧ Shaft and housing fits

Recommended fit and tolerances of shaft and housing shoulder squareness are shown in **Tables. 13.17** and **13.18**.

Table 13.17 Shaft and housing fits

Type code	Fit	
	Shaft outside diameter	Housing
BST HT	h5	H6
BSTU	h5	H6
AXN ARN	j5	J6

Table 13.18 Tolerance of shoulder squareness Unit: μm

Diameter classification mm		Type code			
over	incl.	BST	BSTU	HT	AXN, ARN
—	30	4	4	4	4
30	80	4	4	4	5
80	120	5	5	—	6
120	180	—	—	—	7

⑨ Applications

The BST type is mainly installed on ball screws of machine tool feed systems, and two to four row arrangements are used in many cases. This type is popular because greased sealed angular contact ball bearings are easy to handle. The back-to-back duplex arrangement is commonly used because it allows acquisition of the specified preload by tightening the inner ring. The face-to-face duplex arrangement may be used if more precise alignment is required. It is not commonly used for machine tools. Examples of bearing arrangement are shown in **Figs. 13.22** and **13.24**.

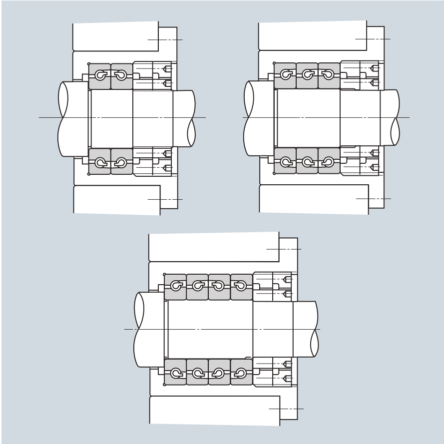


Fig. 13.22

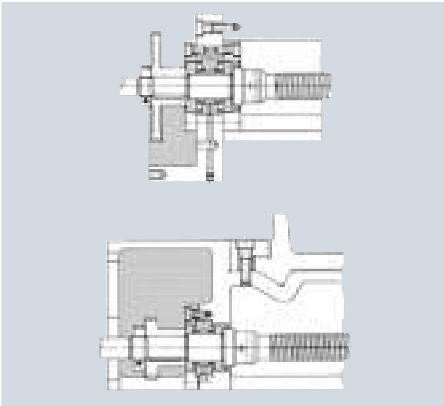


Fig. 13.23

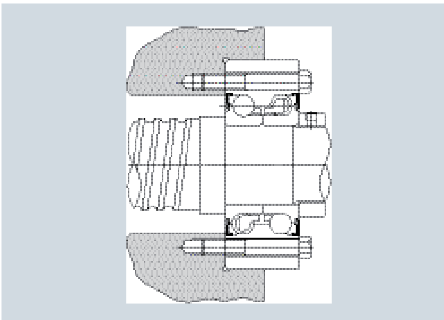


Fig. 13.24

⑩ Starting torque of 2A-BST type

Reference starting torque values for 2A-BST bearings are shown in **Tables 13.19** and **13.20**.

Table 13.19 Open type BST and 2A-BST

	Starting torque (reference) N · mm {kgf · cm}			
	DF type DB type	DFT type DBT type	DTFT type DTBT type	DFTT type DBTT type
BST17X47-1B 2A-BST17X47-1B	175 {1.8}	245 {2.5}	355 {3.6}	275 {2.8}
BST20X47-1B 2A-BST20X47-1B	175 {1.8}	245 {2.5}	355 {3.6}	275 {2.8}
BST25X62-1B 2A-BST25X62-1B	305 {3.1}	420 {4.3}	615 {6.3}	470 {4.8}
BST30X62-1B 2A-BST30X62-1B	305 {3.1}	420 {4.3}	615 {6.3}	470 {4.8}
BST35X72-1B 2A-BST35X72-1B	380 {3.9}	510 {5.2}	755 {7.7}	590 {6.0}
BST40X72-1B 2A-BST40X72-1B	380 {3.9}	510 {5.2}	755 {7.7}	590 {6.0}
BST40X90-1B 2A-BST40X90-1B	960 {9.8}	1305 {13.3}	1930 {19.7}	1500 {15.3}
BST45X75-1B 2A-BST45X75-1B	430 {4.4}	580 {5.9}	860 {8.8}	665 {6.8}
BST45X100-1B 2A-BST45X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}
BST50X100-1B 2A-BST50X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}
BST55X100-1B 2A-BST55X100-1B	1165 {11.9}	1580 {16.1}	2340 {23.9}	1815 {18.5}

Table 13.20 Light-contact sealed type BST LXL/L588 and 2A-BST LXL/L588

	Starting torque (reference) N · mm {kgf · cm}			
	DF type DB type	DFT type DBT type	DTFT type DTBT type	DFTT type DBTT type
BST17X47-1BLXL 2A-BST17X47-1BLXL	215 {2.2}	295 {3.0}	420 {4.3}	355 {3.4}
BST20X47-1BLXL 2A-BST20X47-1BLXL	215 {2.2}	295 {3.0}	420 {4.3}	355 {3.4}
BST25X62-1BLXL 2A-BST25X62-1BLXL	365 {3.7}	510 {5.2}	745 {7.6}	570 {5.8}
BST30X62-1BLXL 2A-BST30X62-1BLXL	365 {3.7}	510 {5.2}	745 {7.6}	570 {5.8}
BST35X72-1BLXL 2A-BST35X72-1BLXL	460 {4.7}	610 {6.2}	900 {9.2}	705 {7.28}
BST40X72-1BLXL 2A-BST40X72-1BLXL	460 {4.7}	610 {6.2}	900 {9.2}	705 {7.2}
BST40X90-1BLXL 2A-BST40X90-1BLXL	1155 {11.8}	1570 {16.0}	2315 {23.6}	1805 {18.4}
BST45X75-1BLXL 2A-BST45X75-1BLXL	520 {5.3}	695 {7.1}	1040 {10.6}	805 {8.2}
BST45X100-1BLXL 2A-BST45X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}
BST50X100-1BLXL 2A-BST50X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}
BST55X100-1BLXL 2A-BST55X100-1BLXL	1400 {14.3}	1890 {19.3}	2815 {28.7}	2175 {22.2}

⑪ Recommended lubrication specifications

BST and HT ball screw support angular contact ball bearings are generally lubricated with grease. (BST LXL bearings with light-contact seals are packed with grease.) AXN and ARN bearings are generally lubricated with circulated oil.

■Grease lubrication

● **Recommended type of grease**
Lithium-mineral oil base general purpose grease of which base oil viscosity is high (for example, Alvania Grease S2, Shell).

● **Recommended grease fill**
25% of the capacity shown in the dimensions tables

● **Recommended grease filling method**
Refer to "6. Handling of Bearings, ① Rinsing of bearings and grease filling" in the Technical Data section.

■Oil lubrication

● **Recommended type of oil**
Hydraulic oils or other industrial oils used for lubrication of sliding surfaces with viscosity grade ISO VG 68 or higher are recommended.

● **Oil quantity**
Recommended oil quantity depends on the lubricating method. As a general guideline, the oil flow rate should be 5 to 10 cm^3/min.

⑫ Dimension tables

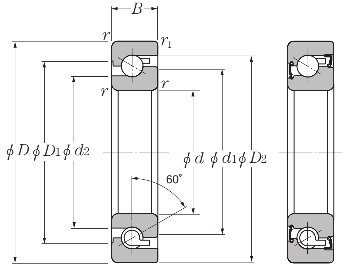
ULTAGE Angular contact thrust ball bearings for ball screws BST series

Contact angle 60° d 17～60mm

Dynamic equivalent axial load $P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
$F_a / F_r \leq 2.17$	X	1.90	—	1.43	2.32	—	1.17	1.90	2.52	—
	Y	0.55	—	0.76	0.35	—	0.88	0.55	0.26	—
$F_a / F_r > 2.17$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1	1

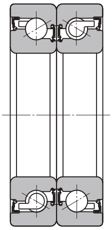
Static equivalent axial load
$P_{oa} = F_a + 3.98F_r$



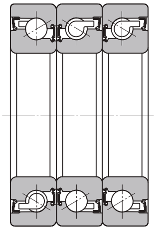
Open type　　Contact sealed type

Part number	Boundary dimensions (mm) d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	Basic dynamic rated load C_a kN / kgf 1	2	3	Basic static rated load C_{oa} kN / kgf 1	2	3
BST17X47-1B BST17X47-1BLXL	17	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
BST20X47-1B BST20X47-1BLXL	20	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
BST25X62-1B BST25X62-1BLXL	25	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
BST30X62-1B BST30X62-1BLXL	30	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
BST35X72-1B BST35X72-1BLXL	35	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
BST40X72-1B BST40X72-1BLXL	40	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
BST40X90-1B BST40X90-1BLXL	40	90	20	1	0.6	58.5 6 000	95.0 9 700	126 12 900	130 13 300	261 26 600	390 40 000
BST45X75-1B BST45X75-1BLXL	45	75	15	1	0.6	32.0 3 300	52.0 5 350	69.5 7 100	77.5 7 900	155 15 800	232 23 700
BST45X100-1B BST45X100-1BLXL	45	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST50X100-1B BST50X100-1BLXL	50	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST55X100-1B BST55X100-1BLXL	55	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
BST55X120-1B BST55X120-1BLXL	55	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000
BST60X120-1B BST60X120-1BLXL	60	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000

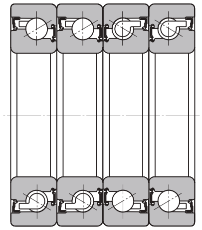
❶ Minimum allowable value for chamfer dimension r or r .



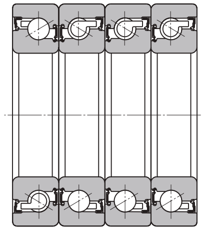
When one row bears axial load (DB)



When two rows bear axial load (DBT)



When two rows bear axial load (DTBT)



When three rows bear axial load (DBTT)

Dimensions mm				Space capacity cm³	Static axial load capacity kN kgf		
d_1	d_2	D_1	D_2	Single-row (approx.)	1	2	3
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
29.9	27.1 25.7	37.1	40.8 41.2	3.3	25.7 2 620	51.5 5 250	77.0 7 850
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
44.4	41.6 40.2	51.6	55.3 55.7	4.6	40.0 4 100	80.5 8 200	121 12 300
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
52.4	49.6 48.2	59.6	63.2 63.7	5.4	47.5 4 850	95.0 9 700	143 14 600
64.8	60.7 59.1	75.2	80.4 81.6	12	88.5 9 000	177 18 000	265 27 000
58.4	55.6 54.2	65.6	69.2 69.7	6.0	52.5 5 350	177 10 700	158 16 100
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	13	104 10 600	208 21 200	315 32 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000
90.8	86.7 85.1	101.2	106.4 107.6	16	124 12 700	249 25 400	375 38 000

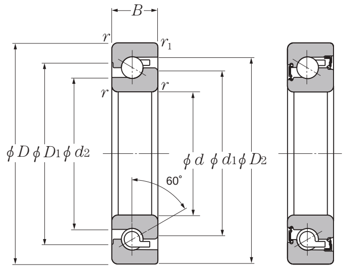
ULTAGE Angular contact thrust ball bearings for ball screws 2A-BST series

Contact angle 60° d 17～60mm

Dynamic equivalent axial load $P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
$F_a / F_r \leqq 2.17$	X	1.90	—	1.43	2.32	—	1.17	1.90	2.52	—
	Y	0.55	—	0.76	0.35	—	0.88	0.55	0.26	—
$F_a / F_r > 2.17$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1	1

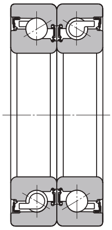
Static equivalent axial load
$P_{oa} = F_a + 3.98F_r$

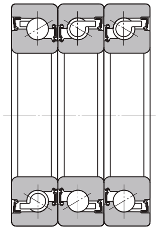


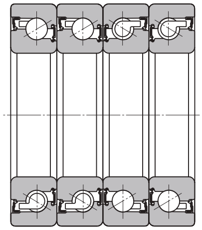
Open type　Contact sealed type

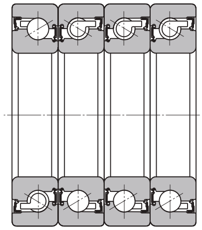
Part number	Boundary dimensions mm					Basic dynamic rated load C_a kN kgf			Basic static rated load C_{oa} kN kgf		
	d	D	B	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	1	2	3	1	2	3
2A-BST17X47-1B 2A-BST17X47-1BLXL	17	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
2A-BST20X47-1B 2A-BST20X47-1BLXL	20	47	15	1	0.6	24.3 2 470	39.5 4 000	52.5 5 350	37.5 3 850	75.0 7 650	113 11 500
2A-BST25X62-1B 2A-BST25X62-1BLXL	25	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
2A-BST30X62-1B 2A-BST30X62-1BLXL	30	62	15	1	0.6	29.2 2 980	47.5 4 850	63.0 6 450	59.0 6 050	118 12 100	177 18 100
2A-BST35X72-1B 2A-BST35X72-1BLXL	35	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
2A-BST40X72-1B 2A-BST40X72-1BLXL	40	72	15	1	0.6	31.0 3 150	50.5 5 150	67.0 6 850	70.0 7 150	140 14 300	210 21 400
2A-BST40X90-1B 2A-BST40X90-1BLXL	40	90	20	1	0.6	58.5 6 000	95.0 9 700	126 12 900	130 13 300	261 26 600	390 40 000
2A-BST45X75-1B 2A-BST45X75-1BLXL	45	75	15	1	0.6	32.0 3 300	52.0 5 350	69.5 7 100	77.5 7 900	155 15 800	232 23 700
2A-BST45X100-1B 2A-BST45X100-1BLXL	45	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST50X100-1B 2A-BST50X100-1BLXL	50	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST55X100-1B 2A-BST55X100-1BLXL	55	100	20	1	0.6	62.0 6 350	101 10 300	134 13 700	153 15 600	305 31 000	459 47 000
2A-BST55X120-1B 2A-BST55X120-1BLXL	55	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000
2A-BST60X120-1B 2A-BST60X120-1BLXL	60	120	20	1	0.6	66.5 6 750	108 11 000	143 14 600	183 18 700	365 37 500	550 56 000

❶ Minimum allowable value for chamfer dimension r or r .


When one row bears axial load (DB)


When two rows bear axial load (DBT)


When two rows bear axial load (DTBT)


When three rows bear axial load (DBTT)

Dimensions mm				Space capacity cm³ Single-row (approx.)	Static axial load capacity kN kgf		
d_1	d_2	D_1	D_2		1	2	3
29.9	27.1 25.7	37.1	40.8 41.2	4.3	25.7 2 620	51.5 5 250	77.0 7 850
29.9	27.1 25.7	37.1	40.8 41.2	6.3	25.7 2 620	51.5 5 250	77.0 7 850
44.4	41.6 40.2	51.6	55.3 55.7	6.1	40.0 4 100	80.5 8 200	121 12 300
44.4	41.6 40.2	51.6	55.3 55.7	6.1	40.0 4 100	80.5 8 200	121 12 300
52.4	49.6 48.2	59.6	63.2 63.7	7.1	47.5 4 850	95.0 9 700	143 14 600
52.4	49.6 48.2	59.6	63.2 63.7	7.1	47.5 4 850	95.0 9 700	143 14 600
64.8	60.7 59.1	75.2	80.4 81.6	17	88.5 9 000	177 18 000	265 27 000
58.4	55.6 54.2	65.6	69.2 69.7	7.9	52.5 5 350	177 10 700	158 16 100
75.8	71.7 70.1	86.2	91.4 92.6	20	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	20	104 10 600	208 21 200	315 32 000
75.8	71.7 70.1	86.2	91.4 92.6	20	104 10 600	208 21 200	315 32 000
90.8	86.7 85.1	101.2	106.4 107.6	17	124 12 700	249 25 400	375 38 000
90.8	86.7 85.1	101.2	106.4 107.6	17	124 12 700	249 25 400	375 38 000

ULTAGE Angular contact thrust ball bearings for ball screws BST Type, 2A-BST Type

Contact angle 60° d 17～60mm

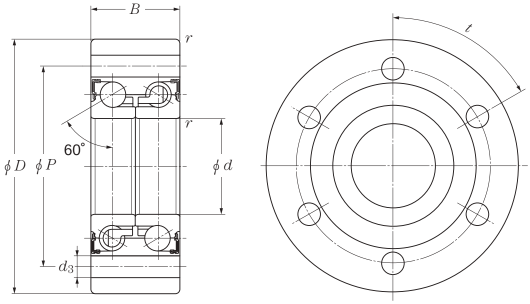
Part number	Basic preload：-1B											
	Double-row (DF/DB types)				Triple-row (DFT/DBT types)				Four-row (DTFT/DTBT types)			
	Preload		Axial spring constant		Preload		Axial spring constant		Preload		Axial spring constant	
	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm
BST17X47 2A-BST17X47	2 060	210	635	65	2 840	290	930	95	4 100	420	1 270	130
BST20X47 2A-BST20X47	2 060	210	635	65	2 840	290	930	95	4 100	420	1 270	130
BST25X62 2A-BST25X62	3 250	330	980	100	4 400	450	1 370	140	6 450	660	1 960	200
BST30X62 2A-BST30X62	3 250	330	980	100	4 400	450	1 370	140	6 450	660	1 960	200
BST35X72 2A-BST35X72	3 800	390	1130	115	5 200	530	1 620	165	7 650	780	2 260	230
BST40X72 2A-BST40X72	3 800	390	1130	115	5 200	530	1 620	165	7 650	780	2 260	230
BST40X90 2A-BST40X90	7 050	720	1470	150	9 600	980	2 110	215	14 100	1 440	2 940	300
BST45X75 2A-BST45X75	4 200	430	1230	125	5 700	580	1 770	180	8 450	860	2 500	255
BST45X100 2A-BST45X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST50X100 2A-BST50X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST55X100 2A-BST55X100	8 250	840	1720	175	11 200	1 140	2 450	250	16 500	1 680	3 450	350
BST55X120 2A-BST55X120	9 900	1 010	2010	205	13 400	1 370	2 890	295	19 800	2 020	4 050	415
BST60X120 2A-BST60X120	9 900	1 010	2010	205	13 400	1 370	2 890	295	19 800	2 020	4 050	415

NOTE) Preload values are those obtained from matched bearings.
Spring constants mean axial spring constants on bearings subjected to the preloads listed in the table.

Part number	Light preload：-11B											
	Double-row (DF/DB types)				Triple-row (DFT/DBT types)				Four-row (DTFT/DTBT types)			
	Preload		Axial spring constant		Preload		Axial spring constant		Preload		Axial spring constant	
	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm	N	kgf	N/μm	kgf/μm
BST17X47 2A-BST17X47	1 000	102	490	50	1 370	140	735	75	1 960	200	980	100
BST20X47 2A-BST20X47	1 000	102	490	50	1 370	140	735	75	1 960	200	980	100
BST25X62 2A-BST25X62	1 470	150	735	75	1 960	200	1 080	110	2 940	300	1 470	150
BST30X62 2A-BST30X62	1 560	159	735	75	2 160	220	1 080	110	3 150	320	1 470	150
BST35X72 2A-BST35X72	1 760	180	885	90	2 350	240	1 270	130	3 550	360	1 770	180
BST40X72 2A-BST40X72	1 860	190	885	90	2 550	260	1 270	130	3 700	380	1 770	180
BST40X90 2A-BST40X90	2 370	240	980	100	3 230	330	1 470	150	4 700	480	2 060	210
BST45X75 2A-BST45X75	2 000	200	980	100	2 650	270	1 370	140	3 900	400	1 960	200
BST45X100 2A-BST45X100	2 880	290	1 180	120	3 800	390	1 770	180	5 700	580	2 450	250
BST50X100 2A-BST50X100	3 010	310	1 180	120	4 100	420	1 770	180	6 100	620	2 450	250
BST55X100 2A-BST55X100	3 010	310	1 180	120	4 100	420	1 770	180	6 100	620	2 450	250
BST55X120 2A-BST55X120	3 520	360	1 370	140	4 800	490	2 060	210	7 050	720	2 840	290
BST60X120 2A-BST60X120	3 520	360	1 370	140	4 800	490	2 060	210	7 050	720	2 840	290

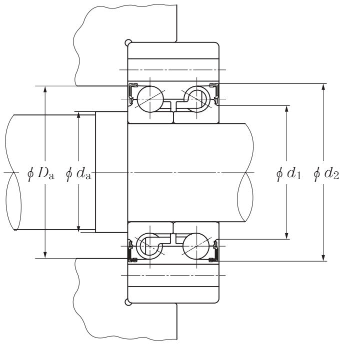
ULTAGE Ball screw support double row thrust angular contact ball bearing unit BSTU LLX type

d 20～100mm



Part number	Boundary dimensions mm						Basic load ratings dynamic kN	static kgf	dynamic kN	static kgf	Allowable axial load kN	kgf	Limiting speed min⁻¹	Reference dimensions mm	
	d	D	B	r_{min} ❶	P	d_3	C_a	C_a	C_{oa}	C_{oa}	(static)		lubrication	d_1	d_2
BSTU2068LLX	20	68	28	0.6	53	6.8	31.0	3 200	48.0	4 900	24.0	2 450	6 000	30.1	43
BSTU2575LLX	25	75	28	0.6	58	6.8	34.0	3 450	58.0	5 950	28.5	2 910	5 000	36.1	49
BSTU3080LLX	30	80	28	0.6	63	6.8	36.5	3 700	68.5	6 950	33.0	3 350	4 500	41.1	54
BSTU30100LLX	30	100	38	0.6	80	8.8	73.5	7 500	121	12 400	61.5	6 250	4 000	47.1	65
BSTU40100LLX	40	100	34	0.6	80	8.8	52.0	5 300	106	10 800	50.5	5 150	3 500	54.1	68.9
BSTU40115LLX	40	115	46	0.6	94	8.8	89.0	9 050	167	17 000	82.5	8 400	3 200	61.1	80.2
BSTU90190LLX	90	190	55	0.6	165	11	158	16 100	415	42 000	195	19 900	1 700	116.1	138.7
BSTU100200LLX	100	200	55	0.6	175	11	160	16 300	435	44 500	205	20 900	1 500	128.1	150.7

❶ Minimum allowable value for chamfer dimension r.



Dynamic equivalent radial load

$P_a = XF_r + YF_a$

e	$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y
2.17	1.90	0.55	0.92	1

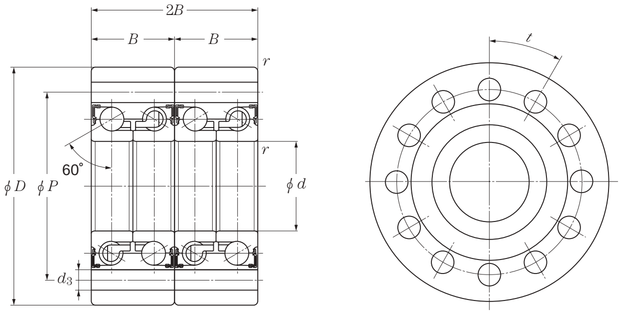
Static equivalent radial load

$P_{oa} = F_a + 3.98\,F_r$

Abutment and fillet dimensions mm		Outer ring mounting bolt		Preload		Mass	Bearing friction torque	Axial bearing rigidity	Rigidity against moment	Mass moment of inertia	Part number
D_a max	d_a min	Screws	Quantity × t	N	kgf	kg (approx.)	Nm (approx.)	N/μm	Nm/mrad	kg · cm^2	
42	26	M6	4×90°	2 100	215	0.60	0.2	675	150	0.25	**BSTU2068LLX**
48	32	M6	4×90°	2 400	245	0.72	0.3	790	230	0.45	**BSTU2575LLX**
53	37	M6	6×60°	2 700	275	0.78	0.3	900	315	0.68	**BSTU3080LLX**
64	39	M8	8×45°	4 800	490	1.71	0.8	1 040	500	1.99	**BSTU30100LLX**
68	49	M8	4×90°	3 200	325	1.46	0.4	1 050	610	2.16	**BSTU40100LLX**
80	52	M8	12×30°	5 800	590	2.57	1.0	1 260	960	5.52	**BSTU40115LLX**
137	104	M10	8×45°	8 200	835	7.95	1.5	2 010	4 700	60.0	**BSTU90910LLX**
150	116	M10	8×45°	8 800	900	8.47	1.7	2 130	5 800	83.8	**BSTU100200LLX**

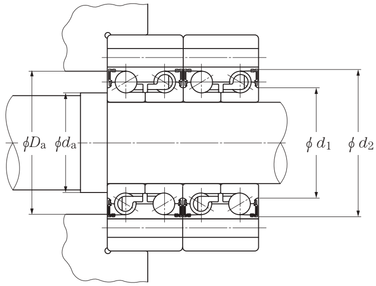
ULTAGE Ball screw support double row thrust angular contact ball bearing unit
BSTU LLX D2 type

d 20～40mm



Part number	Boundary dimensions mm						Basic load ratings dynamic kN	static kgf	dynamic kN	static kgf	Allowable axial load kN	kgf	Limiting speed min-1	Reference dimensions mm	
	d	*D*	*B*	*r* min ❶	*P*	*d*3	*C*a	*C*a	*C*oa	*C*oa	(static)		lubrication	*d*1	*d*2
BSTU2068LLXD2	20	68	56	0.6	53	6.8	50.5	5 150	96.0	9 800	48.0	4 900	6 000	30.1	43
BSTU2575LLXD2	25	75	56	0.6	58	6.8	55.0	5 600	116	11 900	57.0	5 820	5 000	36.1	49
BSTU3080LLXD2	30	80	56	0.6	63	6.8	59.0	6 000	137	13 900	65.0	6 700	4 500	41.1	54
BSTU40100LLXD2	40	100	68	0.6	80	8.8	84.0	8 600	212	21 600	101	10 300	3 500	54.1	68.9
BSTU40115LLXD2	40	115	92	0.6	94	8.8	144	14 700	335	34 000	165	16 800	3 200	61.1	80.2

❶ Minimum allowable value for chamfer dimension *r*.



Dynamic equivalent radial load

$P_a = XF_r + YF_a$

e	$F_a/F_r \leqq e$		$F_a/F_r > e$	
	X	Y	X	Y
2.17	—	—	0.92	1

Static equivalent radial load

$P_{oa} = F_a + 3.98 F_r$

Abutment and fillet dimensions mm		Outer ring mounting bolt		Preload		Mass	Bearing friction torque	Axial bearing rigidity	Rigidity against moment	Mass moment of inertia	Part number
D_a max	d_a min	Screws	Quantity × t	N	kgf	kg (approx.)	Nm (approx.)	N/μm	Nm/mrad	kg · cm^2	
42	26	M6	8×45°	4 200	430	1.20	0.5	1 350	340	0.50	**BSTU2068LLXD2**
48	32	M6	8×45°	4 800	490	1.44	0.5	1 580	510	0.90	**BSTU2575LLXD2**
53	37	M6	12×30°	5 400	550	1.56	0.6	1 800	690	1.36	**BSTU3080LLXD2**
68	49	M8	8×45°	6 350	650	2.92	0.8	2 100	1 310	4.32	**BSTU40100LLXD2**
80	52	M8	12×30°	11 600	1 180	5.14	2.0	2 520	2 150	11.0	**BSTU40115LLXD2**

Duplex angular contact ball bearings (HT series)

Contact angle 30° d 6～40mm

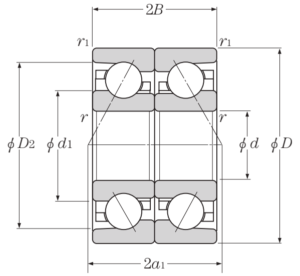
Dynamic equivalent axial load

$P_a = XF_r + YF_a$

Number of rows in bearing arrangement		2		3			4			
Number of rows subjected to axial load		1	2	1	2	3	1	2	3	4
F_a $F_r \leq 0.80$	X	0.81	—	0.61	0.99	—	0.50	0.81	1.07	—
	Y	0.63	—	0.88	0.40	—	1.02	0.63	0.30	—
F_a $F_r > 0.80$	X	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	Y	1	1	1	1	1	1	1	1	1

Static equivalent axial load

$P_{oa} = 1.52F_r + F_a$

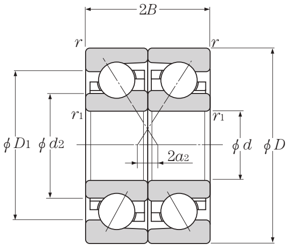


Back-to-back (DB)

Example diagram 1

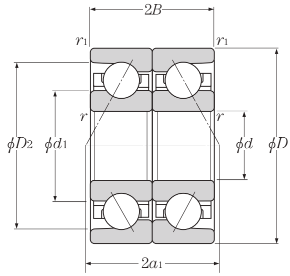
Part number		Boundary dimensions mm					Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Dimensions mm				Load center cm³		Diagram
Back-to-back (DB)	Face-to-face (DF)	d	D	$2B$	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_a	C_{oa}	C_a	C_{oa}	d_1	d_2	D_1	D_2	DB a_1	DF a_2	
79M6ADB	**79M6ADF**	6	15	10	0.2	0.1	2.05	2.09	209	213	9.9	8.4	11.1	12.9	11.1	1.1	1
70M6DB	**70M6DF**	6	17	12	0.3	0.15	2.67	2.41	273	246	9.8	—	13.2	14.8	12.7	0.7	2
79M8ADB	**79M8ADF**	8	19	12	0.3	0.15	2.93	3.25	298	335	12.6	10.9	14.4	16.4	13.9	1.9	1
70M8DB	**70M8DF**	8	22	14	0.3	0.15	4.40	4.40	450	445	12.8	—	17.2	19.1	15.8	1.8	2
7000HTDB	**7000HTDF**	10	26	16	0.3	0.15	6.10	6.30	620	640	15.5	—	20.3	22.7	18.4	2.4	2
7001HTDB	**7001HTDF**	12	28	16	0.3	0.15	6.65	7.45	680	760	18.1	—	22.9	25.4	20.0	4.0	2
7002HTDB	**7002HTDF**	15	32	18	0.3	0.15	7.60	9.50	775	970	21.1	—	25.9	28.4	22.7	4.7	2
7203HTDB	**7203HTDF**	17	40	24	0.6	0.3	13.8	16.4	1 400	1 670	25.0	—	32.0	36.2	28.8	4.8	2
7004HTDB	**7004HTDF**	20	42	24	0.6	0.3	12.8	17.0	1 300	1 730	28.4	—	34.7	38.1	30.3	6.3	2
7204HTDB	**7204HTDF**	20	47	28	1.0	0.6	17.9	23.1	1 830	2 360	30.5	—	38.6	42.7	34.1	6.1	2
7205HTDB	**7205HTDF**	25	52	30	1.0	0.6	20.2	28.8	2 060	2 940	35.0	—	43.0	47.2	37.7	7.7	2
7206HTDB	**7206HTDF**	30	62	32	1.0	0.6	28.1	41.5	2 860	4 200	41.7	—	51.4	56.3	43.1	11.1	2
7207HTDB	**7207HTDF**	35	72	34	1.1	0.6	37.0	56.0	3 800	5 750	47.9	—	59.2	64.9	48.2	14.2	2
7208HTDB	**7208HTDF**	40	80	36	1.1	0.6	44.0	71.0	4 500	7 200	54.0	—	66.0	72.2	52.9	16.9	2

❶ Minimum allowable value for chamfer dimension r or r_1.
❷ The number of rows means the number of bearings that bear the axial load.
❸ Preload values are those obtained from matched bearings.
❹ Spring constants mean axial spring constants on bearings subjected to the preloads listed in the table.

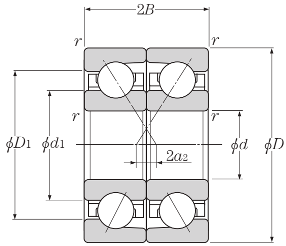


Face-to-face (DF)

Example diagram 1



Back-to-back (DB)
Example diagram 2

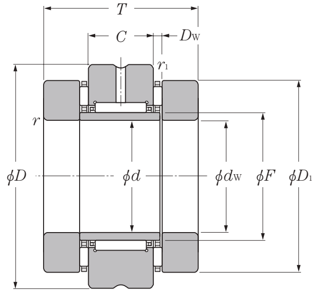


Face-to-face (DF)
Example diagram 2

Static axial load[2] capacity kN kgf				Medium preload (GM) Preload[3] N kgf				Medium preload (GM) Axial spring constant[4] N/µm kgf/µm				Starting torque N·mm (approx.)		Heavy preload (GH) Preload[3] N kgf				Heavy preload (GH) Axial spring constant[4] N/µm kgf/µm				Starting torque N·mm (approx.)	
Single row		Double row		DB DF		DBT DFT		DB DF		DBT DFT		DB DF	DBT DFT	DB DF		DBT DFT		DB DF		DBT DFT		DB DF	DBT DFT
1.83	187	3.66	374	20	2	27	3	37	3.8	55	5.6	0.4	0.6	39	4	53	5.5	48	4.9	67	6.8	1.0	1.1
1.01	103	2.02	206	29	3	39	4	37	3.8	53	5.4	0.8	1.0	49	5	67	7	45	4.6	65	6.6	1.5	2.2
2.14	219	4.28	438	29	3	39	4	48	4.9	68	6.9	0.7	0.9	59	6	80	8	62	6.3	88	9.0	1.7	2.3
1.53	156	3.06	312	49	5	67	7	52	5.3	75	7.6	1.6	2.2	98	10	133	14	67	6.9	97	9.9	4.0	5.7
3.10	314	6.20	628	147	15	200	20	82	8.4	116	11.8	7.4	9.7	196	20	266	27	92	9.4	131	13.3	11.0	14.7
3.25	331	6.50	662	147	15	200	20	88	9.0	125	12.7	7.2	9.5	196	20	266	27	99	10.1	140	14.3	10.8	14.4
4.00	407	8.00	814	147	15	200	20	100	10.2	141	14.4	6.9	9.1	294	30	400	41	131	13.4	187	19.1	18.1	24.7
5.85	595	11.7	1 190	294	30	400	41	126	12.9	180	18.4	20.5	27.9	390	40	530	54	141	14.4	201	20.5	30.5	40.8
7.55	770	15.1	1 540	294	30	400	41	139	14.2	199	20.3	19.3	26.2	490	50	665	68	170	17.3	242	24.7	39.3	53.1
9.50	970	19.0	1 940	490	50	665	68	168	17.2	240	24.5	41.5	56.1	785	80	1070	109	203	20.7	289	29.5	79.7	108
11.5	1 170	23.0	2 340	490	50	665	68	188	19.2	269	27.4	39.7	53.7	785	80	1070	109	226	23.1	323	32.9	76.4	104
16.3	1 660	32.6	3 320	490	50	665	68	197	20.0	281	28.6	41.3	55.8	785	80	1070	109	235	24.0	336	34.2	79.4	108
21.9	2 230	43.8	4 470	885	90	1200	122	255	26.0	363	37.1	96.4	130	1470	150	2000	204	311	31.7	443	45.2	196	265
27.1	2 770	54.2	5 540	885	90	1200	122	272	27.8	389	39.6	95.8	129	1470	150	2000	204	331	33.8	473	48.2	195	264

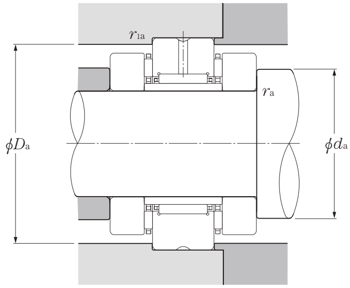
Needle roller bearings with double-direction thrust needle roller bearings (AXN series)

d 20～50mm



Part number	Boundary dimensions mm										Basic load ratings					
											dynamic radial kN	static radial kN	dynamic radial kgf	static radial kgf	dynamic axial kN	static axial kN
	d	d_w	D	D_1 $^{-0.20}_{-0.50}$	T $^{0}_{-0.370}$	C $^{0}_{-0.130}$	F	D_w	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}
AXN2052	20	$20^{+0.061}_{+0.040}$	52	42	40	16	25	2	0.6	0.6	15.1	22.4	1 540	2 280	14.6	58.0
AXN2557	25	$25^{+0.061}_{+0.040}$	57	47	44	20	30	2	0.6	0.6	22.1	34.0	2 260	3 500	16.3	69.5
AXN3062	30	$30^{+0.061}_{+0.040}$	62	52	44	20	35	2	0.6	0.6	24.8	41.5	2 520	4 250	17.8	81.5
AXN3570	35	$35^{+0.075}_{+0.050}$	70	60	48	20	40	3	1	0.6	26.4	47.0	2 700	4 800	27.4	110
AXN4075	40	$40^{+0.075}_{+0.050}$	75	65	48	20	45	3	1	0.6	28.0	52.5	2 860	5 400	29.8	128
AXN4580	45	$45^{+0.075}_{+0.050}$	80	70	54	25	50	3	1	0.6	38.5	74.5	3 950	7 550	31.5	143
AXN5090	50	$50^{+0.075}_{+0.050}$	90	78	54	25	55	3	1	0.6	41.0	82.0	4 150	8 400	38.0	186

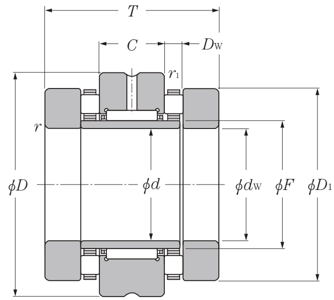
❶ Minimum allowable value for corner radius dimension r or r_1.
❷ Starting torque value relative to the standard preload.



Basic load ratings dynamic C_a (axial, kgf)	static C_{oa} (axial, kgf)	Limiting speeds min⁻¹ grease lubrication	oil lubrication	Radial clearance μm min	max	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max	Preload N	Starting torque ❷ N·mm (approx.)	Mass kg (approx.)	Part number
1 490	5 900	1 800	7 000	10	30	39	46	0.6	0.6	1 300	330	0.400	**AXN2052**
1 660	7 100	1 500	6 000	10	30	44	51	0.6	0.6	1 450	400	0.520	**AXN2557**
1 820	8 300	1 400	5 500	10	40	50	56	0.6	0.6	1 600	550	0.590	**AXN3062**
2 790	11 300	1 200	4 700	10	40	56	64	1	0.6	2 450	900	0.800	**AXN3570**
3 050	13 100	1 100	4 300	10	40	62	69	1	0.6	2 650	1 050	0.890	**AXN4075**
3 250	14 500	1 000	3 900	10	40	67	74	1	0.6	2 800	1 200	1.00	**AXN4580**
3 850	19 000	900	3 500	15	50	75	83	1	0.6	3 400	1 600	1.42	**AXN5090**

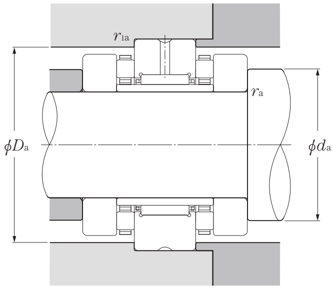
Needle roller bearings with double-direction thrust cylindrical roller bearings (ARN series)

d 20～70mm



Part number	Boundary dimensions (mm)										Basic load ratings					
											dynamic radial (kN)	static radial (kN)	dynamic radial (kgf)	static radial (kgf)	dynamic axial (kN)	static axial (kN)
	d	d_w	D	D_1 (-0.20/-0.50)	T (0/-0.370)	C (0/-0.130)	F	D_w	$r_{s\,min}$ ❶	$r_{1s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	C_a	C_{oa}
ARN2052T2	20	20 $^{+0.061}_{+0.040}$	52	42	46	16	25	5	0.6	0.6	15.1	22.4	1 540	2 280	27.3	68.0
ARN2062	20	20 $^{+0.061}_{+0.040}$	62	52	60	20	30	7.5	1	0.6	22.1	34.0	2 260	3 500	53.5	129
ARN2557T2	25	25 $^{+0.061}_{+0.040}$	57	47	50	20	30	5	0.6	0.6	22.1	34.0	2 260	3 500	27.8	72.5
ARN2572	25	25 $^{+0.061}_{+0.040}$	72	62	60	20	35	7.5	1	0.6	24.8	41.5	2 520	4 250	54.5	139
ARN3062T2	30	30 $^{+0.061}_{+0.040}$	62	52	50	20	35	5	0.6	0.6	24.8	41.5	2 520	4 250	31.0	87.0
ARN3080	30	30 $^{+0.061}_{+0.040}$	80	68	66	20	40	9	1	0.6	26.4	47.0	2 700	4 800	74.5	190
ARN3570T2	35	35 $^{+0.075}_{+0.050}$	70	60	54	20	40	6	1	0.6	26.4	47.0	2 700	4 800	43.0	121
ARN3585	35	35 $^{+0.075}_{+0.050}$	85	73	66	20	45	9	1	0.6	28.0	52.5	2 860	5 400	82.0	222
ARN4075T2	40	40 $^{+0.075}_{+0.050}$	75	65	54	20	45	6	1	0.6	28.0	52.5	2 860	5 400	45.5	135
ARN4090	40	40 $^{+0.075}_{+0.050}$	90	78	75	25	50	9	1	0.6	38.5	74.5	3 950	7 550	85.0	238
ARN4580T2	45	45 $^{+0.075}_{+0.050}$	80	70	60	25	50	6	1	0.6	38.5	74.5	3 950	7 550	48.0	150
ARN45105	45	45 $^{+0.075}_{+0.050}$	105	90	82	25	55	11	1	0.6	41.0	82.0	4 150	8 400	121	340
ARN5090	50	50 $^{+0.075}_{+0.050}$	90	78	60	25	55	6	1	0.6	41.0	82.0	4 150	8 400	62.5	215
ARN50110	50	50 $^{+0.075}_{+0.050}$	110	95	82	25	60	11	1.1	0.6	41.0	85.0	4 200	8 700	125	365
ARN55115	55	55 $^{+0.090}_{+0.060}$	115	100	82	25	65	11	1.1	0.6	44.5	98.0	4 550	10 000	130	385
ARN60120	60	60 $^{+0.090}_{+0.060}$	120	105	82	25	70	11	1.1	0.6	45.0	91.5	4 600	9 350	134	410
ARN65125	65	65 $^{+0.090}_{+0.060}$	125	110	82	25	75	11	1.1	0.6	55.0	104	5 600	10 600	138	435
ARN70130	70	70 $^{+0.090}_{+0.060}$	130	115	82	25	80	11	1.1	0.6	57.0	119	5 800	12 200	142	460

❶ Minimum allowable value for corner radius dimension r or r_1.
❷ Starting torque value relative to the standard preload.



Basic load ratings dynamic C_a (axial, kgf)	Basic load ratings static C_{oa} (axial, kgf)	Limiting speeds (min⁻¹) grease lubrication	Limiting speeds (min⁻¹) oil lubrication	Radial clearance μm min	Radial clearance μm max	Abutment and fillet dimensions mm d_a min	D_a max	r_{as} max	r_{1as} max	Preload N	Starting torque ❷ N·mm (approx.)	Mass kg (approx.)	Part number
2 780	6 900	1 800	7 000	10	30	39	46	0.6	0.6	2 500	430	0.440	**ARN2052T2**
5 450	13 100	1 500	6 000	10	30	48	56	1	0.6	4 950	1 150	0.910	**ARN2062**
2 840	7 400	1 500	6 000	10	30	44	51	0.6	0.6	2 600	500	0.560	**ARN2557T2**
5 550	14 200	1 200	4 900	10	40	56	66	1	0.6	5 050	1 400	1.22	**ARN2572**
3 150	8 900	1 400	5 500	10	40	49	56	0.6	0.6	2 900	650	0.630	**ARN3062T2**
7 600	19 400	1 100	4 400	10	40	63	73	1	0.6	6 900	2 100	1.54	**ARN3080**
4 350	12 400	1 200	4 800	10	40	56	64	1	0.6	3 950	1 050	0.850	**ARN3570T2**
8 350	22 600	1 000	4 100	10	40	68	77	1	0.6	7 600	2 500	1.67	**ARN3585**
4 650	13 800	1 100	4 400	10	40	61	69	1	0.6	4 200	1 250	0.930	**ARN4075T2**
8 650	24 200	950	3 800	10	40	73	87	1	0.6	7 850	2 850	2.15	**ARN4090**
4 900	15 300	1 000	4 000	10	40	66	74	1	0.6	4 450	1 550	1.16	**ARN4580T2**
12 300	34 500	850	3 300	15	50	83	96	1	0.6	11 200	4 350	3.16	**ARN45105**
6 350	21 900	900	3 600	15	50	75	83	1	0.6	5 800	2 050	1.48	**ARN5090**
12 800	37 000	800	3 100	15	50	88	101	1	0.6	11 600	4 900	3.38	**ARN50110**
13 200	39 500	750	2 900	15	50	93	106	1	0.6	12 000	5 500	3.61	**ARN55115**
13 700	42 000	700	2 700	15	50	98	111	1	0.6	12 400	6 000	3.81	**ARN60120**
14 100	44 500	650	2 600	15	50	103	116	1	0.6	12 800	6 500	4.00	**ARN65125**
14 500	47 000	650	2 500	15	50	106	121	1	0.6	13 200	7 000	4.25	**ARN70130**

14. NTN Products

Cam followers for pallet changer

Cam followers are often used on work piece transfer systems (such as pallet changers) of machine tools (such as machining centers) to handle the large loads generated by these systems.
NTN offers various types of cam followers that include a ready-to-install cam follower optimized for pallet changers.

① Structure and features

- The outer ring wall thickness is maximized for resistance to heavy load or impact load.
- **NTN** cam followers for pallet changers feature a compact design and can be easily mounted by tightening a setscrew.
- The outer diameter, outer ring width, and stud diameter are identical to the dimensions of **NTN**'s standard cam followers (KR type).
- Because cam followers for pallet changers are actuated less frequently, they do not need to be relubricated. The oil hole has been deleted.
- Cost is reduced by removing the grease hole and the thread from the stud.

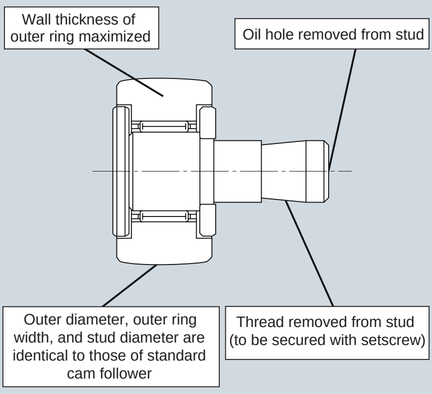
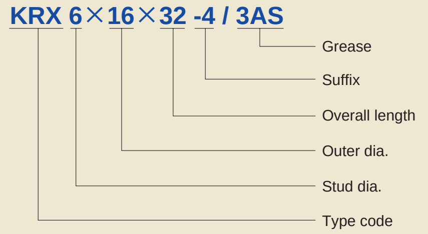


Fig. 14-1 Schematic of NTN pallet changer cam follower

② Cam follower numbering

The part number for cam followers for pallet changers is same as that of **NTN** special cam followers.



③ Accuracy

The accuracy of **NTN** cam followers for pallet changer is same as that of **NTN** standard cam followers (JIS class 0).

④ Fit

The **NTN** pallet changer cam follower has a special stud that is readily secured with a setscrew. As illustrated below, a setscrew locks the pallet changer cam follower in the axial and circumferential directions.

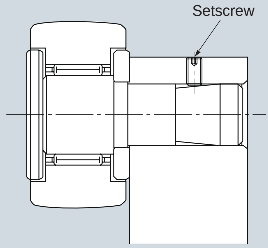


Fig. 14-2 Typical mounting arrangement

⑤ Radial internal clearance

The radial clearance of **NTN** cam followers for pallet changers is same as that of **NTN** standard cam followers (**Table 14-1**).

Table 14-1. Inner ring

Nominal inscribed circle diameter F_w		Clearance CN (normal clearance)	
over	incl.	min	max
3	6	3	17
6	10	5	20
10	18	5	25
18	30	10	30
30	50	10	40

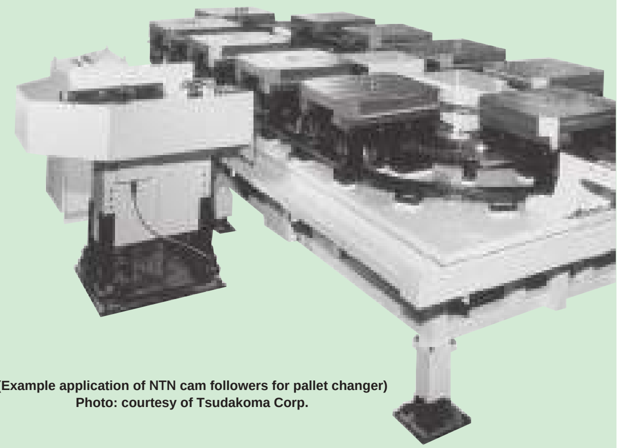
⑥ Lubrication

NTN cam followers for pallet changers are prefilled with lithium based grease and can be used in a temperature range of -25 to +100˚C.

Under the assumption that the user does not perform relubrication with grease, the standard **NTN** pallet changer cam follower does not have an oil hole for relubrication. (If necessary, the cam follower can be provided with an oil hole or a hole for mounting a grease nipple.)

Upon request, **NTN** can also provide cam followers with a synthetic rubber seal.

Lubrication between the outside surface of bearing and track is also necessary. Failure to properly lubricate the outside surface of the cam follower could lead to premature wear of the bearing.

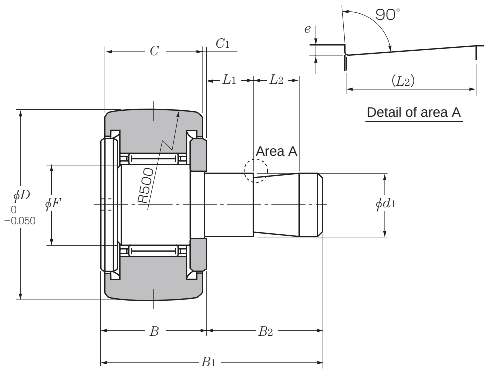


(Example application of NTN cam followers for pallet changer)
Photo: courtesy of Tsudakoma Corp.

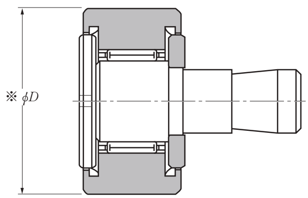
⑦ Cam followers for pallet changers dimension table

Sealed KRX type d 6～20mm

Spherical outer ring type



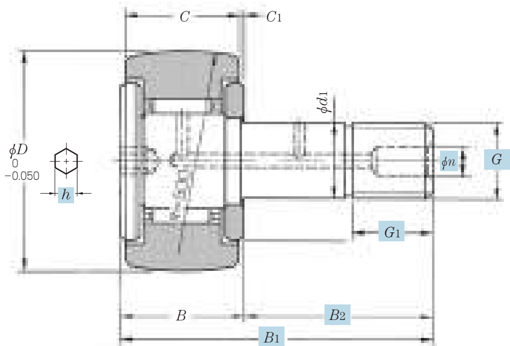
Cylindrical outer ring type



Cam follower number		Dimensions mm												
Spherical outer ring	Cylindrical outer ring	d_1	Tolerance	D	Tolerance※ (cylindrical outer ring)	F	B_1	B	B_2	C	C_1	L_1	L_2	e
KRX6×16×32-4/3AS	KRX6×16×32-2/3AS	6	0 −0.012	16	0 −0.008	8	32	12	20	11	0.6	5	10	0.3
KRX8×19×32-9/3AS	KRX8×19×32-7/3AS	8	0 −0.015	19	0 −0.009	10	32	12	20	11	0.6	5	10	0.5
KRX10×22×33-3/3AS	KRX10×22×33-1/3AS	10	0 −0.015	22	0 −0.009	12	33	13	20	12	0.6	5	10	0.5
KRX10×26×33-4/3AS	KRX10×26×33-2/3AS	10	0 −0.015	26	0 −0.009	12	33	13	20	12	0.6	5	10	0.5
KRX12×30×35-3/3AS	KRX12×30×35/3AS	12	0 −0.018	30	0 −0.009	15	35	15	20	14	0.6	5	10	1.0
KRX12×32×35-3/3AS	KRX12×32×35-1/3AS	12	0 −0.018	32	0 −0.011	15	35	15	20	14	0.6	5	10	1.0
KRX16×35×44.5-1/3AS	KRX16×35×44.5-3/3AS	16	0 −0.018	35	0 −0.011	18	44.5	19.5	25	18	0.8	10	10	1.0
KRX18×40×46.5-6/3AS	KRX18×40×46.5-4/3AS	18	0 −0.018	40	0 −0.011	22	46.5	21.5	25	20	0.8	10	10	1.0
KRX20×47×50.5-13/AS	KRX20×47×50.5-3/3AS	20	0 −0.021	47	0 −0.011	25	50.5	25.5	25	24	0.8	10	10	1.0
KRX20×52×50.5-3/3AS	KRX20×52×50.5-1/3AS	20	0 −0.021	52	0 −0.013	25	50.5	25.5	25	24	0.8	10	10	1.0

※The cam followers in the table above have seals. However, upon request, **NTN** will offer a cam followers without seals.

(Reference) Standard cam follower KR···H type (w/ hex socket)



The dimensions of standard cam followers (marked with [shaded box] in the diagram above) are different from those of **NTN** pallet changer cam followers. Please see the reference dimensions in the table below.

Basic load ratings dynamic N / kgf C_r	static C_{or}	**Track load capacity** N / kgf spherical outer ring	cylindrical outer ring	**(Reference dimensions)** mm B_1'	B_2	G	G_1	n	h
4 050 415	4 200 430	1 080 110	3 400 350	28	16	M6×1	8	—	3
4 750 480	5 400 555	1 380 141	4 050 415	32	20	M8×1.25	10	—	4
5 300 540	6 650 680	1 690 172	5 150 525	36	23	M10×1.25	12	4	4
5 300 540	6 650 680	2 120 216	6 100 620	36	23	M10×1.25	12	4	4
7 850 800	9 650 985	2 620 267	7 700 785	40	25	M12×1.5	13	6	6
7 850 800	9 650 985	2 860 291	8 200 835	40	25	M12×1.5	13	6	6
12 200 1 240	17 900 1 830	3 200 325	11 900 1 220	52	32.5	M16×1.5	17	6	6
14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	58	36.5	M18×1.5	19	6	6
20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	66	40.5	M20×1.5	21	8	8
20 700 2 110	33 500 3 450	5 550 565	23 300 2 370	66	40.5	M20×1.5	21	8	8

Table 1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-1

Single row radial ball bearings			67						68 78										69 79										160	60 70							
Double row radial ball bearings																																					
Cylindrical roller bearings										N28	N38	NN48							N19	N29	NN39	NN49								N10	N20	NN30	NN40				
Needle roller bearings												NA48										NA49	NA59	NA69													
Spherical roller bearings																					239	249										230	240				
Nominal bearing bore diameter *d*		Diameter series 7					Diameter series 8										Diameter series 9										Diameter series 0									
		Nominal outside diameter of bearing	Dimension series				Nominal outside diameter of bearing	Dimension series									Nominal outside diameter of bearing	Dimension series										Nominal outside diameter of bearing	Dimension series								
Number	Dimension		17	27	37	17~37		08	18	28	38	48	58	68	08	18~68		09	19	29	39	49	59	69	09	19~39	49~69		00	10	20	30	40	50	60	00	10~60
		D	Nominal width *B*			Chamfer dimension *γ* s min	*D*	Nominal width *B*							Chamfer dimension *γ* s min		*D*	Nominal width *B*							Chamfer dimension *γ* s min			*D*	Nominal width *B*							Chamfer dimension *γ* s min	
—	0.6	2	0.8	—	—	0.05	2.5	—	1	—	1.4	—	—	—	—	0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	1	2.5	1	—	—	0.05	3	—	1	—	1.5	—	—	—	—	0.05	4	—	1.6	—	2.3	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—
—	1.5	3	1	—	1.8	0.05	4	—	1.2	—	2	—	—	—	—	0.05	5	—	2	—	2.6	—	—	—	—	0.15	—	6	—	2.5	—	3	—	—	—	—	0.15
2	2	4	1.2	—	2	0.05	5	—	1.5	—	2.3	—	—	—	—	0.08	6	—	2.3	—	3	—	—	—	—	0.15	—	7	—	2.8	—	3.5	—	—	—	—	0.15
—	2.5	5	1.5	—	2.3	0.08	6	—	1.8	—	2.6	—	—	—	—	0.08	7	—	2.5	—	3.5	—	—	—	—	0.15	—	8	—	2.8	—	4	—	—	—	—	0.15
3	3	6	2	2.5	3	0.08	7	—	2	—	3	—	—	—	—	0.1	8	—	3	—	4	—	—	—	—	0.15	—	7	—	3	—	5	—	—	—	—	0.15
4	4	7	2	2.5	3	0.08	9	—	2.5	3.5	4	—	—	—	—	0.1	11	—	4	—	5	—	—	—	—	0.15	—	12	—	4	—	6	—	—	—	—	0.2
5	5	8	2	2.5	3	0.08	11	—	3	4	5	—	—	—	—	0.15	13	—	4	—	6	10	—	—	—	0.2	0.15	14	—	5	—	7	—	—	—	—	0.2
6	6	10	2.5	3	3.5	0.1	13	—	3.5	5	6	—	—	—	—	0.15	15	—	5	—	7	10	—	—	—	0.2	0.15	17	—	6	—	9	—	—	—	—	0.3
7	7	11	2.5	3	3.5	0.1	14	—	3.5	5	6	—	—	—	—	0.15	17	—	5	—	7	10	—	—	—	0.3	0.15	19	—	6	8	10	—	—	—	—	0.3
8	8	12	2.5	—	3.5	0.1	16	—	4	5	6	8	—	—	—	0.2	19	—	6	—	9	11	—	—	—	0.3	0.2	22	—	7	9	11	14	19	25	—	0.3
9	9	14	3	—	4.5	0.1	17	—	4	5	6	8	—	—	—	0.2	20	—	6	—	9	11	—	—	—	0.3	0.3	24	—	7	10	12	15	20	27	—	0.3
00	10	15	3	—	4.5	0.1	19	—	5	6	7	9	—	—	—	0.3	22	—	6	8	10	13	16	22	—	0.3	0.3	26	—	8	10	12	16	21	29	—	0.3
01	12	18	4	—	5	0.2	21	—	5	6	7	9	—	—	—	0.3	24	—	6	8	10	13	16	22	—	0.3	0.3	28	7	8	10	12	16	21	29	0.3	0.3
02	15	21	4	—	5	0.2	24	—	5	6	7	9	—	—	—	0.3	28	—	7	8.5	10	13	18	23	—	0.3	0.3	32	8	9	11	13	17	23	30	0.3	0.3
03	17	23	4	—	5	0.2	26	—	5	6	7	9	—	—	—	0.3	30	—	7	8.5	10	13	18	23	—	0.3	0.3	35	8	10	12	14	18	24	32	0.3	0.3
04	20	27	4	—	5	0.2	32	4	7	8	10	12	16	22	0.3	0.3	37	7	9	11	13	17	23	30	0.3	0.3	0.3	42	8	12	14	16	22	30	40	0.3	0.6
/22	22	—	—	—	—	—	34	4	7	—	10	—	16	22	0.3	0.3	39	7	9	11	13	17	23	30	0.3	0.3	0.3	44	8	12	14	16	22	30	40	0.3	0.6
05	25	32	4	—	5	0.2	37	4	7	8	10	12	16	22	0.3	0.3	42	7	9	11	13	17	23	30	0.3	0.3	0.3	47	8	12	14	16	22	30	40	0.3	0.6
/28	28	—	—	—	—	—	40	4	7	—	10	—	16	22	0.3	0.3	45	7	9	11	13	17	23	30	0.3	0.3	0.3	52	8	12	15	18	24	32	43	0.3	0.6
06	30	37	4	—	5	0.2	42	4	7	8	10	12	16	22	0.3	0.3	47	7	9	11	13	17	23	30	0.3	0.3	0.3	55	9	13	16	19	25	34	45	0.3	1
/32	32	—	—	—	—	—	44	4	7	—	10	—	16	22	0.3	0.3	52	7	10	13	15	20	27	36	0.3	0.6	0.6	58	9	13	16	20	26	35	47	0.3	1
07	35	44	5	—	—	0.3	47	4	7	8	10	12	16	22	0.3	0.3	55	7	10	13	15	20	27	36	0.3	0.6	0.6	62	9	14	17	20	27	36	48	0.3	1
08	40	—	—	—	—	—	52	4	7	8	10	12	16	22	0.3	0.3	62	8	12	14	16	22	30	40	0.3	0.6	0.6	68	9	15	18	21	28	38	50	0.3	1
09	45	—	—	—	—	—	58	4	7	8	10	13	18	23	0.3	0.3	68	8	12	14	16	22	30	40	0.3	0.6	0.6	75	10	16	19	23	30	40	54	0.3	1
10	50	—	—	—	—	—	65	5	7	10	12	15	20	27	0.3	0.3	72	8	12	14	16	22	30	40	0.3	0.6	0.6	80	10	16	19	23	30	40	54	0.6	1
11	55	—	—	—	—	—	72	7	9	11	13	17	23	30	0.3	0.3	80	9	13	16	19	25	34	45	0.3	1	1	90	11	18	22	26	35	46	63	0.6	1.1
12	60	—	—	—	—	—	78	7	10	12	14	18	24	32	0.3	0.3	85	9	13	16	19	25	34	45	0.3	1	1	95	11	18	22	26	35	46	63	0.6	1.1
13	65	—	—	—	—	—	85	7	10	13	15	20	27	36	0.3	0.6	90	9	13	16	19	25	34	45	0.6	1	1	100	11	18	22	26	35	46	63	0.6	1.1
14	70	—	—	—	—	—	90	8	10	13	15	20	27	36	0.3	0.6	100	10	16	19	23	30	40	54	0.6	1	1	110	13	20	24	30	40	54	71	0.6	1.1
15	75	—	—	—	—	—	95	8	10	13	15	20	27	36	0.3	0.6	105	10	16	19	23	30	40	54	0.6	1	1	115	13	20	24	30	40	54	71	0.6	1.1
16	80	—	—	—	—	—	100	8	10	13	15	20	27	36	0.3	0.6	110	10	16	19	23	30	40	54	0.6	1	1	125	14	22	27	34	45	60	80	0.6	1.1
17	85	—	—	—	—	—	110	9	13	16	19	25	34	45	0.3	1	120	11	18	22	26	35	46	63	0.6	1.1	1.1	130	14	22	27	34	45	60	80	0.6	1.1
18	90	—	—	—	—	—	115	9	13	16	19	25	34	45	0.3	1	125	11	18	22	26	35	46	63	0.6	1.1	1.1	140	16	24	30	37	50	67	90	1	1.5
19	95	—	—	—	—	—	120	9	13	16	19	25	34	45	0.3	1	130	11	18	22	26	35	46	63	0.6	1.1	1.1	145	16	24	30	37	50	67	90	1	1.5
20	100	—	—	—	—	—	125	9	13	16	19	25	34	45	0.3	1	140	13	20	24	30	40	54	71	0.6	1.1	1.1	150	16	24	30	37	50	67	100	1	1.5
21	105	—	—	—	—	—	130	9	13	16	19	25	34	45	0.3	1	145	13	20	24	30	40	54	71	0.6	1.1	1.1	160	18	26	33	41	56	75	109	1	2
22	110	—	—	—	—	—	140	10	16	19	23	30	40	54	0.6	1	150	13	20	24	30	40	54	71	0.6	1.1	1.1	170	19	28	36	45	60	80	109	1	2
24	120	—	—	—	—	—	150	10	16	19	23	30	40	54	0.6	1	165	14	22	27	34	45	60	80	0.6	1.1	1.1	180	19	28	36	46	60	80	109	1	2
26	130	—	—	—	—	—	165	11	18	22	26	35	46	63	0.6	1.1	180	16	24	30	37	50	67	90	1	1.5	1.5	200	22	33	42	52	69	95	125	1.1	2
28	140	—	—	—	—	—	175	11	18	22	26	35	46	63	0.6	1.1	190	16	24	30	37	50	67	90	1	1.5	1.5	210	22	33	42	53	69	65	125	1.1	2
30	150	—	—	—	—	—	190	13	20	24	30	40	54	71	0.6	1.1	210	19	28	36	45	60	80	109	1	2	2	225	24	35	45	56	75	100	136	1.1	2.1
32	160	—	—	—	—	—	200	13	20	24	30	40	54	71	0.6	1.1	220	19	28	36	45	60	80	109	1	2	2	240	25	38	48	60	80	109	145	1.5	2.1
34	170	—	—	—	—	—	215	14	22	27	34	45	60	80	0.6	1.1	230	19	28	36	45	60	80	109	1	2	2	260	28	42	54	67	90	122	160	1.5	2.1
36	180	—	—	—	—	—	225	14	22	27	34	45	60	80	0.6	1.1	250	22	33	42	52	69	95	125	1.1	2	2	280	31	46	60	74	100	136	180	2	2.1
38	190	—	—	—	—	—	240	16	24	30	37	50	67	90	1	1.5	260	22	33	42	52	69	95	125	1.1	2	2	290	31	46	60	75	100	136	180	2	2.1
40	200	—	—	—	—	—	250	16	24	30	37	50	67	90	1	1.5	280	25	38	48	60	80	109	145	1.5	2.1	2.1	310	34	51	66	82	109	150	200	2	2.1
44	220	—	—	—	—	—	270	16	24	30	37	50	67	90	1	1.5	300	25	38	48	60	80	109	145	1.5	2.1	2.1	340	37	56	72	90	118	160	218	2.1	3
48	240	—	—	—	—	—	300	19	28	36	45	60	80	100	1	2	320	25	38	48	60	80	109	145	1.5	2.1	2.1	360	37	56	72	92	118	160	218	2.1	3
52	260	—	—	—	—	—	320	19	28	36	45	60	80	100	1	2	360	31	46	60	75	100	136	180	2	2.1	2.1	400	44	65	82	104	140	190	250	3	4
56	280	—	—	—	—	—	350	22	33	42	52	69	95	125	1.1	2	380	31	46	60	75	100	136	180	2	2.1	2.1	420	44	65	82	106	140	190	250	3	4
60	300	—	—	—	—	—	380	25	38	48	60	80	109	145	1.5	2.1	420	37	56	72	90	118	160	218	2.1	3	3	460	50	74	95	118	160	218	290	4	4
64	320	—	—	—	—	—	400	25	38	48	60	80	109	145	1.5	2.1	440	37	56	72	90	118	160	218	2.1	3	3	480	50	74	95	121	160	218	290	4	4
68	340	—	—	—	—	—	420	25	38	48	60	80	109	145	1.5	2.1	460	37	56	72	90	118	160	218	2.1	3	3	520	57	82	106	133	180	243	325	4	5
72	360	—	—	—	—	—	440	25	38	48	60	80	109	145	1.5	2.1	480	37	56	72	90	118	160	218	2.1	3	3	540	57	82	106	134	180	243	325	4	5
76	380	—	—	—	—	—	480	31	46	60	75	100	136	180	2	2.1	520	44	65	82	106	140	190	250	3	4	4	560	57	82	106	135	180	243	325	4	5
80	400	—	—	—	—	—	500	31	46	60	75	100	136	180	2	2.1	540	44	65	82	106	140	190	250	3	4	4	600	63	90	118	148	200	272	355	5	5
84	420	—	—	—	—	—	520	31	46	60	75	100	136	180	2	2.1	560	44	65	82	106	140	190	250	3	4	4	620	63	90	118	150	200	272	355	5	5
88	440	—	—	—	—	—	540	31	46	60	75	100	136	180	2	2.1	600	50	74	95	118	160	218	290	4	4	4	650	67	94	122	157	212	280	375	5	6
92	460	—	—	—	—	—	580	37	56	72	90	118	160	218	2.1	3	620	50	74	95	118	160	218	290	4	4	4	680	71	100	128	163	218	300	400	5	6
96	480	—	—	—	—	—	600	37	56	72	90	118	160	218	2.1	3	650	54	78	100	128	170	230	308	4	5	5	700	71	100	128	165	218	300	400	5	6
/500	500	—	—	—	—	—	620	37	56	72	90	118	160	218	2.1	3	670	54	78	100	128	170	230	308	4	5	5	720	71	100	128	167	218	300	400	5	6
/530	530	—	—	—	—	—	650	37	56	72	90	118	160	218	2.1	3	710	57	82	106	136	180	243	325	4	5	5	780	80	112	145	185	250	335	450	6	6
/560	560	—	—	—	—	—	680	37	56	72	90	118	160	218	2.1	3	750	60	85	112	140	190	258	345	5	5	5	820	82	115	150	195	258	355	462	6	6
/600	600	—	—	—	—	—	730	42	60	78	98	128	175	236	3	3	800	63	90	118	150	200	272	355	5	5	5	870	85	118	155	200	272	365	488	6	6
/630	630	—	—	—	—	—	780	48	69	88	112	150	200	272	3	4	850	71	100	128	165	218	300	400	5	6	6	920	92	128	170	212	290	388	515	6	7.5
/670	670	—	—	—	—	—	820	48	69	88	112	150	200	272	3	4	900	73	103	136	170	230	308	412	5	6	6	980	100	136	180	230	308	425	560	6	7.5
/710	710	—	—	—	—	—	870	50	74	95	118	160	218	290	4	4	950	78	106	140	180	243	325	438	5	6	6	1030	103	140	185	236	315	438	580	6	7.5
/750	750	—	—	—	—	—	920	54	78	100	128	170	230	308	4	5	1000	80	112	145	185	250	335	450	6	6	6	1090	109	150	195	250	335	462	615	7.5	7.5
/800	800	—	—	—	—	—	980	57	82	106	136	180	243	325	4	5	1060	82	115	150	195	258	355	462	6	6	6	1150	112	155	200	258	345	475	630	7.5	7.5
/850	850	—	—	—	—	—	1030	57	82	106	136	180	243	325	4	5	1120	85	118	155	200	272	365	488	6	6	6	1220	118	165	212	272	365	500	670	7.5	7.5
/900	900	—	—	—	—	—	1090	60	85	112	140	190	258	345	5	5	1180	88	122	165	206	280	375	500	6	6	6	1280	122	170	218	280	375	515	690	7.5	7.5
/950	950	—	—	—	—	—	1150	63	63	118	150	200	272	355	5	5	1250	95	132	175	224	300	400	545	6	7.5	7.5	1300	132	180	236	300	412	560	730	7.5	7.5
/1000	1000	—	—	—	—	—	1220	71	90	128	165	218	300	400	5	6	1320	103	140	185	236	315	438	580	6	7.5	7.5	1420	136	185	243	308	412	560	750	7.5	7.5
/1060	1060	—	—	—	—	—	1280	71	100	128	165	218	300	400	5	6	1400	109	150	195	250	335	462	615	7.5	7.5	7.5	1500	140	195	250	325	438	600	800	9.5	9.5
/1120	1120	—	—	—	—	—	1360	78	106	140	180	243	325	438	5	6	1460	109	150	195	250	335	462	615	7.5	7.5	7.5	1580	145	200	265	345	462	615	825	9.5	9.5
/1180	1180	—	—	—	—	—	1420	78	106	140	180	243	325	438	5	6	1540	115	160	206	272	355	488	650	7.5	7.5	7.5	1660	155	212	272	355	475	650	875	9.5	9.5
/1250	1250	—	—	—	—	—	1500	80	112	145	185	250	335	450	6	6	1630	122	170	218	280	375	515	690	7.5	7.5	7.5	1750	—	218	290	375	500	—	—	—	9.5
/1320	1320	—	—	—	—	—	1600	88	122	165	206	280	375	500	6	6	1720	128	175	230	300	400	545	710	7.5	7.5	7.5	1850	—	230	300	400	530	—	—	—	12
/1400	1400	—	—	—	—	—	1700	95	132	175	224	300	400	545	6	7.5	1820	—	185	243	315	425	—	—	—	9.5	9.5	1950	—	243	315	412	545	—	—	—	12
/1500	1500	—	—	—	—	—	1820	—	140	185	243	315	—	—	—	7.5	1950	—	195	258	335	450	—	—	—	9.5	9.5	2120	—	272	355	462	615	—	—	—	12
/1600	1600	—	—	—	—	—	1950	—	155	200	265	345	—	—	—	7.5	2060	—	200	265	345	462	—	—	—	9.5	9.5	2240	—	280	365	475	630	—	—	—	12
/1700	1700	—	—	—	—	—	2060	—	160	206	272	355	—	—	—	7.5	2180	—	212	280	355	475	—	—	—	9.5	9.5	2360	—	290	375	500	650	—	—	—	15
/1800	1800	—	—	—	—	—	2180	—	165	218	290	375	—	—	—	9.5	2300	—	218	290	375	500	—	—	—	12	12	2500	—	308	400	530	690	—	—	—	15
/1900	1900	—	—	—	—	—	2300	—	175	230	300	400	—	—	—	9.5	2430	—	230	308	400	530	—	—	—	12	12	—	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	2430	—	190	250	325	425	—	—	—	9.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-2

Single row radial ball bearings												62 72		1,22	1,32						63 73		623	633				64 74		
Double row radial ball bearings												12		42 22	52 32						13		43 23	53 33						
Cylindrical roller bearings						NN31						N2		N22	N32						N3		N23	N33				N4		
Needle roller bearings																														
Spherical roller bearings						231	241							222	232						213		223							
Nominal bearing bore diameter *d*		Diameter series 1								Diameter series 2									Diameter series 3								Diameter series 4			
		Nominal outside diameter of bearing *D*	Dimension series							Nominal outside diameter of bearing *D*	Dimension series								Nominal outside diameter of bearing *D*	Dimension series							Nominal outside diameter of bearing *D*	Dimension series		
Number	Dimension		01	11	21	31	41	01	11~41		82	02	12	22	32	42	82	02~42		83	03	13	23	33	83	03~33		04	24	Chamfer dimension γs min
			Nominal width *B*						Chamfer dimension γs min		Nominal width *B*						Chamfer dimension γs min			Nominal width *B*					Chamfer dimension γs min			Nominal width *B*		
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	3	—	—	—	—	—	—	—	—	10	2.5	4	—	—	5	—	0.1	0.15	13	—	5	—	—	7	—	0.2	—	—	—	—
4	4	—	—	—	—	—	—	—	—	13	3	5	—	—	7	—	0.15	0.2	16	—	5	—	—	9	—	0.3	—	—	—	—
5	5	—	—	—	—	—	—	—	—	16	3.5	5	—	—	8	—	0.15	0.3	19	—	6	—	—	10	—	0.3	—	—	—	—
6	6	—	—	—	—	—	—	—	—	19	4	6	—	—	10	—	0.2	0.3	22	—	7	—	11	13	—	0.3	—	—	—	—
7	7	—	—	—	—	—	—	—	—	22	5	7	—	—	11	—	0.3	0.3	26	—	9	—	13	15	—	0.3	—	—	—	—
8	8	—	—	—	—	—	—	—	—	24	5	8	—	—	12	—	0.3	0.3	28	—	9	—	13	15	—	0.3	30	10	14	0.6
9	9	—	—	—	—	—	—	—	—	26	6	8	—	—	13	—	0.3	0.3	30	—	10	—	14	16	—	0.6	32	11	15	0.6
00	10	—	—	—	—	—	—	—	—	30	7	9	—	14	14.3	—	0.3	0.6	35	9	11	—	17	19	0.3	0.6	37	12	16	0.6
01	12	—	—	—	—	—	—	—	—	32	7	10	—	14	15.9	—	0.3	0.6	37	9	12	—	17	19	0.3	1	42	13	19	1
02	15	—	—	—	—	—	—	—	—	35	8	11	—	14	15.9	20	0.3	0.6	42	9	13	—	17	19	0.3	1	52	15	24	1.1
03	17	—	—	—	—	—	—	—	—	40	8	12	—	16	17.5	22	0.3	0.6	47	10	14	—	19	22.2	0.6	1	62	17	29	1.1
04	20	—	—	—	—	—	—	—	—	47	9	14	—	18	20.6	27	0.3	1	52	10	15	—	21	22.2	0.6	1.1	72	19	33	1.1
/22	22	—	—	—	—	—	—	—	—	50	9	14	—	18	20.6	27	0.3	1	56	11	16	—	21	25	0.6	1.1	—	—	—	—
05	25	—	—	—	—	—	—	—	—	52	10	15	—	18	20.6	27	0.3	1	62	12	17	—	24	25.4	0.6	1.1	80	21	36	1.5
/28	28	—	—	—	—	—	—	—	—	58	10	16	—	19	23	30	0.6	1	68	13	18	—	24	30	0.6	1.1	—	—	—	—
06	30	—	—	—	—	—	—	—	—	62	10	16	—	20	23.8	32	0.6	1	72	13	19	—	27	30.2	0.6	1.1	90	23	40	1.5
/32	32	—	—	—	—	—	—	—	—	65	11	17	—	21	25	33	0.6	1	75	14	20	—	28	32	0.6	1.1	—	—	—	—
07	35	—	—	—	—	—	—	—	—	72	12	17	—	23	27	37	0.6	1.1	80	14	21	—	31	34.9	0.6	1.5	100	25	43	1.5
08	40	—	—	—	—	—	—	—	—	80	13	18	—	23	30.2	40	0.6	1.1	90	16	23	—	33	36.5	1	1.5	110	27	46	2
09	45	—	—	—	—	—	—	—	—	85	13	19	—	23	30.2	40	0.6	1.1	100	17	25	—	36	39.7	1	1.5	120	29	50	2
10	50	—	—	—	—	—	—	—	—	90	13	20	—	23	30.2	40	0.6	1.1	110	19	27	—	40	44.4	1	2	130	31	53	2.1
11	55	—	—	—	—	—	—	—	—	100	14	21	—	25	33.3	45	1	1.5	120	21	29	—	43	49.2	1.1	2	140	33	57	2.1
12	60	—	—	—	—	—	—	—	—	110	16	22	—	28	36.5	50	1	1.5	130	22	31	—	46	54	1.1	2.1	150	35	60	2.1
13	65	—	—	—	—	—	—	—	—	125	18	23	—	31	38.1	56	1	1.5	140	24	33	—	48	58.7	1.1	2.1	160	37	64	2.1
14	70	—	—	—	—	—	—	—	—	125	18	24	—	31	39.7	56	1	1.5	150	25	35	—	51	63.5	1.5	2.1	180	42	74	3
15	75	—	—	—	—	—	—	—	—	130	18	25	—	31	41.3	56	1	1.5	160	27	37	—	55	68.3	1.5	2.1	190	45	77	3
16	80	—	—	—	—	—	—	—	—	140	19	26	—	33	44.4	60	1	2	170	28	39	—	58	68.3	1.5	2.1	200	48	80	3
17	85	—	—	—	—	—	—	—	—	150	21	28	—	36	49.2	65	1.1	2	180	30	41	—	60	73	2	3	210	52	86	4
18	90	150	—	—	—	—	60	—	2	160	22	30	—	40	52.4	69	1.1	2	190	30	43	—	64	73	2	3	225	54	90	4
19	95	160	—	—	—	—	65	—	2	170	24	32	—	43	55.6	75	1.1	2.1	200	33	45	—	67	77.8	2	3	240	55	95	4
20	100	165	21	30	39	52	65	1.1	2	180	25	34	—	46	60.3	80	1.5	2.1	215	36	47	51	73	82.6	2.1	3	250	58	98	4
21	105	175	22	33	42	56	69	1.1	2	190	27	36	—	50	65.1	85	1.5	2.1	225	37	49	53	77	87.3	2.1	3	260	60	100	4
22	110	180	22	33	42	56	69	1.1	2	200	28	38	—	53	69.8	90	1.5	2.1	240	42	50	57	80	92.1	3	3	280	65	108	4
24	120	200	25	38	48	62	80	1.5	2	215	—	40	42	58	76	95	—	2.1	260	44	55	62	86	106	3	3	310	72	118	5
26	130	210	25	38	48	64	80	1.5	2	230	—	40	46	64	80	100	—	3	280	48	58	66	93	112	3	4	340	78	128	5
28	140	225	27	40	50	68	85	1.5	2.1	250	—	42	50	68	88	109	—	3	300	50	62	70	102	118	4	4	360	82	132	5
30	150	250	31	46	60	80	100	2	2.1	270	—	45	54	73	96	118	—	3	320	—	65	75	108	128	—	4	380	85	138	5
32	160	270	34	51	66	86	109	2	2.1	290	—	48	58	80	104	128	—	3	340	—	68	79	114	136	—	4	400	88	142	5
34	170	280	34	51	66	88	109	2	2.1	310	—	52	62	86	110	140	—	4	360	—	72	84	120	140	—	4	420	92	145	5
36	180	300	37	56	72	96	118	2.1	3	320	—	52	62	86	112	140	—	4	380	—	75	88	126	150	—	4	440	95	150	6
38	190	320	42	60	78	104	128	3	3	340	—	55	65	92	120	150	—	4	400	—	78	92	132	155	—	5	460	98	155	6
40	200	340	44	65	82	112	140	3	3	360	—	58	70	98	128	160	—	4	420	—	80	97	138	165	—	5	480	102	160	6
44	220	370	48	69	88	120	150	3	4	400	—	65	78	108	144	180	—	4	460	—	88	106	145	180	—	5	540	115	180	6
48	240	400	50	74	95	128	160	4	4	440	—	72	85	120	160	200	—	4	500	—	95	114	155	195	—	5	580	122	190	6
52	260	440	57	82	106	144	180	4	4	480	—	80	90	130	174	218	—	5	540	—	102	123	165	206	—	6	620	132	206	7.5
56	280	460	57	82	106	146	180	4	5	500	—	80	90	130	176	218	—	5	580	—	108	132	175	224	—	6	670	140	224	7.5
60	300	500	63	90	118	160	200	5	5	540	—	85	98	140	192	243	—	5	620	—	109	140	185	236	—	7.5	710	150	236	7.5
64	320	540	71	100	128	176	218	5	5	580	—	92	105	150	208	258	—	5	670	—	112	155	200	258	—	7.5	750	155	250	9.5
68	340	580	78	106	140	190	243	5	5	620	—	92	118	165	224	280	—	6	710	—	118	165	212	272	—	7.5	800	164	265	9.5
72	360	600	78	106	140	192	243	5	5	650	—	95	122	170	232	290	—	6	750	—	125	170	224	290	—	7.5	850	180	280	9.5
76	380	620	78	106	140	194	243	5	5	680	—	95	132	175	240	300	—	6	780	—	128	175	230	300	—	7.5	900	190	300	9.5
80	400	650	80	112	145	200	250	6	6	720	—	103	140	185	256	315	—	6	820	—	136	185	243	308	—	7.5	950	200	315	12
84	420	700	88	122	165	224	280	6	6	760	—	109	150	195	272	335	—	7.5	850	—	136	190	250	315	—	9.5	980	206	325	12
88	440	720	88	122	165	226	280	6	6	790	—	112	155	200	280	345	—	7.5	900	—	145	200	265	345	—	9.5	1030	212	335	12
92	460	760	95	132	175	240	300	6	7.5	830	—	118	165	212	296	365	—	7.5	950	—	155	212	280	365	—	9.5	1060	218	345	12
96	480	790	100	136	180	248	308	6	7.5	870	—	125	170	224	310	388	—	7.5	980	—	160	218	290	375	—	9.5	1120	230	365	15
/500	500	830	106	145	190	264	325	7.5	7.5	920	—	136	185	243	336	412	—	7.5	1030	—	170	230	300	388	—	12	1150	236	375	15
/530	530	870	109	150	195	272	335	7.5	7.5	980	—	145	200	258	355	450	—	9.5	1090	—	180	243	325	412	—	12	1220	250	400	15
/560	560	920	115	160	206	280	355	7.5	7.5	1030	—	150	206	272	365	475	—	9.5	1150	—	190	258	335	438	—	12	1280	258	412	15
/600	600	980	122	170	218	300	375	7.5	7.5	1090	—	155	212	280	388	488	—	9.5	1220	—	200	272	355	462	—	15	1360	272	438	15
/630	630	1030	128	175	230	315	400	7.5	7.5	1150	—	165	230	300	412	515	—	12	1280	—	206	280	375	488	—	15	1420	280	450	15
/670	670	1090	136	185	243	336	412	7.5	7.5	1220	—	175	243	315	438	545	—	12	1360	—	218	300	400	515	—	15	1500	290	475	15
/710	710	1150	140	195	250	345	438	9.5	9.5	1280	—	180	250	325	450	560	—	12	1420	—	224	308	412	530	—	15	—	—	—	—
/750	750	1220	150	206	272	365	475	9.5	9.5	1360	—	195	265	345	475	615	—	15	1500	—	236	325	438	560	—	15	—	—	—	—
/800	800	1280	155	212	272	375	475	9.5	9.5	1420	—	200	272	355	488	615	—	15	1600	—	258	355	462	600	—	15	—	—	—	—
/850	850	1360	165	224	290	400	500	12	12	1500	—	206	280	375	515	650	—	15	1700	—	272	375	488	630	—	19	—	—	—	—
/900	900	1420	165	230	300	412	515	12	12	1580	—	218	300	388	515	670	—	15	1780	—	280	388	500	650	—	19	—	—	—	—
/950	950	1500	175	243	315	438	545	12	12	1660	—	230	315	412	530	710	—	15	1850	—	290	400	515	670	—	19	—	—	—	—
/1000	1000	1580	185	258	335	462	580	12	12	1750	—	243	330	425	560	750	—	15	1950	—	300	412	545	710	—	19	—	—	—	—
/1060	1060	1660	190	265	345	475	600	12	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1120	1120	1750	—	280	365	475	630	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1180	1180	1850	—	290	388	500	670	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1250	1250	1950	—	308	400	530	710	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1320	1320	2060	—	325	425	560	750	—	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1400	1400	2180	—	345	450	580	775	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
/1500	1500	2300	—	355	462	600	800	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 2: Comparison of SI, CGS and gravity units-1

Quantity / Unit system	Length L	Mass M	Time T	Acceleration	Force	Stress	Pressure	Energy
SI	m	kg	s	m/s^2	N	Pa	Pa	J
CGS system	cm	g	s	Gal	dyn	dyn/cm^2	dyn/cm^2	erg
Gravitation system	m	kgf · s^2/m	s	m/s^2	kgf	kgf/m^2	kgf/m^2	kgf · m

Table 3: SI-customary unit conversion table-1

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Angle	Degree	°	π/180	Radian	rad
	Minute	′	π/10 800		
	Second	″ (sec)	π/648 000		
Length	Meter	m	1	Meter	m
	Micron	μ	10^{-6}		
	Angstrom	Å	10^{-10}		
Area	Square meter	m^2	1	Square meter	m^2
	Are	a	10^2		
	Hectare	ha	10^4		
Volume	Cubic meter	m^3	1	Cubic meter	m^3
	Liter	R.L	10^{-3}		
Mass	Kilogram	kg	1	Kilogram	kg
	Ton	t	10^3		
	Kilogram force / square second per meter	kgf · s^2/m	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meters per second	m/s	1	Meters per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s^{-1} (pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute (rpm)	rpm [min^{-1}]	1/60	Per second	s^{-1}
Angular speed	Radians per second	rad/s	1	Radians per second	rad/s
Acceleration	Meters per square second	m/s^2	1	Meters per second square	m/s^2
	G	G	9.806 65		
Force	Kilogram force	kgf	9.806 65	Newton	N
	Ton force	tf	9 806.65		
	Dyne	dyn	10^{-5}		
Force moment	Kilogram force / meter	kgf · m	9.806 65	Newton meter	N · m
Inertia moment	Kilogram force / meter / square second	kgf · m · s^2	9.806 65	Kilogram / square meter	kg · m^2
Stress	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal or newton per square meter	Pa or N/m^2
Pressure	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal	Pa
	Meter water column	mH_2O	9 806.65		
	Meter of mercury	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmosphere	atm	101 325		
	Bar	bar	10^5		
Energy	Erg	erg	10^{-7}	Joule	J
	IT calorie	cal_{IT}	4.186 8		
	Kilogram force / meter	kgf · m	9.806 65		
	Kilowatt hour	kW · h	3.600×10^6		
	Metric horsepower per hour	PS · h	$2.647\ 79 \times 10^6$		
Power rate and power	Watt	W	1	Watt	W
	Metric horsepower	PS	735.5		
	Kilogram force / meter per second	kgf · m/s	9.806 65		

Table 2: Comparison of SI, CGS and gravity units-2

Unit system \ Quantity	Power rate	Temperature	Viscosity	Dynamic viscosity	Magnetic flux	Flux density	Magnetic field strength
SI	W	K	Pa · s	m^2/s	Wb	T	A/m
CGS system	erg/s	˚C	P	St	Mx	Gs	Oe
Gravitation system	kgf · m/s	˚C	kgf · s/m^2	m^2/s	—	—	—

Table 3: SI-customary unit conversion table-2

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Viscosity	Poise	P	10^{-1}	Pascal second	Pa · s
	Centipoise	cP	10^{-3}		
	Kilogram force / square second per meter	kgf · s/m^2	9.806 65		
Dynamic viscosity	Stokes	St	10^{-4}	Square meter per second	m^2/s
	Centistokes	cSt	10^{-6}		
Temperature	Degree	˚C	+273.15	Kelvin	K
Radioactive	Curie	Ci	3.7×10^{10}	Becquerel	Bq
Dosage	Roentgen	R	2.58×10^{-4}	Coulombs per kilogram	C/kg
Absorption dosage	Rad	rad	10^{-2}	Gray	Gy
Dosage equivalent	Rem	rem	10^{-2}	Sievert	Sv
Magnetic flux	Maxwell	Mx	10^{-8}	Weber	Wb
Flux density	Gamma	γ	10^{-9}	Tesla	T
	Gauss	Gs	10^{-4}		
Magnetic field strength	Oersted	Oe	$10^3/4\pi$	Amperes per meter	A/m
Quantity of electricity	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Current	Ampere	A	1	Ampere	A

Table 4: Tenth power multiples of SI unit

Multiples of unit	Prefix		Multiples of unit	Prefix	
	Name	Symbol		Name	Symbol
10^{18}	Exa	E	10^{-1}	Deci	d
10^{15}	Peta	P	10^{-2}	Centi	c
10^{12}	Tera	T	10^{-3}	Mili	m
10^{9}	Giga	G	10^{-6}	Micro	μ
10^{6}	Mega	M	10^{-9}	Nano	n
10^{3}	Kilo	k	10^{-12}	Pico	p
10^{2}	Hecto	h	10^{-15}	Femto	f
10	Deca	da	10^{-18}	Ato	a

Table 5: Dimensional tolerance for shafts

Diameter division mm over	incl.	a13 high	a13 low	c12 high	c12 low	d6 high	d6 low	e6 high	e6 low	e13 high	e13 low	f5 high	f5 low	f6 high	f6 low	g5 high	g5 low	g6 high	g6 low
3	6	−270	−450	−70	−190	−30	−38	−20	−28	−20	−200	−10	−15	−10	−18	−4	−9	−4	−12
6	10	−280	−500	−80	−230	−40	−49	−25	−34	−25	−245	−13	−19	−13	−22	−5	−11	−5	−14
10	18	−290	−560	−95	−275	−50	−61	−32	−43	−32	−302	−16	−24	−16	−27	−6	−14	−6	−17
18	30	−300	−630	−110	−320	−65	−78	−40	−53	−40	−370	−20	−29	−20	−33	−7	−16	−7	−20
30	40	−310	−700	−120	−370	−80	−96	−50	−66	−50	−440	−25	−36	−25	−41	−9	−20	−9	−25
40	50	−320	−710	−130	−380														
50	65	−340	−800	−140	−440	−100	−119	−60	−79	−60	−520	−30	−43	−30	−49	−10	−23	−10	−29
65	80	−360	−820	−150	−450														
80	100	−380	−920	−170	−520	−120	−142	−72	−94	−72	−612	−36	−51	−36	−58	−12	−27	−12	−34
100	120	−410	−950	−180	−530														
120	140	−460	−1 090	−200	−600	−145	−170	−85	−110	−85	−715	−43	−61	−43	−68	−14	−32	−14	−39
140	160	−520	−1 150	−210	−610														
160	180	−580	−1 210	−230	−630														
180	200	−660	−1 380	−240	−700	−170	−199	−100	−129	−100	−820	−50	−70	−50	−79	−15	−35	−15	−44
200	225	−740	−1 460	−260	−720														
225	250	−820	−1 540	−280	−740														
250	280	−920	−1 730	−300	−820	−190	−222	−110	−142	−110	−920	−56	−79	−56	−88	−17	−40	−17	−49
280	315	−1 050	−1 860	−330	−850														
315	355	−1 200	−2 090	−360	−930	−210	−246	−125	−161	−125	−1 015	−62	−87	−62	−98	−18	−43	−18	−54
355	400	−1 350	−2 240	−400	−970														
400	450	−1 500	−2 470	−440	−1 070	−230	−270	−135	−175	−135	−1 105	−68	−95	−68	−108	−20	−47	−20	−60
450	500	−1 650	−2 620	−480	−1 110														
500	560	–	–	–	–	−260	−304	−145	−189	–	–	–	–	−76	−120	–	–	−22	−66
560	630																		
630	710	–	–	–	–	−290	−340	−160	−210	–	–	–	–	−80	−130	–	–	−24	−74
710	800																		
800	900	–	–	–	–	−320	−376	−170	−226	–	–	–	–	−86	−142	–	–	−26	−82
900	1 000																		
1 000	1 120	–	–	–	–	−350	−416	−195	−261	–	–	–	–	−98	−164	–	–	−28	−94
1 120	1 250																		
1 250	1 400	–	–	–	–	−390	−468	−220	−298	–	–	–	–	−110	−188	–	–	−30	−108
1 400	1 600																		

Diameter division mm over	incl.	j5 high	j5 low	js5 high	js5 low	j6 high	j6 low	js6 high	js6 low	j7 high	j7 low	k4 high	k4 low	k5 high	k5 low	k6 high	k6 low	m5 high	m5 low
3	6	+3	−2	+2.5	−2.5	+6	−2	+4	−4	+8	−4	+5	+1	+6	+1	+9	+1	+9	+4
6	10	+4	−2	+3	−3	+7	−2	+4.5	−4.5	+10	−5	+5	+1	+7	+1	+10	+1	+12	+6
10	18	+5	−3	+4	−4	+8	−3	+5.5	−5.5	+12	−6	+6	+1	+9	+1	+12	+1	+15	+7
18	30	+5	−4	+4.5	−4.5	+9	−4	+6.5	−6.5	+13	−8	+8	+2	+11	+2	+15	+2	+17	+8
30	40	+6	−5	+5.5	−5.5	+11	−5	+8	−8	+15	−10	+9	+2	+13	+2	+18	+2	+20	+9
40	50																		
50	65	+6	−7	+6.5	−6.5	+12	−7	+9.5	−9.5	+18	−12	+10	+2	+15	+2	+21	+2	+24	+11
65	80																		
80	100	+6	−9	+7.5	−7.5	+13	−9	+11	−11	+20	−15	+13	+3	+18	+3	+25	+3	+28	+13
100	120																		
120	140	+7	−11	+9	−9	+14	−11	+12.5	−12.5	+22	−18	+15	+3	+21	+3	+28	+3	+33	+15
140	160																		
160	180																		
180	200	+7	−13	+10	−10	+16	−13	+14.5	−14.5	+25	−21	+18	+4	+24	+4	+33	+4	+37	+17
200	225																		
225	250																		
250	280	+7	−16	+11.5	−11.5	+16	−16	+16	−16	+26	−26	+20	+4	+27	+4	+36	+4	+43	+20
280	315																		
315	355	+7	−18	+12.5	−12.5	+18	−18	+18	−18	+29	−28	+22	+4	+29	+4	+40	+4	+46	+21
355	400																		
400	450	+7	−20	+13.5	−13.5	+20	−20	+20	−20	+31	−32	+25	+5	+32	+5	+45	+5	+50	+23
450	500																		
500	560	–	–	–	–	–	–	+22	−22	–	–	–	–	–	–	+44	0	–	–
560	630																		
630	710	–	–	–	–	–	–	+25	−25	–	–	–	–	–	–	+50	0	–	–
710	800																		
800	900	–	–	–	–	–	–	+28	−28	–	–	–	–	–	–	+56	0	–	–
900	1 000																		
1 000	1 120	–	–	–	–	–	–	+33	−33	–	–	–	–	–	–	+66	0	–	–
1 120	1 250																		
1 250	1 400	–	–	–	–	–	–	+39	−39	–	–	–	–	–	–	+78	0	–	–
1 400	1 600																		

Unit μm

h4		h5		h6		h7		h8		h9		h10		h11		h13		js4		Diameter division mm	
high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	over	incl.
0	−4	0	−5	0	−8	0	−12	0	−18	0	−30	0	−48	0	−75	0	−180	+2	−2	3	6
0	−4	0	−6	0	−9	0	−15	0	−22	0	−36	0	−58	0	−90	0	−220	+2	−2	6	10
0	−5	0	−8	0	−11	0	−18	0	−27	0	−43	0	−70	0	−110	0	−270	+2.5	−2.5	10	18
0	−6	0	−9	0	−13	0	−21	0	−33	0	−52	0	−84	0	−130	0	−330	+3	−3	18	30
0	−7	0	−11	0	−16	0	−25	0	−39	0	−62	0	−100	0	−160	0	−390	+3.5	−3.5	30 40	40 50
0	−8	0	−13	0	−19	0	−30	0	−46	0	−74	0	−120	0	−190	0	−460	+4	−4	50 65	65 80
0	−10	0	−15	0	−22	0	−35	0	−54	0	−87	0	−140	0	−220	0	−540	+5	−5	80 100	100 120
0	−12	0	−18	0	−25	0	−40	0	−63	0	−100	0	−160	0	−250	0	−630	+6	−6	120 140 160	140 160 180
0	−14	0	−20	0	−29	0	−46	0	−72	0	−115	0	−185	0	−290	0	−720	+7	−7	180 200 225	200 225 250
0	−16	0	−23	0	−32	0	−52	0	−81	0	−130	0	−210	0	−320	0	−810	+8	−8	250 280	280 315
0	−18	0	−25	0	−36	0	−57	0	−89	0	−140	0	−230	0	−360	0	−890	+9	−9	315 355	355 400
0	−20	0	−27	0	−40	0	−63	0	−97	0	−155	0	−250	0	−400	0	−970	+10	−10	400 450	450 500
−	−	−	−	0	−44	0	−70	0	−110	0	−175	0	−280	0	−440	0	−	−	−	500 560	560 630
−	−	−	−	0	−50	0	−80	0	−125	0	−200	0	−320	0	−500	0	−	−	−	630 710	710 800
−	−	−	−	0	−56	0	−90	0	−140	0	−230	0	−360	0	−560	0	−	−	−	800 900	900 1 000
−	−	−	−	0	−66	0	−105	0	−165	0	−260	0	−420	0	−660	0	−	−	−	1 000 1 120	1 120 1 250
−	−	−	−	0	−78	0	−125	0	−195	0	−310	0	−500	0	−780	0	−	−	−	1 250 1 400	1 400 1 600

Unit μm

m6		n5		n6		p5		p6		r6		r7		Basic tolerance				Diameter division mm	
high	low	high	low	high	low	high	low	high	low	high	low	high	low	IT2	IT3	IT5	IT7	over	incl.
+12	+4	+13	+8	+16	+8	+17	+12	+20	+12	+23	+15	+27	+15	1.5	2.5	5	12	3	6
+15	+6	+16	+10	+19	+10	+21	+15	+24	+15	+28	+19	+34	+19	1.5	2.5	6	15	6	10
+18	+7	+20	+12	+23	+12	+26	+18	+29	+18	+34	+23	+41	+23	2	3	8	18	10	18
+21	+8	+24	+15	+28	+15	+31	+22	+35	+22	+41	+28	+49	+28	2.5	4	9	21	18	30
+25	+9	+28	+17	+33	+17	+37	+26	+42	+26	+50	+34	+59	+34	2.5	4	11	25	30 40	40 50
+30	+11	+33	+20	+39	+20	+45	+32	+51	+32	+60 +62	+41 +43	+71 +73	+41 +43	3	5	13	30	50 65	65 80
+35	+13	+38	+23	+45	+23	+52	+37	+59	+37	+73 +76	+51 +54	+86 +89	+51 +54	4	6	15	35	80 100	100 120
+40	+15	+45	+27	+52	+27	+61	+43	+68	+43	+88 +90 +93	+63 +65 +68	+103 +105 +108	+63 +65 +68	5	8	18	40	120 140 160	140 160 180
+46	+17	+51	+31	+60	+31	+70	+50	+79	+50	+106 +109 +113	+77 +80 +84	+123 +126 +130	+77 +80 +84	7	10	20	46	180 200 225	200 225 250
+52	+20	+57	+34	+66	+34	+79	+56	+88	+56	+126 +130	+94 +98	+146 +150	+94 +98	8	12	23	52	250 280	280 315
+57	+21	+62	+37	+73	+37	+87	+62	+98	+62	+144 +150	+108 +114	+165 +171	+108 +114	9	13	25	57	315 355	355 400
+63	+23	+67	+40	+80	+40	+95	+68	+108	+68	+166 +172	+126 +132	+189 +195	+126 +132	10	15	27	63	400 450	450 500
+70	+26	−	−	+88	+44	−	−	+122	+78	+194 +199	+150 +155	+220 +225	+150 +155	−	−	−	70	500 560	560 630
+80	+30	−	−	+100	+50	−	−	+138	+88	+225 +235	+175 +185	+255 +265	+175 +185	−	−	−	80	630 710	710 800
+90	+34	−	−	+112	+56	−	−	+156	+100	+266 +276	+210 +220	+300 +310	+210 +220	−	−	−	90	800 900	900 1 000
+106	+40	−	−	+132	+66	−	−	+186	+120	+316 +326	+250 +260	+355 +365	+250 +260	−	−	−	105	1 000 1 120	1 120 1 250
+126	+48	−	−	+156	+78	−	−	+218	+140	+378 +408	+300 +330	+425 +455	+300 +330	−	−	−	125	1 250 1 400	1 400 1 600

Table 6: Dimensional tolerance for housing bore

Diameter division mm over	incl.	E7 high	E7 low	E10 high	E10 low	E11 high	E11 low	E12 high	E12 low	F6 high	F6 low	F7 high	F7 low	F8 high	F8 low	G6 high	G6 low	G7 high	G7 low	H6 high	H6 low
3	6	+ 32	+ 20	+ 68	+ 20	+ 95	+ 20	+140	+ 20	+ 18	+ 10	+ 22	+ 10	+ 28	+ 10	+ 12	+ 4	+ 16	+ 4	+ 8	0
6	10	+ 40	+ 25	+ 83	+ 25	+115	+ 25	+175	+ 25	+ 22	+ 13	+ 28	+ 13	+ 35	+ 13	+ 14	+ 5	+ 20	+ 5	+ 9	0
10	18	+ 50	+ 32	+102	+ 32	+142	+ 32	+212	+ 32	+ 27	+ 16	+ 34	+ 16	+ 43	+ 16	+ 17	+ 6	+ 24	+ 6	+11	0
18	30	+ 61	+ 40	+124	+ 40	+170	+ 40	+250	+ 40	+ 33	+ 20	+ 41	+ 20	+ 53	+ 20	+ 20	+ 7	+ 28	+ 7	+13	0
30 40	40 50	+ 75	+ 50	+150	+ 50	+210	+ 50	+300	+ 50	+ 41	+ 25	+ 50	+ 25	+ 64	+ 25	+ 25	+ 9	+ 34	+ 9	+16	0
50 65	65 80	+ 90	+ 60	+180	+ 60	+250	+ 60	+360	+ 60	+ 49	+ 30	+ 60	+ 30	+ 76	+ 30	+ 29	+10	+ 40	+10	+19	0
80 100	100 120	+107	+ 72	+212	+ 72	+292	+ 72	+422	+ 72	+ 58	+ 36	+ 71	+ 36	+ 90	+ 36	+ 34	+12	+ 47	+12	+22	0
120 140 160	140 160 180	+125	+ 85	+245	+ 85	+335	+ 85	+485	+ 85	+ 68	+ 43	+ 83	+ 43	+106	+ 43	+ 39	+14	+ 54	+14	+25	0
180 200 225	200 225 250	+146	+100	+285	+100	+390	+100	+560	+100	+ 79	+ 50	+ 96	+ 50	+122	+ 50	+ 44	+15	+ 61	+15	+29	0
250 280	280 315	+162	+110	+320	+110	+430	+110	+630	+110	+ 88	+ 56	+108	+ 56	+137	+ 56	+ 49	+17	+ 69	+17	+32	0
315 355	355 400	+182	+125	+355	+125	+485	+125	+695	+125	+ 98	+ 62	+119	+ 62	+151	+ 62	+ 54	+18	+ 75	+18	+36	0
400 450	450 500	+198	+135	+385	+135	+535	+135	+765	+135	+108	+ 68	+131	+ 68	+165	+ 68	+ 60	+20	+ 83	+20	+40	0
500 560	560 630	+215	+145	−	−	−	−	−	−	+120	+ 76	+146	+ 76	+186	+ 76	+ 66	+22	+ 92	+22	+44	0
630 710	710 800	+240	+160	−	−	−	−	−	−	+130	+ 80	+160	+ 80	+205	+ 80	+ 74	+24	+104	+24	+50	0
800 900	900 1 000	+260	+170	−	−	−	−	−	−	+142	+ 86	+176	+ 86	+226	+ 86	+ 82	+26	+116	+26	+56	0
1 000 1 120	1 120 1 250	+300	+195	−	−	−	−	−	−	+164	+ 98	+203	+ 98	+263	+ 98	+ 94	+28	+133	+28	+66	0
1 250 1 400	1 400 1 600	+345	+220	−	−	−	−	−	−	+188	+110	+235	+110	+305	+110	+108	+30	+155	+30	+78	0
1 600 1 800	1 800 2 000	+390	+240	−	−	−	−	−	−	+212	+120	+270	+120	+350	+120	+124	+32	+182	+32	+92	0

Unit μm

Diameter division mm over	incl.	K6 high	K6 low	K7 high	K7 low	M6 high	M6 low	M7 high	M7 low	N6 high	N6 low	N7 high	N7 low	P6 high	P6 low	P7 high	P7 low	R6 high	R6 low	R7 high	R7 low
3	6	+2	− 6	+ 3	− 9	− 1	− 9	0	− 12	− 5	− 13	− 4	− 16	− 9	− 17	− 8	− 20	− 12	− 20	− 11	− 23
6	10	+2	− 7	+ 5	− 10	− 3	− 12	0	− 15	− 7	− 16	− 4	− 19	− 12	− 21	− 9	− 24	− 16	− 25	− 13	− 28
10	18	+2	− 9	+ 6	− 12	− 4	− 15	0	− 18	− 9	− 20	− 5	− 23	− 15	− 26	− 11	− 29	− 20	− 31	− 16	− 34
18	30	+2	−11	+ 6	− 15	− 4	− 17	0	− 21	−11	− 24	− 7	− 28	− 18	− 31	− 14	− 35	− 24	− 37	− 20	− 41
30 40	40 50	+3	−13	+ 7	− 18	− 4	− 20	0	− 25	−12	− 28	− 8	− 33	− 21	− 37	− 17	− 45	− 29	− 42	− 25	− 50
50 65	65 80	+4	−15	+ 9	− 21	− 5	− 24	0	− 30	−14	− 33	− 9	− 39	− 26	− 45	− 21	− 51	− 35 − 37	− 54 − 56	− 30 − 32	− 60 − 62
80 100	100 120	+4	−18	+10	− 25	− 6	− 28	0	− 35	−16	− 38	−10	− 45	− 30	− 52	− 24	− 59	− 44 − 47	− 66 − 69	− 38 − 41	− 73 − 76
120 140 160	140 160 180	+4	−21	+12	− 28	− 8	− 33	0	− 40	−20	− 45	− 12	− 52	− 36	− 61	− 28	− 68	− 56 − 58 − 61	− 81 − 83 − 86	− 48 − 50 − 53	− 88 − 90 − 93
180 200 225	200 225 250	+5	−24	+13	− 33	− 8	− 37	0	− 46	−22	− 51	−14	− 60	− 41	− 70	− 33	− 79	− 68 − 71 − 75	− 97 −100 −104	− 60 − 63 − 67	−106 −109 −113
250 280	280 315	+5	−27	+16	− 36	− 9	− 41	0	− 52	−25	− 57	−14	− 66	− 47	− 79	− 36	− 88	− 85 − 89	−117 −121	− 74 − 78	−126 −130
315 355	355 400	+7	−29	+17	− 40	−10	− 46	0	− 57	−26	− 62	−16	− 73	− 51	− 87	− 41	− 98	− 97 −103	−133 −139	− 87 − 93	−144 −150
400 450	450 500	+8	−32	+18	− 45	−10	− 50	0	− 63	−27	− 67	−17	− 80	− 55	− 95	− 45	−108	−113 −119	−153 −159	−103 −109	−166 −172
500 560	560 630	0	−44	0	− 70	−26	− 70	−26	− 96	−44	− 88	−44	−114	− 78	−122	− 78	−148	−150 −155	−194 −199	−150 −155	−220 −225
630 710	710 800	0	−50	0	− 80	−30	− 80	−30	−100	−50	−100	−50	−130	− 88	−138	− 88	−168	−175 −185	−225 −235	−175 −185	−225 −265
800 900	900 1 000	0	−56	0	− 90	−34	− 90	−34	− 124	−56	−112	−56	−146	−100	−156	−100	−190	−210 −220	−266 −276	−210 −220	−300 −310
1 000 1 120	1 120 1 250	0	−66	0	−105	−40	−106	−40	−145	−66	−132	−66	−171	−120	−186	−120	−225	−250 −260	−316 −326	−250 −260	−355 −365
1 250 1 400	1 400 1 600	0	−78	0	−125	−48	−126	−48	−173	−78	−156	−78	−203	−140	−218	−140	−265	−300 −330	−378 −408	−300 −330	−425 −455
1 600 1 800	1 800 2 000	0	−92	0	−150	−58	−150	−58	−208	−92	−184	−92	−242	−170	−262	−170	−320	−370 −400	−462 −492	−370 −400	−520 −550

Unit μm

H7		H8		H9		H10		H11		H13		J6		Js6		J7		Js7		K5		Diameter division mm	
high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	over	incl.
+12	0	+18	0	+30	0	+48	0	+75	0	+180	0	+5	−3	+4	−4	+6	−6	+6	−6	0	−5	3	6
+15	0	+22	0	+36	0	+58	0	+90	0	+220	0	+5	−4	+4.5	−4.5	+8	−7	+7.5	−7.5	+1	−5	6	10
+18	0	+27	0	+43	0	+70	0	+110	0	+270	0	+6	−5	+5.5	−5.5	+10	−8	+9	−9	+2	−6	10	18
+21	0	+33	0	+52	0	+84	0	+130	0	+330	0	+8	−5	+6.5	−6.5	+12	−9	+10.5	−10.5	+1	−8	18	30
+25	0	+39	0	+62	0	+100	0	+160	0	+390	0	+10	−6	+8	−8	+14	−11	+12.5	−12.5	+2	−9	30 40	40 50
+30	0	+46	0	+74	0	+120	0	+190	0	+460	0	+13	−6	+9.5	−9.5	+18	−12	+15	−15	+3	−10	50 65	65 80
+35	0	+54	0	+87	0	+140	0	+220	0	+540	0	+16	−6	+11	−11	+22	−13	+17.5	−17.5	+2	−13	80 100	100 120
+40	0	+63	0	+100	0	+160	0	+250	0	+630	0	+18	−7	+12.5	−12.5	+26	−14	+20	−20	+3	−15	120 140 160	140 160 180
+46	0	+72	0	+115	0	+185	0	+290	0	+720	0	+22	−7	+14.5	−14.5	+30	−16	+23	−23	+2	−18	180 200 225	200 225 250
+52	0	+81	0	+130	0	+210	0	+320	0	+810	0	+25	−7	+16	−16	+36	−16	+26	−26	+3	−20	250 280	280 315
+57	0	+89	0	+140	0	+230	0	+360	0	+890	0	+29	−7	+18	−18	+39	−18	+28.5	−28.5	+3	−22	315 355	355 400
+63	0	+97	0	+155	0	+250	0	+400	0	+970	0	+33	−7	+20	−20	+43	−20	+31.5	−31.5	+2	−25	400 450	450 500
+70	0	+110	0	+175	0	+280	0	+440	0	−	0	−	−	+22	−22	−	−	+35	−35	−	−	500 560	560 630
+80	0	+125	0	+200	0	+320	0	+500	0	−	0	−	−	+25	−25	−	−	+40	−40	−	−	630 710	710 800
+90	0	+140	0	+230	0	+360	0	+560	0	−	0	−	−	+28	−28	−	−	+45	−45	−	−	800 900	900 1 000
+105	0	+165	0	+260	0	+420	0	+660	0	−	0	−	−	+33	−33	−	−	+52.5	−52.5	−	−	1 000 1 120	1 120 1 250
+125	0	+195	0	+310	0	+500	0	+780	0	−	0	−	−	+39	−39	−	−	+62.5	−62.5	−	−	1 250 1 400	1 400 1 600
+150	0	+230	0	+370	0	+600	0	+920	0	−	0	−	−	+46	−46	−	−	+75	−75	−	−	1 600 1 800	1 800 2 000

Table 7: Basic tolerance

Unit μm

Diameter division mm		IT basic tolerance class									
over	incl.	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10
—	3	0.8	1.2	2	3	4	6	10	14	25	40
3	6	1	1.5	2.5	4	5	8	12	18	30	48
6	10	1	1.5	2.5	4	6	9	15	22	36	58
10	18	1.2	2	3	5	8	11	18	27	43	70
18	30	1.5	2.5	4	6	9	13	21	33	52	84
30	50	1.5	2.5	4	7	11	16	25	39	62	100
50	80	2	3	5	8	13	19	30	46	74	120
80	120	2.5	4	6	10	15	22	35	54	87	140
120	180	3.5	5	8	12	18	25	40	63	100	160
180	250	4.5	7	10	14	20	29	46	72	115	185
250	315	6	8	12	16	23	32	52	81	130	210
315	400	7	9	13	18	25	36	57	89	140	230
400	500	8	10	15	20	27	40	63	97	155	250
500	630	9	11	16	22	30	44	70	110	175	280
630	800	10	13	18	25	35	50	80	125	200	320
800	1 000	11	15	21	29	40	56	90	140	230	360
1 000	1 250	13	18	24	34	46	66	105	165	260	420
1 250	1 600	15	21	29	40	54	78	125	195	310	500
1 600	2 000	18	25	35	48	65	92	150	230	370	600
2 000	2 500	22	30	41	57	77	110	175	280	440	700
2 500	3 150	26	36	50	69	93	135	210	330	540	860

Table 8: Viscosity conversion table

Kinematic viscosity mm²/s	Saybolt SUS (second)	Redwood R"(second)	Engler E (degree)
2.7	35	32.2	1.18
4.3	40	36.2	1.32
5.9	45	40.6	1.46
7.4	50	44.9	1.60
8.9	55	49.1	1.75
10.4	60	53.5	1.88
11.8	65	57.9	2.02
13.1	70	62.3	2.15
14.5	75	67.6	2.31
15.8	80	71.0	2.42
17.0	85	75.1	2.55
18.2	90	79.6	2.68
19.4	95	84.2	2.81
20.6	100	88.4	2.95
23.0	110	97.1	3.21
25.0	120	105.9	3.49
27.5	130	114.8	3.77
29.8	140	123.6	4.04
32.1	150	132.4	4.32
34.3	160	141.1	4.59
36.5	170	150.0	4.88
38.8	180	158.8	5.15
41.0	190	167.5	5.44
43.2	200	176.4	5.72
47.5	220	194.0	6.28
51.9	240	212	6.85
56.5	260	229	7.38
60.5	280	247	7.95
64.9	300	265	8.51
70.3	325	287	9.24
75.8	350	309	9.95
81.2	375	331	10.7
86.8	400	353	11.4
92.0	425	375	12.1
97.4	450	397	12.8

Kinematic viscosity mm²/s	Saybolt SUS (second)	Redwood R"(second)	Engler E (degree)
103	475	419	13.5
108	500	441	14.2
119	550	485	15.6
130	600	529	17.0
141	650	573	18.5
152	700	617	19.9
163	750	661	21.3
173	800	705	22.7
184	850	749	24.2
195	900	793	25.6
206	950	837	27.0
217	1 000	882	28.4
260	1 200	1 058	34.1
302	1 400	1 234	39.8
347	1 600	1 411	45.5
390	1 800	1 587	51
433	2 000	1 763	57
542	2 500	2 204	71
650	3 000	2 646	85
758	3 500	3 087	99
867	4 000	3 526	114
974	4 500	3 967	128
1 082	5 000	4 408	142
1 150	5 500	4 849	156
1 300	6 000	5 290	170
1 400	6 500	5 730	185
1 510	7 000	6 171	199
1 630	7 500	6 612	213
1 740	8 000	7 053	227
1 850	8 500	7 494	242
1 960	9 000	7 934	256
2 070	9 500	8 375	270
2 200	10 000	8 816	284

Table 9: Kgf to N conversion table

kgf		N	kgf		N	kgf		N
0.1020	**1**	9.8066	3.4670	**34**	333.43	6.8321	**67**	657.04
0.2039	**2**	19.613	3.5690	**35**	343.23	6.9341	**68**	666.85
0.3059	**3**	29.420	3.6710	**36**	353.04	7.0361	**69**	676.66
0.4079	**4**	39.227	3.7730	**37**	362.85	7.1380	**70**	686.46
0.5099	**5**	49.033	3.8749	**38**	372.65	7.2400	**71**	696.27
0.6118	**6**	58.840	3.9769	**39**	382.46	7.3420	**72**	706.08
0.7138	**7**	68.646	4.0789	**40**	392.27	7.4440	**73**	715.88
0.8158	**8**	78.453	4.1808	**41**	402.07	7.5459	**74**	725.69
0.9177	**9**	88.260	4.2828	**42**	411.88	7.6479	**75**	735.50
1.0197	**10**	98.066	4.3848	**43**	421.68	7.7499	**76**	745.30
1.1217	**11**	107.87	4.4868	**44**	431.49	7.8518	**77**	755.11
1.2237	**12**	117.68	4.5887	**45**	441.30	7.9538	**78**	764.92
1.3256	**13**	127.49	4.6907	**46**	451.10	8.0558	**79**	774.72
1.4276	**14**	137.29	4.7927	**47**	460.91	8.1578	**80**	784.53
1.5296	**15**	147.10	4.8946	**48**	470.72	8.2597	**81**	794.34
1.6316	**16**	156.91	4.9966	**49**	480.52	8.3617	**82**	804.14
1.7335	**17**	166.71	5.0986	**50**	490.33	8.4637	**83**	813.95
1.8355	**18**	176.52	5.2006	**51**	500.14	8.5656	**84**	823.76
1.9375	**19**	186.33	5.3025	**52**	509.94	8.6676	**85**	833.56
2.0394	**20**	196.13	5.4045	**53**	519.75	8.7696	**86**	843.37
2.1414	**21**	205.94	5.5065	**54**	529.56	8.8716	**87**	853.18
2.2434	**22**	215.75	5.6085	**55**	539.36	8.9735	**88**	862.98
2.3454	**23**	225.55	5.7104	**56**	549.17	9.0755	**89**	872.79
2.4473	**24**	235.36	5.8124	**57**	558.98	9.1775	**90**	882.60
2.5493	**25**	245.17	5.9144	**58**	568.78	9.2794	**91**	892.40
2.6513	**26**	254.97	6.0163	**59**	578.59	9.3814	**92**	902.21
2.7532	**27**	264.78	6.1183	**60**	588.40	9.4834	**93**	912.02
2.8552	**28**	274.59	6.2203	**61**	598.20	9.5854	**94**	921.82
2.9572	**29**	284.39	6.3223	**62**	608.01	9.6873	**95**	931.63
3.0592	**30**	294.20	6.4242	**63**	617.82	9.7893	**96**	941.44
3.1611	**31**	304.01	6.5262	**64**	627.62	9.8913	**97**	951.24
3.2631	**32**	313.81	6.6282	**65**	637.43	9.9932	**98**	961.05
3.3651	**33**	323.62	6.7302	**66**	647.24	10.0952	**99**	970.86

〔How to read the table〕 If for example you want to convert 10 kgf to N, find "10" in the middle column of the first set of columns on the right. Look in the N column directly to the right of "10," and you will see that 10 kgf equals 98.066 N. Oppositely, to convert 10 N to kgf, look in the kgf column to the right of "10" and you will see that 10 N equals 1.0197 kgf.

1kgf＝9.80665N
1N＝0.101972kgf

Table 10: Inch-millimetre conversion table

inch		0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
fraction	decimal										
			25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791
1/16	0.062500	1.588	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584
3/32	0.093750	2.381	27.781	53.181	48.581	103.981	129.381	154.781	180.181	205.581	230.981
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378
1/ 8	0.125000	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966
3/16	0.187500	4.762	30.162	55.562	80.962	106.362	131.762	157.162	182.562	207.962	233.362
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553
1/ 4	0.250000	6.350	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141
5/16	0.312500	7.938	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728
3/ 8	0.375000	9.525	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125
25/64	0.390625	9.922	35.322	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316
7/16	0.437500	11.112	36.512	61.912	87.312	112.721	138.112	163.512	188.912	214.312	239.712
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903
1/ 2	0.500000	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491
9/16	0.562500	14.288	39.688	65.088	90.488	115.888	141.283	166.688	192.088	217.488	242.888
37/64	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284
19/32	0.593750	15.081	40.481	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078
5/ 8	0.625000	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666
11/16	0.687500	17.462	42.862	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.056	246.459
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253
3/ 4	0.750000	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841
13/16	0.812500	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428
7/ 8	0.875000	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222
39/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016
15/16	0.937500	23.812	49.212	74.612	100.012	125.412	150.812	176.212	201.612	227.012	252.412
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809
31/32	0.968750	24.606	50.006	75406	100.806	126.206	151.606	177.006	202.406	227.806	253.206
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603

Table 11: Hardness conversion table (reference)

Rockwell hardness	Vicker's hardness	Brinell hardness		Rockwell hardness		Shore hardness
C scale 1471.0N {150kgf}		Standard steel balls	Tungsten carbide steel balls	A scale 588.4N {60kgf}	B scale 980.7N {100kgf}	
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	—	560	78.5		74
54	577	—	543	78.0		72
53	560	—	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421	421	73.1		60
44	434	409	409	72.5		58
43	423	400	400	72.0		57
42	412	390	390	71.5		56
41	402	381	381	70.9		55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52
38	372	353	353	69.4	—	51
37	363	344	344	68.9	—	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	—	96.7	33
(16)	222	212	212	—	95.5	32
(14)	213	203	203	—	93.9	31
(12)	204	194	194	—	92.3	29
(10)	196	187	187		90.7	28
(8)	188	179	179		89.5	27
(6)	180	171	171		87.1	26
(4)	173	165	165		85.5	25
(2)	166	158	158		83.5	24
(0)	160	152	152		81.7	24

Note 1: From hardness conversion table (SAE J417)

Table 12: Greek alphabet list

Upright	Italic		Reading
Upper case	Upper case	Lower case	
Α	A	α	Alpha
Β	B	β	Beta
Γ	$\mathit{\Gamma}$	γ	Gamma
Δ	$\mathit{\Delta}$	δ	Delta
Ε	E	ε	Epsilon
Ζ	Z	ζ	Zeta
Η	H	η	Eta
Θ	$\mathit{\Theta}$	θ	Theta
Ι	I	ι	Iota
Κ	K	κ	Kappa
Λ	$\mathit{\Lambda}$	λ	Lambda
Μ	M	μ	Mu
Ν	N	ν	Nu
Ξ	$\mathit{\Xi}$	ξ	Xi
Ο	O	o	Omicron
Π	$\mathit{\Pi}$	π	Pi
Ρ	P	ρ	Rho
Σ	$\mathit{\Sigma}$	σ	Sigma
Τ	T	τ	Tau
Υ	$\mathit{\Upsilon}$	υ	Upsolon
Φ	$\mathit{\Phi}$	ϕ	Phi
Χ	X	χ	Khi
Ψ	$\mathit{\Psi}$	ψ	Psi
Ω	$\mathit{\Omega}$	ω	Omega

For New Technology Network

NTN®

HAND BOOK

NEEDLE ROLLER BEARINGS HANDBOOK

HAND BOOK

CAT. No. 9013／E

NTN

Needle Roller Bearing Handbook

Index

1. Needle Roller Bearings

1. 1 Classification of needle roller bearings

Needle roller bearings are categorized into the following two groups:

- **Needle roller and cage assembly bearings**
- **Full-complement needle roller bearings**

1. 2 Comparison with general bearings

(1) Greater load-bearing capacity in a more compact design

Needle roller bearings are smaller than general bearings but have a greater load-carrying capacity. This advantage allows for more compact designs for bearings as well as for bearing housings. Use of these bearings lowers costs by allowing for lighter-weight machinery and more compact structures.

Fig. 1.1 compares bearings with (30) mm bore diameters. Needle roller bearings have 2 to 8 times the load-carrying capacity per given mass than other bearing types.

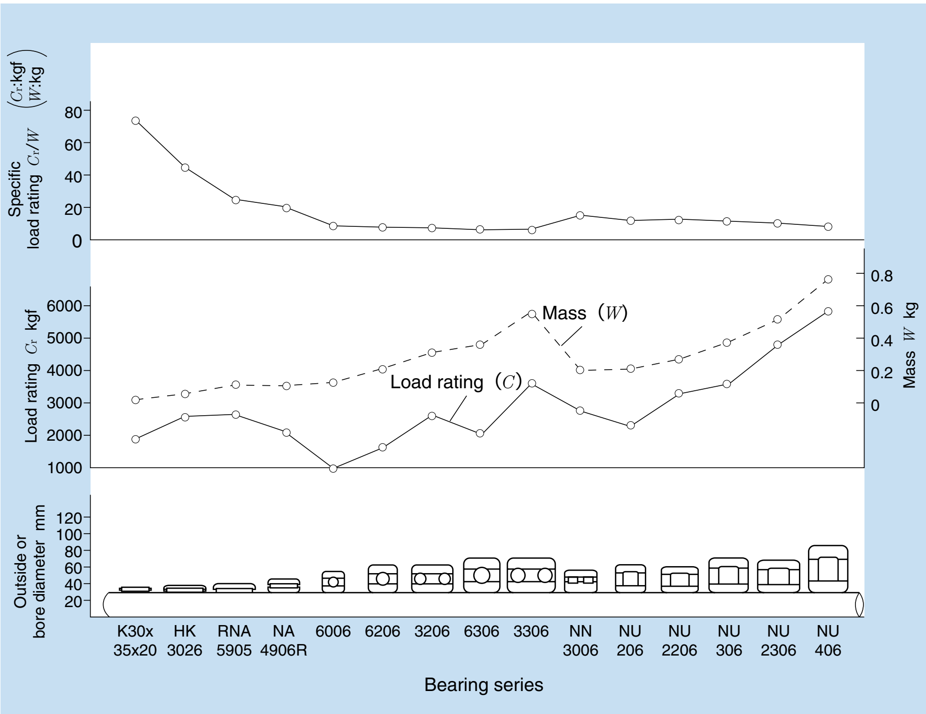


Fig. 1.1

1

Fig. 1.2 shows a comparison of bearing sizes of standard dimensions and similar load-carrying capacity. Needle roller bearings have one-half the outside diameter and one-fifth the mass of deep-groove ball bearings.

Needle roller and cage assembly bearings differ from general bearings in that, if the shaft and bearing housing can be made to a specific hardness, accuracy, and surface roughness, the needle roller and cage assemblies can function as independent bearings without inner and outer rings. Bearings used in this way are smaller and can be used in the same space as a metal bearing.

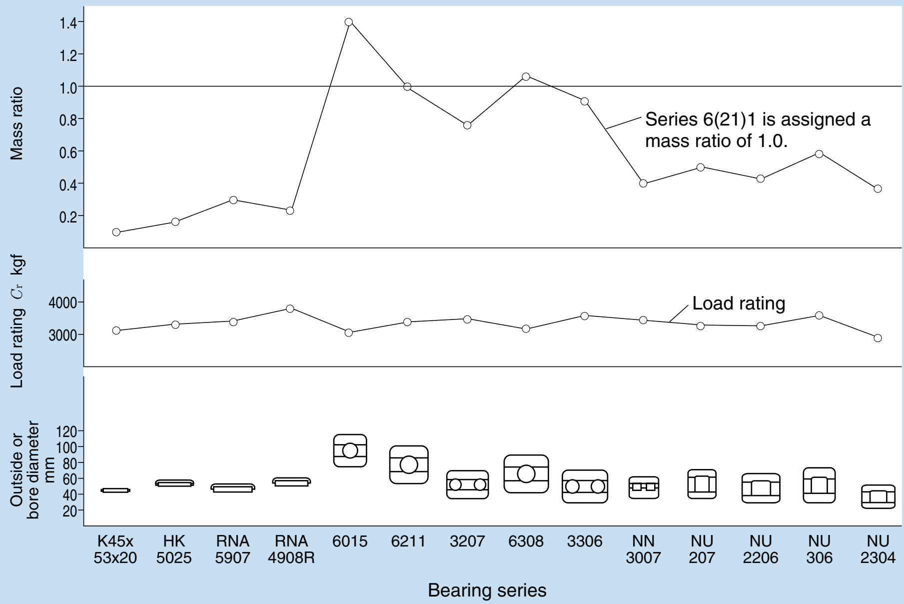


Fig. 1.2

1

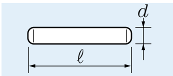
(2) Low inertial force

Because needle roller and cage assemblies have a smaller mass, these bearings are particularly useful for applications in which a smaller inertial force is required, such as in an engine crankshaft. (**Fig. 1.3**)

(3) High rigidity

Fig. 1.4 shows the elastic displacement when the radial load is applied to various bearings with similar basic load ratings.

1. Needle roller bearings have the following characteristics in comparison to cylindrical roller bearings.
   - More rollers are included.
   - ℓ /d is greater.



2. Needle roller bearings have greater rigidity because the load carried per unit area is smaller than ball bearings.

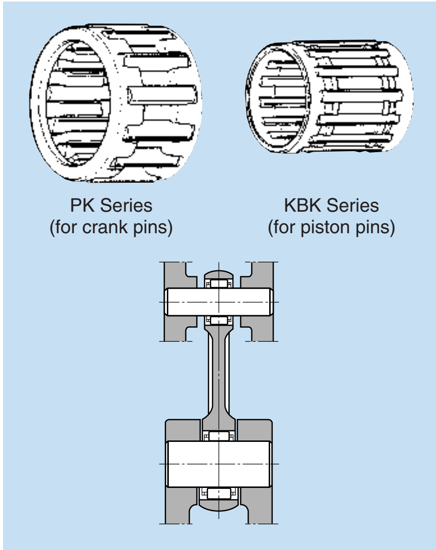


Fig. 1.3

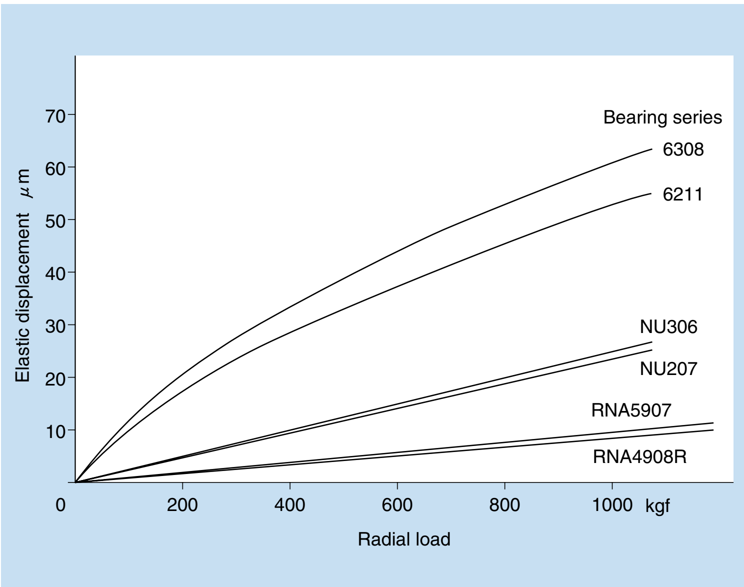


Fig. 1.4

(4) Needle roller bearings are suitable for applications with oscillatory movement.

If the oscillatory movement does not overlap the adjacent rollers, the lubricant between the rollers and bearing ring is pushed out and becomes inadequate. Accordingly, this condition shortens the life of the bearing. To prevent this condition, the bearing must be designed with an oscillatory angle that, at minimum, overlaps the position of the adjacent roller.

This design ensures good lubrication of the adjacent rollers, because the lubricant is forced out of the rollers and prevents them from wearing. **Fig. 1.5** shows the minimum oscillatory angle of the inner and outer rings. This is the most effective means of increasing the number of rollers in one row and ensuring the minimum oscillatory angle. The needle roller bearing is therefore the most suitable for the purpose.

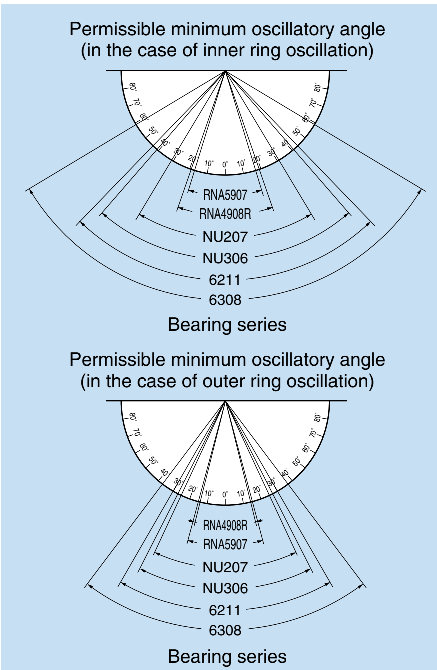


Fig. 1.5

1. 3 Comparison of needle roller and cage assembly bearings and full-complement needle roller bearings

Table 1.1

Item \ Type	Needle roller and cage assembly bearing	Full-complement needle roller bearing
Roller skew	Low incidence	High incidence
Friction coefficient	Small	Large
Temperature rise	Low	High
Permissible speed	High	Low
Load-carrying capacity	Less than that of full-complement needle roller bearings	Can be increased.

Needle roller and cage assembly bearings are used in a wide range of diverse applications, but full-complement needle roller bearings are more suitable for high-load, low-speed, and oscillating applications, as they have a greater load-carrying capacity.

(1) Roller skew

Needle roller and cage assembly bearings feature rotational accuracy due to the ample strength and rigidity of the shaft and bearing housing, which guide the case assembly. This feature ensures the correct rotation of the needle rollers. In contrast, the full-complement needle roller bearing has no structure for precisely guiding the needle rollers, and its instability may cause the needle rollers to skew. (**Fig. 1.6**)

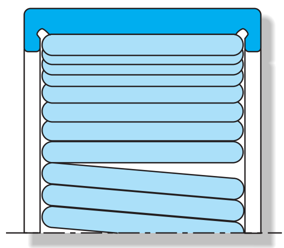
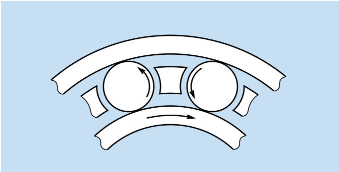


Fig. 1.6

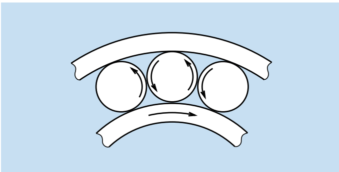
(2) Friction coefficient

Needle roller and cage assembly bearing



The slipping speed between the cage assembly and needle rollers is only the circumference speed of the needle rollers.

Full-complement needle roller bearing



The relative slippage speed of adjacent needle rollers is twice the circumference speed of one needle roller; in addition, skew makes the needle roller rotate while slipping.

Accordingly, the friction coefficient of the full-complement needle roller bearing is about twice that of the needle roller and cage assembly bearing.

Table 1.2 shows the friction coefficient of various types of bearings.

Table 1.2 Friction coefficients of various bearings

Bearing classification	Friction coefficient μ
Deep-groove ball bearings	0.0010～0.0015
Angular contact ball bearings	0.0012～0.0018
Self-aligning ball bearings	0.0008～0.0012
Cylindrical roller bearings	0.0010～0.0015
Tapered roller bearings	0.0017～0.0025
Self-aligning roller bearings	0.0020～0.0025
Thrust ball bearings	0.0010～0.0015
Needle roller and cage assembly bearings	0.0020～0.0030
Full-complement needle roller bearings	0.0040～0.0050
Thrust needle roller bearings	0.0030～0.0040

(3) Temperature rise

The approximate temperature rise of a running bearing is usually calculated with the following formula:

where,

$$T_m - T_0 = 0.00514 \frac{\mu \cdot F_r \cdot d \cdot n}{W_s}$$

T_m : Temperature when the bearing reaches equilibrium ˚C
T_0 : Ambient air temperature ˚C
μ : Friction coefficient
F_r : Radial load kgf
d : Single bore diameter of bearing mm
n : Revolutions per minute rpm
W_s : Heat dissipated to the surroundings per 1˚C temperature difference. Watt / ˚C

(The temperature rise is less with needle roller and cage assembly bearings, as it is proportional to μ.)

Fig. 1.7 shows the effect of changing speed and load on needle roller and cage assembly bearings and full-complement needle roller bearings having the same boundary dimensions for bore diameter (32 mm), outside diameter (47 mm), and width (20 mm).

At 750 kgf and 7500 rpm, as shown in the figure, the full-complement needle roller bearing exceeds 170 ˚C and ceases to rotate, while the needle roller and cage assembly bearing remains below 100 ˚C, thus permitting higher speeds.

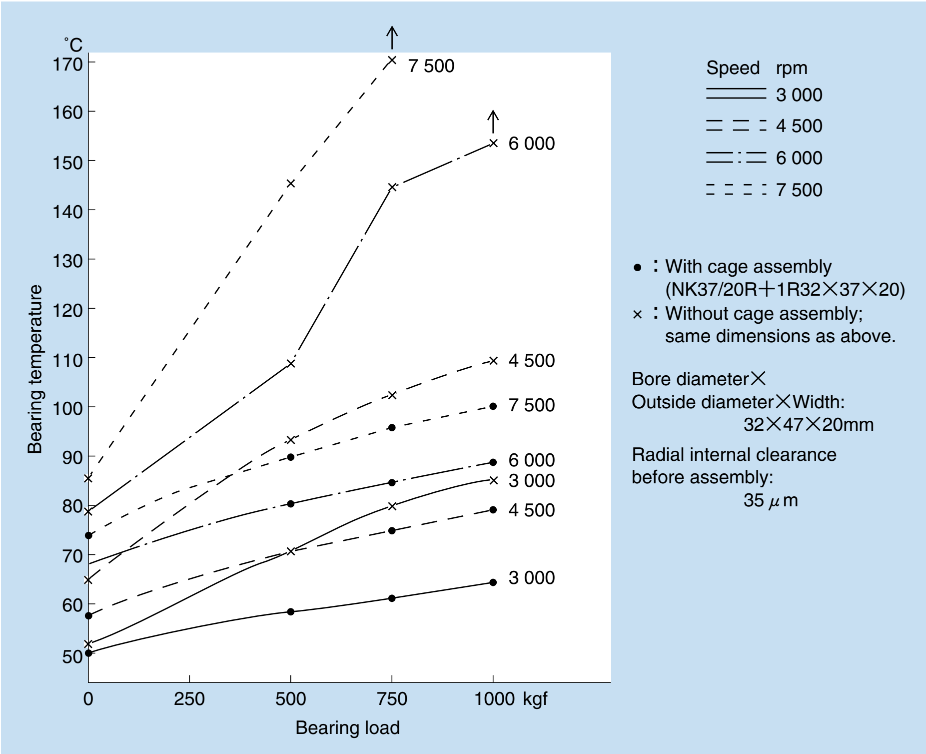


Fig. 1.7

(4) High permissible speeds

According to the characteristics indicated above, needle roller and cage assembly bearings are suitable for high-speed operation. "Permissible speed" is the speed limit that a bearing can safely withstand over a long period. This speed varies with the type and dimensions of the bearing, type of cage assembly, shaft carrying load, lubrication method, peripheral structure around the bearing, and cooling conditions.

The permissible speeds listed in **NTN** catalogs represent the values that can be applied when the bearing is correctly mounted and maintained with the most appropriate lubricant.

(5) Load capacity

The number of rollers in a full-complement needle roller bearing can be increased because there is no cage assembly; therefore, the bearing can be designed with a greater load-carrying capacity.

1

1. 4 Production methods for needle roller bearings

Needle roller bearings (drawn-cup type) are manufactured with the following processes.

The cage shown is a welded type.

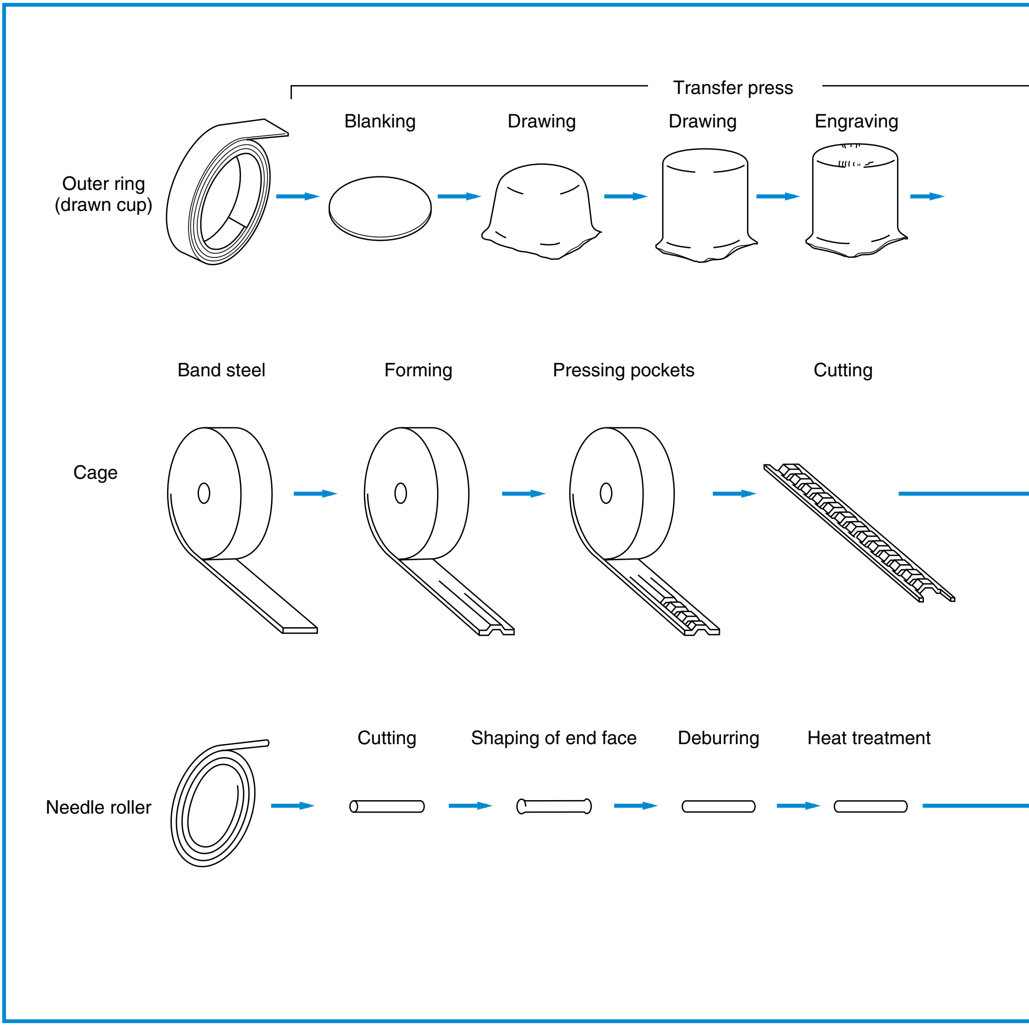
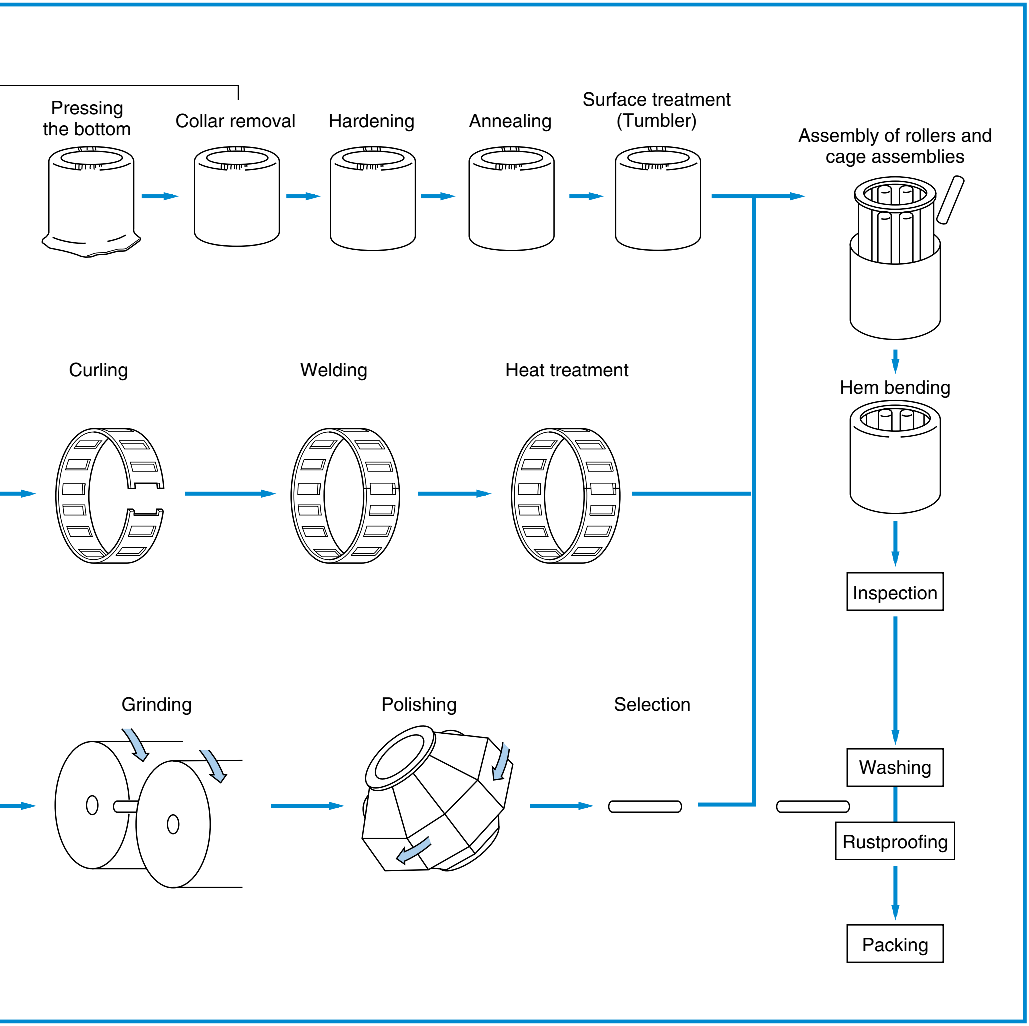


Fig. 1.8 Processing method for drawn-cup needle roller bearings


Pressing
the bottom
Collar removal
Hardening
Annealing
Surface treatment
(Tumbler)
Assembly of rollers and
cage assemblies
Curling
Welding
Heat treatment
Hem bending
Inspection
Grinding
Polishing
Selection
Washing
Rustproofing
Packing

2. Characteristics of Various Series of Needle Roller Bearings

2. 1 Series numbers and bearing names

Table 2.1 Needle roller and cage assemblies

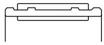
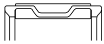
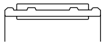
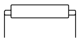
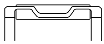
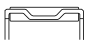
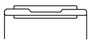
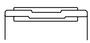
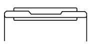
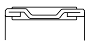
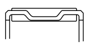
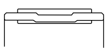
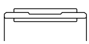
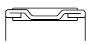
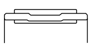
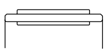
Category		Series code	Bearing name	Appearance	Characteristics
Needle roller and cage assemblies	Machined-ring type	GH	Cage assembly without roller locating (for crank pins)		H Series, split type
		GK	Needle roller and split cage assembly		K Series, split type
		GPK	Needle roller and split cage assembly (for crank pins)		RK Series, split type Cage assembly with M shaped structure
		H	Cage assembly without roller locating (for crank pins)		High-rigidity cage assembly Capable of higher speeds than the PK Series
		K	Needle roller and cage assembly		Basic type (with high-rigidity cage assembly)
		KBK	Needle roller and cage assembly for piston pins		Bore diameter guide for cage assembly (high-rigidity cage assembly)
		PK	Needle roller and cage assembly for crank pins		Outside diameter guide for cage assembly (high-rigidity cage assembly) Cage assembly with M shaped structure
	Pressed type	KMJ	Needle roller and cage assembly		Steel-plate cage assembly Cage assembly with M shaped structure
		PCJ	Needle roller and cage assembly	↑	Steel-plate cage assembly Cage assembly with M shaped structure Inch series
	Welded type	GK··S	Needle roller and split cage assembly		Thick steel-plate cage assembly High-rigidity cage assembly
		GKV··S	Needle roller and split cage assembly		Thick steel-plate cage assembly
		K··S	Needle roller and cage assembly		Thick steel-plate cage assembly High-rigidity cage assembly
		KJ··S	Needle roller and cage assembly		Steel-plate cage assembly
		KMJ··S	Needle roller and cage assembly		Steel-plate cage assembly Cage assembly with M shaped structure
		KV··S	Needle roller and cage assembly		Thick steel-plate cage assembly High-rigidity cage assembly Cage and assembly with V-shaped structure
		SK··S	Needle roller and single-split cage assembly		K-S Series, single-split type
		SKJ··S	Needle roller and single-split cage assembly		KJ-S Series, single-split type
		SKV··S	Needle roller and single-split cage assembly		KV-S Series, single-split type
	Plastic type	K··T2	Needle roller and cage assembly		Molded cage assembly of polyamide plastic Max. permissible temperature: 120˚C Max. continuous operating temperature: 100˚C

Table 2.2 Machined-ring needle roller bearings

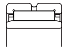
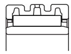
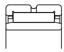
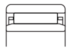
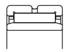
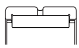
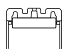
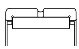
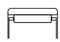
Category		Series code	Bearing name	Appearance	Characteristics
Machined-ring needle roller bearings	With inner ring	MR+MI	Machined-ring needle roller bearings		Inch series Assembly of MR Series and M Series inner rings
		NA 48	Machined-ring needle roller bearing (Dimension series 48)	↑	Assembly of RNA48 Series and IR Series inner rings
		NA 49	Machined-ring needle roller bearing (Dimension series 49)	↑	Assembly of RNA49 Series and IR Series inner rings. Sealed series (L, LL) also available
		NA49··S	Adjustable-clearance needle roller bearing (Dimension series 49)		Assembly of RNA49-S Series and IR Series inner rings
		NA 59	Machined-ring needle roller bearing (Dimension series 59)		Assembly of RNA59 Series and IR Series inner rings
		NA 69	Machined-ring needle roller bearing (Dimension series 69)	↑	Assembly of RNA69 Series and IR Series inner rings
		NAO	Machined-ring needle roller bearings Separable type		Assembly of RNAO Series and IR Series inner rings
		NK+IR	Machined-ring needle roller bearings		Assembly of NK Series and IR Series inner rings
		NKI	Machined-ring needle roller bearings		With inner ring, special
	Without inner ring	MR	Machined-ring needle roller bearings		Inch series High-rigidity outer ring High accuracy, Single-row structure
		NK	Machined-ring needle roller bearings	↑	High-rigidity outer ring High accuracy, Single-row structure
		NKS	Machined-ring needle roller bearings	↑	For heavy loads
		RNA 48	Machined-ring needle roller bearing (Dimension series 48)	↑	High-rigidity outer ring High accuracy, Single-row structure
		RNA 49	Machined-ring needle roller bearing (Dimension series 49)	↑	High-rigidity outer ring High accuracy, Single-row structure Sealed series (L, LL) also available
		RNA49··S	Adjustable-clearance needle roller bearing (Dimension series 49)		Radial clearance is adjustable Single-row structure
		RNA 59	Machined-ring needle roller bearing (Dimension series 59)		High-rigidity outer ring High accuracy, Single-row structure
		RNA 69	Machined-ring needle roller bearing (Dimension series 69)	↑	High-rigidity outer ring, High accuracy Single row ($Fw \leqq 35$), Double row ($Fw \geqq 40$)
		RNAO	Machined-ring needle roller bearings Separable type		High-rigidity outer ring, High accuracy Single-row and double-row series (with ZW) are available
Other items		NKZ	Machined-ring needle roller bearings (with different shape)		Special specifications

Table 2.3 Drawn-cup needle roller bearings-1

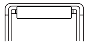
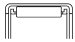
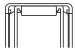
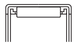
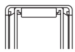
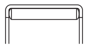
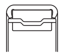
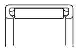
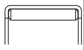
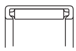
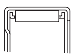
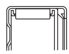
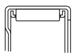
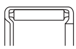
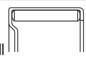
Category		Series code	Bearing name	Appearance	Characteristics
Drawn-cup needle rollers	Open-end type	DCH	Drawn-cup needle roller bearing		Inch series With cage assembly, For heavy loading
		DCL	Drawn-cup needle roller bearing	↑	Inch series, With cage assembly
		HK	Drawn-cup needle roller bearing		Double-row type (with ZW) bearings with cage assembly are available Small-diameter plastic bearings (with T2) are available
		HK··L LL	Drawn-cup needle roller bearing Sealing type		With cage assembly Prelubricated with standard grease (3A)
		HKS	Drawn-cup needle roller bearing		With cage assembly, Special
		HMK	Drawn-cup needle roller bearing	↑	With cage assembly, For heavy loading
		HMK··L LL	Drawn-cup needle roller bearing Sealing type		With cage assembly Prelubricated with standard grease (3A)
		HMV	Drawn-cup needle roller bearing		Full-complement needle roller type
		HR	Drawn-cup cylindrical roller bearing		With cage assembly, For heavy loading
		HV	Drawn-cup needle roller bearing		Full-complement needle roller (with C end face rollers)
		HVS	Drawn-cup needle roller bearing	↑ as well 	Full-complement needle roller type Special Prelubricated with standard grease (3A)
		VS	Drawn-cup needle roller bearing		Full-complement needle roller (with C end face rollers)
		VSH	Drawn-cup needle roller bearing	↑	Full-complement needle roller (with C end face rollers) For heavy loading
	Closed-end type	BK	Drawn-cup needle roller bearing		Double-row type (with ZW) bearings with cage assembly are available Small-diameter plastic bearings (with T2) are available
		BK··L	Drawn-cup needle roller bearing Sealing type		With cage assembly Prelubricated with standard grease (3A)
		BKS	Drawn-cup needle roller bearing		With cage assembly
		BMK	Drawn-cup needle roller bearing	↑	With cage assembly
		BV	Drawn-cup needle roller bearing		Full-complement needle roller type
		BVS	Drawn-cup needle roller bearing	↑ as well 	Full-complement needle roller type Prelubricated with standard grease (3A)

Table 2.3 Drawn-cup needle roller bearings-2

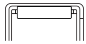
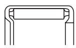
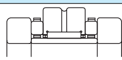
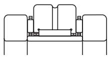
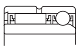
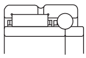
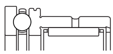
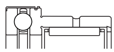
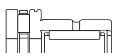
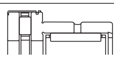
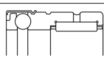
Category		Series code	Bearing name	Appearance	Characteristics
Drawn-cup needle rollers	Closed-end type	DBH	Drawn-cup needle roller bearing		Inch series With cage assembly, For heavy loading
		DBL	Drawn-cup needle roller bearing	↑	Inch series, With cage assembly
		VB	Drawn-cup needle roller bearing		Inch series Full-complement needle roller (with C end face rollers)
		VBH	Drawn-cup needle roller bearing	↑	Inch series, For heavy loading Full-complement needle roller (with C end face rollers)

Table 2.4 Compound bearings
(Needle roller bearing with thrust ball bearing/Needle roller bearing with thrust cylindrical roller bearing)
(Needle roller bearing with angular contact ball bearing / Needle roller bearing with three-point contact ball bearing)

Category	Series code	Bearing name	Appearance	Characteristics
Compound bearings	ARN	Needle roller bearing with double-direction thrust cylindrical roller bearing		Loading with radial load and double-direction axial load For high axial loading
	AXN	Needle roller bearing with double-direction thrust needle roller bearing		Loading with radial load and double-direction axial load For high axial loading
	NKIA 59	Needle roller bearing with angular contact ball bearing (Dimension series 59)		Loading with single-direction axial load
	NKIB 59	Needle roller bearing with three-point contact ball bearing (Dimension series 59)		Loading with double-direction axial load
	NKIT	Compound bearings		With inner ring, Special
	NKT	Compound bearings		Without inner ring, Special
	NKX	Needle roller bearing with thrust ball bearing		Open type Loading with single-direction axial load
	NKX··Z	Needle roller bearing with thrust ball bearing		With cover
	NKXR	Needle roller bearing with thrust cylindrical roller bearing		Open type Loading with single-direction axial load
	NKXR··Z	Needle roller bearing with thrust cylindrical roller bearing		With cover
	NX	Needle roller bearing with full-complement thrust roller bearing		Special product

2

Table 2.5 Thrust roller bearings-1

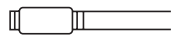
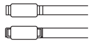
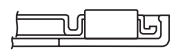
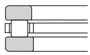
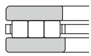
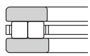
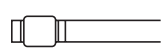
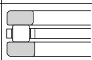
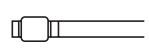
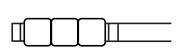
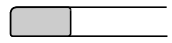
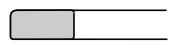
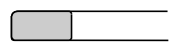
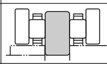
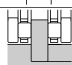
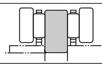
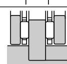
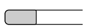
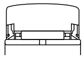
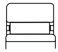
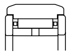
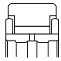
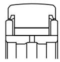
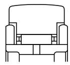
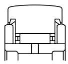
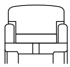
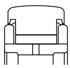
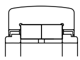
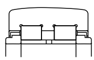
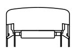
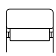
Category		Series code	Bearing name	Appearance	Characteristics
Thrust roller bearings	Thrust needle roller bearings	AK	Needle roller and thrust cage assembly		Flat cage, Special
		AKJ	Needle roller and thrust cage assembly		Stainless steel pressed cage Series W/Box type, special type
		ARXJ	Integrated thrust needle roller bearing		Assembly (Bearing + thrust washer) Available as separable and non-separable types
		AXK 11	Needle roller and thrust cage assembly		Stainless steel pressed cage
		NTC	Needle roller and thrust cage assembly	↑	Inch series Stainless steel pressed cage
	Thrust washers	AS 11	Thrust washers (Dimension series 11)		Made from steel plate
		NWA	Thrust washers	↑	Inch series, Made from steel plate
		NWB	Thrust washers	↑	↑
	Thrust cylindrical roller bearings	811	Thrust cylindrical roller bearings (Dimension series 11)		Assembly of K811 Series and WS / GS Series bearing washers
		812	Thrust cylindrical roller bearings (Dimension series 12)	↑	Assembly of K812 Series and WS / GS Series bearing washers
		874	Thrust cylindrical roller bearings (Dimension series 74)		Assembly of K874 Series and WS / GS Series bearing washers
		893	Thrust cylindrical roller bearings (Dimension series 93)		Assembly of K893 Series and WS / GS Series bearing washers
		CTC	Cylindrical roller and thrust cage assembly		Inch series
		CTCA	Thrust cylindrical roller bearings		Inch series CTC Series and CWS Series in inch series / Assembly of CGS Series bearing washers
		K811	Cylindrical roller and thrust cage assembly (Dimension series 11)		Cage assemblies of aluminum alloy, steel plate (J, JW--), brass (L1), and plastics (T2) are also available
		K812	Cylindrical roller and thrust cage assembly (Dimension series 12)	↑	↑
		K874	Cylindrical roller and thrust cage assembly (Dimension series 74)		Cage assemblies of aluminum alloy for heavy loading
		K893	Cylindrical roller and thrust cage assembly (Dimension series 93)		↑

Table 2.5 Thrust roller bearings-2

Category		Series code	Bearing name	Appearance	Characteristics
Thrust roller bearings	Thrust cylindrical roller bearings	CGS	Thrust bearing washer (outer ring)		Inch series
		CWS	Thrust bearing washer (inner ring)	↑	Inch series
		GS 811	Thrust bearing washer (outer ring) (Dimension series 11)		Machined-ring type
		GS 812	Thrust bearing washer (outer ring) (Dimension series 12)	↑	Machined-ring type
		GS 874	Thrust bearing washer (outer ring) (Dimension series 74)	↑	Machined-ring type
		GS 893	Thrust bearing washer (outer ring) (Dimension series 93)	↑	Machined-ring type
		NWC	Thrust bearing washer		Machined-ring type
		NWD	Thrust bearing washer	↑	Machined-ring type
		NWE	Thrust bearing washer	↑	Machined-ring type
		NWF	Thrust bearing washer	↑	Machined-ring type
		WS 811	Thrust bearing washer (inner ring) (Dimension series 11)	↑	Machined-ring type
		WS 812	Thrust bearing washer (inner ring) (Dimension series 12)	↑	Machined-ring type
		WS 874	Thrust bearing washer (inner ring) (Dimension series 74)	↑	Machined-ring type
		WS 893	Thrust bearing washer (inner ring) (Dimension series 93)	↑	Machined-ring type
		XS	Thrust bearing washer	↑	Machined-ring type, Special
	Other items	ARA821	Double-direction thrust cylindrical roller bearing (Dimension series 21)		Assembly of K811 Series + Central ring (single-bore diameter side is stationary) of WS and GS Series bearing washers
		ARB821	Double-direction thrust cylindrical roller bearing (Dimension series 21)		Assembly of K811 Series + Central ring (single outside diameter side is stationary) of WS and GS Series bearing washers
		ARX	Thrust roller bearings		Special product (needle roller or cylindrical roller) Assembly of bearing, inner ring, outer ring and spacer
		AXA 21	Double-direction thrust needle roller bearing (Dimension series 21)		Assembly of AXK811,WS, and GS Series bearing washers and ZS Series central ring (Single-bore diameter side is stationary.)
		AXB 21	Double-direction thrust needle roller bearing (Dimension series 21)		Assembly of AXK811,WS, and GS Series bearing washers and ZS Series central ring (Single outside diameter side is stationary.)
		ZS	Thrust bearing washer (central ring)		Machined-ring type

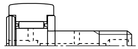
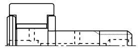
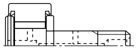
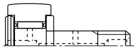
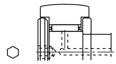
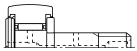
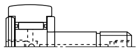
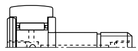
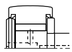
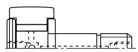
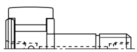
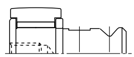
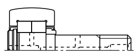
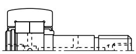
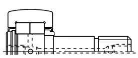
2

Table 2.6 Roller followers

Category	Series code	Bearing name	Appearance	Characteristics
Roller followers	NA22··LL	Roller followers (Sealed type) (Dimension series 22)		With inner ring/cage assembly Prelubricated with standard grease (3A)
	NAB2	Roller followers (Sealed type) (Dimension series 2)		With inner ring/cage assembly (Open type)
	NABR	Roller followers		With inner ring/cage assembly (Equivalent to IKO, NAST)
	NACV··X	Roller followers		Inch series full-complement rollers/non-separable (Equivalent to McGill, CYR) Outside surface of outer ring is cylindrical Prelubricated with standard grease (3A)
	NACV··XLL	Roller followers (Sealed type)		Inch series full-complement rollers/non-separable Outside surface of outer ring is cylindrical Prelubricated with standard grease (3A)
	NATR	Roller followers		With cage and assemblies/non-separable
	NATR··LL	Roller followers (Sealed type)		With cage and assemblies/non-separable Prelubricated with standard grease (3A)
	NATV	Roller followers		Full-complement rollers/non-separable Prelubricated with standard grease (3A)
	NATV··LL	Roller followers (Sealed type)		Full-complement rollers/non-separable Prelubricated with standard grease (3A)
	NUTR2	Roller followers (Dimension series 2)		With double-row cylindrical rollers (Full-complement rollers) / non-separable shield plate Prelubricated with standard grease (3A)
	NUTR3	Roller followers (Dimension series 3)	↑	With double-row cylindrical rollers (Full-complement rollers) / non-separable shield plate Prelubricated with standard grease (3A)
	NUTW2	Roller follower with outer ring and center rib (Dimension series 2)		With double-row cylindrical rollers (Full-complement rollers) / non-separable shield plate Prelubricated with standard grease (3A)
	RNA22··LL	Roller followers (Sealed type) (Dimension series 22)		Without inner ring, with cage and assembly Prelubricated with standard grease (3A)
	RNAB2	Roller followers (Dimension series 2)		Without inner ring (open type), with cage and assembly

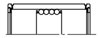
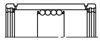
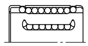
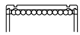
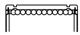
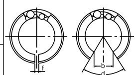
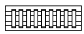
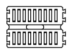
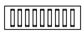
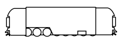
Remarks: 1. The external surface of the outer ring is spherical as standard. If a cylindrical outside surface is required, add "X" to the bearing series code.
(Allowance of outside diameter D; Manufactured to JIS Class 0.)
Example: NA2203XLL······
2. The outer surface of the outer ring of the NACV--X(LL) type is cylindrical as standard.
If a spherical outside surface is required, delete the "X" from the bearing series code.
Example: NACV12······

Table 2.7 Cam follower

Category	Series code	Bearing name	Appearance	Characteristics
Cam follower	CR	Cam follower		Inch series, With cage assembly
	CRV··X	Cam follower		Inch series full-complement rollers Outside surface of outer ring is cylindrical Prelubricated with standard grease (3A)
	CRV··XLL	Cam follower (Sealed type)		↑
	KR	Cam follower		With cage assembly Small-diameter plastic type (with T2) is available
	KR··H	Cam follower (with hexagonal hole)		↑ Shaft end (at head side) with hexagonal hole
	KR··LL	Cam follower (Sealed type)		With cage assembly Prelubricated with standard grease (3A)
	KRT	Cam follower (with tap hole)		With cage assembly
	KRU	Cam follower (Eccentric-shaft type)		With cage assembly Eccentricity: 0.25 to 1.0 mm
	KRV	Cam follower		Full-complement needle roller type Prelubricated with standard grease (3A)
	KRV··LL	Cam follower (Sealed type)		↑
	KRVT	Cam follower (with tap hole)		↑
	KRVU	Cam follower (Eccentric-shaft type)		↑ Eccentricity: 0.25 to 1.0 mm
	KRX	Cam follower		Special
	NUKR	Cam follower		Double-row cylindrical rollers (Full-complement rollers) Prelubricated with standard grease (3A)
	NUKRT	Cam follower (with tap hole)		↑
	NUKRU	Cam follower (Eccentric-shaft type)		↑ Eccentricity: 0.4 to 2.5 mm

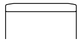
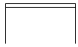
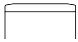
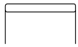
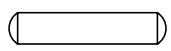
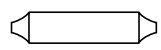
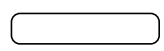
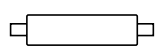
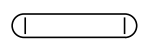
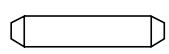
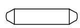
Remarks: 1. The external surface of the outer ring is spherical as standard. If a cylindrical outside surface is required, add "X" to the bearing series code.
(Allowance of outside diameter D; Manufactured to JIS Class 0.)
Example: KR22XLL······
2. If a spherical outside surface is required for the CRV-X (LL) type, which has a cylindrical outside surface of the outer ring as standard, delete the "X" from the bearing series code.
Example: CRV96······
3. If a hexagonal hole is required at the shaft end, add "H" to the bearing series code.
Example: KRV12H······

Table 2.8 Bearings for linear motion

Category		Series code	Bearing name	Appearance	Characteristics
Bearings for linear motion	Linear ball bearings	KD	Linear ball bearings Stroke type (open type)		High-rigidity, high-accuracy outer ring Limited reciprocating motion
		KD··LL	Linear ball bearings Stroke type (sealed type)		↑ Prelubricated with standard grease (3A)
		KDX	Linear ball bearings		Special
		KH	Linear ball bearings Drawn-cup type		Outer ring of steel plate; lightweight and compact design Ball rows rotate, with unlimited linear motion
		KLM	Linear ball bearings Machined-ring type		High-rigidity, high-accuracy outer ring Ball rows rotate, with unlimited linear motion
		KLM··LL	Linear ball bearings Machined-ring type (Sealed type)		↑ Prelubricated with standard grease (3A)
		KLM··S	Linear ball bearings Machined-ring type (Adjustable-clearance type)	 KLM-S KLM-P	Radial clearance is adjustable
		KLM··P	Linear ball bearings Machined-ring type (open type)		A fan-shaped part of the bearing is removed (in the axial direction) Obstacles such as the shaft support can pass through the bearing
	Linear flat rollers	BF	Linear flat rollers		Cage and assembly of pressed steel Unit length: 1000 mm
		FF	Linear flat rollers		Molded cage assemblies of polyamide plastic
		FF··ZW	Linear flat rollers (Double-row type)		↑ Cage assemblies can be mounted on the bent-V-shaped surface
		RF	Linear flat rollers		↑ Unit length: 705 mm
	Linear roller bearings	RLM	Linear roller bearings		The row of cylindrical rollers rotates in unlimited linear motion. To mount the bearing, secure the bearing by using the threaded holes provided on the reference surface.

Remarks: The standard lengths of BF and RF Series linear flat rollers are specified.
If a special length is required, add the length after the bearing series code.
Example: If the total length L_1 of BF3020 must be 500 mm, indicate it as BF3020/500.

Table 2.9 Other items, Components-1

Category		Series code	Bearing name	Appearance	Characteristics
Other items, Components	Bearing rings	IR	Inner ring		Machined-ring type provides high rigidity and high accuracy (Outside surface is used as raceway surface)
		IRJ	Inner ring (Drawn-cup type)		Pressed steel plate
		IRZ	Inner ring		Special specifications (Flange, etc)
		MI	Inner ring		Inch series
		OR	Outer ring		Machined-ring type provides high rigidity and high accuracy (Bore surface is used as raceway surface)
		ORJ	Outer ring (Drawn-cup type)		Pressed steel plate
		ORZ	Outer ring		Special specifications (Key groove, etc)
	Needle rollers	A	Needle roller (A-end face roller)		End face is round
		C	Needle roller (C-end face roller)		End face is pointed
		F	Needle roller (F-end face roller)		End face is flat (the most common roller)
		M	Needle roller (M-end face roller)		End face is stepped
		R	Needle roller (R-end face roller)		End face is spherical
		T	Needle roller (T-end face roller)		End section is conical, End face is flat
		TR	Needle roller (TR-end face roller)		End section is conical, End face is round
	Shafts	KP	Shaft for bearings for linear motion		For linear ball bearings
		NP	Pin		Shafts and various pins with diameters not exceeding 12 mm
		VP	Precision shaft		For use with audio components
		ZP	Pin		Shafts and various pins with diameters exceeding 12 mm

2

Table 2.9 Other items, Components-2

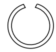
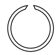
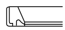
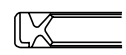
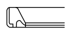
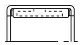
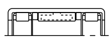
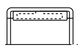
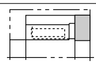
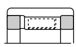
Category		Series code	Bearing name	Appearance	Characteristics
Other items, Components	Snap rings	BR	Snap rings (for housing)		Mounted on locating snap ring groove in housing
		BRX	Snap rings (for housing)	↑	Special
		WR	Snap rings (for shaft)		Mounted on locating snap ring groove in shaft
		WRX	Snap rings (for shaft)	↑	Special
	Seals	G	Seals		1-sheet lip Standard rubber material is nitrile rubber (NBR)
		GD	Seals		2-sheet lip
		GSC	Seals		Inch series
		GX	Seals		Special
	One-way clutches	HF	One-way clutches (Drawn-cup type)		Pressed steel plate, torque transmission in one direction Prelubricated with standard grease (L313)
		HFU	One-way clutch unit		Unit with built-in HF Series
		HFL	One-way clutches (Drawn-cup type, with radial bearing)		Bearings are mounted in both sides of clutch This bearing can withstand a constant radial load
		HFLU	One-way clutch unit		Unit with built-in HFL Series
		HFZ	One-way clutches		Inch series
		HFZU	One-way clutch unit		Unit with built-in HFZ Series
		NCU	One-way clutch unit		Unit with plastic gears and pulleys mounted on the circumference of the clutch
		NHF	One-way clutches (Machined-ring type)		BEARFITE oil-retaining bearings are mounted on both sides. This bearing can withstand a constant radial load
		NHFU	One-way clutch unit		Unit with built-in NHF Series
		NHS	Sprag one-way clutch (Machined-ring type)		Assembly of multiple sprags (Torque is transmitted by the inclination of sprags)

Table 2.9 Other items, Components-3

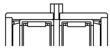
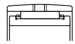
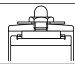
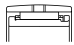
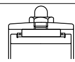
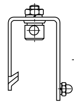
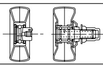
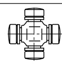
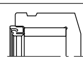
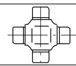
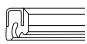
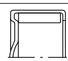
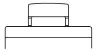
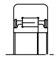
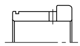
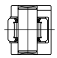
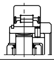
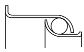
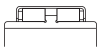
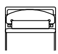
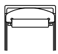
Category		Series code	Bearing name	Appearance	Characteristics
Other items, Components	Bottom roller bearings for textile machinery	FR	Bottom roller bearing		For draw frames Prelubricated with standard grease (3A) Assembled drawn-cup needle roller bearing
		FRIS	Bottom roller bearing (A-series)		For spinning frames and roving frames Applicable to international standards Prelubricated with standard grease (L113)
		FRIS··SA	Bottom roller bearing (A-series)		↑ Bearing with saddle for securing bearings, separable type
		FRIS··SB	Bottom roller bearing (A-series)	↑	↑ Bearing with saddle for securing bearings, non-separable type
		FRIS··SB	Bottom roller bearing (B-series)		For spinning frames and roving frames, JIS-compatible
		FRIS··NP	Bottom roller bearing (B-series)		↑ Bearing with grease nipple and knock pin
	Tension pulleys for textile machinery	JF··S	Holder		Special holder for JPU··S Series
		JPB	Shaft bearing		Ball bearing unit for JPU··S Series Prelubricated with standard grease (3A)
		JPU··S	Tension Pulley		For spinning, roving and false twisting frames Prelubricated with standard grease (3A)
		JPU ··S +JF··S	Tension Pulley (with holder)		↑ Mounts on machine roller carrier with holder bolts
		JPP	Pulley (unit)		Pressed steel plate Press-fit mounting to the outside surface of outer ring for JPU··S Series
	For textile machinery	HKW	Bearing for spindles (Drawn-cup)		For spinning machines
		TEXZ	Bearing for textile machinery		Bearing for textile machinery meets the series standard
	Cross joints	CJ	Machined-ring bearing assembly		Assembly of bearing (CK) and shaft (CL)
		CK	Machined-ring bearing		Machined outer ring With cage assemblies or full-complement rollers
		CL	Cross shaft (spider or cross pin)		Used as a set with CK or HCK Series bearings
		GU	Seal for drawn cup		Used as a set with HCK Series bearings
		HCK	Drawn cup (Closed-end drawn-cup needle roller bearing)		Full-complement rollers, outer ring of steel plate Prelubricated with standard grease (2S)
		HCK..+CL +GU	Drawn-cup assembly		For motor vehicles (Steering and propeller shaft mechanisms)

Table 2.9 Other items, Components-4

Category		Series code	Bearing name	Appearance	Characteristics
Other items, Components	Rocker arm bearings	RAB	Rocker arm bearings		Full-complement roller-type for motor vehicle engine valve mechanisms
		RJ	Shafts for rocker arm bearings		Shaft for assembly
		RO	Outer ring for rocker arm bearing		Outer ring for assembly
		RS	Side washer for rocker arm bearing		Side washer for assembly
	Cross roller bearings	CRG	Guide roller		Bearing for CRZ Series assembly (outside) Prelubricated with standard grease (8A)
		CRP	Stud		Shaft for Series CRZ assembly
		CRS	Side roller unit		Bearing for Series CRZ assembly (inside) Prelubricated with standard grease (8A)
		CRZ	Cross roller		For truck lifts Assembly, prelubricated with standard grease (8A)
	Other items	BU	Bushing		Special specifications (mainly for spacers)
		HKZ	Drawn-cup needle roller bearing of different shape		Special product using drawn-cup needle roller bearings
		HSF	Bearing for steering		With inner and outer bearing rings of steel plate and steel balls Prelubricated with standard grease (2S)
		HSL	Drawn-cup double-row cylindrical roller bearing		Full-complement roller, for heavy loading, outer ring of steel plate, machined inner ring, prelubricated with standard grease (3A)
		NIP	Grease nipple		For cam followers (Press fitting, mounted with screws)
		SEN	Plug		Grease nipples provided on unlubricated side
		TKBN	Components		Components not meeting standards of needle bearing series
		PNA	Self-aligning needle roller and cage assembly bearing		With inner ring. Self-aligning model available
		RPNA	Self-aligning needle roller and cage assembly bearing		Without inner ring. Self-aligning model available

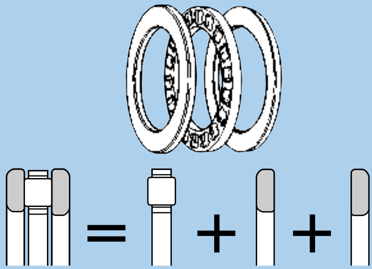
Tips & Hints

●Thrust roller bearings

Two categories of thrust roller bearings exist: assembled needle roller bearings and assembled cylindrical roller bearings.

They are assembled with bearing washers before use. The cylindrical roller bearing group comprises of a cylindrical roller and thrust cage assembly (K811, K812 and K893 Series), inner ring (WS Series), and outer ring (GS Series); bearings that combine these components are available (811, 812 and 893 Series).

Customers can either purchase an assembled bearing or purchase the components separately and assemble them as required.



The shaft aligns with the single bore diameter for WS Series bearing rings and the housing aligns with the outside surface for GS Series bearing rings; therefore, they feature high rigidity and accurate running.

Fig. 1 Assembly example

Bearing assembly	Assembly drawing	Assembly of thrust cage assemblies	Bearing ring (inner ring)	Bearing ring (outer ring)
———		AXK11	AS811	AS811
———		AXK11	WS811	GS811
811		K811	WS811	GS811
812		K812	WS812	GS812
874		K874	WS874	GS874
893		K893	WS893	GS893

●Machined-ring needle roller bearings

Machined-ring needle roller bearings are available in two categories: RNA Series without an inner ring and NA Series with an inner ring. All components are common except the inner ring, as follows.

Example:

RNA4905R+IR25×30×17···/NA4905R

Accordingly, it is possible to purchase the RNA and IR separately and assemble them as needed. Note that the separable RNAO Series without an inner ring and NAO Series with an inner ring have common model numbers, except for the inner ring.

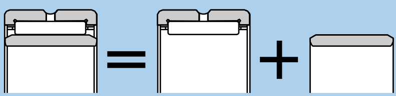


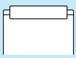
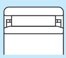
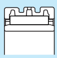
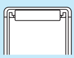
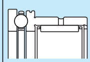
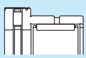
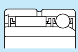
Fig. 2 Assembly example

3. Bearing Selection

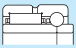
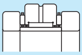
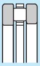
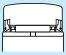
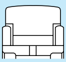
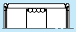
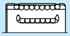
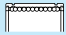
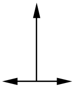
Table 3.1 shows the types and characteristics of needle roller bearings.

Needle roller bearings are available in a wide range of varying dimensions. Selecting a particular bearing requires a thorough knowledge of the structure and characteristics of different bearings and their correct applications. No bearing, no matter how well made, will achieve its full potential if not carefully selected and correctly used. When selecting bearings, consider the following points.

Table 3.1 Classifications and characteristics of bearings

Category / Items	Needle roller and cage assemblies	Needle roller and cage assembly bearing	Separable needle roller and cage assembly bearing	Adjustable-clearance needle roller bearing	Drawn-cup needle roller bearing	Needle roller bearing with thrust ball bearing	Needle roller bearing with thrust cylindrical roller bearing	Needle roller bearing with angular contact ball bearing
Illustration								
Series	K K· ·ZW KMJ PK KBK	NK· ·+IR NK· ·R NA48 NA49R NA59 NA69 MR· ·+MI	NAO NAO· ·ZW RNAO RNAO· ·ZW	RNA49· ·S NA49· ·S	HK· ·(+IR) BK· ·(+IR) HMK· ·(+IR) DCL· ·(+MI)	NKX NKX· ·+IR NKX· ·Z NKX· ·Z+IR	NKXR NKXR· ·+IR NKXR· ·Z NKXR· ·Z+IR	NKIA59
Load (Radial ↑ / Axial ↔)	↑	↑	↑	↑	↑	↑	↑ →	↑ →
Speed (High speed): Suitable for high-speed use ○, Adequate for high-speed use △, Unsuitable for high-speed use ×	○	○	○	○	△	△	△	○
Accuracy (High accuracy): Suitable for high-speed use ○, Adequate for high-speed use △, Unsuitable for high-speed use ×	○	○	○	○	×	△	△	△
Mounting practice: Simple ○, Fairly simple △, Difficult ×	△	○	○	△	△	△	△	△
Main application	Trans-mission engine	All machinery	Construction machinery, Printing machinery, etc.	Construction machinery, etc.	General production machinery	Construction machinery, Gear change machinery, General machinery, etc.		Construction machinery, etc.

(1) The magnitude size, direction, and type of the load that will be applied to the bearing
(2) The speed and type (rotating inner ring, rotating outer ring) of rotation, and application to vertical or horizontal shafts
(3) Required bearing life and maximum permissible load
(4) Ambient temperature conditions around the bearing
(5) Required accuracy
(6) Friction and noise levels
(7) Lubrication and sealing devices
(8) Bearing mounting and removal
(9) Materials and finish accuracy of the shaft and housing
(10) Space available for bearing installation

	Needle roller bearing with three-point contact ball bearing	Needle roller bearing with double-direction thrust roller bearing	Thrust roller bearing	Roller follower (Separable)	Roller follower (Non-separable)	Cam follower	Linear flat roller	Machined-ring linear ball bearing (KD Series)	Drawn-cup linear ball bearing	Machined-ring linear ball bearing (KLM Series)	Linear roller bearing
											
	NKIB59	AXN ARN	811 812 893 AXK11 AS WS GS	NA22・・LL RNA22・・LL	NATR NATV NUTR	KR・・(LL) KRV・・(LL) NUKR CR	FF FF・・ZW BF RF	KD KD・・LL	KH	KLM KLM・・S KLM・・P KLM・・(LL)	RLM
											
	○	○	△	△	△	△	△	○	△	△	△
	△	○	△	△	△	△	○	△	△	○	○
	△	△	△	○	○	○	△	△	△	△	○
	Construction machinery, etc.		Pump, Construction machinery, General machinery	General machinery	General machinery Guide rollers		General production machinery, Construction machinery, etc.	Printing machinery, etc.	General production machinery, Construction machinery, Robots, etc.		

4. Load Rating and Life

4. 1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly subjected to repeated compressive stresses that cause flaking of these surfaces. This flaking is due to material fatigue and eventually causes bearing failure. The effective life of a bearing is normally defined as the total number of revolutions a bearing can undergo before flaking occurs on either the raceway surface or the rolling element surfaces.

4. 2 Basic rated life and basic dynamic load rating

If a group of seemingly identical bearings is subjected to identical load and operating conditions, they will exhibit a wide diversity in their durability. This can be attributed to the difference in the fatigue of the bearing material itself. This disparity is statistically monitored, and the basic rated life is expressed as "the total number of revolutions that 90% ('90% reliability') of the bearings in an identical group of bearings subjected to identical operating conditions will attain or surpass before flaking due to material fatigue occurs." For bearings operating at constant fixed speeds, it is expressed as the total number of hours of operation.

The basic dynamic load rating is an expression of the load capacity of a rolling bearing and can be described as the constant load under which a bearing can sustain a basic rated life of one million revolutions. For radial bearings it refers to pure radial loads; for thrust bearings it refers to pure axial loads.

The relationship between the basic rated life, basic dynamic load rating and bearing load is given in formula (4.1).

$$L_{10}=\left(\frac{C}{P}\right)^{p} \cdots\cdots\cdots\cdots (4.1)$$

where,

p=10/3 ·········For roller bearings

p=3 ···············For ball bearings

L_{10}: Basic rated life of 10^6 revolutions

C : Basic dynamic rated load N {kgf}

Radial bearings: C_r

Thrust bearings: C_a

P : Bearing load N {kgf}

Radial bearings: P_r

Thrust bearings: P_a

The basic rated life can also be expressed in terms of hours of revolution, and is calculated as shown in formula (4.2).

$$L_{10h}=\frac{10^6}{60n}\left(\frac{C}{P}\right)^{p} \cdots\cdots\cdots\cdots (4.2)$$

where,

L_{10h}: Basic rated life h

n : Rotational speed, rpm

4. 3 Factors affecting bearing life

Apart from bearing load and revolution speed, the factors affecting bearing life include lubricating conditions, internal clearance, roughness of raceway surface, hardness, heat treatment (structure), and installation errors (misalignment). Consider all these factors when using bearings. For details, refer to the relevant catalog.

Table 4.1 Outline of bearing operating conditions

Permissible revolutions (N)	Refer to catalog values Note: When lubricating, $F_w \cdot n \leqq 40\times10^4$ rpm F_w: Roller set bore diameter
Roughness of raceway surface	Within 0.4a (Rmax 1.6 μm)
Hardness of raceway surface	HRC58-64 Note: Refer to Section 6.3 for materials and heat treatment hardness.
Installation error	Less than 1/2 000
Radial internal clearance	Normal (C2, C3, C4)

4. 4 Installation error and crowning

It is well known that bearing life can be dramatically reduced due to stress concentration at the roller ends (edge load) caused by installation error. "Roller crowning" is employed as a countermeasure to this problem. However, this may reduce the effective contact length of the rollers and reduce the bearing life unless a proper design is made. Installation error and loading conditions may require calculation of the proper crowning value. **Figs. 4.1** to **4.3** show examples of analyses of the contact face pressure according to the computer calculation for reference.

Figs. 4.1 to **4.3** (examples of analyses of contact face pressure) show that the rollers without crowning provide higher edge face pressure, but the rollers with crowning are limited to lower edge face pressure in the range of constant installation error. **Fig. 4.4** shows the relationship (example of computer analysis) between installation error and bearing life. The figure shows the influence of installation errors on the bearing life.

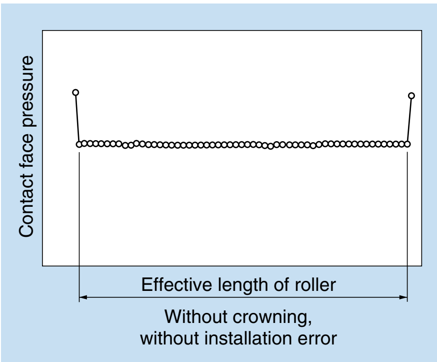


Fig. 4.1

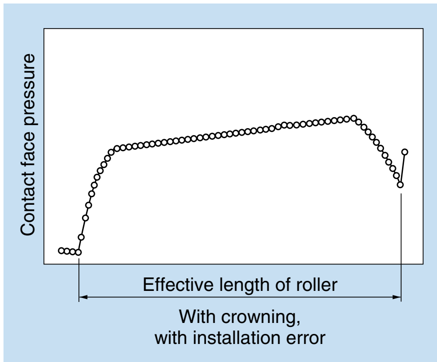


Fig. 4.2

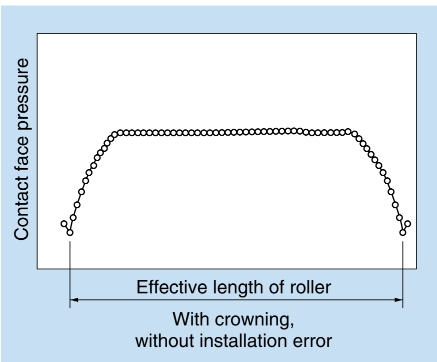


Fig. 4.3

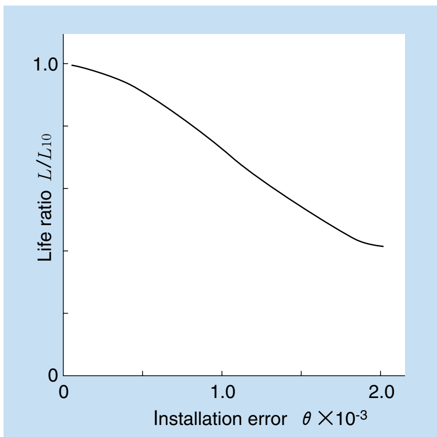


Fig. 4.4 Relationship between installation error and bearing life

4. 5 Radial internal clearance, surface roughness, surface hardness and bearing life

Fig. 4.5 shows the relationship between radial internal clearance and bearing life.

Fig. 4.6 shows the relationship between surface roughness and bearing life.

Fig. 4.7 shows the relationship between surface hardness and bearing life.

The following figures show factors affecting bearing life.

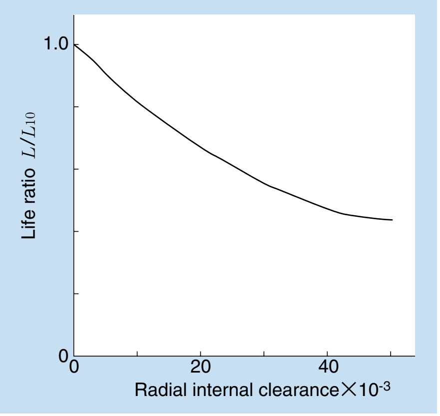


Fig. 4.5 Relationship between radial interna clearance and bearing life

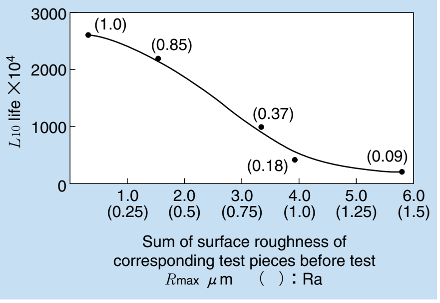


Fig. 4.6 Relationship between surface roughness and life

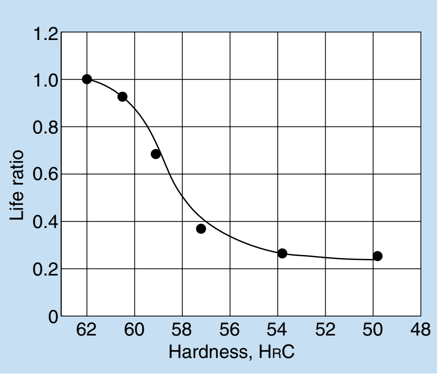


Fig. 4.7 Influence of hardness on rolling fatigue life

4. 6 Tips for longer bearing life

To increase the life of needle roller bearings, special heat treatment (AS treatment) has been applied to double or even triple the life compared to the standard product, as determined by bench tests. Moreover, a high oil-film formation capability has been achieved through a recently developed surface-processing technology known as the HL process. As a result, a longer life effect is observed in the areas where surface damage at starting points easily occurs. This development has been well received in the market. For details, refer to catalogs and references.

4. 7 Basic static load rating

When bearings are subjected to loads, they suffer from partial permanent deformation of the contact surface between the rolling elements and the bearing ring. The deformity increases as the load increases, and if this increase in load exceeds certain limits, smooth operation of the bearings is subsequently impaired. Experience has revealed that a total permanent deformity of 0.0001 times the diameter of the rolling element -- occurring at the center of the most heavily stressed contact point between the raceway and the rolling elements -- can be tolerated without any impairment in running efficiency. The basic static load rating refers to the fixed static load limit at which a specified amount of permanent deformation occurs. It represents pure radial loads for radial bearings and pure axial loads for thrust bearings. These values are listed in the bearing dimensions table. They are listed in the C_{or} column for radial bearings and in the C_{oa} column for thrust bearings. The contact stresses occurring at the center of the rolling element and raceway contact points under the maximum load are given below.

Roller bearings ···4000 MPa (408 kgf/mm^2)
Ball bearings ······4200 MPa (428 kgf/mm^2)

Generally, the permissible static equivalent load is limited by the basic static load rating. However, depending on the requirements for smooth operation and friction of revolution, these limits may be greater or lesser than the basic static rated load.

In the following formula (4.3) and **Table 4.2**, the maximum static equivalent load can be determined with consideration for the safety factor S_o.

Table 4.2 Minimum safety factor S_o

Operating conditions	Roller bearing	Ball bearing
Demand for high rotational accuracy	3	2
Demand for normal rotating accuracy (Universal application)	1.5	1

Remarks 1. For thrust roller bearings using the drawn-cup needle roller bearing and pressed thrust washer, the minimum S_o value should be 3.
2. When vibration and/or shock loads are present, a load factor based on the shock load must be included in the P_o max value.

$$S_o = \frac{C_o}{P_{o\,\max}} \cdots\cdots\cdots\cdots\cdots\cdots (4.3)$$

where,

S_o : Safety factor
C_o : Basic static rated load N {kgf}
Radial bearings: C_{or}
Thrust bearings: C_{oa}

P_o max:
Maximum static equivalent load N {kgf}
Radial bearings: P_{or} max
Thrust bearings: P_{oa} max

5

5. Fitting Needle Roller Bearings

5. 1 Fitting machined-ring radial needle roller bearings

The inner and outer rings of needle roller bearings are separable. Both inner and outer rings can be mounted with a given interference, but in the case of a tight fit, the bearing ring subjected to static loads can be provided with a loose fit, considering the ease of mounting and removal of the bearing.

Table 5.1 shows the bearing fit according to a given load.

Table 5.2 shows the recommended fits for radial needle roller bearings (machined ring, with inner rings). However, the interference may be reduced due to temperature increase or surface roughness of fitting surfaces. In this case, refer to the relevant catalogs for details.

Table 5.1 Characteristics and fittings of radial loads

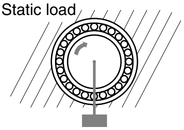
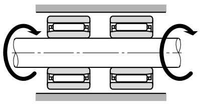
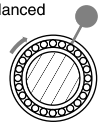
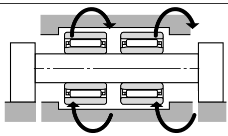
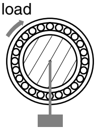
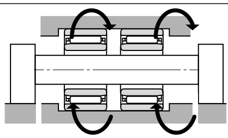
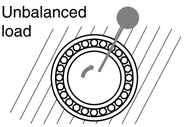
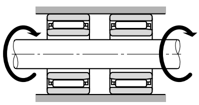
Illustration	Rotation type	Load type	Fitting
Static load 	 Rotating inner ring Stationary outer ring	Rotating inner ring load Stationary outer ring load	Inner ring : Tight fit Outer ring: Loose fit
Unbalanced load 	 Stationary inner ring Rotating outer ring		
Static load 	 Stationary inner ring Rotating outer ring	Stationary inner ring load Rotating outer ring load	Inner ring : Loose fit Outer ring: Tight fit
Unbalanced load 	 Rotating inner ring Stationary outer ring		

Table 5.2 Fitting of needle roller bearings

Table (a) Axial allowance

Conditions			Tolerance range class
Load type	Load size	Shaft diameter d mm	
Rotating inner ring load or indeterminate direction load	Light loads	～ 50	j5
	Normal loads	～ 50	k5
		50～150	m5
		150～	m6
	Heavy loads and shock loads	～150	m6
		150～	n6
Stationary inner ring load	Medium/low revolutions, light loads	All shaft diameters	g6
	General applications		h6
	When high accuracy is required		h5

Table (b) Housing allowance

Conditions		Tolerance range class
Stationary outer ring load	Normal and heavy loads	J7
	Normal load with double split housing	H7
Rotating outer ring load	Light loads	M7
	Normal loads	N7
	Heavy loads and shock loads	P7
Indeterminate loads	Light loads	J7
	Normal loads	K7
	Heavy loads and shock loads	M7
When high rotational accuracy is required with light loads		K6

Remarks: For classifications of light loads, normal loads, and heavy loads, refer to the following values:
Light load $Pr \leqq 0.06Cr$
Normal load $0.06Cr < Pr \leqq 0.12Cr$
Heavy load $Pr > 0.12Cr$

5. 2 Fitting of drawn-cup needle roller bearings

The dimensional accuracy of drawn-cup needle bearings is guaranteed when the standard ring is used because they are designed to correct the deformation by press fitting in the housing hole and their specified dimensional accuracy is assured. Refer to the relevant catalog for the dimensional allowances of roller set bore diameter when press-fitting the standard ring.

Table 5.3 shows the recommended fits of bearings.

Table 5.3 Fitting of housing and shaft

Bearing series	Housing		Shaft	
	Ferric group	Light alloy	Without inner ring	With inner ring
HK, BK	N6 (N7)	R6 (R7)	h5 (h6)	k5 (j6)
HMK, DCL	J6 (J7)	M6 (M7)		
HCK	F7	—	k6	—

The method for examining internal clearance during fitting of drawn-cup needle roller bearings is described on the next page for reference. If the housing material is a light alloy, care should be taken in consideration of reduced interference due to temperature increase.

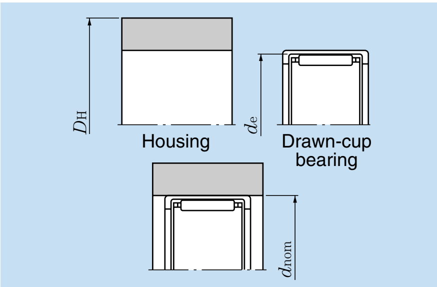
5

5. 3 Examination of contraction ratio and clearance after mounting

Recommended fits of standard products are listed in catalogs. The calculation method is also provided in detailed examination to be carried out.

1) Calculation of bearing contraction ratio

If a drawn-cup bearing is used, the contraction ratio is calculated as shown in the formula.



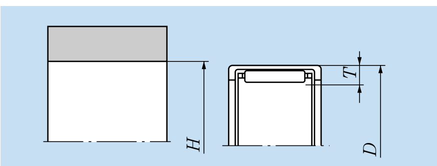
$$\lambda = \frac{2t}{E_2} \cdot \frac{1-S^2}{\frac{(0.7S^2+1.3)(1-t^2)}{E_1} + \frac{(0.7+1.3t^2)(1-S^2)}{E_2}} \quad \cdots\cdots\cdots\cdots (1)$$

λ : Outer ring contraction ratio
D_H : Housing single outside diameter mm
d_{nom} : Nominal diameter of fitting section mm
d_e : Diameter of rolling contact surface of the outer ring mm
E_1 : Young's modulus of housing kgf/mm²
E_2 : Young's modulus of outer ring (21 200 kgf/mm²)

$$S = \frac{d_{nom}}{D_H} \qquad t = \frac{d_e}{d_{nom}}$$

2) Setting bore diameter after fitting the actual housing

① Press fitting of standard ring



H : Housing bore diameter mm
T : Roller diameter + plate thickness mm
D : Drawn-cup bearing single outside diameter mm
L_i : Roller set bore diameter after press fitting mm

When the standard ring is press-fit, the dimensions of the roller diameter plus the plate thickness do not change. Accordingly, the roller set bore diameter, L_i, is as follows:

$$L_i = D - 2T - \lambda(D-H) = (1-\lambda)D - 2T + \lambda H \cdots (2)$$

The mean value and standard deviation of the "roller diameter + plate thickness" (=T) can be calculated by the formula (2). The mean value given by formula (2) is:

$$m_{Li} = (1-\lambda)m_D - m_{2T} + \lambda m_H \cdots\cdots\cdots\cdots (3)$$

Standard deviation of formula (2) is:

$$\sigma_{Li}^2 = (1-\lambda)^2 \cdot \sigma_D^2 + \sigma_{2T}^2 + \lambda^2 \sigma_H^2 \cdots\cdots (4)$$

In the case of the standard ring, because $\sigma H^2 = 0$, formula (4) is:

$$\sigma_{Li}^2 = (1-\lambda)^2 \cdot \sigma_D^2 + \sigma_{2T}^2 \quad \cdots\cdots\cdots (5)$$

Unknown values in formula (3) and (5) are only m_{2T} and σ_{2T}^2. Accordingly, substitute known numerical values for (3) and (5) to obtain m_{2T} and σ_{2T}^2.

② For press fitting of the actual housing, consider the same method as the standard ring press fitting.

Here, terms for press fitting of the actual housing are identified with an apostrophe (') for classification/clarification.

$$m_{Li'} = (1-\lambda')m_D - m_{2T} + \lambda' m_{H'} \cdots\cdots\cdots\cdots (6)$$

$$\sigma_{Li'}^2 = (1-\lambda')^2 \cdot \sigma_D^2 + \sigma_{2T}^2 + \lambda'^2 \sigma_{H'}^2 \cdots (7)$$

③ Previously calculated values are substituted for m_{2T} and σ_{2T}^2 in formulas (6) and (7).

④ The roller set bore diameter, L_i', for press fitting the actual housing can be calculated by the following formula.

$$L_i' = m_{Li'} \pm 3\sigma_{Li'} \quad \cdots\cdots\cdots\cdots (8)$$

⑤ To calculate the radial internal clearance, consider the mean value and standard deviation of the shaft in formulas (6) and (7).

⑥ The target value of radial internal clearance is usually set so that the normal clearance can be obtained. However when used for motor vehicles, recommended values are indicated for the respective components. For details, consult **NTN**.

6. Shaft and Housing Design

6. 1 Shaft and housing accuracy

Because the bearing rings of needle roller bearings are so thin, the accuracy of the surfaces of the shaft and housing in which the bearing is mounted has a considerable effect on the accuracy of the raceways.

Under normal conditions of use, a turned finish is adequate for mating surfaces. However, if a heavy load rating, noise reduction, or high precision are required, a ground finish is necessary.

Table 6.1 shows the dimensional accuracy of the fitting face between the shaft and housing, the shape accuracy, the surface roughness, and the shoulder perpendicularity against the fitting face under normal operating conditions.

With split-type housings, if a grinding undercut is made on the inside diameter of the mating surface, distortion of the outer ring is prevented when the housing is assembled.

Table 6.1 Shaft and housing accuracy

Characteristic		Shaft	Housing
Dimensional accuracy		IT6 {IT5}	IT7 {IT6}
Circular deviation Cylindrical deviation	(Maximum)	IT3 {IT2}	IT4 {IT3}
Shoulder perpendicularity (Maximum)		IT5 {IT4}	IT5 {IT4}
Roughness of fitting surface		0.8a	1.6a

Note: Bearings with an accuracy exceeding Class 5 appear within brackets.

6. 2 Raceway accuracy

A shaft and housing are often used directly in place of needle roller bearings with raceways. To regulate the radial internal clearance to the specified allowance and ensure high revolution accuracy, the dimensional accuracy, shape accuracy, and surface roughness of the raceway must be equivalent to that of the raceway surface of the bearing. **Table 6.2** shows the accuracy and surface roughness of the raceway surface.

Table 6.2 Accuracy of raceway surface

Characteristic		Shaft	Housing
Dimensional accuracy		IT5 {IT4}	IT6 {IT5}
Circular deviation Cylindrical deviation	(Maximum)	IT3 {IT2}	IT4 {IT3}
Shoulder perpendicularity (Maximum)		IT3 {IT2}	IT3 {IT2}
Axial runout (Maximum) Thrust bearing		IT5 {IT4}	
Surface roughness		Within 0.4a (R_{max}1.6 μm)	

Remarks: Components with high rotational accuracy appear in brackets.

6. 3 Raceway materials and their hardness

When the single outside diameter or single bore diameter of a shaft or housing is used in place of a raceway, the surface hardness should be HRC58 to HRC64 in order to maintain sufficient load-bearing capacity. In this case, the types of materials shown in **Table 6.3** should be used following suitable heat treatment.

When raceways have been hardened by carburization or induction, the hardness penetration is defined as the adequate depth of a hardened surface layer with a hardness of HV550 when measured from the surface. The minimum depth of hardness can be calculated according to Formula 6.1.

$$E_{ht\,\min} \geqq 0.8D_W\,(0.1+0.002D_W) \cdots\cdots (6.1)$$

where,

$E_{ht\,\min}$: Minimum hardness adequate depth mm

D_W : Roller diameter mm

Table 6.3 Raceway materials and their hardness

Steel type	Code	Standard
High carbon chromium bearing steel	SUJ2	JIS G 4805
Carbon tool steel	SK3	JIS G 4401
Nickel chromium molybdenum steel	SNCM420	JIS G 4103
Chromium steel	SCr420	JIS G 4104
Chromium molybdenum steel	SCM420	JIS G 4105
Nickel chromium steel	SNC420	JIS G 4102

7. Tips on Bearing Use

Needle roller and cage assembly bearings have various advantages, yet they also have limitations. Before using these bearings, follow the precautions listed in this section in order to ensure the optimal service life.

(1) Minimal space for lubricant

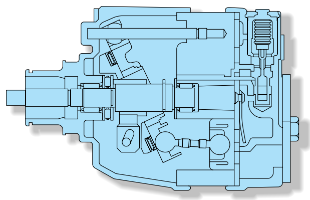
Although a small cross-sectional bearing height is an advantage, this space includes the cage assembly, which leaves very little room available for the lubricant.

In addition, as the cage assembly is guided by either the inner ring or outer ring, the lubrication of these guiding surfaces must be considered.

Accordingly, except in the case of extremely low speed operation, a lubrication hole must be provided for oil lubrication, or, in the case of grease lubrication, adequate maintenance must be ensured through rigid scheduling of lubrication intervals.

(2) Axial loads

Except for a partial grouping, needle roller bearings cannot carry axial loads. Axial loads caused by pure radial loads are generally about 3% to 5% of radial loads, and paying attention to the lubricating surface is normally sufficient. However, if the axial loads act expressly on a bearing, consider the use of thrust bearings.



Tips & Hints

●Guide surface in the axial direction

When a needle roller and cage assembly is used alone and is guided in an axial direction at the shaft shoulder (**Fig. 7.1**), the shaft shoulder surface should have a burr-free, improved finish where it contacts the side face of the cage assembly. In high-speed applications, the contact faces should be hardened and finish-ground. Thrust rings stamped from spring plate with a press are also suitable as axial guides for the cage assembly.

When the cage assembly is guided in an axial direction through the use of a locating snap ring (**Fig. 7.1**), it is recommended that a thrust ring be used between the cage assembly and locating snap ring so that the cut ends of the locating snap ring do not directly contact the cage assembly.

Generally, when a shaft with a radial needle roller bearing is to be positioned in the axial direction, ball bearings or thrust bearings are used to determine the axial direction. However, when the axial direction load is small and the revolution speed is not high (for example, an idler gear in a gear box), mount the thrust ring on the shaft and position the thrust ring by striking it against the outer ring or housing shoulder, as shown in **Fig. 7.2**. In this design, lubrication on the guide surface requires care. **Fig. 7.3** shows an example of a thrust ring with an oil groove processed on the guide surface. This oil groove and the flat part of the shaft must be chamfered and smoothed.

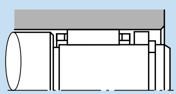


Fig. 7.1

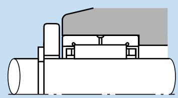


Fig. 7.2

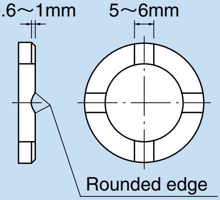


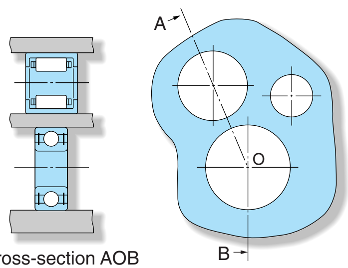
Fig. 7.3 Thrust ring

(3) Shape errors

Needle roller and cage assembly bearings have good accuracy and can be rotated at high speed with small internal clearance. The accuracy of the bearing box of the single outside diameter of the shaft or single bore diameter requires special care, because the shaft or housing shapes directly appear on the raceway surface due to the thin materials used for the inner ring or outer ring.

Regarding general housing accuracy, inferior accuracy is found where differences exist in ribs and material thicknesses.

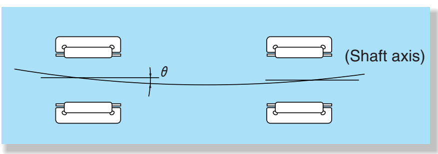
Care should be taken because needle roller bearings used under such conditions contribute to negative clearances and generate large axial loads or result in heating and seizure.



Cross-section AOB

4) Misalignment

Always be careful to keep the axial deflection to less than 1/2 000, as twisting can have a serious effect due to the high rigidity. When the internal clearance is small, or a wide needle roller bearing is used, a particular effort is required to ensure minimal misalignment.

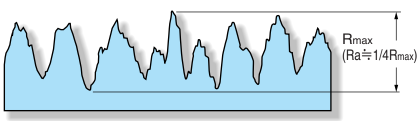


(5) Materials, hardness, and accuracy of the raceway surface

For general bearings, an appropriate bearing steel is used for inner rings, outer rings, and rollers, and a precision finishing process is applied following careful heat treatment. On the other hand, needle roller bearings are also used without inner rings only, or without either inner or outer rings (in other words, the shaft or housing is used in place of raceway surface), to achieve certain advantages.

The basic rated static load listed in catalogs refers to the bearings mentioned above. If the shaft or housing is used in place of a bearing ring, it should comply with the inner and outer rings of the bearing. Consequently, it is necessary to select a flawless steel containing no nonmetals and to produce a surface hardness of HRC 58-64 through careful heat treatment. If only the surface is hardened by carburization, it is recommended that careful attention be paid to ensure that the hardened surface layer has adequate depth and surface hardness.

The roughness of the raceway surface should be in the range of 0.4a ($R_{max} \times 16\ \mu m$), and there should be no winding along the circumference. The roundness and cylindricity should be less than 50% of the dimensional allowance.



8. Engineering Data

8. 1 Track loading capacity of cam followers and roller followers

The track loading capacity is calculated by the relationship between the stress and Hertzian stress by establishing a standard hardness (standard tension stress) with the relationship between the hardness and pure tension stress of the materials. The methods for setting the standard hardness (tension stress) vary slightly by manufacturer, but the accompanying table from the JIS Iron and Steel Handbook (showing approximate values based on the revised conversion table of JIS Z8413) is used to determine the relationship between hardness and tension stress.
HRC40 = σ =127 kgf/mm² is adopted as the standard hardness (tension stress).

(1) Track capacity factor

The tension stress of a material increases as the hardness increases; at the same time, the track loading capacity also increases. In this case, the actual track loading capacity can be calculated by multiplying the track loading capacity with the track capacity factors listed in **Table 8.1**.

Note: The calculated track loading capacity shown above is based on the pure tension stress, but not the permissible Hertzian stress. In general, the stress (corresponding force) causing material creep is greater than the tension stress. With static loads in particular, this track loading capacity is considered a safe value.

Example: If the track capacity with a specific hardness is calculated with the track capacity factor:

When the track loading capacity is C_t, the track capacity factor is A at the subject hardness, and the track loading capacity can be found as follows:

$$C_t' = A \cdot C_t$$

For NATR15X, if the hardness is HRC 50:

C_t =1 220 kgf, A=1 987

$\therefore C_t'$=1 987×1 220=2 424 kgf

(2) References (Calculation of track capacity)

- If the outer ring is cylindrical:

$$\sigma_{max} = 60.9\sqrt{\frac{F_r \Sigma \rho}{B_{eff}}}$$

- If the outer ring is spherical with R:

$$\sigma_{max} = \frac{187}{\mu \nu}\sqrt[a]{(\Sigma \rho)^2 F_r}$$

where,

σ_{max}=127kgf/mm²

F_r : Track loading capacity (kgf)

$\Sigma \rho$: Sum of curvatures

B_{eff} : Effective contact length (mm)

where (outer ring width – 2×chamfer)

Table 8.1 Track capacity factor

Hardness HRC	Tension stress kgf/mm²	Cylindrical outside surface	Spherical outside surface
20	77	0.368	0.223
21	79	0.387	0.241
22	80	0.397	0.250
23	82	0.417	0.269
24	84	0.437	0.289
25	86	0.459	0.311
26	88	0.480	0.333
27	90	0.502	0.356
28	93	0.536	0.393
29	95	0.560	0.419
30	97	0.583	0.446
31	100	0.620	0.488
32	102	0.645	0.518
33	105	0.684	0.565
34	108	0.723	0.615
35	110	0.750	0.650
36	114	0.806	0.723
37	118	0.863	0.802
38	120	0.893	0.844
39	124	0.953	0.931
40	127	1.0	1.0
41	132	1.080	1.123
42	136	1.147	1.228
43	141	1.233	1.369
44	146	1.322	1.519
45	151	1.414	1.681
46	156	1.509	1.853
47	161	1.607	2.037
48	167	1.729	2.274
49	172	1.834	2.484
50	179	1.987	2.800
51	186	2.145	3.141
52	192	2.286	3.455
53	199	2.455	3.847
54	205	2.606	4.206
55	212	2.787	4.652

8. 2 Outer ring strength

Generally, outer rings do not break under normal operating loads, but the following is calculated as a checkpoint for operations under shock loads and heavy loads.

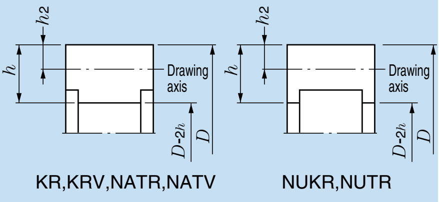


Fig. 8.1

Fig. 8.1 shows outer ring shapes. They are calculated with the following formula. Outer ring breaking strength means the fracture strength of rollers when in a bridge formation.

To determine the fracture strength, generally 180 kgf/mm² can be applied to bearing steel, but we use 120 kgf/mm² as max here in keeping with our own experiences and in consideration of applied concentration. For normal use, the stress is recommended to be less than 20 kgf/mm² and the strength in this case is calculated as follows.

$$P=\frac{4\pi}{1+f(\alpha)}\times\frac{D-2h}{h(D-2h2)^2}\times I\times\alpha \quad \text{(kgf)}$$

$$f(\alpha)=\frac{(\pi-\alpha)\sin\alpha-(1+\cos\alpha)}{2\cos\ \alpha} \quad \text{(rad.)}$$

$$\alpha=\frac{180}{Z} \quad \text{(rad.)}$$

where,

I : Outer ring cross-section secondary moment (mm⁴)

Z : Number of rollers

σ : Breaking stress (kgf/mm²)

P : Breaking load (kgf)

※Use special care if a spring washer is used to lock the screws, as this may reduce the stud strength.

8. 3 Stud strength of cam followers

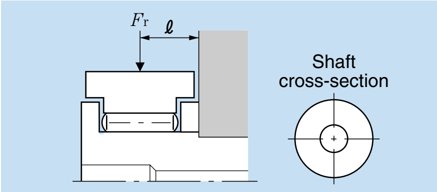


Fig. 8.2

In **Fig. 8.2**, if the load Fr acts at the center of the width of the outer ring, the stud receives the bending moment equivalent to $Fr \times \ell$. Tension stress created on the stud surface by this moment is established as σ_1. Further, the stud itself is tightened with a nut or machine unit, generating tension stress σ_2.

The sum of the tension stresses $\sigma_1+\sigma_2$ must not exceed the material allowance. The recommended tightening torque listed in the catalogs is $\sigma_2 ≒ 10$ kg/mm² for most types.

The stud strength is calculated for all types in this section. However, the spring washer is not used in this case※.

- As shown in the figure, loads should act at the center of the outer ring.
- The shaft cross-section should follow the drawing.
- The permissible stress in each case refers to the following items. The tension stress due to tightening is set as $\sigma_2 ≒ 10$ kg/mm².

Static bending stress σ =140kgf/mm²

Repeating bending stress (pulsating)
σ =100kgf/mm²

Repeating bending stress (alternating)
=40kgf/mm²

$$\sigma_1=\frac{M}{Z}=\frac{Fr\cdot\ell}{Z}$$

where,

$$\sigma_1+\sigma_2=\sigma$$

Z : Shaft section modulus (mm³)

Fr: Load (Stud strength in kgf)

8

Calculation/Roller follower NATR, NATV, NUTR

Outside diameter mm	Series	Rated load {kgf}		Track loading capacity {kgf}		Outer ring strength {kgf}	
		C_r	C_{or}	Cylinder	Spherical surface R	Static σ =120	σ =20
16	NATR5	395	400	350	110	1 210	202
	NATV5	640	910			1 940	325
19	NATR6	460	520	415	141	1 840	305
	NATV6	735	1 140			2 850	470
24	NATR8	675	745	680	193	2 600	430
	NATV8	1 050	1 580			4 200	700
30	NATR10	765	930	785	267	4 900	820
	NATV10	1 190	1 980			7 600	1 270
32	NATR12	865	1 130	835	291	5 200	860
	NATV12	1 280	2 250			8 000	1 330
35	NATR15	1 320	2 050	1 220	325	7 600	1 270
	NATV15	1 830	3 750			11 800	1 970
40	NATR17	1 390	2 250	1 480	390	11 800	1 970
	NATV17	1 930	4 150			18 300	3 050
47	NATR20	2 070	3 350	2 150	480	17 200	2 850
	NATV20	2 900	6 100			26 000	4 350
52	NATR25	2 280	4 000	2 370	565	17 800	2 950
	NATV25	3 150	7 350			28 500	4 750
62	NATR30	3 600	6 550	3 350	710	21 000	3 500
	NATV30	4 750	11 400			31 500	5 200
72	NATR35	3 850	7600	3 750	820	30 000	5 000
	NATV35	5 200	13 300			45 000	7 500
80	NATR40	4 950	9 150	4 500	1 000	27 500	4 600
	NATV40	6 850	17 100			44 500	7 400
85	NATR45	5 150	9 950	4 800	1 060	28 000	4 650
90	NATR50	5 300	10 700	5 100	1 160	28 500	4 700
	NATV50	7 600	20 400			46 500	7 700
35	NUTR202	2 280	2 620	1 220	325	4 350	730
40	NUTR203	2 450	2 970	1 480	390	8 000	1 340
42	NUTR302	2 280	2 620	1 460	415	10 900	1 820
47	NUTR303	2 450	2 970	1 740	480	16 700	2 800
	NUTR204	3 950	4 900	2 150		9 100	1 520
52	NUTR304	3 950	4 900	2 370	565	15 700	2 600
	NUTR205	4 350	5 850	2 370		10 100	1 680
62	NUTR305	4 350	5 850	2 830	710	25 500	4 250
	NUTR206	5 750	7 400	3 350		12 700	2 120
72	NUTR306	5 750	7 400	3 900	820	29 000	4 800
	NUTR207	6 350	8 700	3 750		19 400	3 250
80	NUTR307	6 350	8 700	4 150	1 000	34 500	5 700
	NUTR208	8 850	12 700	4 500		16 900	2 800
85	NUTR209	9 350	14 000	4 800	1 060	17 800	2 950
90	NUTR308	8 850	12 700	5 100	1 160	35 500	5 900
	NUTR210	9 800	15 300	5 100		18 600	3 100
100	NUTR309	9 350	14 000	5 650	1 330	49 000	8 100
110	NUTR310	9 800	15 300	6 200	1 500	64 000	10 700

Calculation/Cam follower KR, KRV, NUKR

Outside diameter mm	Series	Rated load {kgf} C_r	Rated load {kgf} C_{or}	Track loading capacity {kgf} Cylinder	Track loading capacity {kgf} Spherical surface R	Stud strength {kgf} Static $\sigma=140$	Stud strength {kgf} Pulsating $\sigma=100$	Stud strength {kgf} Alternating $\sigma=40$	Outer ring strength {kgf} Static $\sigma=120$	Outer ring strength {kgf} $\sigma=20$
16	**KR16**	395	400	350	110	450	315	104	1 210	202
	KRV16	640	910						1 940	325
19	**KR19**	460	520	415	141	1 070	740	247	1 840	305
	KRV19	735	1 140						2 850	470
22	**KR22**	515	635	525	172	1 920	1 330	445	2 600	435
	KRV22	810	1 360						3 950	660
26	**KR26**	515	635	620	216	1 920	1 330	445	5 400	910
	KRV26	810	1 360						8 200	1 370
30	**KR30**	765	930	785	267	2 850	1 990	660	4 900	820
	KRV30	1 190	1 980						7 600	1 270
32	**KR32**	765	930	835	291	2 850	1 990	660	6 400	1 070
	KRV32	1 190	1 980						9 900	1 650
35	**KR35**	1 210	1 760	1 220	325	5 300	3 650	1 220	9 300	1 560
	KRV35	1 750	3 400						14 100	2 360
	NUKR35	2 280	2 620						4 350	730
40	**KR40**	1 390	2 250	1 480	390	6 900	4 750	1 580	11 800	1 970
	KRV40	1 930	4 150						18 300	3 050
	NUKR40	2 450	2 970						8 000	1 340
47	**KR47**	2 070	3 350	2 150	480	7 900	5 500	1 830	17 200	2 850
	KRV47	2 890	6 100						26 000	4 350
	NUKR47	3 950	4 900						9 100	1 520
52	**KR52**	2 070	3 350	2 370	565	7 900	5 500	1 830	25 500	4 250
	KRV52	2 890	6 100						38 500	6 500
	NUKR52	4 350	5 850						10 100	1 680
62	**KR62**	2 960	5 650	3 500	710	11 500	7 900	2 650	48 000	8 000
	KRV62	3 950	9 850						74 000	12 400
	NUKR62	5 750	7 400						13 400	2 240
72	**KR72**	2 960	5 650	3 900	820	11 500	7 900	2 650	75 000	12 500
	KRV72	3 950	9 850						116 000	19 400
	NUKR72	6 350	8 700						20 500	3 400
80	**KR80**	4 500	8 800	5 400	1 000	18 600	12 900	4 300	8 100	13 500
	KRV80	5 800	14 700						121 000	20 200
	NUKR80	10 300	15 400						19 600	3 250
85	**KR85**	4 500	8 800	5 750	1 060	18 600	12 900	4 300	97 000	16 200
90	**KR90**	4 500	8 800	6 100	1 160	18 600	12 900	4 300	11 500	19 200
	KRV90	5 800	14 700						17 100	28 500
	NUKR90	10 300	15 400						41 500	6 880
100	**NUKR100**	12 100	17 000	8 050	1 300	26 000	17 900	6 000	62 000	10 300
120	**NUKR120**	17 600	27 100	11 500	1 670	35 000	24 700	8 200	90 000	15 000
140	**NUKR140**	20 500	30 000	15 500	2 040	47 000	32 500	10 900	140 000	22 700
150	**NUKR150**	26 300	39 000	17 600	2 250	57 000	39 500	13 100	112 000	18 700
160	**NUKR160**	27 900	41 000	19 800	2 450	68 000	47 000	15 700	127 000	21 100
170	**NUKR170**	32 500	48 500	22 200	2 650	79 000	55 000	18 200	136 000	22 600
180	**NUKR180**	37 500	56 500	25 800	2 840	88 000	61 000	20 000	155 000	26 000

8. 4 Calculating tightening torque of cam follower

The following relationship exists between the screw tightening torque and tightening force.

$$T=\frac{F}{2}\left\{(1.15\mu+\tan\beta)d_2+\mu_w d_w\right\}$$

where,

T : Tightening torque
F : Tightening force
μ : Friction coefficient
μ_w : Nut bearing surface coefficient
β : Lead angle of thread
d_2 : Effective diameter of thread
d_w : Effective diameter between the nut bearing surface and mounting hole (with hexagon nut)

Here, $\mu=\mu_w$=0.15 is assumed.

$d_2=0.92d$

$\tan\beta=P/(\pi\cdot d_2)$

$$d_w=\frac{0.608B^3-0.524D_i^3}{0.866B^2-0.785D_i^2}$$

where,

d : Nominal diameter of thread
P : Thread pitch
B : Width across flat of nut
D_i : Mounting hole bore
$D_i \fallingdotseq d$ is established.

On the other hand, the relationship between the tightening force and tension stress is expressed as follows:

$$\sigma_2=\frac{F}{S}$$

σ_2 : Tension stress
S : Shaft cross-section area

where, σ_2 refers to the setting according to the cam follower stud strength calculation in Section 8.3.

$\sigma_2=10\text{kgf/mm}^2$

$F=S\cdot\sigma_2=S\cdot 10$ {kgf}

The tightening torque is as follows:

$$F=\frac{F}{2}\{(0.1725+\tan\beta)\times 0.92d+0.15d_w\}\times 10^3$$

$$F=\frac{S\cdot 10}{2}\{(0.1725+\frac{P}{0.92d\cdot\pi})\times 0.92d$$

$$+0.15\times\frac{0.608B^3-0.524d^3}{0.866B^2-0.785d^2}\}\times 10^3 \ \{\text{kgf-m}\}$$

Table. 8.2 Calculation of standard cam follower

Series KR KRV NUKR \ Calculation	Tightening torque T {kgf-m}		Tightening force F {kgf}	
	Shaft lubrication hole is taken into account	Shaft lubrication hole is not taken into account	Shaft lubrication hole is taken into account	Shaft lubrication hole is not taken into account
#16	—	0.36	—	283
#19	—	0.84	—	503
#22	1.36	1.62	660	785
#26	1.36	1.62	660	785
#30	2.05	2.73	848	1 131
#32	2.05	2.73	848	1 131
#35	5.33	6.20	1 728	2 011
#40	7.78	8.75	2 262	2 545
#47	10.0	11.9	2 639	3 142
#52	10.0	11.9	2 639	3 142
#62	18.1	20.4	4 021	4 524
#72	18.1	20.4	4 021	4 524
#80	36.9	39.7	6 566	7 069
#85	36.9	39.7	6 566	7 069
#90	36.9	39.7	6 566	7 069
#100	64.7	68.1	9 676	10 179
#120	104	108	13 352	13 854
#140	157	161	17 593	18 096
#150	199	203	20 735	21 237
#160	253	258	24 127	24 630
#170	310	315	27 772	28 274
#180	374	380	31 667	32 170

9. Product Introduction & Index

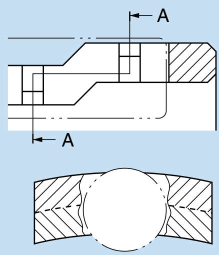
Needle roller and welded cage assemblies with large diameters

We developed needle bearings for idlers in the transmissions of large vehicles. Conventional welded cage assemblies have been difficult to use in this application.

■ Features

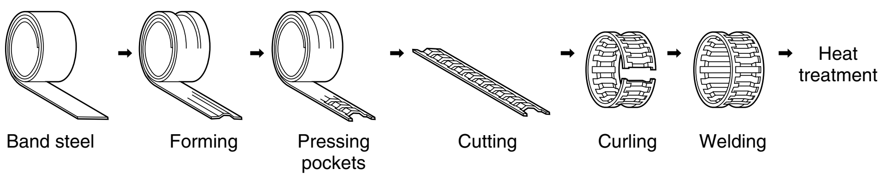
1) The use of a plate thicker than the former welded cage assembly improves the strength of the cage assembly.
2) Ensures a stable roller guide surface and roller retention.
3) For excellent value, bearings are available with a roller set bore diameter of up to 120 mm dia.

■ Structure

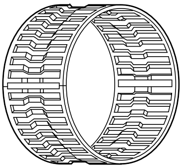
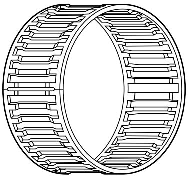
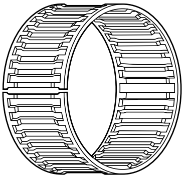
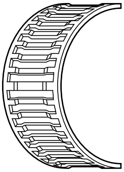


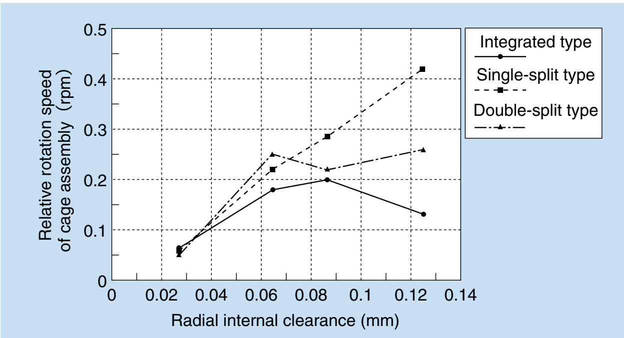
A-A Cross section

■ Welded cage manufacturing process



■ Bearing series and characteristics

KJ······S		● Outside diameter guide cage assembly ● Made from thin band steel. ● Accommodates medium-size shaft diameters ranging from 20 to 40 mm dia. ● Used mainly for car-class transmissions.
KV······S		● Outside diameter guide cage assembly. ● Made from relatively thick steel plate. ● Cage assembly has high-rigidity ring. ● Accommodates large diameters. ● Used mainly for truck-class transmissions. ● **Conventional type does not have rollers installed in the welded pocket.**
SKV······S		● KV······S is temporarily welded, then the weld is separated to create a single-split cage assembly. ● Has anti-fretting feature. (**See following chart**.)
GKV······S		● KV······S is cut apart at almost half its length, and is then bent to form a double-split (half-split) type cage assembly. ● Has anti-fretting feature. (**See following chart**.)



Measured data on the relative rotation speeds according to the difference in cage assembly

9

Full-complement needle roller bearings for sliding seats

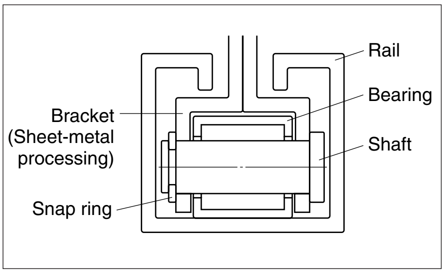
A rolling mechanism is employed to improve the sliding motion of rear seats in minivans.

■ Features

Economical full-complement roller bearings with thick pressed outer ring

1) Thick steel plate is applied directly to the outside surface of the pressed outer ring as the rolling surface for the roller follower.
2) A new pressing process has been introduced for mating components, so less chamfering of the outside surface of the pressed outer ring is required.
3) All press processes are designed for economy.

■ Structure



Rail cross section

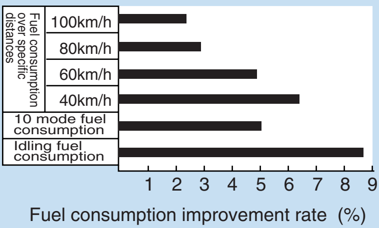
Bearings for Rocker Arms

Automotive manufacturers, both domestic and international, place the highest priority on the technical issue of improving fuel consumption. One aspect of this commitment has been the aggressive pursuit of low-friction engine design. It has been determined that the friction loss of the valve system is high in the low-speed and middle-speed ranges, which are the most frequently used.

Usually, a sliding mechanism known as the "slipper system" is employed, but the needle roller type has been adopted to improve fuel consumption and performance.

■ Features

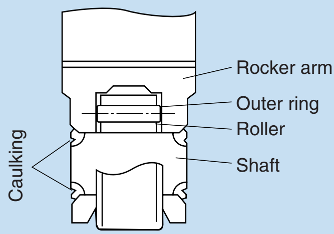
A rocker arm bearing rotates in contact with the engine camshaft. The surface roughness of shaft L is usually R_{max} 2 to 4 μm (Ra 0.5 to 1 μm), and may cause peeling of the surface of the rocker arm bearing. To prevent this, the HL treatment is standard for **NTN** rocker arm bearings.

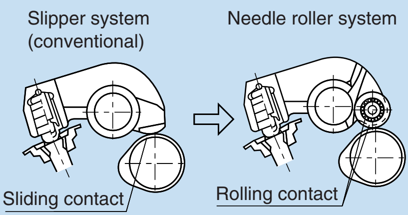


Fuel consumption improvement due to use of needle roller rocker arm

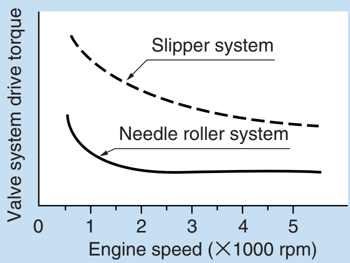
■ Structure

Both ends of the shaft are caulked and fixed with a yoke.





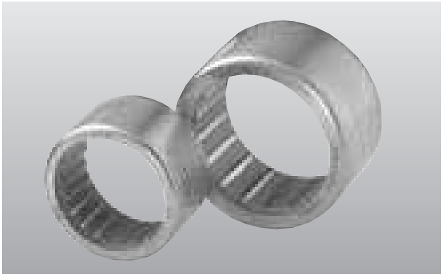
Design comparison



Difference in drive torques

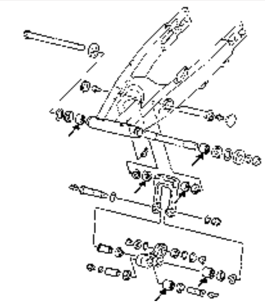
9

Needle roller bearings with solid grease



The bearing is prelubricated with thermosetting grease to ensure maximum advantage.

■ Application



Structure of rear suspension link of two-wheeled vehicle (Arrows indicate bearings.)

■ Features

1) Less lubricant leakage

When thermosetting grease is used, oil is gradually supplied to the rolling contact surface through the generation of heat and centrifugal force during operation of the bearing. As a result, there is less oil leakage.

2) Proper lubrication characteristics

The lubricant is unlikely to leak, even if strong vibrations or a large centrifugal force acts on the bearing. The lubricant will not become emulsified or flow out even if water enters.

Lubrication characteristics are superior to the general grease. However, it may get rust if moisture remains in the shaft, or if the bearings are used under the condition to be forced to get water splash on. Accordingly, we recommend you to take sealing measures such as using the additional seal.

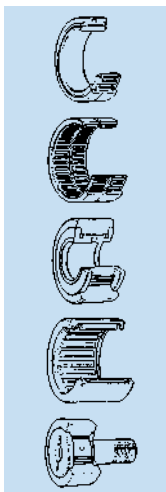
■ Notices for use

Operate the bearing only in an ambient temperature range of –20 to 80˚C. For continuous operation, the ambient temperature should not exceed 60˚C.

Care should be taken since these bearings cannot be used under the condition that the organic solvents (such as acetone, pertoleum-benzine and white kerosene) may splash on.

■ Table of operation results of solid grease bearings (Extracts)

Reason for selection	Application		Actual bearing (Type)
No greasing	Sheet printers Sheet printers Sheet printers Sheet printers Sheet printers Packaging machines Mechanical presses Bottling machines Bottling machines Two-wheeled vehicles	Flip-over trunk Claw shaft oscillating parts Register device Transport section Link mechanism Guide roller Rotary Suspension	Machined-ring bearings Cam followers, Machined-ring bearings Machined-ring bearings Drawn-cup bearings Machined-ring bearings, cam followers Machined-ring bearings Integrated thrust bearings Full-complement drawn-cup bearings
Protection against grease leakage	Automatic weaving machines Sheet printers Medicine packaging machines Slurry pump Painting machines	 Roller with ink Conveyor Crankshaf	Machined-ring bearings Drawn-cup bearings Machined-ring bearings Machined-ring bearings Drawn-cup bearings
Water sealing	Food machines Confectionery machines Food machinery Packaging machines Water jet room Canning machinery Rollers of window-washer gondola winch	Conveyors Conveyors Cutting roller for kamaboko boiled fish paste Traveling section Guide rollers	Machined-ring bearings Roller followers Machined-ring bearings Drawn-cup bearings Drawn-cup bearings Cam followers Drawn-cup bearings
Dust protection	Transferring unit Filling machines Bag-forming machines Presses Steel facilities Ceramic machinery	Conveyors Guide rollers Steering floor guide rollers Conveyors (for special equipment)	Drawn-cup bearings Cam followers Machined-ring bearings Roller followers Cam followers Cam followers



Cam followers/Roller followers with outer ring grooves

Cam followers with outer ring grooves (above) and various roller followers with outer ring grooves (right)

Bearings are provided with grooves on the outside diameter of the outer ring to match the shape of the mating material. These bearings are used as guide rollers. The groove shape can be processed as an R or V shape. Mounting instructions are identical to those of standard bearings.

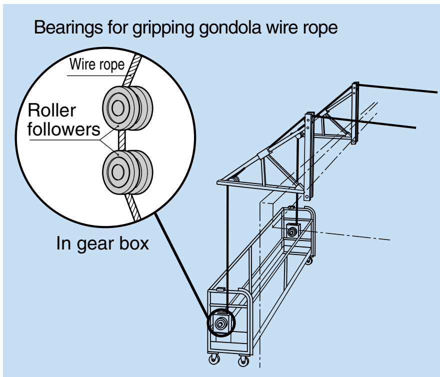
■ Features

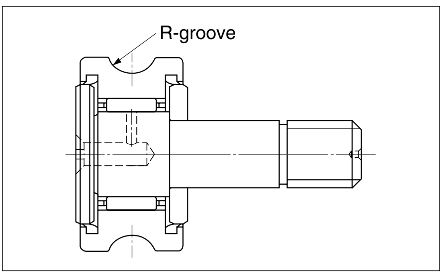
1) The R-groove shape can be mirror-finished according to the requirements of the application. (Generally, turning followed by lapping.)
2) The basic design accommodates the cam follower standard.
3) Easy mounting.
4) Can also be used as an economical guide roller for direct drive machines.

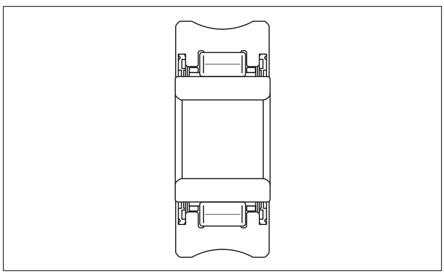
■ Applications

- Guide rollers for steel wires and steel pipes
- Leveling rollers
- Rope-gripping devices for winches of window-washing gondolas

■ Example applications of poly-lubricated bearings







Roller follower with outer ring with center rib

A roller follower with an outer ring with a center rib (**Fig. 1** NUTW Series) comprises cylindrical rollers, an outer ring, an inner ring, side plates, and shield plates. The outer ring follows a rolling motion on the raceway (track). The outer ring is designed to be thick in order to withstand shock loads, as it operates in direct contact with the track.

In addition to the NUTR Series (**Fig. 2**), which was introduced in a succession of models, the width of the outer ring has been widened, the center rib has been equipped with an outer ring, and the roller follower has been designed to carry larger axial loads. The outside surface of the outer ring is spherical or cylindrical. An outer ring with a spherical surface is effective at easing edge loads due to mounting error.

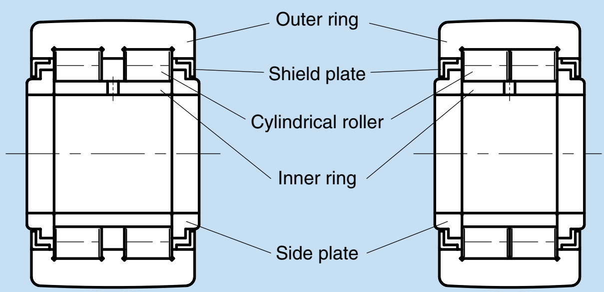


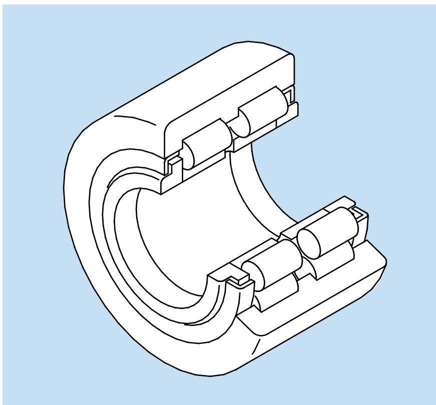
Fig. 1. NUTW Series **Fig. 2. NUTR Series**

■ Features

1) The outer ring is designed to be thick in order to withstand shock loads.
2) The outside surface can have a spherical or cylindrical surface.
3) The outer ring is equipped with a center rib, making it effective against axial loads and the moment loading effect.
4) Increasing the prelubricated grease capacity increases the lubrication effect and contributes to longer service life.

■ Applications

1) Under heavy loads or shock loads
2) As a cam mechanism or guide roller for straight and curved lines
3) Where moment loads act due to installation errors



NUTW Series

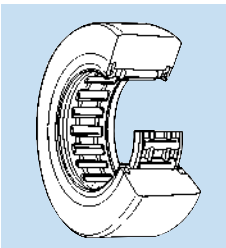
■ Dimensions

Outside diameter❶ mm $D\ ^{-0}_{0.05}$	Bearing series		Dimensions (mm)						Basic load rating dynamic N {kgf} static		Mass kg (reference)
	Spherical outer ring	Cylindrical outer ring	d	B	C	e	F_w	$r_{s\ min}$ ❷	C_r	C_{or}	
35	**NUTW202**	**NUTW202X**	15	$22\ ^{0}_{-0.210}$	21	20	19	0.3	24 100 {2 460}	28 300 {2 880}	0.115
40	**NUTW203**	**NUTW203X**	17	$24\ ^{0}_{-0.210}$	23	22	21.5	0.3	26 000 {2 650}	32 000 {3 250}	0.167
47	**NUTW204**	**NUTW204X**	20	$29\ ^{0}_{-0.210}$	28	27	25.5	0.3	40 500 {4 150}	51 500 {5 250}	0.280
52	**NUTW205**	**NUTW205X**	25	$29\ ^{0}_{-0.210}$	28	31	30	0.3	45 000 {4 600}	61 500 {6 250}	0.322
62	**NUTW206**	**NUTW206X**	30	$35\ ^{0}_{-0.210}$	34	38	35	0.3	59 500 {6 050}	77 000 {7 900}	0.549
72	**NUTW207**	**NUTW207X**	35	$35\ ^{0}_{-0.210}$	34	44	41.5	0.6	65 000 {6 650}	91 000 {9 250}	0.747
80	**NUTW208**	**NUTW208X**	40	$38\ ^{0}_{-0.250}$	36	51	47.5	0.6	90 500 {9 250}	131 000 {13 400}	0.953
85	**NUTW209**	**NUTW209X**	45	$38\ ^{0}_{-0.250}$	36	55	52.5	0.6	95 500 {9 750}	144 000 {14 700}	1.03
90	**NUTW210**	**NUTW210X**	50	$38\ ^{0}_{-0.250}$	36	60	57	0.6	100 000 {10 200}	158 000 {16 100}	1.11

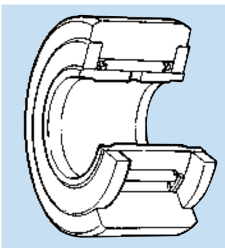
❶ For bearings with a cylindrical outside surface, add "X" to the bearing series code. In this case, the allowance of the outside diameter "D" of the outer ring is manufactured according to JIS Class O.
Example: NUTW203X

❷ This is the permissible minimum of chamfering dimension r.

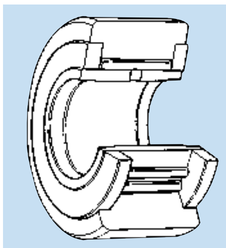
Standard series of roller followers



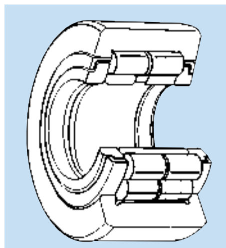
RNA 22 Series
NA 22 Series



NATR Series



NATV Series
NACV Series



NUTR Series

Cam followers (with eccentric shaft/tapping hole)

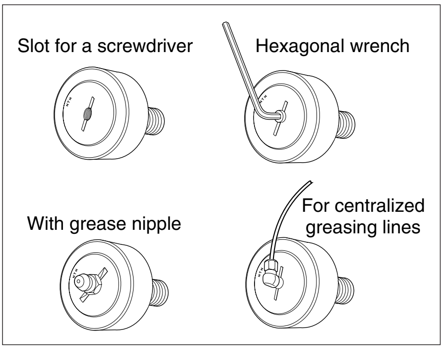
Adoption of an eccentric shaft provides easy adjustment of the mounting position. As a result, highly accurate mounting hole positioning has become unnecessary. Furthermore, the included threaded grease nipple can be installed at the tapping hole on the stud for easy greasing. It can also be used as a mounting thread for centralized pipelines.

■ Features

1) This bearing for outer ring rolling has a thick outer ring and high rigidity.
2) Available in three types: needle roller and cage assembly (KRU Series); needle roller without cage assembly (KRVU Series); and double-row cylindrical rollers (NUKRU Series) according to the type of rolling element.
3) The outside surface of the outer ring is spherical or cylindrical. The KRU Series and KRVU Series are available with seals. The NUKRU Series is sealed with sealing plates.
4) Axial eccentricity is 0.25 to 1.0 mm. This is especially advantageous for level adjustments when many bearings are mounted.
5) The driver groove on the flange side and tapping holes at both ends are provided for the stud. Either a screwdriver or hexagon wrench can be used.
6) Conventional press-greasing work is unnecessary because the threaded grease nipple is provided for greasing.

■ Applications

- Construction machinery, packaging machinery, industrial robots, medical appliances
- Transportation equipment at parking garages and automatic warehouses



Rubber mold cam followers

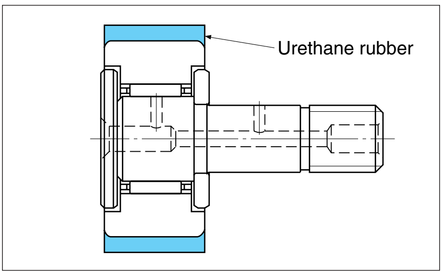
These are cam followers with an outer ring whose outside surface is vulcanized and coated with urethane rubber. This provides an effective means of preventing noise and absorbing vibration.

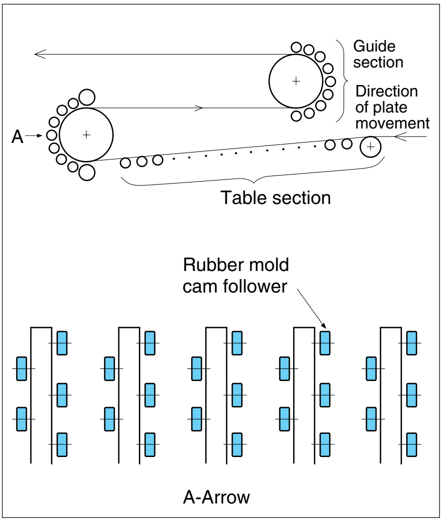
■ Features

1) Prevents noise.
2) Prevents bearing wear and damage.
3) Maintenance-free design
4) Easy installation

■ Applications

- Bridle roller guide





Steel bridle roll structure

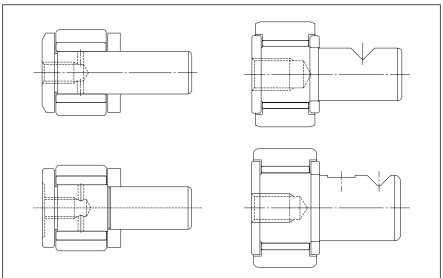
9

Cam followers for indexing

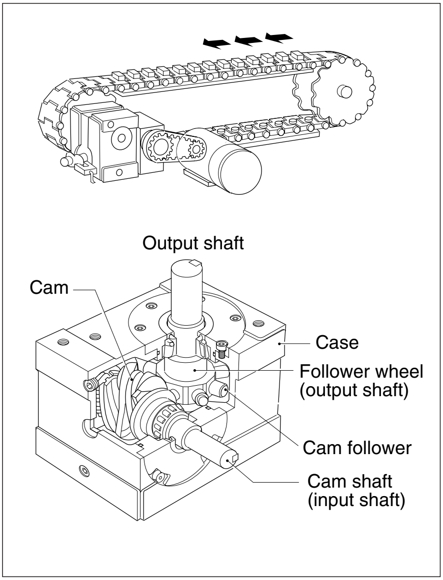
Automatic machinery performs a variety of movements including intermittent, oscillating and continuous rotation with high accuracy and at high speed. Cam followers are used as the roller cam mechanisms of driving devices.

■ Features

1) Provides ample outer ring and stud rigidity in a compact space.
2) Full-complement roller design ensures a long service life and larger load-carrying capacity than a roller and cage assembly.
3) This cam follower offers precision-class dimensions and rotational accuracy.
4) Secured with set screws for easy installation.



Examples of index cam follower shapes



Structure of indexing drive

9

Small-diameter drawn-cup needle roller bearings

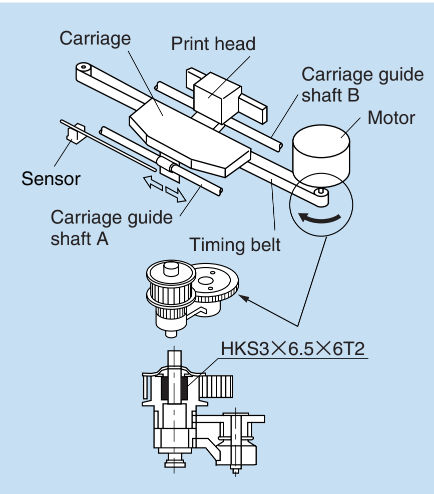
■ **Features**

The small diameter drawn-cup needle roller bearing has a low section height, is assembled with a cage assembly and rollers, and has a set bore diameter dimension (F_w) less than 10 mm. The outer ring surface is hardened by carburizing following precision deep drawing of the thin band steel.

■ **Application**

These bearings have a wide range of application thanks to their low section height and compact design.

Printer (timing pulley a ssembly).



Application: Printer (timing pulley assembly)

9

Bearing units for steel leveler backup roller

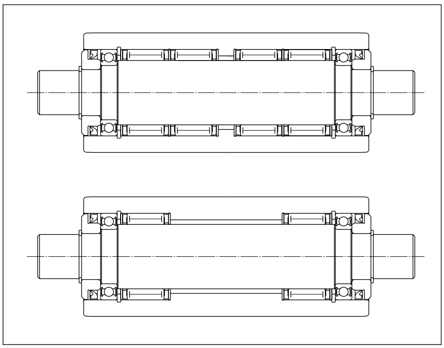
These bearings are used as backup rollers for leveling band steel.
They are available in long and narrow models.

■ Structure and advantages of long bearings

This unit is an assembly comprising a roller, shaft, and bearing. The bearing differs with the intended roll operating conditions, but the design has both a needle roller and cage assembly bearing (when carrying radial loads) and a deep-groove ball bearing (for carrying axial loads).

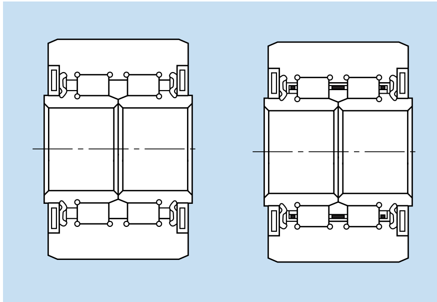
With the sealed type, the deep groove ball bearing seal, rubber seal, and clearances between cover and roller provide a satisfactory seal.

The starting torque and grease prelubrication, as well as the shape, hardness, roughness and rotational accuracy of the roller, meet all the requirements of a backup roller.



NTN can accommodate specifications other than the above for work rollers or leveler units used as middle rollers. For details, refer to "CAT. No. 2250/J, Large Rolling Bearings."

■ Structure and advantages of narrow bearings

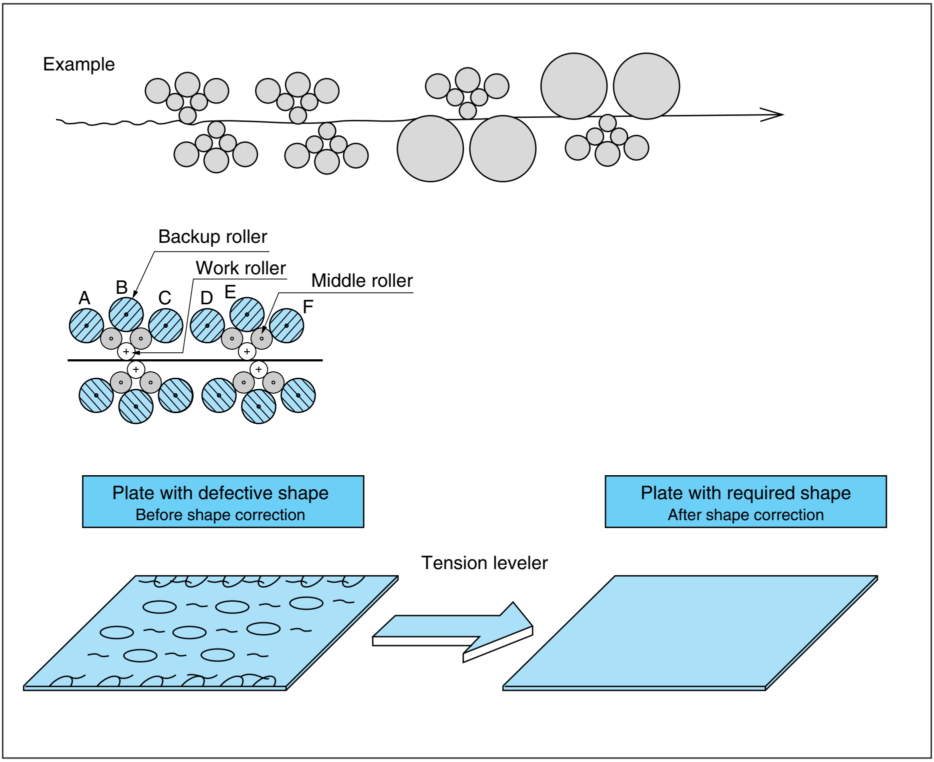


The outer ring has a thick design in order to provide greater rigidity, as the outside surface of the outer ring is used directly as the raceway surface. These bearings carry larger loads because double-row cylindrical rollers are used as the rolling elements.

The internal rubber seal and external steel seal plates of the sealed type form a labyrinth seal that provides a sufficient sealing effect.

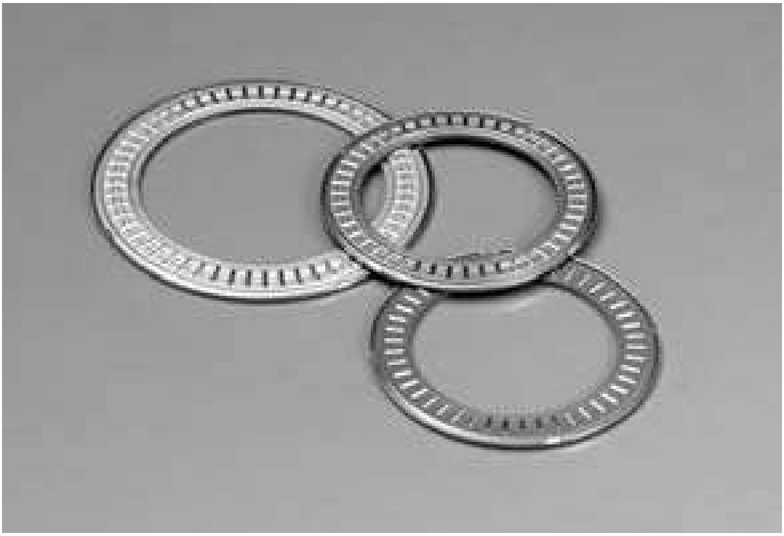
The starting torque and grease prelubrication, as well as the shape, hardness, roughness and rotational accuracy of the roller, meet all the requirements of a backup roller.

■ Application



9

Thrust bearing with integrated non-separable raceway



This non-separable thrust bearing is a remodeled separable bearing comprising of a thrust needle roller bearing and bearing ring made of steel plate, with a new structure designed to hold the cage assembly or other bearing ring with the rib of the bearing ring.

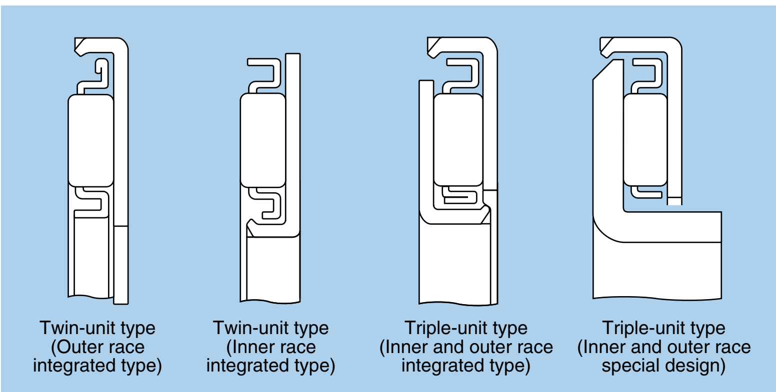
■ Features

The non-separable type of cage assembly and bearing rings ensures easier handling and fewer assembly steps than the standard thrust needle roller bearing.

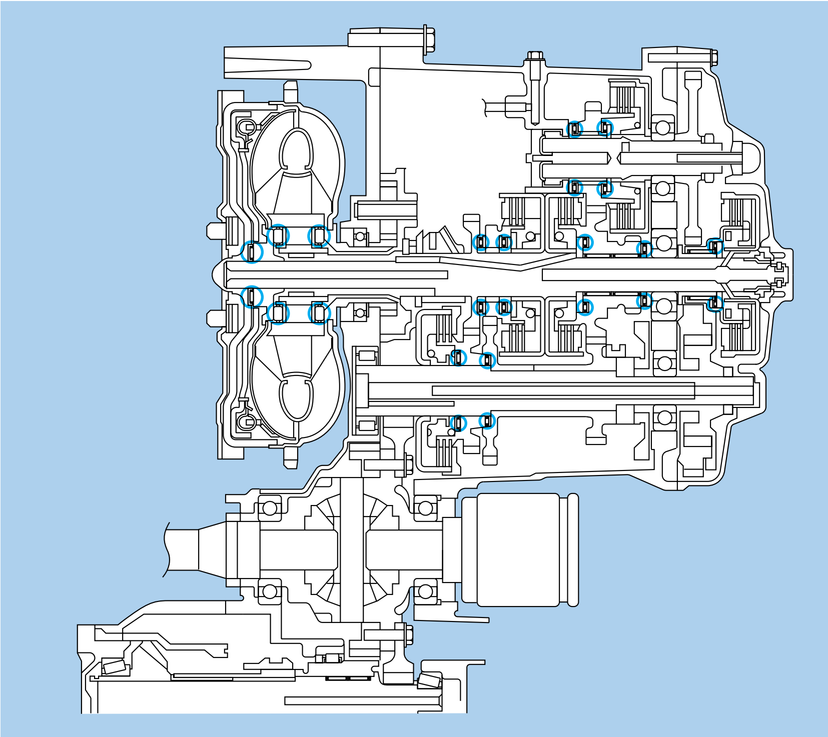
■ Applications

These bearings are used in automotive transmissions and air conditioner compressors.

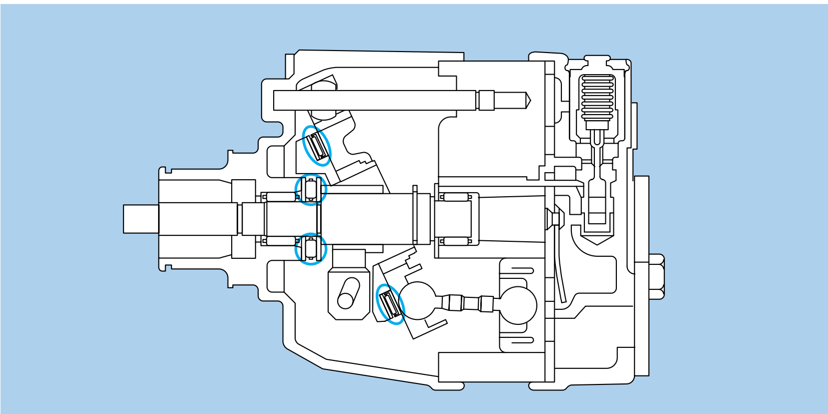
9



Structure



Application example 1: Automatic transmission (Front-mounted engine, front-wheel drive models)



Application example 2: Car air conditioner compressor

Thrust cylindrical roller and cage assemblies (JW) of pressed steel plate

The cage assembly made of pressed steel plate makes for an economical thrust cylindrical roller and cage assembly.

Conventionally, the cage assembly of thrust cylindrical rollers is made of machined aluminum. However, the mass productivity of machined cage assemblies is inferior and their cost is high.

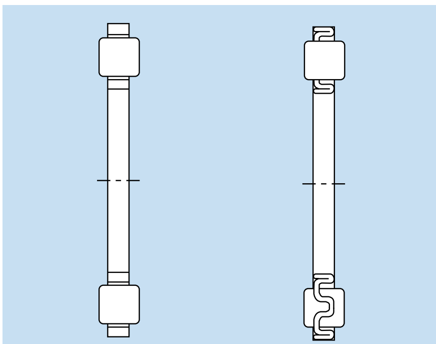
As a result, integrated cage assemblies made of pressed steel plate have been found to provide satisfactory results for the thrust needle rollers of cylindrical roller thrust bearings.

Previously, it was considered difficult to create the pocket shape for W Series cylindrical rollers because of the low ratio of roller length to roller diameter. Now, however, we have succeeded in producing the appropriate shape so that these rollers can be employed in cylindrical roller bearings.

9

■ Features

1) Because steel plate is used for the cage assembly and the rollers are manufactured by press forming, mass productivity is excellent.
2) The use of steel plate for these rollers allows for a variety of heat treatments and surface treatments.
3) Because it is possible to narrow the width of the pillar as well as the distance between the bore diameter/outside diameter and pocket end, the rated capacity of a given size can be increased by increasing the roller length and the number of rollers.



Conventional product (Machined cage assembly of aluminum)   JW type (Cage assembly of pressed steel plate)

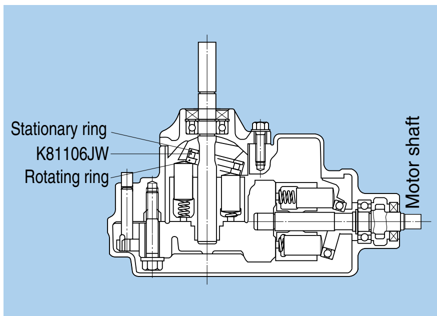
■ Name

K811・・JW
K812・・JW
Cage assembly of steel plate (Series JW)

■ Dimensions

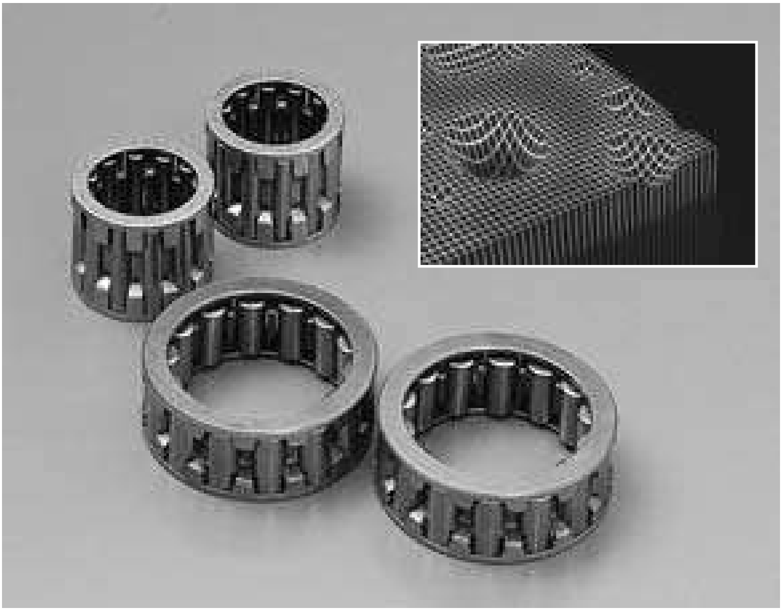
Bearing series	Bore diameter D_{cl} E11	Outside diameter D_c c12	Roller diameter D_W $^{0}_{-0.010}$	Basic rating load C_a N	{kgf}	C_{oa} N	{kgf}
K81100JW	10	24	3.5	11 000	{1 120}	21 500	{2 190}
K81101JW	12	26	3.5	11 600	{1 180}	23 900	{2 430}
K81102JW	15	28	3.5	12 900	{1 320}	28 600	{2 920}
K81103JW	17	30	3.5	13 500	{1 370}	31 000	{3 150}
K81104JW	20	35	4.5	20 300	{2 070}	46 500	{4 700}
K81105JW	25	42	5	27 500	{2 800}	68 000	{6 900}
K81106JW	30	47	5	28 000	{2 860}	72 500	{7 400}
K81107JW	35	52	5	31 000	{3 200}	87 000	{8 900}
K81108JW	40	60	6	43 000	{4 400}	121 000	{12 400}
K81109JW	45	65	6	45 500	{4 650}	135 000	{13 800}
K81110JW	50	70	6	48 500	{4 900}	150 000	{15 300}
K81111JW	55	78	6	64 500	{6 600}	225 000	{22 900}
K81112JW	60	85	7.5	71 500	{7 300}	225 000	{23 000}
K81113JW	65	90	7.5	75 500	{7 700}	247 000	{25 200}
K81114JW	70	95	7.5	79 000	{8 050}	268 000	{27 300}
K81115JW	75	100	7.5	80 500	{8 200}	279 000	{27 400}
K81116JW	80	105	7.5	81 500	{8 350}	290 000	{29 500}
K81117JW	85	110	7.5	85 000	{8 700}	310 000	{31 500}
K81118JW	90	120	9	118 000	{12 000}	430 000	{43 500}
K81206JW	30	52	7.5	53 500	{5 450}	129 000	{13 100}
K81207JW	35	62	7.5	57 500	{5 850}	150 000	{15 300}
K81208JW	40	68	9	74 500	{7 600}	190 000	{19 400}
K81209JW	45	73	9	82 000	{8 400}	222 000	{22 600}
K81210JW	50	78	9	85 000	{8 650}	238 000	{24 200}
K81211JW	55	90	11	121 000	{12 400}	340 000	{34 500}
K81212JW	60	95	11	126 000	{12 800}	365 000	{37 000}
K81213JW	65	100	11	130 000	{13 300}	385 000	{39 500}
K81214JW	70	105	11	134 000	{13 700}	410 000	{42 000}
K81215JW	75	110	11	139 000	{14 100}	435 000	{44 500}
K81216JW	80	115	11	143 000	{14 500}	460 000	{47 000}

Application: Riding mower



Bearing assembly structure

HL roller bearings



■ Features

If the shaft or housing is used as the raceway surface of a needle roller bearing, in place of an inner ring or outer ring, the bearing will tend to have a short operating life because of a lack of lubricant film caused by the difference in surface roughness between the rollers and mating components (mainly the shaft).

NTN has developed a surface processing method through which a sufficiently thick oil film is maintained under these operating conditions. This method changes the orientation of the surface roughness according to the Micro EHL Theory.

These bearings are called HL (High Lubrication) roller bearings.

A HL surface has no orientation because, as shown in **Fig. 1**, the surface has a large number of minute dimples of more than 10 μm to provide a roughness wave form in the axial and circumference directions. The depth of the dimples is approximately 1 μm.

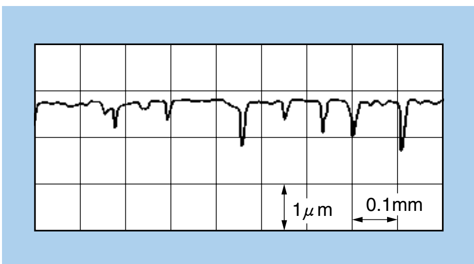


Fig. 1 Roughness of HL surface

9

To confirm the capacity of a HL surface to form an oil film, we compared the oil-film formation capacity of the HL surface with that of a super-finish surface with the 2-cylinder test unit. **Fig. 2** shows the results, which confirm that the HL surface has a greater oil-film formation capacity.

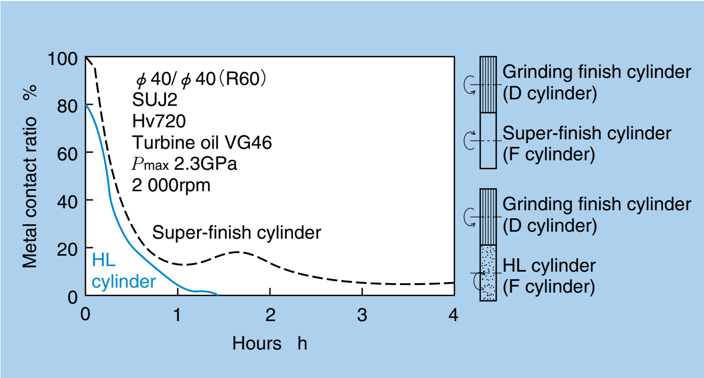


Fig. 2 Metal contact ratio of HL surface

■ Application

The superior oil-film formation capacity enables these roller bearings to achieve optimal performance under severe lubricating conditions, as shown below. Moreover, protection against peeling and an extended service life can be expected. The HL surface can also be applied effectively to bearing rings other than roller bearings.

- Travel speed reducers for construction machinery
- Various types of transmissions
- Engine roller rocker arm
- Hydraulic pumps

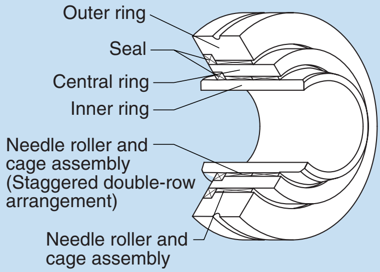
Triple raceway bearings

These needle roller bearings contribute to high-quality printing and easier maintenance.

■ Features

These needle roller bearings boast high-accuracy rotation and dimensions. The adoption of the needle roller bearing design ensures a bearing section with a simple structure and compact design. Assembly and adjustment are simplified and stable, long-term rotation is assured.

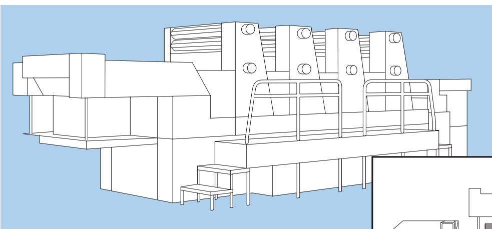
■ Structure



9

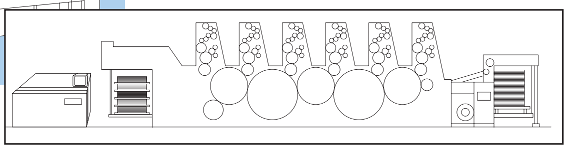
■Applications

- Offset sheet printing machine
  Blanket cylinder (with rubber trunk)
- Maximum speed: 15,000 sheets/hour



▲4-color machine

▼6-color machine



PK Series needle roller and cage assemblies for general production machinery

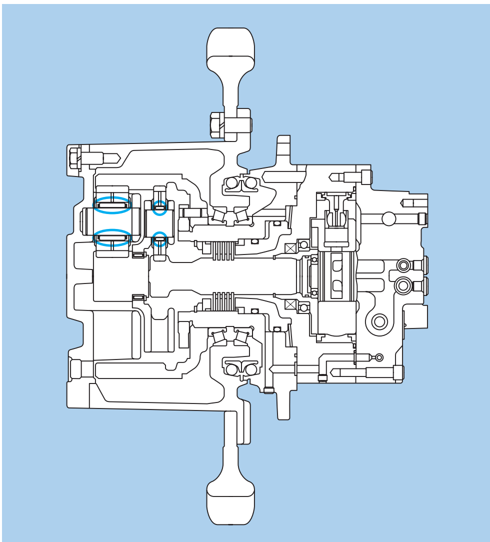
■ Features

The cage assembly features an outside diameter guide structure, which has the same structure and rigidity as the cage assembly for the connecting rod. It is designed for a high loading capacity within the limits of the available space. The cage assembly is of carburized steel, and appropriate heat treatment ensures sufficient strength.

■ Applications

These bearings are widely used in construction machinery, agricultural machinery, hydraulic equipment and the steel industry.

Often, numerous needle roller bearings are used in the planetary gear speed-reduction mechanism for construction machinery. In particular, PK Series roller and cage assemblies are in wide use.



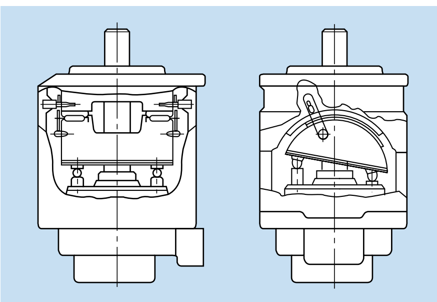
Application: Planetary gear speed reduction mechanism for construction machinery

Cradle bearings

In recent years, the use of an arc-shaped rolling bearing behind the swash plate, instead of the conventional trunnion system and sliding contact system, has been considered for the variable mechanism of the variable capacity plunger pump motor. Application of this system allows the bearing to carry larger loads in a smaller space. It also solves the problem of friction on the sliding surfaces of the sliding system. In addition, the reduction of oscillating resistance improves response.

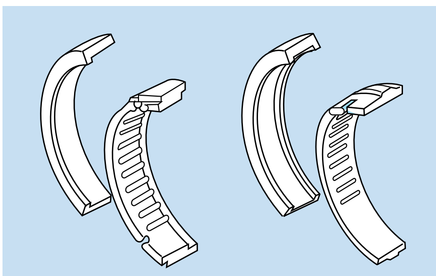
9

■ Application



■ Types

The needle roller and cage assembly of these bearings is split (usually into 3 parts) along its circumference. Many bearings have a split outer ring. The single-rib type and double-rib type are shown in the figure.

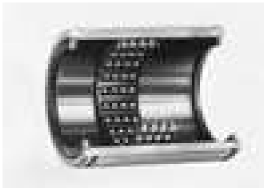


Bearings for linear motion (KLM, KD, KH)

KLM | **KD** | **KH**








■ Features

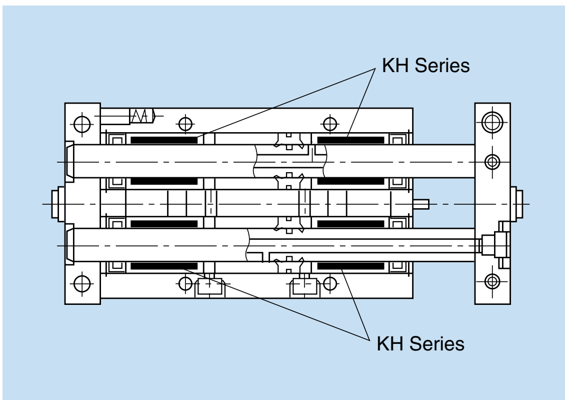
These rolling bearings use steel balls and exhibit excellent friction and motion characteristics compared to sliding bearings. With their easy handling and compact size, they are widely used in applications where stroke movement is required.

With the standard KLM and KH Series, the row of balls rotates to provide unlimited linear motion along the shaft. The outer ring of the KH Series is the drawn-cup type and offers a smaller cross-section. This series is more economical than the KLM Series.

With the KD Series, the equally distributed ball rows in the axial direction reciprocate in limited linear motion along the shaft without rotating.

■ Application

These bearings are used for sliding parts of office appliances or construction machinery. Bearings can be selected according to their specifications (shaft diameter and stroke length).



Application: Work transferring slide unit

10. Nominal number

A nominal number of a bearing expresses the type, dimensions, accuracy and internal structure of the bearing and is composed of the basic number and supplemental code.

Table 10.1 shows the nominal number composition. **Table 10.2** also shows the arrangement order of nominal numbers.

Table 10.1-1 Nominal number composition (Prefix supplemental code, basic number)

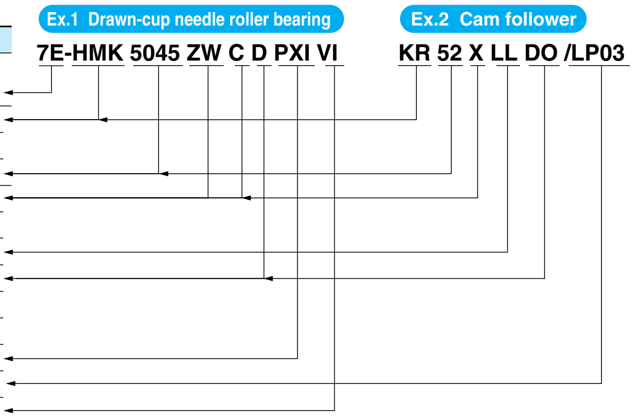
Prefix supplemental code Special application, material, heat treatment	Basic number			
	Bearing name	Series code	Dimension code or dimension group code+inner diameter number	
E-Bearings using carbonized steel	Needle roller and cage assemblies bearing	K, KJ, KMJ, PCJ, PK, KBK	F_w×E_w×B_c (Bore diameter×Outside diameter×Width)	
F-Bearings using stainless steel	Drawn-cup needle roller bearing	HK, HMK, BK	F_w • C (Bore diameter / Width)	
		DCL	F_w" • C" (Inch series: Bore diameter / Width)	
C-Bearings using carbon steel M-Bearings with plating process	Machined-ring needle roller bearing	RNA, NA	49, 48, 59, 69	5~9 (Inner diameter: ϕ5~9) 00~03 (Inner diameter: ϕ10, 12, 15, 17) / 22, 28, 32 (Inner diameter: ϕ22, 28, 32) 04~88 (Inner diameter: ϕ20~440)
HL-Bearings using HL rollers refer to pg. 62		NK (+IR), RNAO, NAO	F_w / C (Bore diameter / Width) F_w (or d)×D×C (Bore diameter or Inner diameter×Outer diameter×Width)	
		MR (+MI)	F_w" • D" • C" (Inch series: Bore diameter / Outer diameter / Width)	
8Q-Bearings with cage assemblies treated by soft-nitriding	Thrust roller bearing	AXK, AS, WS8, GS8, K8, 8	11 11, 12, 93 11, 12, 93	00~03 (Inner diameter: ϕ10, 12, 15, 17) 04~32 (Inner diameter: ϕ20~160)
TS2-Bearings for high temperature up to 160˚C treated by the dimension stabilization.	Compound bearing	NKX (+IR) NKXR (+IR)	F_w (Bore diameter)	
		NKIA NKIB	59	02, 03, /22 (Inner diameter: ϕ15, 17, 22) 04~14 (Inner diameter: ϕ20~70)
		AXN, ARN	d • D (Inner diameter / Outer diameter)	
TS3-Bearings for high temperature up to 200˚C treated by the dimension stabilization.	Roller follower	RNA, NA	22	/ 6, 8 (Inner diameter: ϕ6, 8) 00~03 (Inner diameter: ϕ10, 12, 15, 17) 04~10 (Inner diameter: ϕ20~50)
TS4-Bearings for high temperature up to 250˚C treated by the dimension stabilization.		NATR, NATV	d • D (Inner diameter / Outer diameter)	
		NACV	d" • D" (Inch series: Inner diameter / Outer diameter)	
		NUTR	2, 3	02~03 (Inner diameter: ϕ15, 17) 04~10 (Inner diameter: ϕ20~50)
	Cam follower	KR, KRV, KRU, KRVU, NUKR	D (Outer diameter)	
		CRV	D" Inch series: (Inner diameter / Outer diameter)	
	Components	IR MI A, F WR, BR G, GD	d×F×B (Inner diameter×Raceway diameter×Width) d" • F" • B" (Inch series: Inner diameter×Raceway diameter×Width) D_w×L_w (Diameter×Length) d_1 (Shaft diameter or Hole diameter) d×D×b (Inner diameter×Outer diameter×Width)	
	Bearing for linear motion	KLM KH KD RLM FF RF, BF	F_w (Bore diameter) F_w • C (Bore diameter / Width) F_w • D • C (Bore diameter / Outer diameter / Width) H×L (Height x Length) D_w • b (or B) (Diameter×10 / Width) D_w • b / L_1 (Diameter×10 / Width/Length)	
	One-way clutches	HF NHF, NCU	F_w • C (Bore diameter / Width) F_w (Bore diameter)	

Table 10.1-2 Nominal number composition (Suffix supplemental code)

Suffix supplemental code								
Internal change code	Cage assemblies code	Seal, shield code	Raceway shape code	Combination code	Internal clearance code	Accuracy code	Lubricant code	Special code
ZW: Double-row cage assemblies A, B, C: Internal structure change R: Outer ring with double ribs X: Outer ring outside surface of the cam follower and roller follower is cylindrical.	L1: High strength brass machined cage F1: Carbon steel machined cage J, JW: Steel plate pressed cage T2: Plastic mold cage L3: Aluminum alloy cage S: Welded cage	L: With the synthetic rubber seal on one side (contact type) LL: With the synthetic rubber seals on both sides (contact type)	N: Locating snap ring with groove NR: With the locating snap ring D: With lubrication holes DO: Without lubrication holes and oil groove H: Cam follower with the hexagonal hole S: Clearance adjusting type	D2, Dn: Combination of same bearings more than two pieces $+\alpha$: With the spacer (α is expressed by the width dimension of spacer.)	C2: Narrower than the usual clearance (CN) Usual clearance C3: Wider than the usual clearance C4: Wider than the C3 clearance	P6: JIS Class 6 P5: JIS Class 5 P4: JIS Class 4 PX1 to PXn: Special dimension tolerance	/2A: Albania 2 /3A: Albania 3 /8A: Albania EP2 /5K: Martenp SRL /LP03: Heat hardening type grease (solid grease)	V1 to Vn: Special specifications, requirements

Table 10.2 Arrangement of nominal numbers

Arrangement of nominal numbers	
Suffix supplemental code	Special application code Material, Heat treatment
Basic number	Series code
	Dimension group code inner diameter number
	Dimension code
Suffix supplemental code	Internal change code
	Cage assemblies code
	Seal, shield code
	Raceway shape code
	Combination code
	Internal clearance code
	Accuracy code
	Lubricant code
	Special code



Remarks:
1. Contact **NTN** about the basic number, prefix or suffix supplemental codes other than the list.
2. Soft nitriding treatment is the standard specification for the welded cage assemblies and the prefix supplemental code (8Q-) should be omitted.
3. If the prelubricated grease is standardized per the bearing type and product type, the grease code should be omitted.
4. If the special code (Vn) is used, Vn includes the material, heat treatment and lubrication code, but the internal change code such as prefix supplemental code HL- and ABC, S (welded cage assemblies), seals, locating snap rings, H (with hexagonal hole) combination codes and precision codes are not included in Vn but described.

Comparison of Bearing Series by Manufacturer ●Needle roller and cage assemblies/Machined-ring needle roller bearings

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Needle roller and cage assemblies	mm	**K**	K	FWJ	FWJ	KT	R,RS		B	K	
		K··ZW	K··ZW		FDJ	FTW	WR,WRS		BB	K··ZW	
		KMJ		FWJ	FWJ	KT	R,RS,V,VS		B		
		RK	KZK		FWF	KT··EG	VS,VS··P			KZK	
		KBK	KBK		FBN	KTV··EG	R··P,UR··P			KBK	
	inch	**PCJ**	C	WJ	WJ						
Machined-ring needle roller bearings	mm	**NK**	NK							NK	
		NK+IR	NKI							NKI	
		NK··R	NK		(RLM)	TAF	NQ	TAF	NB	NK	
		NK··R+IR	NKI			TAFI	NQI	TAFI	NBI	NKI	
		RNA49									
		NA49									
		RNA··R	RNA49		RNA49	RNA49	RNA49	RNA49	RNA49	RNA49	
		NA49··R	NA49		NA49	NA49	NA49	NA49	NA49	NA49	
		RNA49··L,LL	RNA49··RS,2RS			RNA49··U,UU	RNA49··UU	RNA49··U,UU		RNA49··RS,2RS	
		NA49··L,LL	NA49··RS,2RS			NA49··U,UU	NA49··UU	NA49··U,UU		NA49··RS,2RS	
		RNA59			RNA59		RNA59				
		NA59			NA59		NA59				
		RNA69	RNA69		RNA69	RNA69	RNA69			RNA69	
		NA69	NA69		NA69	NA69	NA69			NA69	
					RNA69··U,UU						
					NA69··U,UU						
		RNA48	RNA48		RNA48	RNA48				RNA48	
		NA48	NA48		NA48	NA48				NA48	
		RNAO	RNAO		RNAF	RNAF				RNAO	
		NAO	NAO		NAF	NAF				NAO	
		RNAO··ZW	RNAO		RNAFW	RNAFW				RNAO	
		NAO··ZW	NAO		NAFW	NAFW				NAO	
		NKS	NKS				NQS			NKS	
		NKS+IR	NKIS				NQIS			NKIS	
		RNA49··S	RNA49··S								
		NA49··S	NA49··S								
		RPNA··R	RPNA							RPNA	
		PNA··R	PNA							PPNA	
		IR	IR			IRT	IRM			LNA	
	inch	**MR**	NCS	HJ	HJ	BR					MR
		MR+MI	NCS+PI	HJ+IR	HJ+IR	BRI					MR+MI
		MI	PI	IR	IR	IRB	IR				MI

Comparison of Bearing Series by Manufacturer ●Drawn-cup needle roller bearings

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Drawn-cup needle roller bearings	mm	HK	HK	FJ	FJ	TLA··Z	BTM		DB	HK	
		HK..ZWD	HK			TLA··Z					
		HK..L,LL	HK..RS,2RS	FJT,FJTT	FJT,FJTT	TLA··UU			DB··E	HK··RS,2RS	
		HMK			FJL	TA··Z	BHTM				
		HMK..ZWD				TA··Z					
		HMK..L,LL			FJLT,FJLTT	TA··U,UU					
		BK	BK	MFJ	MFJ	TLAM	MKM		DBF	BK	
		BK..ZWD	BK			TLAM					
		BK..L	BK..RS	MFJT	MFJT	TLAM··U				BK··RS	
		BMK			MFJL	TAM	MHKM				
		BMK..ZWD				TAM					
		BMK..L			MFJLT						
		HV		F	F		BM		(DL)		
		HMV					BHM				
		BV			MF		MM		(DLF)		
				FY		YTL	YM				
						YT	YM				
	inch	DCL	SCE	J	J	BA··Z	BT				
		DCL..L,LL	SCE..P,PP	JT,JTT	JT,JTT						
		DCH	SCH	JH	JH	BHA··Z	BHT				
		DCH..L,LL	SCE..P,PP	JHT,JHTT	JHT,JHTT						
		DBL	BCE	MJ	MJ	BAM	MK				
		DBL..L	BCE..P	MJT							
		DBH	BCH	MJH	MJH	BHAM	MHK				
		DBH..L	BCH..P	MJHT							
		VS	S	B	B		B		JL		
		VSH	SH	BH	BH		BH				
		VB	CS	M	M		M		JLF		
		VBH	CSH	MH	MH		MH				
			SN	Y	Y	YB	Y				
			SNH	YH	YH	YBH					
			CSN								
			CSNH								

Comparison of Bearing Series by Manufacturer ●Thrust roller bearings and thrust bearing rings

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Thrust roller bearings and thrust bearing rings	mm	**AXK11**	AXK	FNTA	FNTA	NTB	TP,TPK			AXK	
		K811	K811			AZK			(ARZ)		
		K812	K812		FNTH	AZK					
		K893	K893		FNTH				(ARZ)		
		K874	K874								
		811	811			AZ					
		812	812		FNTHA	AZ					
		893	893		FNTHA						
		874	874								
		AS11	AS	(FTA)	FTRA	AS	W		(CP)	AS	
		GS	GS		(FTRD··F)	GS			(CP,CPR)	GS	
		WS	WS		(FTRD··F)	WS	WS		(CP,CPR)	WS	
		AXA21	AXK+GS+ZS						PM		
		AXB21	AXK+WS+ZS						PM		
		ARA821	K811+GS+ZS								
		ARB821	K811+WS+ZS						PMH		
		ZS	ZS								
	inch	**NTC**	TC	NTA	NTA				BT		
		CTC		NTH	NTH						
		CTCA		NTHA	NTHA						
		NWA	TWA	TRA	TRA				TW		
		NWB	TWB	TRB	TRB				TW		
		NWC	TWC	TRC	TRC				TW		
		NWD	TWD	TRD	TRD				TW		
		NWE		TRE	TRE						
		NWF		TRF							
		CWS		TRI,TRJ							
		CGS		TRID,TRJD							

Comparison of Bearing Series by Manufacturer ●Compound bearings

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Compound bearings	mm	**NKX**	NKX			NAX				NKX	
		NKX··Z	NKX··Z			NAX··Z				NKX··Z	
		NKX+IR	NKX+IR			NAXI				NKX+IR	
		NKX··Z+IR	NKX··Z+IR			NAXI··Z				NKX··Z+IR	
		NKXR	NKXR			NBX				NKXR	
		NKXR··Z	NKXR··Z			NBX··Z			RAXZ	NKXR··Z	
		NKXR+IR	NKXR+IR			NBXI				NKXR+IR	
		NKXR··Z+IR	NKXR··Z+IR			NBXI··Z				NKXR··Z+IR	
		NKIA59	NKIA59			NATA59				NKIA59	
		NKIB59	NKIB59			NATB59				NKIB59	
		NX··ZNR	NX··Z+IR							NX··Z+WR	
		NX··ZNRD	NX+WR							NX+WR	
		NX··ZNR+IR	NX··Z+WR+IR							NX··Z+WR+IR	
		NX··ZNRD+IR	NX+WR+IR							NX+WR+IR	
		AXN	ZAXN						AXNB		
		ARN	ZARN						ARNB		

Comparison of Bearing Series by Manufacturer ●Cam followers

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Cam followers	mm	**KR**	KR	FRJC	FCJ··R	CF··R	KM··RM	CF··R		KR	MCFR
		KR··LL	KR··PP	FRJSC	FCJS··R	CF··UUR	KM··UURM	CF··UUR			MCFR··S
		KR··X	KR··X		FCJ	CF	KM··M	CF		KR··X	MCFR··X
		KR··XLL	KR··PPX		FCJS	CF··UU	KM··UMU	CF··UU			MCFR··SX
		KR··H				CF··BR					
		KR··LLH				CF··BUUR					
		KR··XH				CF··B					
		KRT									
		KRU									
		KRV	KRV		FCR··R	CF··VR	CM··RM		GC	KRV	MCF
		KRV··LL	KRV··PP		FCRS··R	CF··VUUR	CM··UURM		GC··EE		MCF··S
		KRV··X	KRV··X		FCR	CF··V	CM··M			KRV··X	MCF··X
		KRV··XLL	KRV··PPX		FCRS	CF··VUU	CM··UUM				MCF··SX
		KRV··H				CF··VBR					
		KRV··LLH				CF··VBUUR					
		KRV··XH				CF··VB					
		KRVT									
		KRVU									
		KRE				CFE··R					
		KRE··LL				CFE··UUR					
		KRVE			(FCRE)	CFE··VR					
		KRVE··LL				CFE··VUUR					
		NUKR	NUKR			NUCF··R	DKM··R			NUKR	
		NUKR··X	NUKR··X							NUKR··X	
		NUKR··H									
		NUKR··XH									
		NUKRT									
		NUKRU									
	inch	**CR**	CFC··Y			CR··R					
		CR··LL	CFC··PPY			CR··UUR					
		CR··X	CFC			CR					
		CR··XLL	CFC··PP			CR··UU					
		CRV	CF··Y	CRC	CRC						CCF
		CRV··LL	CF··PPY	CRCS	CRCS						CCF··S
		CRV··X	CF	CR	CR		CR				CF
		CRV··XLL	CF··PP	CRS	CRS		CR··UU				CF··S
		CRV··H									
		CRV··LLH									
		CRV··XH									

Comparison of Bearing Series by Manufacturer ●Roller followers

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	NADELLA	SKF	Mc,GILL
Roller followers	mm	**RNAB2**	RSTO			RNAST··R		RNAST··R		RSTO	
		NAB2	STO			NAST··R		NAST··R		STO	
		RNAB2··X	RSTO··X			RNAST				RSTO··X	
		NAB2··X	STO··X			NAST		NAST		RST··X	
		RNA22··LL	RNA22··2RS							RNA22··2RS	
		NA22··LL	NA22··2RS							NA22··2RS	
		RNA22··XLL	RNA22··2RSX							RNA22··2RSX	
		NA22··XLL	NA22··2RSX							NA22··2RSX	
		NATR	NATR	FYRJC	FYCJ··R	NART··R	CXM··RM	NART··R		NATR	MCYRR
		NATR··LL	NATR··PP	FYRJSC	FYCJS··R	NART··UUR	CXM··UURM	NART··UUR		NATR··PP	MCYRR..S
		NATR··X	NATR··X		FYCJ		CXM··M			NATR··X	MCYRR..X
		NATR··XLL	NATR··PPX		FYCJS	NART··VR	CXM··UUM			NATR··PPX	MCYRR..SX
		NATV	NATV		FYCR··R	NART··VUUR	CYM··RM	NART··VR	FG	NATV	MCYR
		NATV··LL	NATV··PP		FYCRS··R		CYM··UURM	NART··VUUR	FG··EE	NATV··PP	MCYR..S
		NATV··X	NATV··X		FYCR		CYM··M			NATV··X	MCYR..X
		NATV··XLL	NATV··PPX		FYCRS		CYM··UUM			NATV··PPX	MCYR..SX
		NUTR	NUTR			NURT··R	DCZM··R			NUTR	
		NUTR··X	NUTR··X							NUTR··X	
		NUTW									
		NUTW··X									
		NABR				NAST··ZZR	CZM··R	NAST··ZZR		NAST··-2Z	
						NAST··ZZUUR		NAST··ZZUUR			
		NABR··X				NAST··ZZ	CZM	NAST··ZZ		NAST··P-2Z	
						NAST··ZZUU		NAST··ZZUU			
	inch	**NACV**	RF··Y	YCRC	YCRC						CYR
		NACV··LL	RF··PPY	YCRSC	YCRSC						CYR..S
		NACV··X	RF	YCR	YCR						CCYR
		NACV··XLL	RF··PP	YCRS	YCRS						CCYR..S

Comparison of Bearing Series by Manufacturer ●Linear motion bearings/Other items

		NTN	INA	TORRINGTON	NSK	IKO	KOYO	THK	SKF	NADELLA	Mc,GILL
Linear motion bearings	mm	**FF**	FF			FT··N					
		FF··ZW	FF··ZW								
		BF	BF			FT		FT			
		RF									
		KD	RLF			ST		ST			
		KD··LL				ST··UU	STUU				
		KH	KH								
		KLM	KB		LB	LM··N		LM			
		KLM··LL				LM··NUU		LM··UU			
		KLM··S				LM··NAJ		LM··AJ			
		KLM··SLL				LM··NUUAJ					
		KLM··P				LM··NOP		LM··-OP			
		KLM··PLL				LM··NUUOP					
		RLM	RUS			(SR,GSN)		LRU	PNC··EE		
Other items	mm	**HF**	HF	FC	FC						
		HFL	HFL	FCB	FCB						
		WR	WR			WR			JA		
		BR	BR			AR			JB		
		G	G		VC	OS	HM,HMS,MH,MHS		ET	G	
		GD	SD		KC	DS	HMSA,MHSA			UL	
		FRIS	UWL,UW21		NFB	M··ZZ,MB··ZZ					
		FR	RUW21								
		JPU..S	BSR								
		JPU··S+JF··S	BSRF								
	inch	**HFZ**	HFZ	RC	RC						
		GSC									

11

NAME

ADDRESS PHONE

OFFICE PHONE

NTN®

ROLLING BEARINGS HANDBOOK

CAT. No. 9012-Ⅱ／E

NTN

Rolling Bearings Handbook

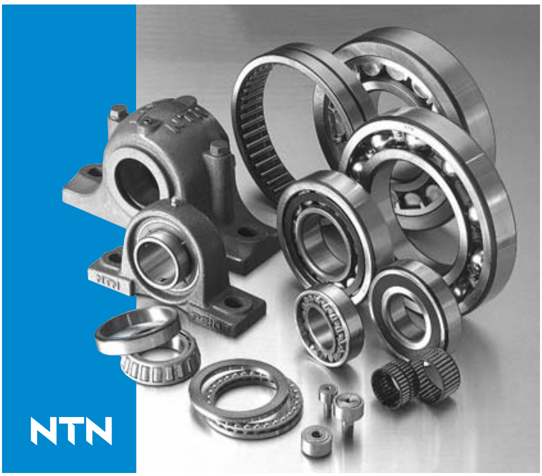
Introduction

When moving an object, friction force often comes into play, and must be surpassed to move the object. Various types of bearings are used to lessen this friction force for moving mechanisms such as machines.

The bearing gets its name from the fact that it bears a turning axle or shaft, but those parts used for sliding surfaces are also called bearings. Bearings include rolling bearings, which use balls, or rollers called "rolling elements."

The history of rolling bearings goes back a long time, but there has been striking technological progress in recent years. Such technological innovations have become an extremely important factor for various types of machines and equipment.

This Rolling Bearing Handbook provides a description of the fundamentals and proper use of rolling bearings in easy-to-understand terms. We hope you find this information helpful.



Contents

1. Rolling Bearings

1.1 Sliding Friction and Rolling Friction

As shown in **Fig. 1.1**, the amount of force it takes to move an object of the same weight varies largely between the cases where the object is laid directly on the ground and pulled, and where the object is laid on rollers and pulled. This is because the coefficient of friction (μ) varies largely for these two cases.

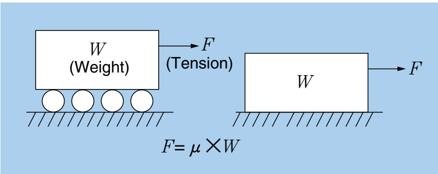
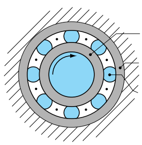
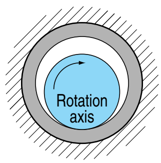


Fig. 1.1 Comparison of Friction Force

The force it takes to bring the object to the verge of moving can be calculated as $F = \mu \times W$, but the value of the coefficient of friction μ of a rolling bearing is a minute value of less than 1/100 that of a sliding bearing. The coefficient of friction of a rolling bearing is generally μ = 0.001 to 0.005.

1.2 Sliding Bearings and Rolling Bearings

There are various forms of each type of bearing, each having its own particular characteristics. If you compare the two, the general characteristics are as follows.

Characteristic	Rolling bearing	Sliding bearing
Construction	Generally has inner and outer rings, in between which there are ball or roller rolling elements which support a rotating load by rolling. 	Rotating load is supported by the surface, and makes direct sliding contact in some cases, or maintains sliding by film thickness using a fluid as a medium. 
Dimensions	Cross-sectional area is large due to intervention of rolling element.	Cross-sectional area is extremely small.
Friction	Friction torque is extremely small during rotation at start-up.	Friction torque is large at start-up, and may be small during rotation, depending on the conditions.
Internal clearance rigidity	Can be used by making internal clearance negative to provide rigidity as a bearing.	Used with clearance. Therefore, moves only the amount of the clearance.
Lubrication	As a rule, lubricant is required. Using grease, etc., facilitates maintenance; is sensitive to dirt.	Some types can be used without lubrication; generally speaking, are comparatively insensitive to dirt. Oil lubrication conditions require attention.
Temperature	Can be used from high to low temperatures. Cooling effect can be expected, depending on lubricant.	Generally speaking, there are high and low temperature limits.

Dimensions of rolling bearings have been internationally standardized.
The bearings are widely used because they are interchangeable, easy to get, and inexpensive.

2. Classification and Characteristics of Rolling Bearings

2.1 Rolling Bearing Construction

Rolling bearings basically consist of four parts (outer ring, inner ring, rolling elements, cage). The shapes of parts of typical bearings are shown in **Fig. 2.1**.

- **Rolling bearing rings (inner and outer rings) or bearing washer ❶)**

The surface on which the rolling elements roll is referred to as the "raceway surface." The load placed on the bearings is supported by this contact surface. Generally speaking, the inner ring is used fitted on the shaft and the outer ring on the housing.

❶ In the new JIS (Japanese Industrial Standards), rolling bearing rings of thrust bearings are referred to as "rolling bearing washers," the inner ring as "shaft washer," and the outer ring as "housing washer."

- **Rolling elements**

Rolling elements come in two general shapes: balls or rollers. Rollers come in four basic styles: cylindrical, needle, tapers and spherical. Rolling elements function to support the load while rolling on the bearing ring.

- **Cages**

Along with keeping the rolling elements in the correct position at a uniform pitch, cages also function to prevent the rolling elements from falling out. Cages include pressed cages pressed out of metal plating, precut machined cages, and resin formed cages.

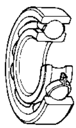
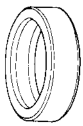
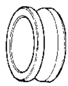
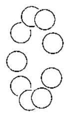
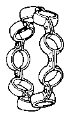
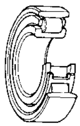
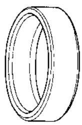
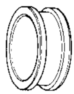
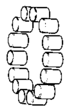
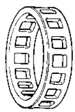
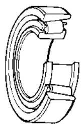
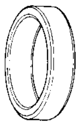
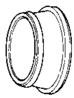
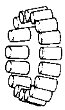
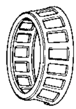
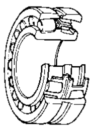
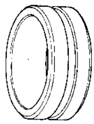
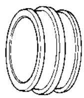
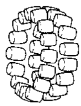
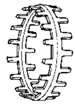
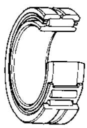
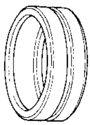
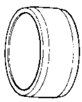
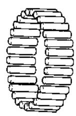
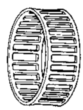
Bearing type	Finished part	Part			
		Outer ring	Inner ring	Rolling elements	Cage
Deep groove ball bearing					
Cylindrical roller bearing					
Tapered roller bearing					
Self-aligning roller bearing					
Needle roller bearing					

Fig. 2.1 Comparison of Typical Rolling Bearings

2

2.2 Classification of Rolling Bearings

Rolling bearings are generally classified as shown in **Fig. 2.2**. In addition to these, there are bearings of various other shapes.

For more information, see the various **NTN** catalogs. For terminology used for the parts of typical bearings, see **Fig. 2.3**.

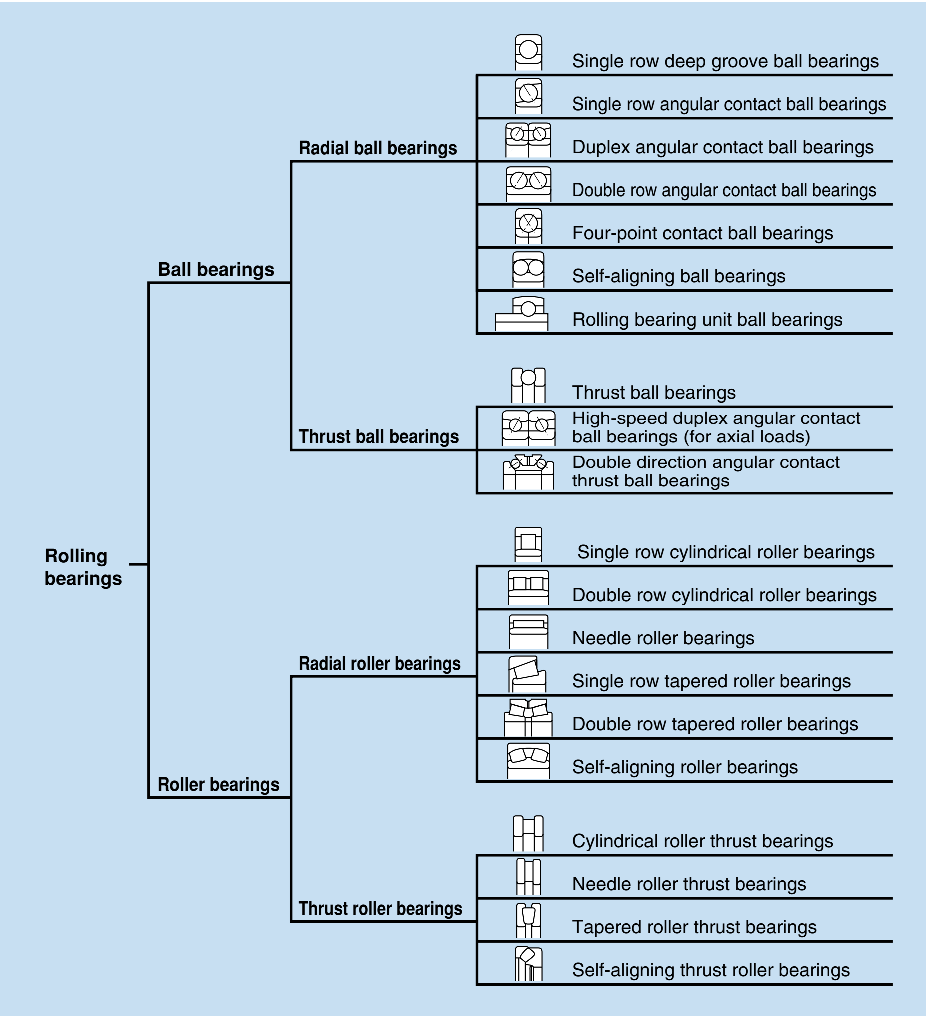


Fig. 2.2 Classification of Roller Bearings

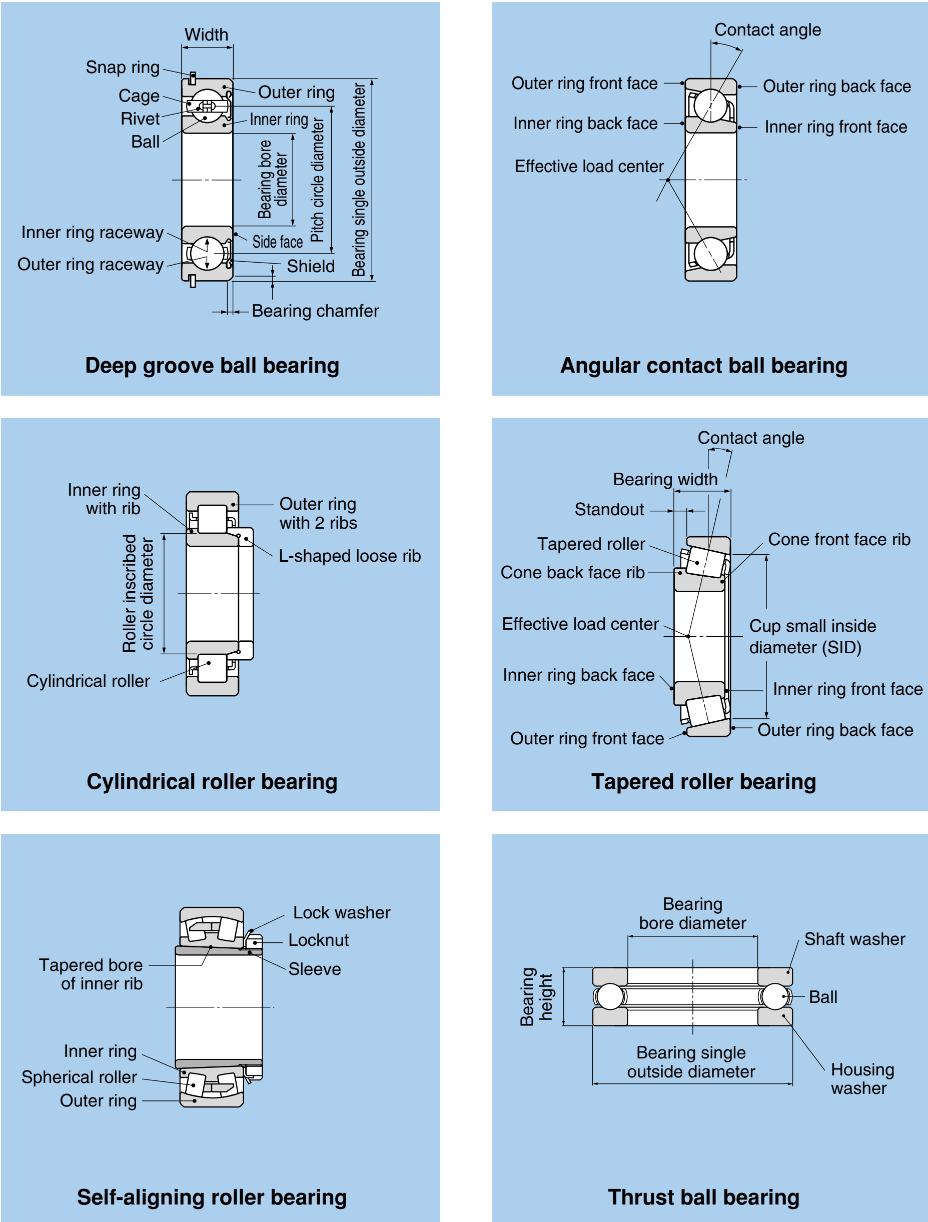


Fig. 2.3 Terminology of Bearing Parts

2.3 Bearing Manufacturing Process

There are many types of bearings, and manufacturing processes with many fine points of difference according to the type of bearing. Generally speaking, bearing manufacturing consists of the processes of forging, turning, heat treatment, grinding, and assembly.

The manufacturing process for deep groove ball bearings is shown below.

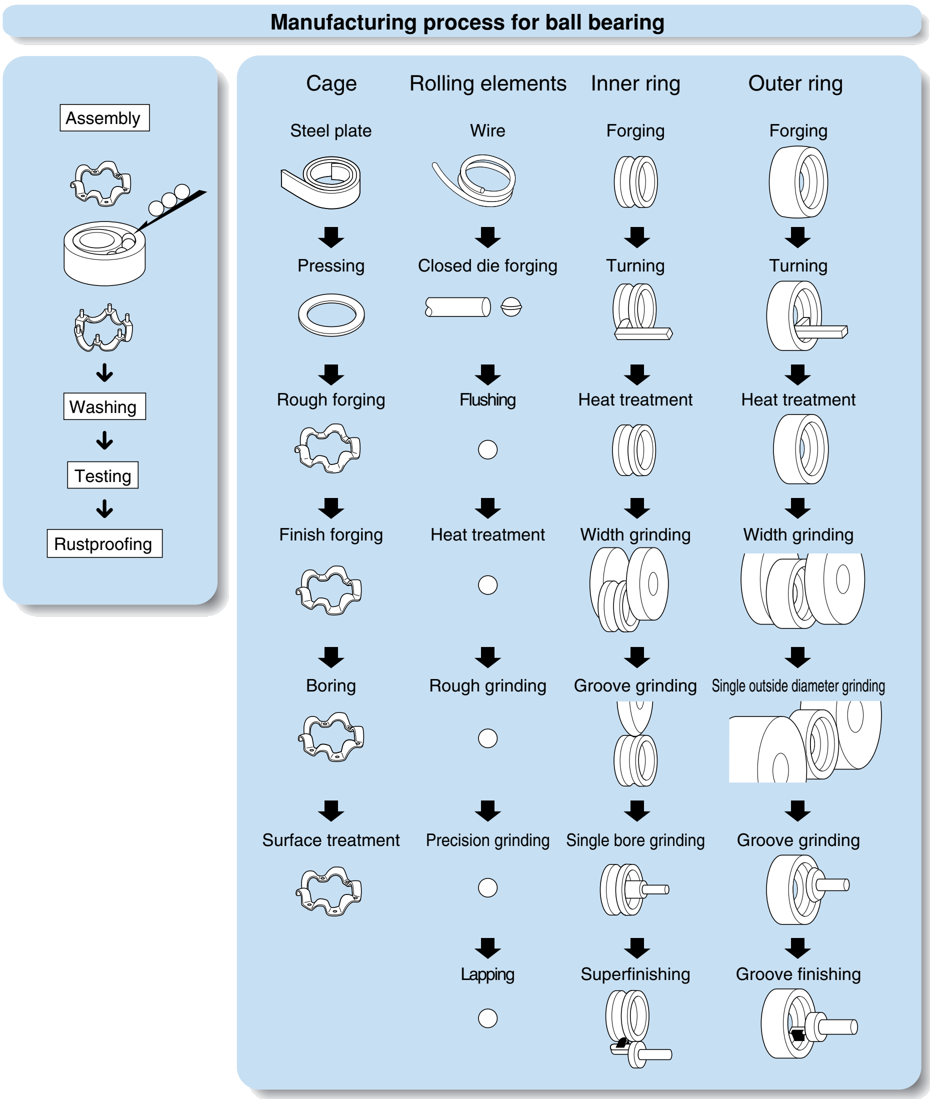
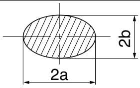
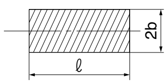


Fig. 2.4 Deep Groove Ball Bearing Manufacturing Process

2.4 Characteristics

● Ball bearings and roller bearings

Table 2.1 Comparison of Ball Bearings and Roller Bearings

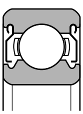
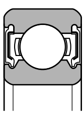
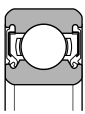
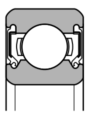
	Ball bearings	Roller bearings
Contact with bearing ring	Point contact Contact surface becomes elliptical when a load is received. 	Line contact Contact surface generally becomes rectangular when a load is received. 
Characteristics	Balls make point contacts, so rolling resistance is slight, thus making it suitable for low torque, high-speed applications. Also has superior sound characteristics.	Because axial contact is made, rotation torque is less than that of balls, and rigidity is high.
Load capacity	Load capacity is small, so loads can be received in both radial and axial directions with radial bearings.	Load capacity is large. With cylindrical roller bearings with ribs, slight axial load can also be received. With tapered roller bearings, a combination of two bearings enables large axial load in both directions to be received.

● Deep Groove Ball Bearings

Widely used in a variety of fields, deep groove ball bearings are the most common type of bearing. Deep groove ball bearings may include seals or shields as shown in **Table 2. 2**.

Deep groove ball bearings also include bearings with snap rings for positioning when mounting the outer ring; expansion adjustment bearings which absorb dimension variation of the bearing fitting surface caused by temperature of the housing; and other various types of bearings such as TAB bearings which can withstand dirt in the lubrication oil.

Table 2.2 Construction and Characteristics of Sealed Ball Bearings

Type and symbol		Shielded type	Sealed type		
		Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Construction					
		● A metal shield is fastened to the outer ring, forming a labyrinth clearance with the V-groove of the inner ring seal surface.	● A seal plate of synthetic rubber anchored to a steel plate is fastened to the outer ring, and the edge of the seal forms a labyrinth clearance along the V-groove of the inner ring seal surface.	● A seal plate of synthetic rubber anchored to a steel plate is fastened to the outer ring, and the edge of the seal makes contact with the side of the V-groove of the inner ring seal surface.	● Basic construction is the same as the LU type, except the lip of the seal edge is specially designed with a slit to prevent absorption, forming a low-torque seal.
Performance comparison	Friction torque	Small	Small	Somewhat large	Medium
	Dustproof	Good	Better than ZZ type	Best	Better than LLB type
	Waterproof	Poor	Poor	Extremely good	Good
	High speed	Same as open type	Same as open type	Contact seal is limited	Better than LLU type
	Allowable temperature range ❶	-25˚C~120˚C	-25˚C~120˚C	-25˚C~120˚C	-25˚C~120˚C

❶ Allowable temperature range is indicated for standard product.

2

See page B-2 of the "Ball and Roller Bearings" catalog.

Angular Contact Ball Bearin
Single and duplex arrangements 79
High speed single and duplex arrange
Ultra-high speed angular contact ball
Ceramic ball angular contact ball bea
Four-point contact ball bearings QJ2
Double row angular contact ball beari

● Angular Contact Ball Bearings

The straight line that connects the inner ring, ball and outer ring runs at an angle (contact angle) to the radial direction. The angle is basically designed for three types of contact angle.

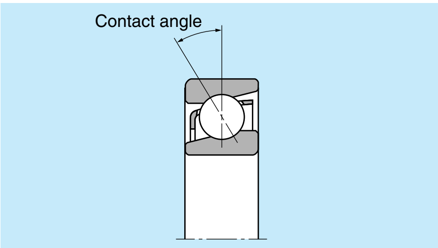
Angular contact ball bearings can bear an axial load. Since they however posses a contact angle, they cannot be used by themselves, but must rather be used in pairs or in combination. There is also a series that reconsiders internal design for high speed.

For more information, see the catalog. ☞

There are double row angular contact ball bearings that contain the inner and outer rings all in one, instead of duplex bearings, and have 30˚C contact angle.

Another bearing is the four-point contact ball bearing which can receive an axial load in both directions. Problems of temperature rise and friction however may occur depending upon load conditions.

Table 2.3 Contact Angle and Symbol



Contact Angle and Contact Angle Symbol

Contact angle	15˚	30˚	40˚
Contact angle symbol	C	A ❶	B

❶ Contact angle symbol A is omitted in nomenclature.

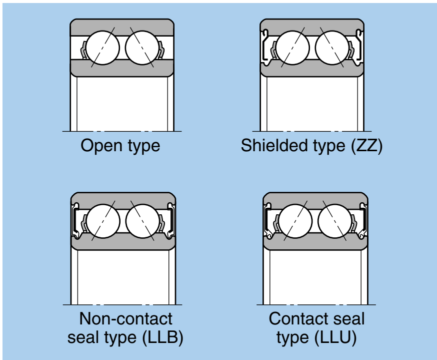
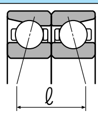
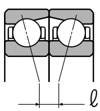
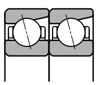


Fig. 2.5 Double Row Angular Contact Bearings

Table 2.4 Combinations Types and Characteristics of Duplex Angular Contact Bearings

Combination		Characteristics
Back-to-back duplex (DB)		● Able to receive radial load and axial load in both directions. ● Distance ℓ between load centers of bearings is large. Load capacity of moment load is consequently also large. ● Allowable inclination angle is small.
Face-to-face duplex bearing (DF)		● Able to receive radial load and axial load in both directions. ● Distance ℓ between load centers of bearings is small. Load capacity of moment load is consequently also small. ● Allowable inclination angle is larger than that of back-to-back duplex.
Tandem duplex bearing (DT)		● Able to receive radial load and axial load in one direction. ● Receives axial load in tandem. Is consequently able to receive a large axial load.

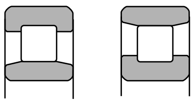
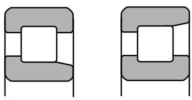
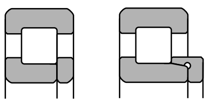
Remarks 1. Bearings are made in sets in order to adjust preload and internal clearance of the bearing, so a combination of bearings having the same product number must be used.

● Cylindrical Roller Bearings

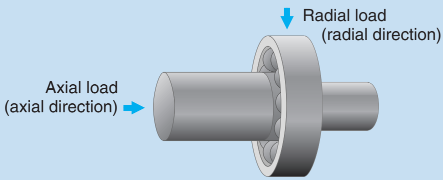
Because cylindrical roller bearings use rollers for rolling elements, load capacity is large, and the rollers are guided by the ribs of the inner and outer rings. The inner and outer rings can be separated to facilitate assembly, and tight fitting is possible for either. Types where either the inner or outer ring does not have a rib move freely in the direction of the shaft and therefore, are ideal for use as so-called "floating-side bearings" that absorb elongation of the shaft. Types with a rib, on the other hand, can receive an axial load, albeit slight, between the roller end face and rib. In order to further enhance axial load capacity, there is the HT type that takes roller end face shape and rib into consideration, and the E-type cylindrical roller bearing with a special internal design for raising radial load capacity. The E-type is standard for small diameter size. Basic shape is given in **Table 2.5**.

Besides these, there are full complement SL bearings without cages and bearings with multiple rows of rollers suitable for even larger loads.

Table 2.5 Types and Characteristics of Cylindrical Roller Bearings

Bearing type symbol	Example	Characteristics
NU type N type	 NU type N type	● The NU type has double ribs on the outer ring, and the outer ring / roller / cage assembly and inner ring can be separated. The N type has double ribs on the inner ring, and the inner ring / roller / cage assembly and outer ring can be separated. ● Cannot receive any axial load whatsoever. ● Most suitable types for floating side bearing; widely used.
NJ type NF type	 NJ type NF type	● The NJ type has double ribs on the outer ring, and a single rib on the inner ring; the NF type has a single rib on the outer ring, and double ribs on the inner ring. ● Able to receive axial load in one direction. ● If fixed and floating sides are not differentiated, they may be used by placing two close together.
NUP type NH type (NJ + HJ)	 NUP type NH type	● The NUP type has a loose rib mounted on the side of inner ring with no rib, and the NH type has an L-type loose rib mounted on the NJ type. The loose ribs can be separated, so the inner ring must be fixed in the axial direction. ● Able to receive an axial load in both directions. ● Sometimes used as a fixed side bearing.

Load Direction and Name



2

● Tapered Roller Bearings

The tapered vertex of the rollers and raceway surface of the outer and inner rings is designed to intersect a point on the centerline of the bearing. The rollers therefore are guided along the raceway surface by being pushed against the inner ring rib by synthetic power received from the outer and inner ring raceway surfaces.

Because component force is produced in the axial direction when a radial load is received, the bearings must be used in pairs. The outer and inner rings with rollers come apart, thus facilitating mounting with clearance and preload. It is however difficult to control the clearance. Tapered roller bearings are capable of receiving both large radial and axial loads.

NTN bearings with 4T-, ET-, T- and U conform to ISO and JIS sub-unit dimensions standards (contact angle, outer ring groove small diameter, outer ring width), and have international compatibility.

NTN offers bearings made of carburizing steel to extend life, such as ETA- and ET- bearings. We also have double row tapered roller bearings that combine two bearings, and heavy-duty four row tapered roller bearings.

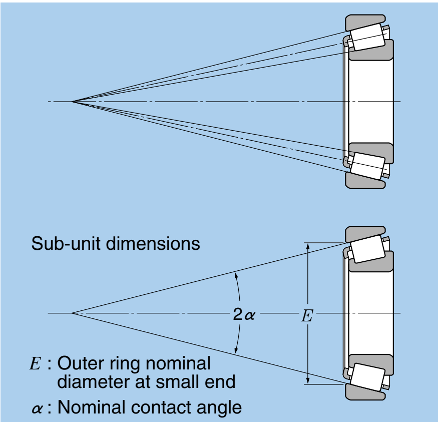


Fig. 2.6 Tapered Roller Bearing

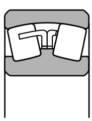
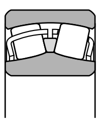
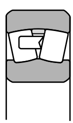
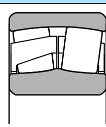
● Self-Aligning Roller Bearings

Having an outer ring with a spherical raceway surface and an inner ring with a double row of barrel-shaped rolling elements, self-aligning roller bearings enable alignment of shaft inclination.

Types of self-aligning roller bearings differ according to internal design.

Some have a tapered inner ring bore to facilitate mounting on the shaft by adapter or withdrawal sleeve. The bearings are capable of receiving large loads and are therefore often used in industrial machinery. Single row rollers however bear no load when axial load becomes great, and are subject to various other problems.

Table 2.6 Types of Self-Aligning Roller Bearings

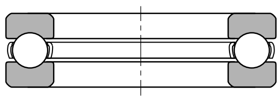
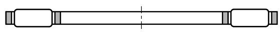
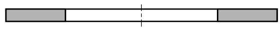
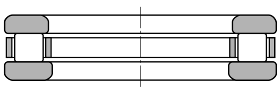
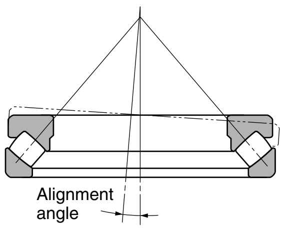
Type	Standard type (B type)	C type	213 type	E type
Construction				
Bearing series	Other than C type	Bore 50 mm or series (222, 223, 213) and 24024 - 24038	Single bore 55 mm or more (213)	22211 - 22218
Roller	Asymmetrical rollers	Symmetrical rollers	Asymmetrical rollers	Symmetrical rollers
Roller guide system	By center rib united with inner ring	By guide ring positioned between rows of rollers	By guide ring between rows of rollers positioned on the outer ring raceway	By high-precision cage (no center rib or guide ring)
Cage type	Pressed cage Machined cage	Pressed cage	Machined cage	Resin formed cage

● Thrust Bearings

There are various types of thrust bearings that differ according to application and shape of rolling elements. Allowable speed is generally low, and lubrication requires attention.

There are various types of thrust bearings for special applications besides those listed below. For more information, see the **NTN** catalogs.

Table 2.7 Types and Characteristics of Thrust Bearings

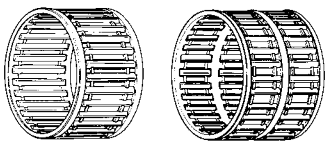
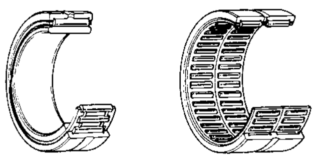
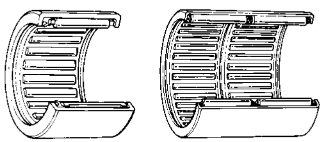
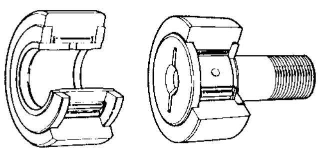
Type	Characteristics
● Single-direction thrust ball bearing 	Has balls retained by a cage between the shaft washer (equivalent of inner ring) and housing washer (equivalent of outer ring), and is capable of receiving an axial load in one direction only.
● Needle roller thrust bearing  AXK type  AS type bearing washer  GS/WS type bearing washer	Some bearing washers use precut bearing washers, and some use bearing washers of pressed steel plate. Pressed bearing washers are used for bearings with the smallest cross-section height and large load capacity.
● Cylindrical roller thrust bearing 	The most common type uses a single row of cylindrical rollers, but some use two or three rows for larger load capacity.
● Self-aligning thrust roller bearing 	The raceway surface of the housing washer (outer ring) has a spherical surface that lines up with the bearing axis, and uses barrel shaped rolling elements to facilitate alignment. Self-aligning thrust roller bearings are capable of bearing large axial loads. The bearings have many sliding surfaces such as roller end faces and cages, and therefore requires lubricating oil even at low speeds.

● Needle Roller Bearings

The needle-shaped rollers used as rolling elements have a diameter of 6 mm or less and length three to ten times the diameter. Because needle rollers are used as rolling elements, cross-section height is slight and load capacity is large for the dimensions. Because the bearing has many rolling elements, rigidity is high, therefore it suitable for rocking motion.

There are many types of needle roller bearings, but here we shall introduce the most typical types only. For details, see the **NTN** catalog.

Table 2.8 Main Types and Characteristics of Needle Roller Bearings

Type	Characteristics
● Needle roller bearing with cage 	Most basic type of bearing, where the needle rollers are retained by the cage. Because the shaft and housing are directly used as the raceway surface, hardness and finish surface roughness require attention. There are various cage materials and shapes available.
● Machined ring needle roller bearing 	The basic shape is a precut outer ring attached to the previously described needle roller bearing with cage, and some are further equipped with an inner ring. In the case of a double rib type outer ring, there are many types where the cage is set in the bore diameter side and the needle rollers are inserted from the bore diameter. Some also come with seals.
● Drawn cup needle roller bearing 	With drawn cup needle roller bearings, the outer ring has a deep drawn steel plate and is press fit into the housing. Precision bore diameter shape of the housing affects the bearing performance as is. Housing precision therefore requires attention. The bearing on the other hand is retained by press fitting only, so it doesn't require snap rings, etc., thus enabling more economic design. This type includes sealed bearings and closed end bearings where one end is closed.
● Yoke type track rollers **● Stud type track rollers** 	Bearing is used for rolling where the outer ring single outside diameter is made to come in direct contact with the counterpart material. There is no need to cover the outer ring with a tire, etc., thus enabling compact design. Wear life however varies according to operating conditions and hardness of counterpart material.

● **Bearing Unit**

The unit that incorporates ball bearings inside housings of various shapes and sizes. The housing is mounted by bolting to the machine, and the shaft is simply attached to the inner ring by lockscrew. This means that rotating equipment can be supported without any sort of special design in the periphery of the bearing. Standardized housing shapes include pillow and flange types. The single outside diameter of the bearing is spherical, as is the bore diameter of the housing, to facilitate alignment.

Lubrication is sealed inside the bearing by grease; the double seal prevents dust from getting inside.

For more information concerning shapes, see the **NTN** catalog.

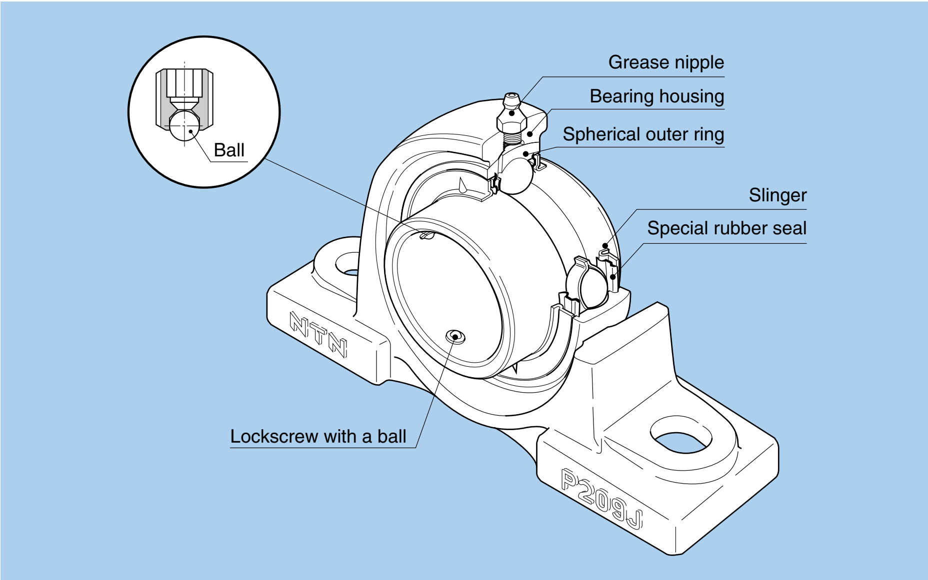


Fig. 2.7 Oiling Type Bearing Unit

3. Bearing Selection

3.1 Selection Procedure

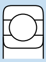
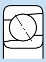
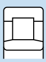
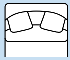
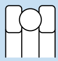
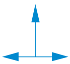
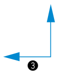
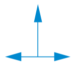
Rolling bearings include many types and sizes. Selecting the best bearing is important for getting the machine or equipment to function in the way it's supposed to. There are various selection procedures, but the most common are shown in the following figure.

Procedure	Check items
Confirm operating conditions and operating environment	● Function and construction of components to house bearings ● Bearing mounting location ● Bearing load (direction and magnitude) ● Rotational speed ● Vibration and shock load ● Bearing temperature (ambient and friction-generated) ● Operating environment (potential for corrosion, degree of contamination, extent of lubrication)
↓ Select bearing type and configuration	● Allowable space of bearing ● Bearing load (magnitude, direction, vibration, presence of shock load) ● Rotational speed ● Bearing precision ● Rigidity ● Allowable misalignment of inner/outer rings ● Friction torque ● Bearing arrangement (floating side, fixed side) ● Installation and disassemble requirements ● Bearing availability and cost
↓ Select bearing dimensions	● Design life of components to house bearings ● Dynamic/static equivalent load conditions and life of bearing ● Safety factor ● Allowable speed ● Allowable axial load ● Allowable space
↓ Select bearing precision	● Shaft runout precision ● Rotational speed ● Torque fluctuation ● Noise level
↓ Select bearing's internal clearance	● Material and shape of shaft and housing ● Fit ● Temperature differential between inner/outer rings ● Allowable misalignment of inner/outer rings ● Load (magnitude, nature) ● Amount of preload ● Rotational speed
↓ Select cage type and material	● Rotational speed ● Noise level ● Vibration and shock load ● Load fluctuation ● Moment load ● Misalignment of inner/outer rings ● Lubrication type and method
↓ Select lubricant, lubrication method, sealing method	● Operating temperature ● Rotational speed ● Lubrication type and method ● Sealing method ● Maintenance and inspection
↓ Select any special bearing specifications	● Operating environment (high/low temperature, vacuum, pharmaceutical, etc.) ● Requirement for high reliability
↓ Confirm handling procedures	● Installation-related dimensions ● Assembly and disassembly procedures

3.2 Types and Performance Comparison

A comparison of the performance of the main rolling bearings is given in the following table.

Table 3.1 Types and Performance of Rolling Bearings

Bearings types / Characteristics	Deep groove ball bearings 	Angular contact ball bearings 	Cylindrical roller bearings 	Needle roller bearings 	Tapered roller bearings 	Self-aligning roller bearings 	Thrust ball bearings 
Load carrying capacity  Radial load / Axial load			 ❸				
High speed rotation ❶	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆	☆☆☆	☆☆	☆
Low noise/vibration ❶	☆☆☆☆	☆☆☆	☆	☆			☆
Low friction torque ❶	☆☆☆☆	☆☆☆	☆				
High rigidity ❶			☆☆	☆☆	☆☆	☆☆☆	
Allowable misalignment for inner/outer rings ❶	☆					☆☆☆	★
Non-separable or separable ❷			○	○	○		○

❶ ☆The number of stars indicates the degree to which that bearing type displays that particular characteristic.
★Not applicable to that bearing type.
❷ ○Indicates both inner ring and outer ring are detachable.
❸ Some cylindrical roller bearings with rib can bear an axial load.

3

3.3 Bearing Arrangement

Shafts are generally supported by two bearings in the radial and axial directions. The side that fixes relative movement of the shaft and housing in the axial direction is called the "fixed side bearing," and the side that allows movement is called the "floating side bearing." The floating side bearing is needed to absorb mounting error and avoid stress caused by expansion and contraction of the shaft due to temperature change. In the case of bearings with detachable inner and outer rings such as cylindrical and needle roller bearings, this is accomplished by the raceway surface. Bearings with non-detachable inner and outer rings, such as deep groove ball bearings and self-aligning roller bearings, are designed so that the fitting surface moves in the axial direction.

If bearing clearance is short, the bearings can be used without differentiating between the fixed and floating sides. In this case, the method of having the bearings face each other, such as with angular contact ball bearings and tapered roller bearings, is frequently used.

Table 3.2 (1) Sample Bearing Arrangement (fixed and floating sides differentiated)

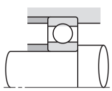
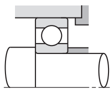
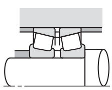
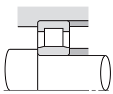
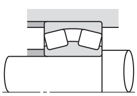
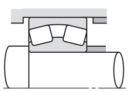
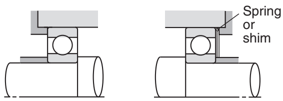
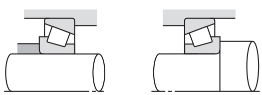
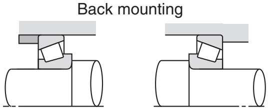
Arrangement		Abstract	Application example (reference)
Fixed side	Floating side		
		1. Typical arrangement for small machinery. 2. Capable of bearing a certain degree of axial load, as well as radial loads.	Small pumps Automobile transmissions
		1. Capable of bearing heavy loads. 2. You can enhance rigidity of shaft system by using back-to-back duplex bearing and applying preload. 3. Required improvement of shaft/housing precision and less mounting error.	General industrial machinery Reduction gears
		1. Frequently used in general industrial machinery for heavy loads and shock loads. 2. Able to tolerate a certain degree of mounting error and shaft flexure. 3. Capable of bearing radial loads and a certain degree of axial load in both directions.	General industrial machinery Reduction gears

Table 3.2 (2) Sample Bearing Arrangement (fixed and floating sides not differentiated)

Arrangement	Abstract	Application example (reference)
	1. Typical usage method for small machinery. 2. Preload sometimes provided by spring or adjusted shim on outer ring side.	Small electrical machinery Small Reduction gears
 Back mounting  Front mounting	1. Able to withstand heavy loads and shock loads, and has a wide range of use. 2. Rigidity can be enhanced by applying preload, but be careful not to apply too much preload. 3. Back mounting is suitable when moment load is produced, and front mounting when there is mounting error. 4. Front mounting facilitates mounting when the inner ring is tight-fitted.	Reduction gears Front and rear axles of automobiles

4. Main Dimensions and Bearing Numbers

4.1 Main Dimensions

As shown in **Figs. 4.1 - 4.3**, main dimensions of rolling bearings include bearing bore diameter, single outside diameter, width/height, and chamfer. These dimensions must be known when mounting on the shaft and housing.

The main dimensions have been standardized by the International Standards Organization (ISO), and the Japanese International Standard (JIS) is used in Japan.

The standard range of dimensions for single bore metric rolling bearings has been established as 0.6 - 2500 mm. For single bore, a code is used to express diameter series and width series, which indicate the size of the bearing cross-section.

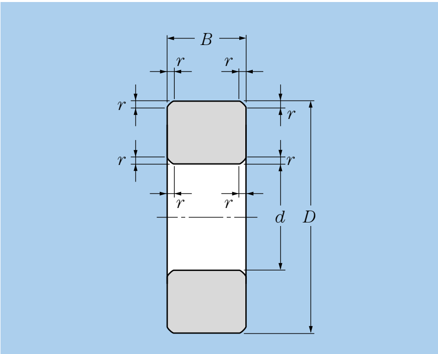


Fig. 4.1 Radial Bearing (tapered roller bearings not included)

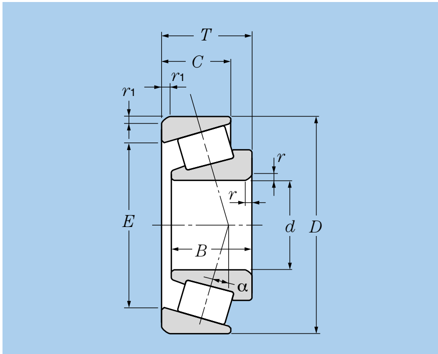


Fig. 4.2 Tapered Roller Bearing

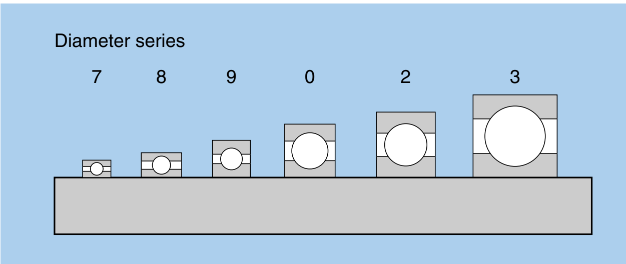


Fig. 4.3 Diameter Series of Radial Bearings

Table 4.1 Dimension Series Code

		Dimension series	
		Diameter series (outer dimension)	Width series (width dimension)
Radial bearing (tapered roller bearings not included)	Code	7. 8. 9. 0. 1. 2. 3. 4	8. 0. 1. 2. 3. 4. 5. 6
	Dimension	Small ←→ Large	Small ←→ Large
Tapered roller bearing	Code	9. 0. 1. 2. 3	0. 1. 2. 3
	Dimension	Small ←→ Large	Small ←→ Large

4

4.2 Bearing Numbers

Bearing numbers indicate the type, dimensions, precision and internal construction of the bearing. Bearing numbers are comprised of a basic number and supplementary code. The arrangement sequence of bearing numbers is as shown in **Table 4.2**.

Special code contents are given in **Table 4.3**.

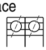
Table 4.2 Configuration and Arrangement Sequence of Bearing Numbers

Prefix supplementary code Special application / material / heat treatment code		Basic number						
		Bearing series			Single bore number		Contact angle code	
		Bearing series code	Dimension series code					
			Width/height series ❶	Diameter series	Code	Single bore mm	Code ❶	Contact angle
4T-	4T tapered roller bearing	Deep groove ball bearings (type code 6)			/0.6	0.6	Angular contact ball bearings	
ET-	ET tapered roller bearing	67	(1)	7	/1.5	1.5		
		68	(1)	8			(A)	Standard contact angle 30°
E-	Bearing using cemented steel	69	(1)	9	/2.5	2.5	B	Standard contact angle 40°
		60	(1)	0				
F-	Bearing using stainless steel	62	(0)	2			C	Standard contact angle 15°
H-	Bearing using high-speed steel	63	(0)	3	1	1		
		Angular contact ball bearing (type code 7)			⋮	⋮	Tapered roller bearings	
		78	(1)	8	9	9	(B)	More than contact angle 10° and 17° or less
M-	Plated bearing	79	(1)	9				
5S-	Bearing using ceramic rolling elements	70	(1)	0				
		72	(0)	2	00	10	C	More than contact angle 17° and 24° or less
		73	(0)	3	01	12		
HL-	Bearing using HL rollers	Cylindrical roller bearings (type code NU, N, NF, NNU, NN, etc.)			02	15	D	More than contact angle 24° and 32° or less
TS2-	High-temperature bearing treated for dimension stabilization (up to 160°C)	NU10	1	0	03	17		
		NU2	(0)	2				
		NU22	2	2				
		NU3	(0)	3	/22	22		
TS3-	High-temperature bearing treated for dimension stabilization (up to 200°C)	NU23	2	3				
		NU4	(0)	4	/28	28		
		NNU49	4	9	/32	32		
		NN30	3	0	⋮	⋮		
TS4-	High-temperature bearing treated for dimension stabilization (up to 250°C)	Tapered roller bearings (type code 3)			04	20		
		329X	2	9	05	25		
		320X	2	0				
		302	0	2	06	30		
		322	2	2				
		303	0	3				
		303D	0	3	88	440		
		313X	1	3	92	460		
		323	2	3				
					96	480		
		Self-aligning roller bearings (type code 2)						
		239	3	9				
		230	3	0	/500	500		
		240	4	0	/530	530		
		231	3	1	/560	560		
		241	4	1				
		222	2	2				
		232	3	2	/2 360	2 360		
		213	1	3				
		223	2	3	/2 500	2 500		

❶ Parentheses not displayed for bearing number.

Table 4.3 Bearing Number Arrangement

	Bearing number arrangement		Example: TS2-7 3 05 B L1 DF+10 C3 P5
Prefix supplementary code	Special application code Material / heat treatment code		TS2-
Basic number	Bearing series	Type code	7
		Dimensions series code: Width/height series code	
		Dimensions series code: Diameter series code	3
	Single bore No.		05
	Contact angle code		B
Suffix supplementary code	Internal modification code		
	Cage code		L1
	Seal/shield code		
	Bearing ring shape code		
	Combination code		DF+10
	Internal clearance code		C3
	Precision code		P5
	Lubrication code		

Suffix supplementary code							
Internal modification code	Cage code	Seal/shield code	Bearing ring shape code	Combination code	Internal clearance/ preload code ❶	Precision code	Lubrication
U Tapered roller bearing with international interchangeability R Tapered roller bearing without international interchangeability ST Tapered roller bearing with low torque specifications HT Cylindrical roller bearing with high axial load specifications	L1 High-strength brass machined cage F1 Carbon steel machined cage G1 High-strength brass rivetless cage with square holes G2 Pin-type cage J Steel plate pressed cage T2 Resin formed cage	LLB With synthetic rubber seal (non-contact type) LLU With synthetic rubber seal (contact type) LLH With synthetic rubber seal (low-torque type) ZZ With steel plate shield	K Standard taper single bore 1/12 taper hole K30 Standard taper single bore 1/30 taper hole N With ring groove NR With snap ring D With oil hole D1 With oil hole/groove	DB  Back-to-back duplex DF  Face-to-face duplex  DT Tandem duplex D2 Set of 2 of same type of bearing G Flush ground $+\alpha$ With spacer ($+\alpha$ indicates basic width dimension of spacer.)	C2 Smaller than normal clearance (CN) Normal clearance C3 Larger than normal clearance C4 Larger than C3 clearance C5 Larger than C4 clearance CM Radial internal clearance for electric motor /GL Light preload /GN Normal preload /GM Medium preload /GH Heavy preload	P6 JIS Class 6 P5 JIS Class 5 P4 JIS Class 4 P2 JIS Class 2 -2 ABMA Class 2 -3 ABMA Class 3 -0 ABMA Class 0 -00 ABMA Class 00	/2A Alvania 2 /3A Alvania 3 /8A Alvania EP2 /5K MULTEMP SRL /LX11 Barierta JFE552 /LP03 Solid grease (for polylube bearing)

Remarks: Contact **NTN** for bearing series codes and prefix/suffix supplementary codes not given in the table.

5. Bearing Precision

5.1 Dimension and Turning Precision

Dimension and turning precision are regulated by ISO and JIS standards.

Dimension precision

- Single bore, single outside diameter, width, assembled bearing width tolerance
- Chamfer dimensions, tapered hole tolerance

Shape precision

- Bore diameter variation, mean bore diameter deviation, outside diameter variation, mean outside diameter variation
- Bearing ring width or height variation (in case of thrust bearing) tolerance

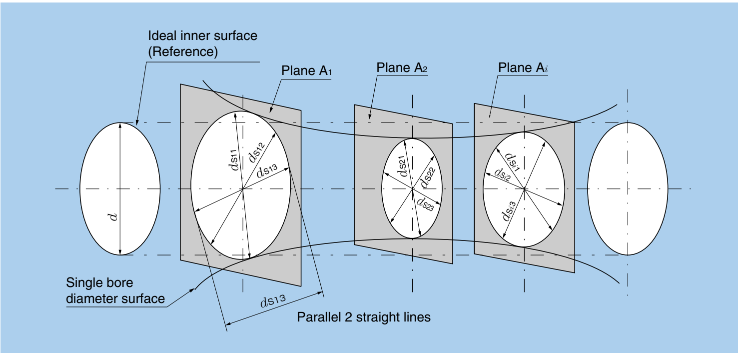
Turning precision

- Inner/outer ring radial and axial runout tolerance
- Inner ring face runout with bore tolerance
- Outer ring variation of outside surface generatrix inclination with face

5

Explanation of JIS Terminology

Because there are ambiguous expressions concerning dimension precision among those given in **Table 5.1**, an explanation of JIS terminology is provided below. (The terminology for outside surface is the same and has therefore been omitted.)



Shape Model Diagram

Nominal bore diameter d:
Reference dimension that expresses the size of a single bore diameter. Reference value for the dimension tolerance of the actual bore diameter surface.

Single bore diameter d_s:
Distance between two parallel straight lines that touch the intersecting line of the actual bearing bore diameter surface and radial plane.

Dimension tolerance of single bore diameter Δd_s:
Difference between d_s and d (difference between a single bore diameter and nominal bore diameter).

Single plane mean bore diameter d_{mp}:
In the arithmetic mean and model of the maximum and minimum values of a single bore diameter inside a single radial plane, concerning any radial plane A$_i$, if d_{si1} is the maximum single bore diameter and d_{si3} in the minimum, you get the value $(d_{si1} + d_{si3})$ /2. Thus there is one value per plane.

With ISO492, ISO 199 (JIS B 1514), precision class is decided; with JIS 0 class (generally called "ordinary class"), precision increases in the order of class 6 → class 5 → class 4 → class 2. **Table 5.1** is a sample precision table for radial bearings.

There are various other standards besides ISO (JIS).

The most frequently requested ones are provided as a reference in the back of this handbook.

Mean bore diameter d_m:

In the model diagram, the arithmetic mean of the maximum and minimum values of a single bore diameters obtained from the entire cylinder surface, concerning the entire surface of planes $A_1A_2 \cdots A_i$, if d_{s11} is the maximum measurement value of the single bore diameter and the minimum value is d_{s23}, then $(d_{s11} + d_{s23})/2$ is the mean bore diameter, and has one value for one cylinder surface.

Dimension tolerance of mean bore diameter Δd_m:

Difference between the mean bore diameter and the nominal bore diameter.

Dimension tolerance of single plane mean bore diameter Δd_{mp}:

Difference between the nominal bore diameter and the arithmetic mean of the maximum and minimum values of a single bore diameter of a single radial plane. Value as prescribed by ISO 492, ISO 199 (JIS B 1514).

Bore diameter variation in a single radial plane V_{dp}:

In the model diagram, difference between the maximum and minimum values of a single bore diameter of a single radial plane. In radial plane A_1, if d_{s11} is the maximum single bore diameter and d_{s13} is the minimum, we can obtain one value for the difference V_{dp} concerning the single plane. This characteristic could be thought of as an index for expressing roundness. Value as prescribed by ISO (JIS).

Mean bore diameter variation V_{dmp}:

Difference between the maximum and minimum values of a single plane mean bore diameter obtained for all planes. A unique value is obtained for each individual product. Expresses a type of cylindricity (differs from geometric cylindricity). Value as prescribed by ISO (JIS).

Nominal inner ring width B:

Theoretical distance between both sides of the bearing ring. In other words, the reference dimension for expressing the width of the bearing ring (distance between both sides).

Single inner ring width B_s:

Distance between the actual sides of the inner ring and both points of intersection of straight lines perpendicular to the plane that touches the reference side of the inner ring. Expresses the actual width dimension of the inner ring.

Dimension tolerance of single inner ring width ΔB_s:

Difference between the single inner ring width and the nominal inner ring width, and the difference between the actual inner ring width dimension and inner ring width. Value as prescribed by ISO (JIS).

Inner ring width variation V_{Bs}:

Difference between the maximum and minimum value of a single inner ring width. Value as prescribed by ISO (JIS).

Table 5.1 Tolerance for radial bearings (except tapered roller bearings)

(1) Inner rings

Nominal bore diameter d mm		Single plane mean bore diameter deviation Δ_{dmp}										Single radial plane bore diameter deviation V_{dp}														
		Class 0		Class 6		Class 5		Class 4[1]		Class 2[1]		Diameter series 9 Class 0,6,5,4,2					Diameter series 0,1 Class 0,6,5,4,2					Diameter series 2,3,4 Class 0,6,5,4,2				
over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	Max					Max					Max				
0.6[4]	2.5	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
2.5	10	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
10	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	0	-10	0	-8	0	-6	0	-5	0	-2.5	13	10	6	5	2.5	10	8	5	4	2.5	8	6	5	4	2.5
30	50	0	-12	0	-10	0	-8	0	-6	0	-2.5	15	13	8	6	2.5	12	10	6	5	2.5	9	8	6	5	2.5
50	80	0	-15	0	-12	0	-9	0	-7	0	-4	19	15	9	7	4	19	15	7	5	4	11	9	7	5	4
80	120	0	-20	0	-15	0	-10	0	-8	0	-5	25	19	10	8	5	25	19	8	6	5	15	11	8	6	5
120	150	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-22	0	-15	0	-12	0	-8	38	28	15	12	8	38	28	12	9	8	23	17	12	9	8
250	315	0	-35	0	-25	0	-18	—	—	—	—	44	31	18	—	—	44	31	14	—	—	26	19	14	—	—
315	400	0	-40	0	-30	0	-23	—	—	—	—	50	38	23	—	—	50	38	18	—	—	30	23	18	—	—
400	500	0	-45	0	-35	—	—	—	—	—	—	56	44	—	—	—	56	44	—	—	—	34	26	—	—	—
500	630	0	-50	0	-40	—	—	—	—	—	—	63	50	—	—	—	63	50	—	—	—	38	30	—	—	—
630	800	0	-75	—	—	—	—	—	—	—	—	94	—	—	—	—	94	—	—	—	—	55	—	—	—	—
800	1 000	0	-100	—	—	—	—	—	—	—	—	125	—	—	—	—	125	—	—	—	—	75	—	—	—	—
1 000	1 250	0	-125	—	—	—	—	—	—	—	—	155	—	—	—	—	155	—	—	—	—	94	—	—	—	—
1 250	1 600	0	-160	—	—	—	—	—	—	—	—	200	—	—	—	—	200	—	—	—	—	120	—	—	—	—
1 600	2 000	0	-200	—	—	—	—	—	—	—	—	250	—	—	—	—	250	—	—	—	—	150	—	—	—	—

❶ Tolerance of the inner bore dimensional difference Δ_{ds} which applies to classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{dmp} of the mean bore diameter. Diameter series' 0, 1, 2, 3 and 4 however apply to class 4, while all series' apply to class 2.

(2) Outer ring

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}										Single radial plane outside diameter variation[6] V_{Dp} Open type														
		Class 0		Class 6		Class 5		Class 4[5]		Class 2[5]		Diameter series 9 Class 0,6,5,4,2					Diameter series 0.1 Class 0,6,5,4,2					Diameter series 2,3,4 Class 0,6,5,4,2				
over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	Max					Max					Max				
2.5[8]	6	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
6	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	0	-9	0	-8	0	-6	0	-5	0	-4	12	10	6	5	4	9	8	5	4	4	7	6	5	4	4
30	50	0	-11	0	-9	0	-7	0	-6	0	-4	14	11	7	6	4	11	9	5	5	4	8	7	5	5	4
50	80	0	-13	0	-11	0	-9	0	-7	0	-4	16	14	9	7	4	13	11	7	5	4	10	8	7	5	4
80	120	0	-15	0	-13	0	-10	0	-8	0	-5	19	16	10	8	5	19	16	8	6	5	11	10	8	6	5
120	150	0	-18	0	-15	0	-11	0	-9	0	-5	23	19	11	9	5	23	19	8	7	5	14	11	8	7	5
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-20	0	-15	0	-11	0	-8	38	25	15	11	8	38	25	11	8	8	23	15	11	8	8
250	315	0	-35	0	-25	0	-18	0	-13	0	-8	44	31	18	13	8	44	31	14	10	8	26	19	14	10	8
315	400	0	-40	0	-28	0	-20	0	-15	0	-10	50	35	20	15	10	50	35	15	11	10	30	21	15	11	10
400	500	0	-45	0	-33	0	-23	—	—	—	—	56	41	23	—	—	56	41	17	—	—	34	25	17	—	—
500	630	0	-50	0	-38	0	-28	—	—	—	—	63	48	28	—	—	63	48	21	—	—	38	29	21	—	—
630	800	0	-75	0	-45	0	-35	—	—	—	—	94	56	35	—	—	94	56	26	—	—	55	34	26	—	—
800	1 000	0	-100	0	-60	—	—	—	—	—	—	125	75	—	—	—	125	75	—	—	—	75	45	—	—	—
1 000	1 250	0	-125	—	—	—	—	—	—	—	—	155	—	—	—	—	155	—	—	—	—	94	—	—	—	—
1 250	1 600	0	-160	—	—	—	—	—	—	—	—	200	—	—	—	—	200	—	—	—	—	120	—	—	—	—
1 600	2 000	0	-200	—	—	—	—	—	—	—	—	250	—	—	—	—	250	—	—	—	—	150	—	—	—	—
2 000	2 500	0	-250	—	—	—	—	—	—	—	—	310	—	—	—	—	310	—	—	—	—	190	—	—	—	—

❺ Tolerance of the outside diameter dimensional difference Δ_{Ds} which applies to classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{Dmp} of the mean bore diameter. Diameter series' 0, 1, 2, 3 and 4 however apply to class 4, while all series' apply to class 2.

Unit: μm

Mean single plane bore diameter variation V_{dmp} Class 0,6,5,4,2 Max					Inner ring radial runout K_{ia} Class 0,6,5,4,2 Max					Face runout with bore S_d Class 5,4,2 Max			Inner ring (2) axial runout (with side) S_{ia} Class 5,4,2 Max			Deviation of a single inner ring width Δ_{Bs} Normal Class 0,6		Normal Class 5.4		Normal Class 2		Modified (3) Class 0,6,5,4,				Inner ring width variation V_{Bs} Class 0,6,5,4,2 Max				
																High	Low	High	Low	High	Low	High	Low	High	Low					
6	5	3	2	1.5	10	5	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-40	0	-40	0	-40	—	—	0	-250	12	12	5	2.5	1.5
6	5	3	2	1.5	10	6	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-120	0	-40	0	-40	0	-250	0	-250	15	15	5	2.5	1.5
6	5	3	2	1.5	10	7	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-120	0	-80	0	-80	0	-250	0	-250	20	20	5	2.5	1.5
8	6	3	2.5	1.5	13	8	4	3	2.5	8	4	1.5	8	4	2.5	0	-120	0	-120	0	-120	0	-250	0	-250	20	20	5	2.5	1.5
9	8	4	3	1.5	15	10	5	4	2.5	8	4	1.5	8	4	2.5	0	-120	0	-120	0	-120	0	-250	0	-250	20	20	5	3	1.5
11	9	5	3.5	2	20	10	5	4	2.5	8	5	1.5	8	5	2.5	0	-150	0	-150	0	-150	0	-380	0	-250	25	25	6	4	1.5
15	11	5	4	2.5	25	13	6	5	2.5	9	5	2.5	9	5	2.5	0	-200	0	-200	0	-200	0	-380	0	-380	25	25	7	4	2.5
19	14	7	5	3.5	30	18	8	6	2.5	10	6	2.5	10	7	2.5	0	-250	0	-250	0	-250	0	-500	0	-380	30	30	8	5	2.5
19	14	7	5	3.5	30	18	8	6	5	10	6	4	10	7	5	0	-250	0	-250	0	-300	0	-500	0	-380	30	30	8	5	4
23	17	8	6	4	40	20	10	8	5	11	7	5	13	8	5	0	-300	0	-300	0	-350	0	-500	0	-500	30	30	10	6	5
26	19	9	—	—	50	25	13	—	—	13	—	—	15	—	—	0	-350	0	-350	—	—	0	-500	0	-500	35	35	13	—	—
30	23	12	—	—	60	30	15	—	—	15	—	—	20	—	—	0	-400	0	-400	—	—	0	-630	0	-630	40	40	15	—	—
34	26	—	—	—	65	35	—	—	—	—	—	—	—	—	—	0	-450	—	—	—	—	—	—	—	—	50	45	—	—	—
38	30	—	—	—	70	40	—	—	—	—	—	—	—	—	—	0	-500	—	—	—	—	—	—	—	—	60	50	—	—	—
55	—	—	—	—	80	—	—	—	—	—	—	—	—	—	—	0	-750	—	—	—	—	—	—	—	—	70	—	—	—	—
75	—	—	—	—	90	—	—	—	—	—	—	—	—	—	—	0	-1 000	—	—	—	—	—	—	—	—	80	—	—	—	—
94	—	—	—	—	100	—	—	—	—	—	—	—	—	—	—	0	-1 250	—	—	—	—	—	—	—	—	100	—	—	—	—
120	—	—	—	—	120	—	—	—	—	—	—	—	—	—	—	0	-1 600	—	—	—	—	—	—	—	—	120	—	—	—	—
150	—	—	—	—	140	—	—	—	—	—	—	—	—	—	—	0	-2 000	—	—	—	—	—	—	—	—	140	—	—	—	—

❷ Applies to deep groove bearings and ball bearings such as angular contact ball bearings.
❸ Applies to individual raceways made to use with duplex bearings. ❹ 0.6 mm is included in the dimensional division.

Unit: μm

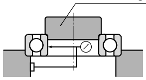
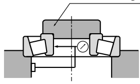
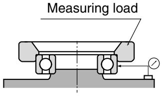
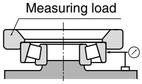
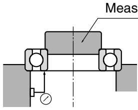
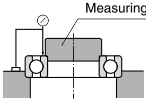
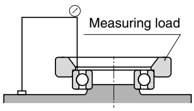
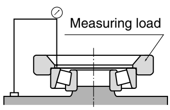
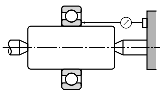
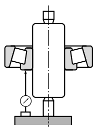
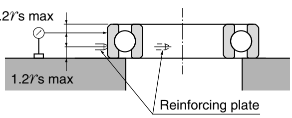
Single radial plane outside (6) diameter variation V_{Dp} Capped bearings Diameter series Class 2,3,4,0 Max	Class 0,1,2,3,4,6 Max	Mean single plane outside diameter variation V_{Dmp} Class 0,6,5,4,2 Max					Outer ring radial runout K_{ea} Class 0,6,5,4,2 Max					Variation of outside surface generatrix inclination with face S_D Class 5,4,2 Max			Outside ring (6) axial runout S_{ea} Class 5,4,2 Max			Deviation of a single inner ring width Δ_{Cs} All type	Inner ring width variation V_{Cs} Class 0,6 Max	Class 5,4,2 Max		
10	9	6	5	3	2	1.5	15	8	5	3	1.5	8	4	1.5	8	5	1.5	Depends on tolerance of Δ_{Bs} relative to d of same bearing.	Depends on tolerance of V_{Bs} relative to d of same bearing.	5	2.5	1.5
10	9	6	5	3	2	1.5	15	8	5	3	1.5	8	4	1.5	8	5	1.5			5	2.5	1.5
12	10	7	6	3	2.5	2	15	9	6	4	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
16	13	8	7	4	3	2	20	10	7	5	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
20	16	10	8	5	3.5	2	25	13	8	5	4	8	4	1.5	10	5	4			6	3	1.5
26	20	11	10	5	4	2.5	35	18	10	6	5	9	5	2.5	11	6	5			8	4	2.5
30	25	14	11	6	5	2.5	40	20	11	7	5	10	5	2.5	13	7	5			8	5	2.5
38	30	19	14	7	5	3.5	45	23	13	8	5	10	5	2.5	14	8	5			8	5	2.5
—	—	23	15	8	6	4	50	25	15	10	7	11	7	4	15	10	7			10	7	4
—	—	26	19	9	7	4	60	30	18	11	7	13	8	5	18	10	7			11	7	5
—	—	30	21	10	8	5	70	35	20	13	8	13	10	7	20	13	8			13	8	7
—	—	34	25	12	—	—	80	40	23	—	—	15	—	—	23	—	—			15	—	—
—	—	38	29	14	—	—	100	50	25	—	—	18	—	—	25	—	—			18	—	—
—	—	55	34	18	—	—	120	60	30	—	—	20	—	—	30	—	—			20	—	—
—	—	75	45	—	—	—	140	75	—	—	—	—	—	—	—	—	—			—	—	—
—	—	94	—	—	—	—	160	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	120	—	—	—	—	190	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	150	—	—	—	—	220	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	190	—	—	—	—	250	—	—	—	—	—	—	—	—	—	—			—	—	—

❻ Applies when snap ring is not mounted. ❼ Applies to deep groove bearings and ball bearings such as angular contact ball bearings.
❽ 2.5 mm is included in the dimensional division.

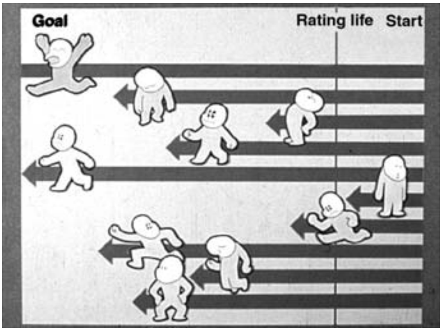
5.2 Bearing Precision Measurement Methods

The figure shows difficult-to-understand turning precision measurement methods only.

Table 5.2 Bearing Precision Measurement Methods

Precision characteristics	Measurement method	
Inner ring radial runout (K_{ia})	 	For inner ring radial runout, record the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring radial runout (K_{ea})	 	For outer ring radial runout, record the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Inner ring axial runout (S_{ia})	 	For inner ring axial runout, record the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring axial runout (S_{ea})	 	For outer ring axial runout, record the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Face runout with bore (S_d)	 	For face runout with bore, record the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution together with the tapered mandrel.
Variation of outside surface generatrix inclination with face for outer ring (S_D)		Variation of outside surface generatrix inclination with face for outer ring, record the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution along the reinforcement plate.

6. Load Rating and Life



6.1 Bearing Life

One of the most important factors when selecting bearings is the life of the bearing. Bearing life depends on the functions required of a machine.

Fatigue life ··· Life of the bearing in terms of material fatigue caused by rolling.

Lubrication life ··· Life of the bearing in terms of burning caused by deterioration of lubricant.

Sound life ··· Life of the bearing in terms of obstruction of bearing function caused by increase of turning sound.

Wear life ··· Life of the bearing in terms of obstruction of bearing function caused by wear of the internal parts, single bore diameter and outside diameter of the bearing.

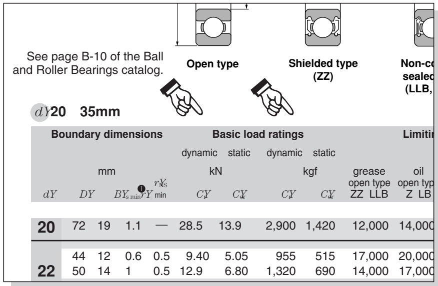
Precision life ··· Life of the bearing in terms of becoming unusable due to deterioration of the turning precision required by the machine.

In the case of fatigue life, the material becomes fatigued due to repeated load stress between the raceway and rolling elements, resulting in flaking. Duration of life can be predicted by statistical calculation. Generally speaking, fatigue life is treated as bearing life.

6.2 Basic Rating Life and Basic Dynamic Load Rating

When individual bearings of a group of the same type of bearing are turned under the same conditions, basic rating life is defined as the total number of times the bearing can be turned without flaking due to rolling fatigue in 90% (90% reliability) of the bearings.

Basic dynamic load rating expresses dynamic load capacity of rolling bearings, and therefore refers to a certain load, which provides basic rating life of one million revolutions. Basic dynamic load is expressed as pure radial load for radial bearings, and pure axial load for thrust bearings. Basic dynamic load rating C_r or C_a is given in the NTN catalog dimensions tables. ☞


See page B-10 of the Ball and Roller Bearings catalog.

Open type | Shielded type (ZZ) | Non-co sealed (LLB,

d 20 35mm

Boundary dimensions					Basic load ratings				Limiti	
					dynamic	static	dynamic	static		
mm					kN		kgf		grease	oil
d	D	B	$r_{s\,min}$	$r_{NS\,min}$	C_r	C_{or}	C_r	C_{or}	open type ZZ LLB	open typ Z LB
20	72	19	1.1	—	28.5	13.9	2,900	1,420	12,000	14,000
22	44	12	0.6	0.5	9.40	5.05	955	515	17,000	20,000
	50	14	1	0.5	12.9	6.80	1,320	690	14,000	17,000

Basic rating life is calculated by equation 6.1 or 6.2.

$$L_{10} = \left(\frac{C}{P}\right)^{p} \quad \text{.........................} \quad (6.1)$$

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^{p} \quad \text{....................} \quad (6.2)$$

Where:

L_{10} : Basic rating life (10^6 revolutions)
L_{10h} : Basic rating life h (hours)
C : Basic dynamic load rating N {kgf}
C_r : Radial bearing
C_a : Thrust bearing
P : Dynamic equivalent load N {kgf}
P_r : Radial bearing
P_a : Thrust bearing
n : Rotational speed rpm
p : Ball bearing $p=3$
Roller bearing $p=10/3$

In equipment with several bearings, if the life of one develops rolling fatigue, it is considered to be the total life for all the bearings. Life can be calculated by equation 6.3.

$$L = \frac{1}{\left(\frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_n}\right)^{1/e}} \quad \cdots\cdots\cdots (6.3)$$

Where:

L : Total basic rating life as all bearings (h)

$L_1, L_2 \cdots L_n$: Basic rating life of individual bearings 1, $2 \cdots n$ (h)

e : Ball bearing········· $e=10/9$

Roller bearing······ $e=9/8$

In the case where load conditions vary at a fixed time percentage for a single bearing, life can be calculated by equation 6.4.

$$L_m = (\Sigma\, \phi_j / L_j)^{-1} \quad \cdots\cdots\cdots (6.4)$$

Where:

L_m : Total life of bearing

ϕ_j : Usage frequency of each condition ($\Sigma\, \phi_j = 1$)

L_j : Life under each condition

Life can also be calculated as bearing life of the entire machine by equation 6.3. To put life in more simple terms, in the case of a ball bearing for example, when load (dynamic equivalent load) is doubled, it has the effect of a cube, so life is reduced by 1/8, as shown by equation 6.2. When rotational speed is doubled, life is halved.

6.3 Adjusted Rating Life

If much is known about how the machine is being used, bearing life can be more accurately estimated under a variety of conditions. In other words, adjusted rating life can be calculated by equation 6.5.

$$L_{na} = a_1 \cdot a_2 \cdot a_3\, (C/P)^P \quad \cdots\cdots\cdots (6.5)$$

Where:

L_{na} : Adjusted rating life (10^6 revolutions)

a_1 : Life adjustment factor for reliability

a_2 : Bearing characteristic coefficient

a_3 : Usage condition coefficient

Life adjustment factor for reliability a_1

Bearing life is generally calculated at 90% reliability. In the case of bearings used in airplane engines, for example, reliability must however be above 90% if life directly affects the life of human beings. In this case, life is adjusted according to the values given in **Table 6.1**.

Table 6.1 Life adjustment factor for reliability a_1

Reliability %	L_n	Life adjustment factor for reliability a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

Bearing characteristic coefficient a_2

Bearing characteristics concerning life vary if special materials, quality or manufacturing processes are used for bearings. In this case life is adjusted by the bearing characteristic coefficient a_2. Basic dynamic load rating given in the bearing dimensions table depends on the standard material and manufacturing method used by **NTN**, but $a_2 = 1$ is used under ordinary circumstances. $a_2 > 1$ is used for bearings made of special improved materials and manufacturing methods.

If bearings made of high carbon chrome are used at temperatures in excess of 120˚C for an extended period of time, with ordinary heat treatment, dimension variation is large. Bearings having undergone dimension stabilizing treatment (**TS treatment**) are therefore used in this case. Life is sometimes affected by a decrease in hardness due to treatment temperature. (See **Table 6.2**)

Table 6.2 Dimension stabilizing treatment

Code	Max. operating temp. (˚C)	Adjustment coefficient a_2
TS2	160	1.0
TS3	200	0.73
TS4	250	0.48

Life adjustment factor for operating condition a_3

Coefficient for adjusting life for lubrication conditions, rotational speed, running temperature, and other operating conditions. If lubrication conditions are favorable, a_3 is generally "1." If lubrication conditions are particularly good and other factors are normal, $a_3 > 1$ may be used.

Oppositely $a_3 < 1$ is used in the following cases:

- If lubrication oil viscosity is low (13 mm^2/s or less for ball bearing; 20 mm^2/s for roller bearing)
- Rotational speed is low (Rotational speed n by rolling element pitch circular d_p, $d_p \cdot n < 10,000$)
- If operating temperature is high (adjusted by **Fig. 6.1** due to decrease in hardness)

Items that consider coefficient a_2 by dimension stabilization treatment do not require adjustment of **Fig. 6.1** as long as each is used within maximum operating temperature.

Bearings are affected by various conditions other than these, but are not clarified as the a_3 coefficient. There is also the way of the a_{23} coefficient matching a_2 and a_3, but at the present there is need to overlap the data.

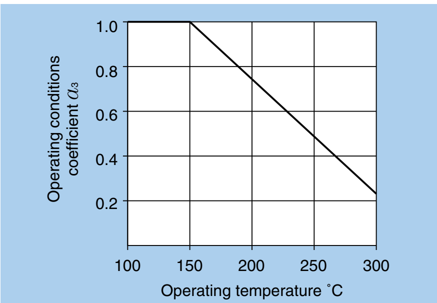


Fig. 6.1 Operating Conditions Coefficient According to Operating Temperature

In the case of an extremely large load, and there is danger of harmful plastic deformation developing on the contact surfaces of the rolling element and raceway, if P_r exceeds either C_{or} or 0.5 P_a in the case of radial bearings, or P_a exceeds 0.5 C_a in the case of thrust bearings, equations 6.1, 6.2 and 6.5 for calculating basic rating life cannot be applied.

6.4 Machine Applications and Requisite Life

When selecting bearings, you must select bearings that provide the life required for the machine. The general standards for life are given in **Table 6.3**.

6

6.5 Basic Static Load Rating

Bearing load where contact stress of maximum rolling element load is the following values is defined as basic static load rating.

Ball bearing	4 200MP	{428kgf/mm^2}
Roller bearing	4 000MPa	{408kgf/mm^2}

These values are the equivalent of the load where permanent set of approximately 0.0001 time the rolling element diameter is produced by the load in the area where the rolling elements make contact with the raceway surface. It is empirically known that the degree of deformation is as far as smooth rotation of the shaft is not impeded.

This basic static load rating is given in the dimension table as C_{or} and C_{oa} for radial and thrust bearings respectively.

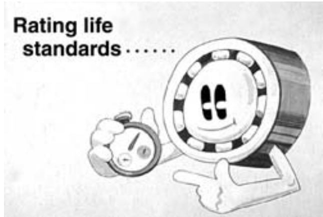


Table 6.3 Machine and Required Life (Reference)

Usage type	Machine and required life (reference) L_{10h}				×10³ hours
	~4	4~12	12~30	30~60	60~
Machine used occaisionally or for limited periods of time	Household electrical appliances Power tools	Farming equipment Office equipment			
Machine used occaisionally or for limited periods of time, but requires reliable operation	Medical equipment Measuring devices	Home air-conditioner Construction equipment Elevators Cranes	Cranes (sheave)		
Machine sometimes run for extended periods of time	Automobiles Motorcycles	Small motors Buses and trucks General gear-operated equipment Construction equipment	Machine tool spindles General purpose motors for factories Crushers Vibration screens	Important gear-operated equipment For use with rubber and plastic Calendar rollers Web presses	
Machines usually used more than 8 hours per day		Roller necks for rolling mills Escalators Conveyors Centrifuges	Passenger and freight vehicles (wheel) Air-conditioning equipment Large motors Compressor pumps	Locomotives (wheel) Traction motors Mining hoists Press flywheels	Pulp and papermaking equipment Ship propulsion units
Machines that operate 24 hours a day, for which breakdown cannot be permitted					Water works Mine drainage/ventilation equipment Power plant equipment

6.6 Allowable Static Equivalent Load

The quality of maximum static load for bearings is generally determined based on the value of the safety factor S_o.

$$S_o = \frac{C_o}{P_o} \quad \text{........................(6.6)}$$

Where:

S_o : Safety factor

C_o : Basic static load rating
(C_o or C_{oa}) N {kgf}

P_o : Static equivalent load
(P_{or} or P_{oa}) N {kgf}

For evaluation of S_o, the amount of permanent set is based on the previous definition of C_{or} and C_{oa}. It does not consider cracking of the rolling bearing ring or edge load of roller bearings. Evaluation must be empirically decided according to the machine and where it is used.

Table 6.4 Lower Limit Value of Safety Factor S_o

Operating conditions	Ball bearing	Roller bearing
If high rolling precision is required	2	3
If normal rolling precision is required (general purpose)	1	1.5

Remarks 1. "4" is used for the lower limit value of S_o for self-aligning thrust roller bearings.
2. "3" is used for the lower limit value of S_o for drawn cup needle roller bearings.
3. P_o is calculated taking shock load factor into consideration if there is vibration or shock load.
4. If a large axial load is applied to deep groove ball bearings or angular contact ball bearings, the fact that contact ellipse may ride up on the raceway surface must be considered.

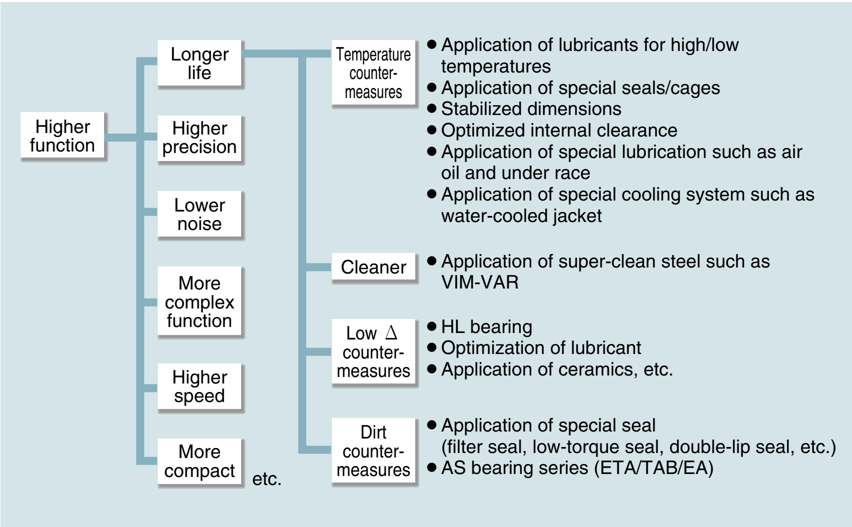
One-Point Advice

Bearing Tips

● Bearing with Higher Function and Longer Life

The life described in this handbook is basic rating life.

Bearings used for automobiles, steel equipment, machine tools, etc., must be designed to last a long time while providing the required function under limited conditions. **NTN** has the technologies required to do this. Some of them are given below.



7. Bearing Load

In order to calculate bearing life and safety factor, you must first know what sort of load is applied to the bearing. In other words, there are various types of loads and directions such as the weight of the rolling elements and the object supported by the bearing, conductivity of the belt and gears and the load produced when the machine performs work. These must be arranged in radial and axial load directions and calculated as a combined radial and axial load.

7.1 Load Used for Shafting

(1) Load factor

Depending upon the machine, a large load is produced by vibration and shock from theoretical calculation values. Taking advantage of the load factor, it is sometimes treated as actual load.

$$K = f_w \cdot K_c \quad \text{......(7.1)}$$

Where:
- K : Actual load placed on shaft N {kgf}
- f_w : Load factor (**Table 7.1**)
- K_c : Theoretical calculation value N {kgf}

Table 7.1 Load Factor fw f_w

Shock type	f_w	Machine
Almost no shock	1.0~1.2	Electric machinery, machine tools, measuring devices
Light shock	1.2~1.5	Railway cars, automobiles, rolling mills, metal machines, papermaking equipment, printing equipment, aircraft, textile machinery, electrical equipment, office equipment
Strong shock	1.5~3.0	Crushers, farming equipment, construction equipment, hoists

(2) Load on gears

When power is conveyed by gears, operating load differs according to the type of gear (spur, helical, bevel). As the simplest examples, spur and helical gears calculation is given here. Gear tangent load when shaft input torque is known:

$$K_t = \frac{2T}{D_p} \quad \text{......(7.2)}$$

Where:
- K_t : Gear tangent load N {kgf}
- T : Input torque N・mm {kgf・mm}
- D_p : Gear pitch round mm

When transfer power as shaft input is known:

$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \quad \text{N}$$

$$K_t = \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \quad \{\text{kgf}\} \quad \text{......(7.3)}$$

Where:
- n : Rotational speed rpm
- H : Transfer power kW

$$K_r = K_t \cdot \tan\alpha \quad \text{(Spur gear) ......(7.4)}$$

$$= K_t \cdot \frac{\tan\alpha}{\cos\beta} \quad \text{(Helical gear) ......(7.5)}$$

$$K_a = K_t \cdot \tan\beta \quad \text{(Helical gear) ......(7.6)}$$

Where:
- K_r : Radial load of gear
- K_a : Parallel load on gear shaft
- α : Pressure angle of gear
- β : Helix angle of gear

The following is calculated as a combined radial and axial load of radial load:

$$F_r = \sqrt{K_t^2 + K_t^2} \quad \text{......(7.7)}$$

F_r : Right angle load on gear shaft

When actually calculating bearing load, however, axial load Ka also affects radial load. It is therefore easier to calculate combined radial and axial load last.

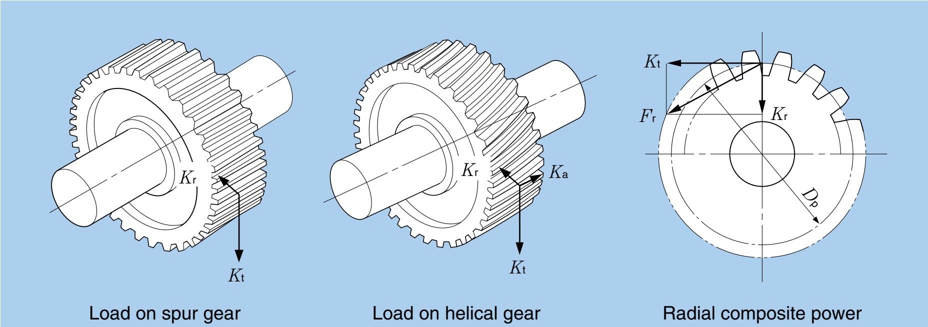


Fig. 7.1 Load on Gears

7

(3) Load on chain and belt shaft

The load on a sprocket or pulley when power is conveyed by a chain or belt is calculated as follows:

$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \quad \text{N}$$

$$= \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \quad \{\text{kgf}\} \quad \cdots\cdots\cdots\cdots(7.8)$$

Where:

K_t : Load on sprocket or pulley N {kgf}
H : Transfer power kW
D_p : Pitch diameter of sprocket or pulley mm

To account for initial tension applied to the belt or chain, radial load is calculated by equation 7.9.

$$K_r = f_b \cdot K_t \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots(7.9)$$

Where:

K_r : Radial load
f_b : Chain/belt factor

Table 7.2 Chain/Belt Factor f_b

Type of chain/belt	f_b
Chain (single row)	1.2～1.5
V-belt	1.5～2.0
Timing belt	1.1～1.3
Flat belt (with tension pulley)	2.5～3.0
Flat belt	3.0～4.0

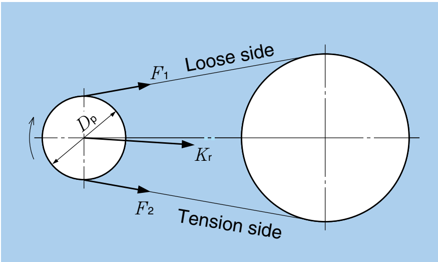


Fig. 7.2 Load on Chain/Belt

7

7.2 Bearing Load Distribution

Generally speaking, loads are placed on a shaft supported by bearings from various directions. The load is arranged as a radial or axial load depending on the size and direction of the load.

The following calculation procedure is modeled on the gears of the most common reduction gears. In **Fig. 7.3**, gear 1 is output (spur gear) and gear 2 is input (helical gear).

Where:

K_{t1}, K_{t2} : Gear tangential force (perpendicular to space)
K_{r1}, K_{r2} : Gear separation force
K_a : Gear axial force
r_1, r_2 : Gear pitch circular radius

$$K_{t1} = \frac{r_2}{r_1} \cdot K_{t2}$$

The correlation of K_t and K_r/K_a is in accordance with equations 7.4, 7.5 and 7.6.

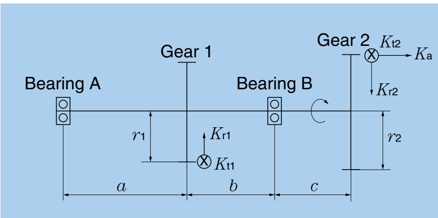


Fig. 7.3 Gear Load Transfer Example

(1) Load on bearing A

Load by K_{t1}/K_{t2}

$$F_{rAt} = \frac{b}{a+b} \cdot K_{t1} - \frac{c}{a+b} \cdot K_{t2}$$

Load by K_{r1}/K_{r2}/K_a

$$F_{rAr} = \frac{b}{a+b} \cdot K_{r1} + \frac{c}{a+b} \cdot K_{r2} + \frac{r_2}{a+b} \cdot K_a$$

Thus radial load on bearing A is:

$$F_{rA} = \sqrt{F_{rAt}^2 + F_{rAr}^2}$$

(2) Load on bearing B

(Axial load received by bearing B)

Load by K_{t1}/K_{t2}

$$F_{rBt} = \frac{a}{a+b} \cdot K_{t1} + \frac{a+b+c}{a+b} \cdot K_{t2}$$

Load by K_{r1}/K_{r2}/K_a

$$F_{rBr} = \frac{a}{a+b} \cdot K_{r1} - \frac{a+b+c}{a+b} \cdot K_{r2} - \frac{r_2}{a+b} \cdot K_a$$

Radial load on bearing B:

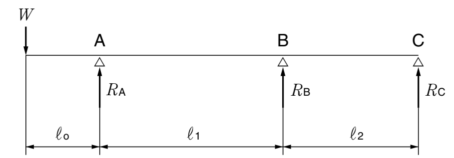
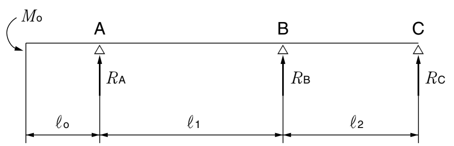
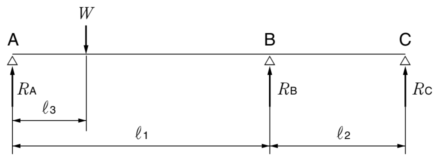
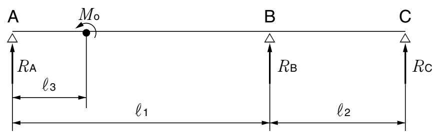
$$F_{rB} = \sqrt{F_{rBt}^2 + F_{rBr}^2}$$

Axial load on bearing B is K_a.

When one shaft is supported by three bearings, and there is a lot of distance between bearings, bearing load is calculated as 3-point support. A specific calculation example is extremely complicated, so the bearing load equation is given for a simple load example only. (See **Table 7.3**)

In actuality, various complicated loads are applied. We have therefore clearly indicated load direction and calculated these for each load individually. Finally we calculated bearing life as combined radial and axial load.

Table 7.3 Bearing Load of 3-Point Support Bearings

Load and moment direction	Bearing load
	$R_B = -\frac{\ell_o(2\ell_2+\ell_1)}{2\ell_1\ell_2}W$ $R_A = \frac{(\ell_1+\ell_2+\ell_o)W-\ell_2 R_B}{\ell_1+\ell_2}$ $R_C = -\frac{\ell_o W+\ell_1 R_B}{\ell_1+\ell_2}$
	$R_B = -\frac{(2\ell_2+\ell_1)M_o}{2\ell_1\ell_2}$ $R_A = \frac{M_o-\ell_2 R_B}{\ell_1+\ell_2}$ $R_C = -\frac{M\ \ell_1 R_B}{\ell_1+\ell_2}$
	$R_B = \frac{\ell_3(\ell_1^2+2\ell_1\ell_2-\ell_3^2)W}{2\ell_1^2\ell_2}$ $R_A = \frac{(\ell_1+\ell_2-\ell_3)W-\ell_2 R_B}{\ell_1+\ell_2}$ $R_C = \frac{\ell_3 W-\ell_1 R_B}{\ell_1+\ell_2}$
	$R_B = \frac{(-\ell_1^2-2\ell_1\ell_2+3\ell_3^2)M_o}{2\ell_1^2\ell_2}$ $R_A = \frac{M_o-\ell_2 R_B}{\ell_1+\ell_2}$ $R_C = -\frac{M_o+\ell_1 R_B}{\ell_1+\ell_2}$

7

7.3 Equivalent Load

7.3.1 Dynamic Equivalent Load

In many cases, both radial and axial loads are applied to bearings at the same time. In such a case, this is converted to pure radial load for radial bearings, and pure axial load for thrust bearings. A hypothetical load which provides an equal life is called a "dynamic equivalent load."

(1) Dynamic equivalent radial load

Dynamic equivalent radial load is calculated by equation 7.10.

$$P_r = XF_r + YF_a \quad \cdots\cdots\cdots\cdots (7.10)$$

Where:

P_r : Dynamic equivalent radial load N {kgf}
F_r : Radial load N {kgf}
F_a : Axial load N {kgf}
X : Radial load factor
Y : Axial load factor

The values of XY are given in the dimensions table of the catalog.

(2) If bearing has a contact angle

A bearing having a contact angle such as angular contact ball bearings and tapered roller bearings have their pressure cone apex at a position off center of the bearing. When a radial load is placed on the bearing, a component force is produced in the axial direction. This force is generally referred to as "induced thrust," and its magnitude is calculated by equation 7.11.

$$F_a = \frac{0.5F_r}{Y} \quad \cdots\cdots\cdots\cdots (7.11)$$

Where:

F_a : Axial direction component force (induced thrust) N {kgf}
F_r : Radial load N {kgf}
Y : Axial load factor

These bearings are generally used in symmetrical arrangement. A sample calculation is given in **Table 7.4.**

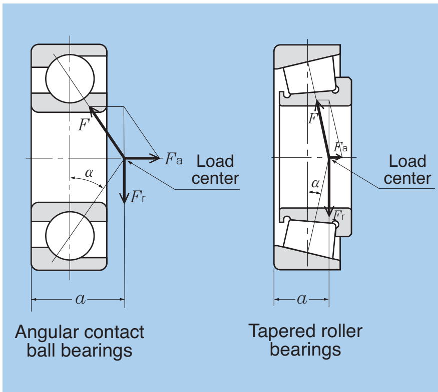
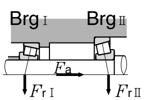


Fig. 7.4 Pressure Cone Apex and Axial Component Force

Table 7.4 Sample Calculation of Axial Component Force

Bearing arrangement	Load conditions	Axial load	Dynamic equivalent radial load
	$\frac{0.5F_{rI}}{Y_I} \leqq \frac{0.5F_{rII}}{Y_{II}} + F_a$	$F_{aI} = \frac{0.5F_{rII}}{Y_{II}} + F_a$	$P_{rI} = XF_{rI} + Y_I\left(\frac{0.5F_{rII}}{Y_{II}} + F_a\right)$
		$F_{aII} = \frac{0.5F_{rII}}{Y_{II}}$	$P_{rII} = F_{rII}$
	$\frac{0.5F_{rI}}{Y_I} > \frac{0.5F_{rII}}{Y_{II}} + F_a$	$F_{aI} = \frac{0.5F_{rI}}{Y_I}$	$P_{rI} = F_{rI}$
		$F_{aII} = \frac{0.5F_{rI}}{Y_I} - F_a$	$P_{rII} = XF_{rII} + Y_{II}\left(\frac{0.5F_{rI}}{Y_I} - F_a\right)$

Remarks 1. F_{rI} and F_{rII} are applied to bearings I and II respectively, as well as axial load F_a.
2. Applies when preload is 0.

7.3.2 Static Equivalent Load

Static equivalent load refers to pure radial or axial load that provides the same amount of permanent set as the maximum permanent set produced in the contact surface of the rolling elements and raceway when receiving the maximum load under actual load conditions.

This is used for bearing selection under load conditions where the bearing is stationary or turns at extremely low speed.

(1) Static equivalent radial load

The larger one of the values calculated by equations 7.12 and 7.13 is used for static equivalent radial load of radial bearings.

$$P_{or}=X_oF_r+Y_oF_a \quad \text{........................(7.12)}$$
$$P_{or}=F_r \quad \text{...................................(7.12)}$$

Where:

P_{or} : Static equivalent radial load N {kgf}
F_r : Radial load N {kgf}
F_a : Axial load N {kgf}
X_o : Static radial load factor
Y_o : Static axial load factor

The values of X_o and Y_o are given in the dimensions table of the catalog. ☞

When PҰ<FҰuse PҰ=FҰ
For values of eҰҰand ҰҰ
see the table below.

See page B-135 of the Ball and Roller Bearings catalog.

s	SҰ min	rҰ max	rҰas max	Load center mm aҰ	Constant eҰ	Axial load factors ҰҰ	ҰҰ	Mass kg approx.
	3	1	1	9.5	0.29	2.11	1.16	0.098
	2	1	1	9.5	0.35	1.74	0.96	0.08
	3	1	1	11.5	0.31	1.92	1.06	0.102
	3	1	1	11	0.35	1.74	0.96	0.104

7.4 Allowable Axial Load

A radial bearing can also receive an axial load, but there are various limits according to the type of bearing.

(1) Ball bearings

When an axial load is applied to ball bearings such as deep groove ball bearings and angular contact ball bearings, contact angle changes along with load. When the permissible range is exceeded, contact ellipse of the balls and raceway surface protrudes from the groove.

As shown in **Fig. 7.5**, the contact surface is elliptical with a major axis radius of a. The critical load where the contact ellipse doesn't go over the edge of the groove is the maximum allowable axial load (even if the contact ellipse doesn't go over the edge of the groove, allowable axial load must be P_{max} < 4 200 MPa). This load differs for the bearing internal clearance, groove curvature, groove edge, etc. If it is also carrying a radial load, critical load is checked by maximum rolling element load.

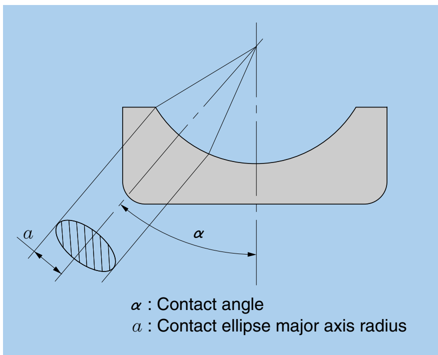


Fig. 7.5 Contact Ellipse

7

(2) Tapered roller bearings

Tapered roller bearings receive an axial load at both the raceway surface and where the roller end faces come in contact with the cone back face rib. Thus, by increasing contact angle α , the bearing becomes capable of receiving a large axial load. Because the roller end faces slide along the surface of the cone back face rib, this is limited according to rotational speed and lubrication conditions. This is generally checked by the value of PV, which takes advantage of sliding speed of surface pressure of the sliding surface.

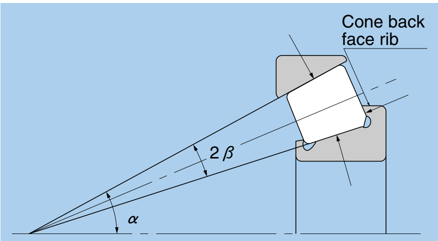


Fig. 7.6 Tapered Roller Bearing

(3) Allowable axial load for cylindrical roller bearings

Cylindrical roller bearings with inner and outer rings having ribs are capable of simultaneously receiving a radial load and a certain amount of axial load. In this case, allowable axial load is decided by heat and wear of the sliding surface between the roller end faces and rib.

Based on experience and testing, allowable load in the case where a centric axial load is to be supported can be approximated by equation 7.14.

$$P_t = k \cdot d^2 \cdot P_z \quad \text{……………………} \quad (7.14)$$

Where:

P_t : Allowable axial load when turning N {kgf}

k : Factor decided according to bearing internal design (see **Table 7.5**)

d : Bearing bore mm

P_z : Allowable surface pressure of rib MPa {kgf/mm²} (see **Fig. 7.7**)

If axial load is however larger than radial load, normal rolling of the rollers is negatively affected, so be careful not to allow $F_{a\ max}$ to be exceeded. Lubrication conditions, mounting dimensions and precision must also be taken into consideration.

Table 7.5 Value of Factor k and Allowable Axial Load ($F_{a\ max}$)

Bearing series	K	$F_{a\ max}$
NJ, NUP10 NJ, NUP, NF, NH2, NJ, NUP, NH22	0.040	$0.4F_r$
NJ, NUP, NF, NH3, NJ, NUP, NH23	0.065	$0.4F_r$
NJ, NUP, NH2E, NJ, NUP, NH22E	0.050	$0.4F_r$
NJ, NUP, NH3E, NJ, NUP, NH23E	0.080	$0.4F_r$
NJ, NUP, NH4,	0.100	$0.4F_r$
SL01-48	0.022	$0.2F_r$
SL01-49	0.034	$0.2F_r$
SL04-50	0.044	$0.2F_r$

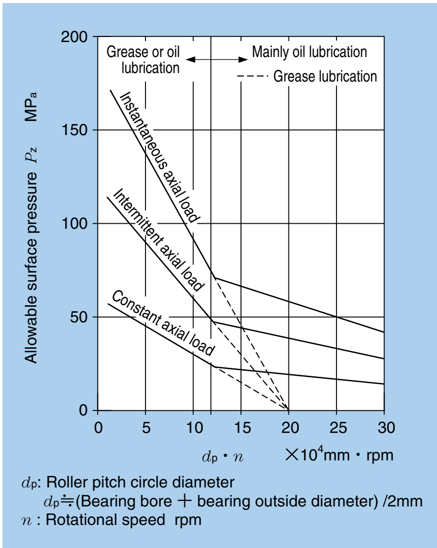


Fig. 7.7 Allowable Surface Pressure of Rib

8. Fits

8.1 Bearing Fits

The inner and outer rings of bearings support a load that rotates, and are therefore mounted on the shaft and housing. In this case, fitting of the inner ring with the shaft, and outer ring with the housing differs according to nature of the load, assembly of the bearing and ambient environment, depending upon whether the fit is provided with clearance or interference. The three basic types of fitting are as follows:

(1) Clearance fit

Mounted with clearance in the fit.

(2) Transition fit

Mounted with both clearance and interference in the fit.

(3) Interference fit

Mounted in if fixed position with interference in the fit.

The most effective method of mounting a bearing to support a load is to provide interference by fastening with an interference fit. There are also advantages in providing clearance, such as mounting, dismounting and absorption of expansion and contraction of the shaft and housing due to change in temperature. If you do not provide interference that matches the load, creep may be produced by rotation. As shown in **Fig. 8.1**, if there is creep in the clearance difference of the fit that turns while receiving the load, slipping may be produced by the difference in the inner ring bore and circumference length, resulting in abnormal heat, abrasion and powder which negatively affect the bearing. Even if there is no clearance, creep may occur if the load is large. You should therefore decide the proper fit using **Table 8.2** as a guideline.

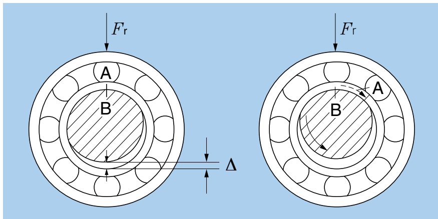
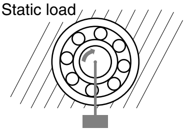
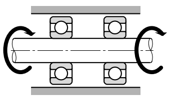
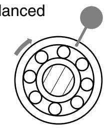
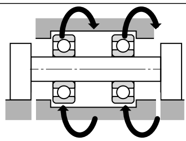
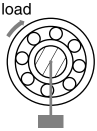
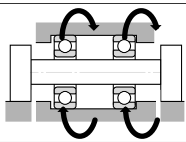
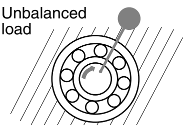
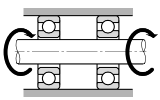


Fig. 8.1 Bearing Creep

Table 8.1 Nature and Fit of Radial Loads

Diagram	Rotation division		Nature of load	Fit
Static load 		Inner ring: rotating Outer ring: stationary	Inner ring turning load Outer ring static load	Inner ring: Interference fit Outer ring: Clearance fit
Unbalanced load 		Inner ring: stationary Outer ring: rotating		
Static load 		Inner ring: stationary Outer ring: rotating	Inner ring static load Outer ring turning load	Inner ring: Clearance fit Outer ring: Interference fit
Unbalanced load 		Inner ring: rotating Outer ring: stationary		

Interference or clearance range on the other hand is decided by dimension tolerance of the bearing, shaft and housing. Fit therefore requires sufficient consideration.

8.2 Fit Selection

Proper fit selection is dependent upon thorough analysis of bearing operating conditions:

- **Shaft and housing material, wall thickness, rigidity and finished surface precision**
- **Machinery operating conditions (nature and magnitude of load, rotating speed, temperature, etc.)**

The basic philosophy for fit concerns whether it is the inner or outer ring that turns. Fit is decided by which of the bearing rings the load moves along, and is as given in **Table 8.1**.

The relationship of dimension tolerance for the housing and shaft on which the bearing is to be mounted is as shown in **Fig. 8.2**.

Some of the general fitting criteria for various types of bearings under various operating conditions is given in **Figs. 8.2** through **8.4**. For details, see "A45 - 53 of the NTN Ball and Roller Bearings catalog".

8

Table 8.2 Tolerance Class of Shaft Used for Radial Bearings (Class 0, 6X, 6)

Conditions		Ball bearings		Cylindrical roller bearings Tapered roller bearings		Self-aligning roller bearings		Shaft tolerance class	Remarks
		Shaft diameter (mm)							
		Over	Up to	Over	Up to	Over	Up to		
Cylindrical bore bearing (Class 0, 6X, 6)									
Inner ring rotating load or indeterminate direction load	Light or ❶ fluctuating load	—	18	—	—	—	—	h5	js5, k5 and m5 may be used in place of js6, k6 and m6 if more precision is required.
		18	100	—	40	—	—	js6	
		100	200	40	140	—	—	k6	
		—	—	140	200	—	—	m6	
	Normal load ❶	—	18	—	—	—	—	js5	Internal clearance variation according to fit doesn't have to be considered for single row angular contact ball bearings and tapered roller bearings. You may therefore use k6 and m6 in place of k5 and m5.
		18	100	—	40	—	40	k5	
		100	140	40	100	40	65	m5	
		140	200	100	140	65	100	m6	
		200	280	140	200	100	140	n6	
		—	—	200	400	140	280	p6	
		—	—	—	—	280	500	r6	
	Heavy or ❶ shock load	—	—	50	140	50	100	n6	Use bearing with internal clearance larger than CN clearance bearing.
		—	—	140	200	100	140	p6	
		—	—	200	—	140	200	r6	
Inner ring static load	Inner ring must be able to move easily on shaft.	All shaft diameters						g6	Use g5 if more precision is required. F6 is also OK to facilitate movement in the case of large bearings.
	Inner ring does not have to be able to move easily on shaft.	All shaft diameters						h6	Use h5 if more precision is required.
Centric axial load		All shaft diameters						js6	Shaft and bearing are not generally fixed by fit.
Tapered bore bearing (class 0) (W/ adapter or withdrawal sleeve)									
All loads		All shaft diameters						h9/IT5 ❷	H10/IT7 may also be used with conductive shaft ❷

❶ Light, normal and heavy load refer to basic dynamic radial load rating of 6% or less, above 6% to 12% and less, and over 12% for dynamic equivalent radial load.

❷ Shaft circular and cylindrical tolerance values are given for IT5 and IT7.

Remarks: This table applies to steel solid shafts.

Table 8.3 Tolerance Class of Housing Bore Used for Radial Bearings (Class 0, 6X, 6)

Conditions				Tolerance class of housing bore	Remarks
Housing	Load type, etc.		Transfer in axial ❸ direction of outer ring		
Integral or two-piece housing	Outer ring static load	All load types	Able to transfer.	H7	G7 may be used for large bearings or when there is a large temperature difference between outer ring and housing.
		❶ Light or normal loads ❶	Able to transfer.	H8	—
		Temperature of shaft and inner ring become high.	Easily able to transfer.	G7	F7 may be used for large bearings or when there is a large temperature difference between outer ring and housing.
Integral housing		Requires precision rotation with light or normal loads.	As a rule, not able to transfer.	K6	Primarily applies to roller bearings.
			Able to transfer.	JS6	Primarily applies to ball bearings.
		Requires silent running.	Able to transfer.	H6	—
	Indeterminate direction load	Light or normal loads	Able to transfer.	JS7	JS6 and K6 may be used in place of JS7 and K7 if more precision is required.
		Normal or heavy loads ❶	As a rule, not able to transfer.	K7	
		Large shock loads	Not able to transfer	M7	—
	Outer ring rotating load	Light or fluctuating loads	Not able to transfer	M7	—
		Normal or heavy loads	Not able to transfer	N7	Primarily applies to ball bearings.
		Heavy or large shock loads with thin wall housing	Not able to transfer	P7	Primarily applies to roller bearings.

❶ In accordance with ❶ of **Table 8.2**.
❸ Data for non-separable bearings is given separately according to whether or not the outer ring is capable of transfer in the axial direction.
Remarks 1. This table applies to cast iron or steel housing.
2. If only centric axial load is applied to the bearing, select a tolerance class that provides the outer ring with clearance in the radial direction.

Table 8.4 Tolerance Class of Shaft Used for Thrust Bearings (Class 0, 6X, 6)

Conditions		Shaft diameter (mm)		Shaft tolerance class	Remarks
		Over	Up to		
Centric axial load (thrust bearings in general)		All shaft diameters		js6	Also used for h6.
Combined radial and axial load (self-aligning thrust roller bearing)	Inner ring static load	All shaft diameters		js6	—
	Inner ring rotating or indeterminate direction load	—	200	k6	js 6, k6 and m6 may be used in place of k6, m6 and n6 respectively.
		200	400	m6	
		400	—	n6	

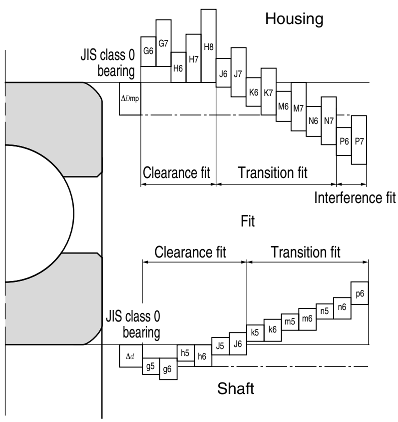


Fig. 8.2 Bearing Fit Status

8.3 Fit Calculation

As was previously stated, standards for bearing fits have already been set, but problems such as creep, bearing ring cracking and premature flaking may occur depending on conditions such as actual assembly, load and temperature. The following items must be checked if interference is necessary.

(1) Load and interference

When a radial load is placed on a bearing, interference between the inner ring and shaft is reduced. Thus, interference varies according to the size of the load. The required interference is calculated by the following equation. (The equation supposes that a solid steel shaft is used.)

When $F_r \leqq 0.3\,C_{or}$

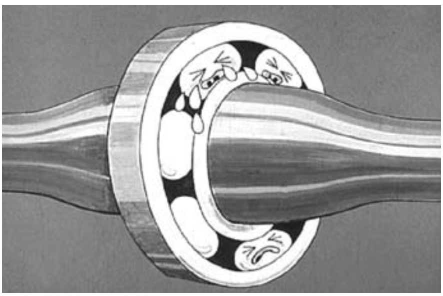
$$\left.\begin{aligned}\Delta d_F &= 0.08\,(d \cdot F_r/B)\ 1/2\ \text{N}\\ &= 0.25\,(d \cdot F_r/B)\ 1/2\ \{\text{kgf}\}\end{aligned}\right\} \cdots (8.1)$$

When $F_r > 0.3\,C_{or}$

$$\left.\begin{aligned}\Delta d_F &= 0.02\,(F_r/B)\ \text{N}\\ &= 0.2\ (F_r/B)\ \{\text{kgf}\}\end{aligned}\right\} \cdots (8.2)$$

Where

Δd_F : Required effective interference according to radial load (μm)
d : Bearing bore (mm)
B : Inner ring width (mm)
F_r : Radial load N {kgf}
C_{or} : Basic static load rating N {kgf}



(2) Temperature and interference

The temperature of the shaft and housing generally rises while the bearing is operating. As a result, interference between the inner ring and shaft is reduced. In this case, interference is calculated by the following equation.

$$\Delta d_r = 0.0015 \cdot d \cdot \Delta T \qquad (8.3)$$

Where:

Δd_r : Required effective interference according to temperature difference (μm)
ΔT : Difference between bearing temperature and ambient temperature (˚C)
d : Bearing bore (mm)

(3) Interference and surface roughness of fit surface

Fit surface roughness of the shaft and housing is crushed to a certain extent, reducing interference by that amount. The amount that interference is reduced differs according to roughness of the fit surface, but this is generally compensated somewhat when calculating inner ring expansion and outer ring contraction factors.

(4) Maximum interference

Tensile stress is produced in the bearing ring mounted on the shaft when interference is provided. If excessive interference is applied, the bearing ring could be cracked or life reduced. The upper limit value for interference is generally 1/1000 of the shaft diameter or less.

In the case of heavy or shock loads, calculate fit stress with detailed analysis. It is generally safe as long as 13 kgf/mm^2 is not exceeded for bearing steel, or 18 kgf/mm^2 for carburizing steel.

8.4 Pressure of Fit Surface

The pressure that is produced on the fit surface and equation for calculating maximum stress are given in **Table 8.5**.

Mean groove diameter for the inner and outer rings of the bearing can be approximated from **Table 8.6**.

Interference that effectively works on fit surface pressure, i.e. "effective interference Δ_{deff}, is smaller than interference Δ_d (theoretical interference) calculated from dimension measurements of the shaft or bearing bore. This is primarily due to the influence of finish surface roughness. The following reduction amounts must therefore be anticipated.

Grinding shaft : 1.0 ～ 2.5 μm
Turning shaft : 5.0 ～ 7.0 μm

Table 8.5 Pressure and Maximum Stress of Fit Surface

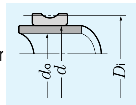
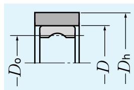
Fit conditions		Equation	Symbols (Unit: N {kgf} , mm)
Fit surface pressure MPa {kgf / mm^2}	Fit of hollow steel shaft and inner ring	$P = \frac{E}{2}\frac{\Delta_{deff}}{d}\left[1-\left(\frac{d}{D_i}\right)^2\right]$	d : Shaft diameter, inner ring bore d_o : Hollow shaft bore D_i : Inner ring mean groove diameter Δ_{deff} : Effective interference E : Elastic factor = 208 000 MPa {21 200 kgf/mm^2} 
	Fit of hollow steel shaft and inner ring	$P = \frac{E}{2}\frac{\Delta_{deff}}{d}\frac{[1-(d/D_i)^2][1-(d_o/d)^2]}{[1-(d_o/D_i)^2]}$	
	Fit of steel housing and outer ring	$P = \frac{E}{2}\frac{\Delta_{Deff}}{D}\frac{[1-(D_o/D)^2][1-(D/D_h)^2]}{[1-(D_o/D_h)^2]}$	DS : Housing bore, bearing outside diameter D_o : Outer ring mean groove diameter D_h : Housing outside diameter Δ_{Deff} : Effective interference 
Max. stress MPa {kgf / mm^2}	Fit of shaft and inner ring	$\sigma_t max = P\frac{1+(d/D_i)^2}{1-(d/D_i)^2}$	Tangent stress of inner ring bore is maximum.
	Fit of housing and outer ring	$\sigma_t max = P\frac{2}{1-(D_o/D)^2}$	Tangent stress of outer ring bore is maximum.

Table 8.6 Mean Groove Diameter

Bearing type		Mean groove diameter	
		Inner ring (D_i)	Outer ring (D_o)
Deep groove ball bearing	All types	$1.05\frac{4d+D}{5}$	$0.95\frac{d+4D}{5}$
Cylindrical roller bearing ❶	All types	$1.05\frac{3d+D}{4}$	$0.98\frac{d+3D}{4}$
Self-aligning roller bearing	All types	$\frac{2d+D}{3}$	$0.97\frac{d+4D}{5}$

d: Inner ring bore mm　　D: Outer ring outside diameter mm
❶ Values given for mean groove diameter are those for double ribs.

8.5 Force Required for Press Fit and Drawing

The force required to pressure fit the inner ring on the shaft and the outer ring on the housing, or for drawing the inner ring off the shaft or outer ring off the housing is calculated by equations 8.4 and 8.5.

For shaft and inner ring:

$$K_d = \mu \cdot P \cdot \pi \cdot d \cdot B \quad \text{(8.4)}$$

For housing and outer ring:

$$K_D = \mu \cdot P \cdot \pi \cdot D \cdot B \quad \text{(8.5)}$$

Where:

K_d : Inner ring pressure fit or drawing force N {kgf}
K_D : Outer ring pressure fit or drawing force N {kgf}
P : Fit surface pressure MPa {kgf/mm^2} (See **Table 8.5**)
d : Shaft diameter, inner ring bore (mm)
D : Housing bore, outer ring outside diameter (mm)
B : Inner or outer ring width
μ : Sliding friction coefficient (See **Table 8.7**)

Table 8.7 Sliding Friction Coefficient for Pressure Fit and Draw

Item	μ
When pressure fitting inner (outer) ring on cylindrical shaft (hollow)	0.12
When drawing inner (outer) ring off cylindrical shaft (hollow)	0.18
When pressure fitting inner ring on tapered shaft or sleeve	0.17
When drawing inner ring off tapered shaft	0.14
When pressure fitting sleeve on shaft or bearing	0.30
When drawing sleeve off shaft or bearing	0.33

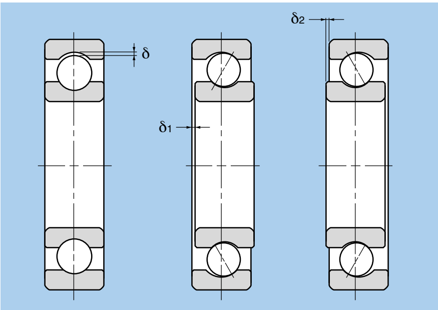
8

9. Bearing Internal Clearance and Preload

9.1 Bearing Internal Clearance

As shown in **Fig. 9.1**, prior to mounting the bearing on the shaft and housing, when either the inner or outer ring is in a fixed position the amount of transfer when the counterpart is moved in the radial or axial direction is called radial internal clearance or axial internal clearance. This internal clearance is standardized by ISO 5753 (JIS B 1520). Radial internal clearance for deep groove ball bearings is given as an example in **Table 9.1**. For details, see "A54 - 65 of the "**NTN** Ball and Roller Bearings catalog".

Measurement load is of course applied when measuring clearance. Measurement load and correction values have been established as shown in **Table 9.2** due to elastic deformation caused by measurement load, particularly for ball bearings.



Radial internal clearance = δ
Axial internal clearance = $\delta_1 + \delta_2$

Fig. 9.1 Bearing Internal Clearance

Table 9.2 Radial Internal Clearance Correction Values for Measurement Load (Deep Groove Ball Bearing) Unit: μm

Nominal bearing bore diameter d mm Over	Up to	Measurement load N	{kgf}	Internal clearance correction amount C2	CN	C3	C4	C5
10 ❶	18	24.5	{2.5}	3~4	4	4	4	4
18	50	49	{5}	4~5	5	6	6	6
50	200	147	{15}	6~8	8	9	9	9

❶ This diameter is included in the group.

Table 9.1 Radial Internal Clearance for Deep Groove Ball Bearings Unit: μm

Nominal bearing bore diameter d mm Over	Up to	C2 Min.	C2 Max.	CN Min.	CN Max.	C3 Min.	C3 Max.	C4 Min.	C4 Max.	C5 Min.	C5 Max.
—	2.5	0	6	4	11	10	20	—	—	—	—
2.5	6	0	7	2	13	8	23	—	—	—	—
6	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690

9.2 Internal Clearance Selection

During operation, clearance largely affects bearing performance such as bearing life, heat, vibration and sound. It is therefore necessary to select the clearance that matches operating conditions. If the clearance is theoretically slightly negative, optimal bearing life values are given, but if the clearance is further to the negative side, life decreases radically. Operating conditions are likely to fluctuate during operation due to a variety of factors. Generally speaking, you should therefore select initial bearing internal clearance so that operating clearance is slightly larger than 0.

Internal clearance during operation is calculated by the following equation:

$$\delta_{eff} = \delta_o - (\delta_f + \delta_t) \quad \cdots\cdots(9.1)$$

Where:

δ_{eff} : Operating clearance (mm)
δ_o : Bearing initial internal clearance (mm)
δ_f : Internal clearance reduction due to interference (mm)
δ_t : Internal clearance reduction due to the difference in temperature of the inner and outer rings (mm)

(1) Internal clearance reduction due to interference

If the inner and outer rings are mounted on the shaft or housing with interference, the inner ring expands, the outer ring contracts, and internal clearance decreases by that amount.

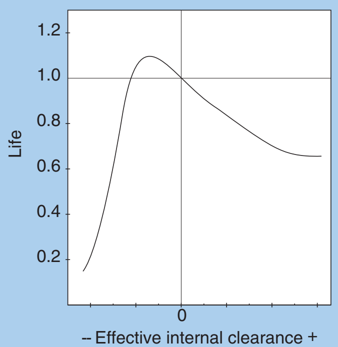


Fig. 9.2 Internal Clearance and Life

The amount of reduction differs according to the type of bearing, shape of shaft or housing, dimensions and material, but it is approximately 70 - 90% of effective interference.

$$\delta_f = (0.70 \sim 0.90)\ \Delta_{eff} \quad \cdots\cdots(9.2)$$

δ_f : Internal clearance reduction due to interference (mm)
Δ_{eff} : Effective interference (mm)

To calculate more precisely, you can take material, shape and dimensional shape of each part into consideration. Dimension tolerance is supposed to be normal distribution, and is generally calculated by 3σ.

(2) Internal clearance reduction due to the difference in temperature of the inner and outer rings

As for bearing temperature during operation, temperature of the outer ring is generally 5 - 10˚C lower than that of the inner ring or rolling elements. When heat radiation of the housing and shaft are connected to the heat source, temperature difference further increases. Internal clearance decreases by precisely the amount of the inner and outer rings expand due to the difference in temperature.

$$\delta_t = \alpha \cdot \Delta T \cdot D_o \quad \cdots\cdots(9.3)$$

δ_t : Internal clearance reduction due to the difference in temperature of the inner and outer rings
α : Coefficient of linear expansion for bearing materials 12.5×10^{-6}/˚C
ΔT : Difference in temperature of the inner and outer rings (˚C)
D_o : Raceway diameter of the outer ring (mm)

Raceway diameter of outer ring is approximated by the following equation.

For ball bearings and self-aligning roller bearings

$$D_o = 0.2\,(d + 4D) \quad \cdots\cdots(9.4)$$

For ball bearings and self-aligning roller bearings

$$D_o = 0.25\,(d + 3D) \quad \cdots\cdots(9.5)$$

d : Bearing bore diameter
D : Bearing outside diameter

Note that the formula in item 9. 2 only applies to copper bearings, shafts and housings.

9.3 Preload

Bearings are used with minimal clearance during operation. Bearings used in pairs such as angular contact ball bearings and tapered roller bearings are sometimes used with negative clearance in the axial direction, depending upon the application. This condition is called "preload." This means there is elastic contact between the rolling elements and raceway surface.

The following effects are obtained as a result:

- Bearing rigidity increases.
- Suitable for high-speed rotation.
- Rotation precision and positioning precision is enhanced.
- Vibration and noise are suppressed.
- Smearing which can cause the rolling element to slip is reduced.
- Fretting produced by external vibration is prevented.

Excessive preload however invites life reduction, abnormal heating, and increase of rotating torque.

(1) Preload method

There are two ways to provide preload: one is fixed position preload where the opposing bearing is fastened in a fixed position and a certain preload is applied by adjusting bearing width dimensions, spacer and shim dimensions, and the other is fixed pressure preload where preload is applied by a spring.

Concrete examples of the preload methods are given in **Table 9.3**.

Standard preload amounts are set for duplex angular contact ball bearings. (See NTN catalog) ☞

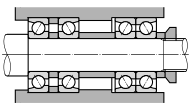
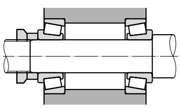
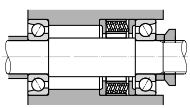
●Bearing Internal Clearance and Preload

See page A-64 of the Ball and Roller Bearings catalog.

Table 8.13 The normal preload of duplex arrangement angular contact ball bearings

Nominal bore diameter d mm		78C								79C HSB9C					
over	inch	Low		Normal		Central		Heavy		Low		Normal		Central	
-	12	-		-		-		-		-		-		-	
12	18	-		-		-		-		-		-		-	
18	32	10	1	29	3	78	8	147	15	20	2	49	5	98	10
32	40	10	1	29	3	78	8	147	15	29	3	78	8	196	20
40	50	20	2	49	5	98	10	196	20	39	4	98	10	245	25
50	65	29	3	98	10	196	20	390	40	49	5	118	12	294	30

Table 9.3 Preload Method and Characteristics

Preload method	Preload basic pattern	Applicable bearings	Objective of preload	Method and preload amount	Usage example
Fixed position preload		Angular contact ball bearings	Maintain shaft precision, prevent vibration, enhance rigidity	Certain amount of preload is provided by planar difference of inner/outer ring width or spacer.	Grinders Turning machines Milling machines Measuring devices
		Tapered roller bearings Thrust ball bearings Angular contact ball bearings	Enhance rigidity of bearing.	Preload is provided by loosening screws. Amount of preload is set with measuring starting torque of bearing or transfer distance of bearing rings.	Turning machines Milling machines Automobiles Differential pinions Printing presses Wheels
Fixed pressure preload		Angular contact ball bearings Deep groove ball bearings Tapered roller bearings (high speed)	Maintain precision and prevent vibration/noise without changing preload by load, temperature, etc.	Preload is provided by coil springs, disc springs, etc. Deep groove ball bearings 4～10 d N 0.4～1.0 d {kgf} d : Shaft diameter (mm)	Internal cylindrical grinding machines Electric motors Small high-speed shafts Tension reels

(2) Preload and rigidity

When an axial load is placed on a bearing, in many cases rigidity is enhanced and preload is applied to reduce displacement of the bearing in the axial direction. Let's therefore consider the correlation of load and displacement when outside pressure is placed on a bearing to which preload is applied.

Displacement of various bearings by elastic deformation is shown in **Fig. 9.3**.

As shown in the figure, when the inner ring tightly adheres in the axial direction, preload load F_o is applied, producing δ_o elastic deformation. When external force F_a is added, displacement increases by exactly δ_a for bearing Ⅰ, and decreases for bearing Ⅱ. At this time bearings Ⅰ and Ⅱ become balanced by the loads of $F_Ⅰ$ and $F_Ⅱ$ respectively. The amount of displacement of bearing Ⅰ when external force F_a is applied without preload is δ_b, which is quite a bit larger than δ_a. In other words, this shows that rigidity is enhanced by preload.

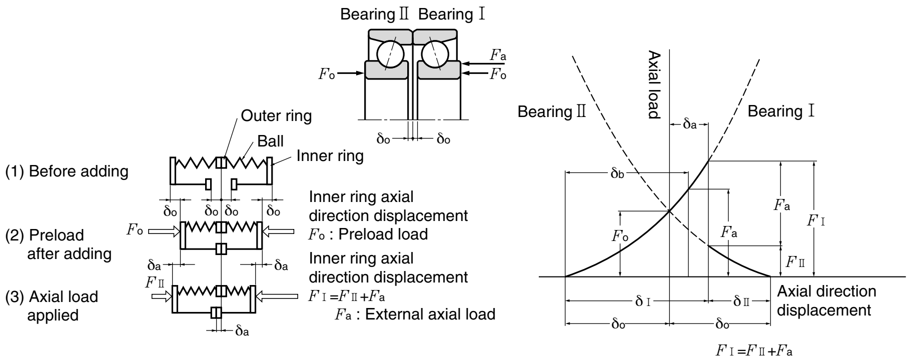


Fig. 9.3 Fixed Position Preload Model Diagram and Preload Line Diagram

9.4 Correlation of Axial and Radial Internal Clearance for Deep Groove Ball Bearings

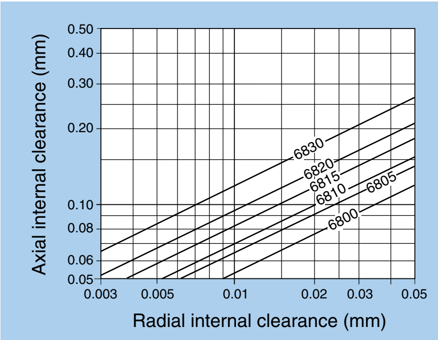


Fig. 9.4.1 Axial and Radial Internal Clearance for 68 Series

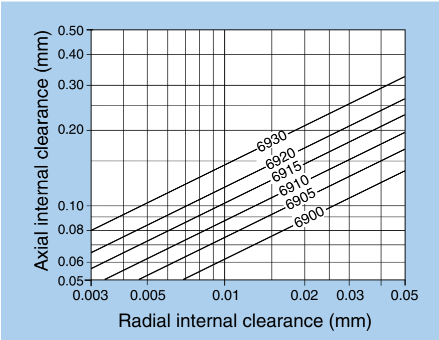


Fig. 9.4.2 Axial and Radial Internal Clearance for 69 Series

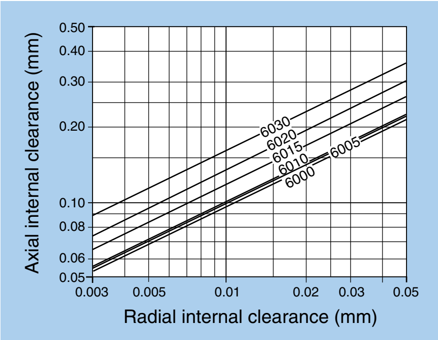


Fig. 9.4.3 Axial and Radial Internal Clearance for 60 Series

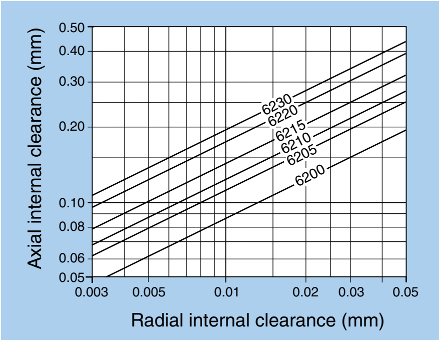


Fig. 9.4.4 Axial and Radial Internal Clearance for 62 Series

※Technical data is based on typical figures. The values therefore cannot be guaranteed.

9.5 Axial Load and Displacement of Angular Contact Ball Bearings

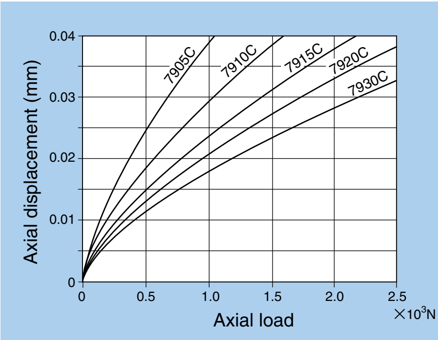


Fig. 9.5.1 Axial Load and Displacement for 79C Series

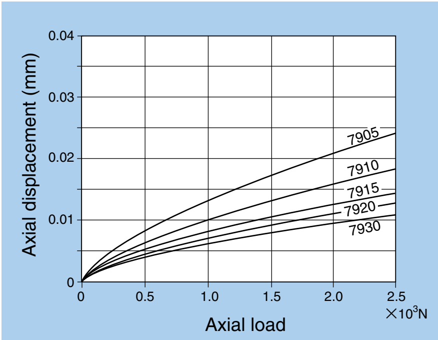


Fig. 9.5.2 Axial Load and Displacement for 79 Series

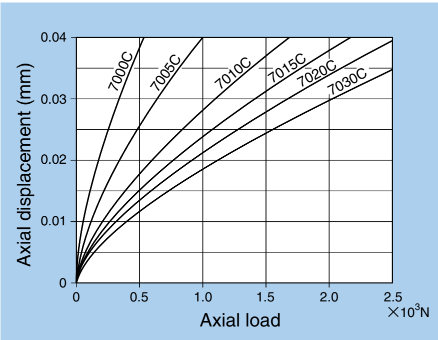


Fig. 9.5.3 Axial Load and Displacement for 70C Series

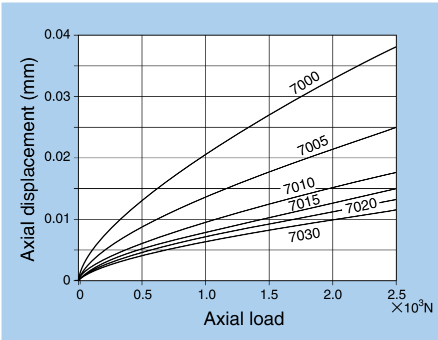


Fig. 9.5.4 Axial Load and Displacement for 70 Series

※Technical data is based on typical figures. The values therefore cannot be guaranteed.

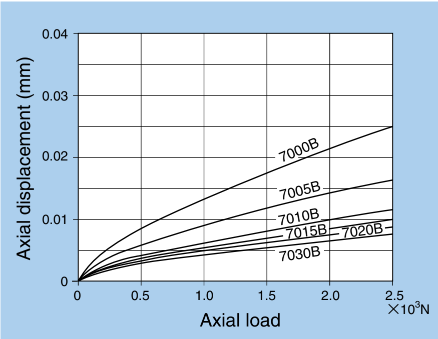


Fig. 9.5.5 Axial Load and Displacement for 70B Series

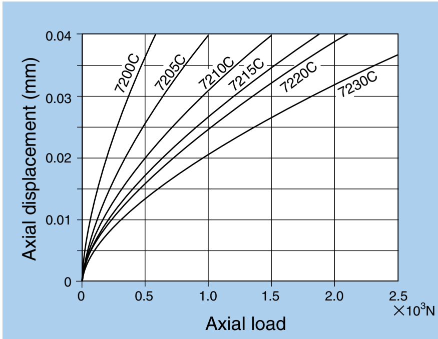


Fig. 9.5.6 Axial Load and Displacement for 72C Series

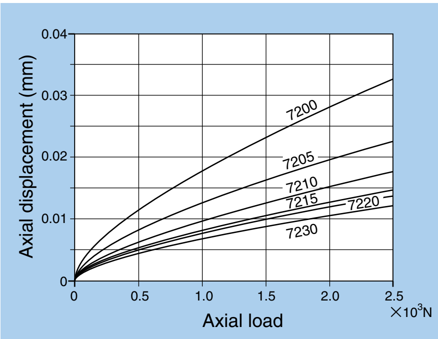


Fig. 9.5.7 Axial Load and Displacement for 72 Series

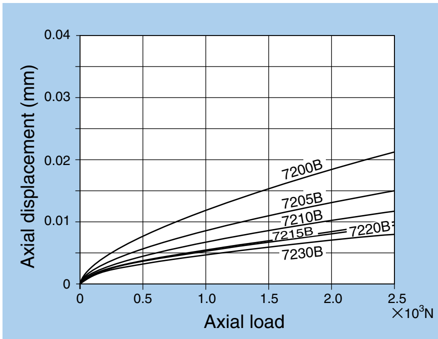


Fig. 9.5.8 Axial Load and Displacement for 72B Series

9

※Technical data is based on typical figures. The values therefore cannot be guaranteed.

9.6 Axial Load and Displacement for Tapered Roller Bearings

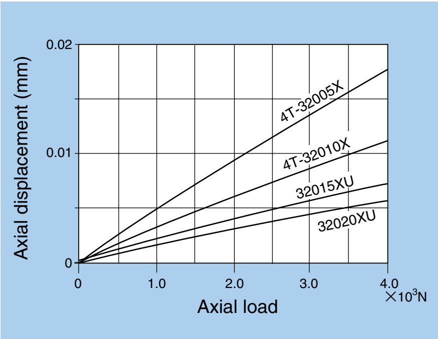


Fig. 9.6.1 Axial Load and Displacement for 320 Series

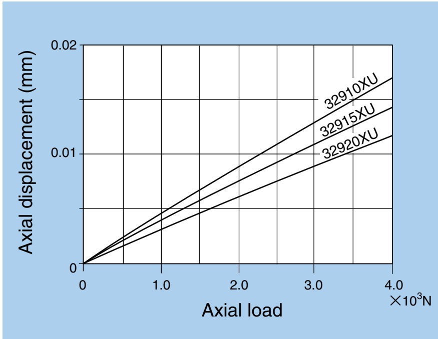


Fig. 9.6.2 Axial Load and Displacement for 329 Series

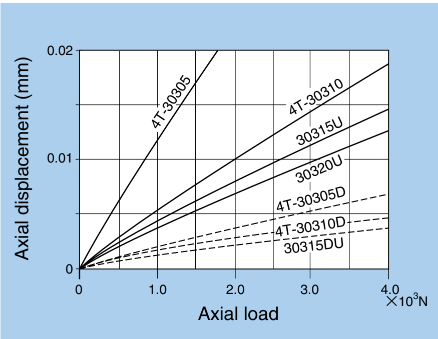


Fig. 9.6.3 Axial Load and Displacement for 303 Series, 303D Series

※Technical data is based on typical figures. The values therefore cannot be guaranteed.

10. Allowable Speed

As rotational speed of the bearing becomes larger, bearing temperature rises due to friction produced inside the bearing, producing damage such as seizure, making continued stable operation impossible. Allowable speed is the rotational speed limit at which the bearing can perform. Allowable speed differs according to bearing type, dimensions, precision, clearance, type of cage, load conditions, lubrication conditions, and various other factors.

The catalog dimensions table gives allowable speed standards for grease and oil lubrication, but allowable speed is based on the following conditions: ☞

- Bearing of proper internal design and clearance is correctly mounted.
- Suitable lubricant is used, and is properly replenished or replaced.
- Normal operating temperature under normal load conditions ($P \leqq 0.09\,C_r$, $F_a/F_r \leqq 0.3$).

Correction is necessary if load is large (see **Figs. 10.1** and **10.2**). For sealed bearings, speed is determined by peripheral speed of the seal contact section. If a radial bearing is used for a vertical shaft, there are disadvantages concerning lubrication maintenance and cage guide, so about 80% of the allowable speed is suitable. If using in excess of the allowable speed, you must reconsider bearing specifications and lubrication conditions.

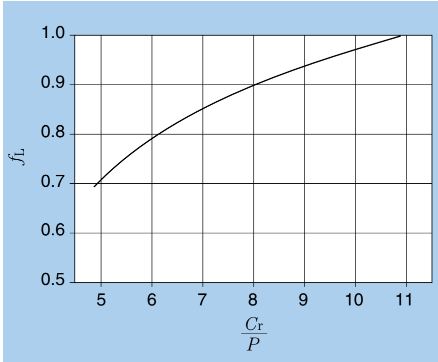


Fig. 10.1 Value of Correction Factor f_L by Bearing Load

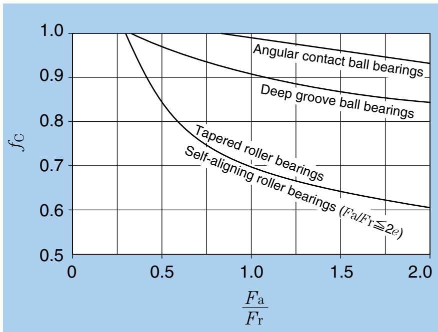


Fig. 10.2 Value of Correction Factor f_C by Combined Radial and Axial Load

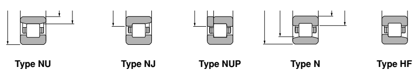
for Bearing (25/100)

From electronic catalog

Products Found

Cylindrical Roller Brg.

Number	d (mm)	D (mm)	B (mm)	Cr (KN)	Limiting speeds Grease (rpm)	Oil (rpm)
204	20.000	47.000	14.000	15.4	17000	20000
204	20.000	47.000	14.000	15.4	17000	20000
P204	20.000	47.000	14.000	15.4	17000	20000
04	20.000	47.000	14.000	15.4	17000	20000
204	20.000	47.000	14.000	15.4	17000	20000
204E	20.000	47.000	14.000	25.7	15000	18000
204E	20.000	47.000	14.000	25.7	15000	18000
P204E	20.000	47.000	14.000	25.7	15000	18000



See page B-94 of the Ball and Roller Bearings catalog.

~55mm

oundary dimensions (mm) D	B	$r_{s\,min}$ [2]	$r_{1s\,min}$ [2]	Basic load ratings dynamic (kN) C_r	static (kN) C_{0r}	dynamic (kgf) C_r	static (kgf) C_{0r}	Limiting speeds [1] (rpm) grease	oil	Bearing numbers type NU	type NJ	type NUP	type N
75	16	1	0.6	31.0	34.0	3,200	3,450	9,900	12,000	NU1009	NJ	NUP	N
85	19	1.1	1.1	46.0	47.0	4,700	4,800	8,400	9,900	NU209	NJ	NUP	N
85	19	1.1	1.1	63.0	66.5	6,450	6,800	7,600	9,000	NU209E	NJ	NUP	—

10

11. Bearing Characteristics

11.1 Friction

One characteristic of rolling bearings is that they produce less friction than sliding bearings, particularly starting friction. Friction of rolling bearings involves a variety of factors.

- Friction that accompanies rolling (load)
- Sliding friction between cage and rolling elements, and cage and guide surface
- Sliding friction between roller end faces and guide rib
- Friction of lubricant or sealing device

The friction factor for rolling bearings is generally expressed by the following equation.

$$\mu = \frac{2M}{Pd} \quad \text{.................................} \quad (11.1)$$

Where:
μ : Friction factor
M : Friction moment N·mm {kgf·mm}
P : Bearing load N {kgf}
d : Bearing bore mm

The dynamic friction factor for rolling bearings is affected by various factors as mentioned before. Dynamic friction factor also differs according to rotational speed as well as bearing type. Values are generally taken from **Table 11.1**

11

Table 11.1 Friction Factor for Bearings

Bearing type	Friction factor $\mu \times 10^{-3}$
Deep groove ball bearings	1.0～1.5
Angular contact ball bearings	1.2～1.8
Self-aligning ball bearings	0.8～1.2
Cylindrical roller bearings	1.0～1.5
Needle roller bearings	2.0～3.0
Tapered roller bearings	1.7～2.5
Self-aligning roller bearings	2.0～2.5
Thrust ball bearings	1.0～1.5
Thrust roller bearings	2.0～3.0

11.2 Temperature Rise

Almost all friction loss is converted to heat inside the bearing, causing the temperature of the bearing itself to rise. The amount of heat produced by friction moment is expressed by equation 11.2.

$$Q = 0.105 \times 10^{-6}\, M \cdot n \quad \text{N}$$
$$= 1.03 \times 10\text{-}6^{-6}\, M \cdot n \quad \{\text{kgf}\} \quad \text{......}(11.2)$$

Where:
Q : Amount of heat produced kW
M : Friction moment N·mm {kgf·mm}
n : Rotational speed of bearing rpm

Bearing temperature is determined by the balance of the amount of heat produced and the amount of heat released.

In most cases temperature rises sharply during the initial stages of operation, and then stabilizes to a somewhat lower temperature after a certain amount of time elapses. The amount of time it takes to reach this constant temperature differs according to various conditions such as bearing size, type, rotational speed, load, lubrication, and heat release of the housing. If constant temperature is never reached, it is assumed that there is something wrong. Possible causes are as follows:

- Insufficient bearing internal clearance or excessive preload.
- Bearing is mounted improperly.
- Excessive axial load due to heat expansion or improper mounting of the bearing.
- Excess/lack of lubricant, improper lubricant.
- Heat is being generated from the sealing device.

Data concerning temperature rise due to load or rotational speed is provided for your reference. (See **Figs. 11.1** and **11.2** on the following page)

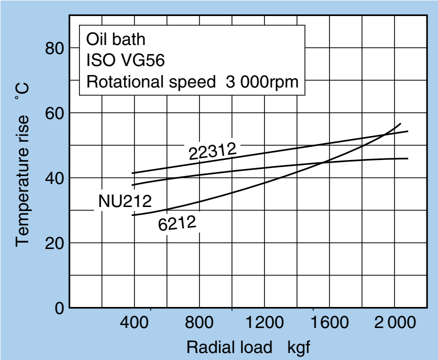


Fig. 11.1 Radial Load and Temperature Rise

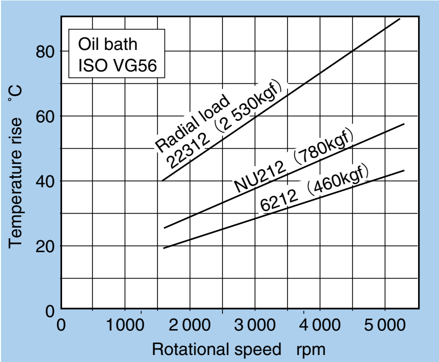


Fig. 11.2 Rotational Speed and Temperature Rise

11.3 Sound

When the inner or outer ring of the bearing turns, the rolling elements roll along the raceway surface accompanying the cage, thus producing various sounds and vibrations. In other words, vibration and sound is produced according to shape and roughness of the rolling surface and sliding parts, and the lubrication status.

With improved quality in various fields, including the data equipment field, the demand for less vibration and sound has escalated in recent years. It is rather difficult to express sound, but a list of typical abnormal sounds produced by bearings is given in **Table 11.2**.

One-Point Advice

Bearing Tips

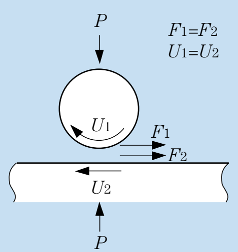
●What is rolling friction?

They say it is theoretically extremely difficult to measure pure rolling friction where difference in speed of two surfaces must be zero.

In actuality, however, the influence of pure rolling friction is extremely small compared to other factors involved in rolling bearings (such as friction between the cage and rolling elements, agitation resistance of the lubricant), and is usually ignored.

Friction is however produced between two surfaces by rolling, and there is an intimate connection between rolling and sliding friction.

Various past experiments suggest that the rolling friction factor is approximately between 0.00001 and 0.001.



Rolling friction measurement model diagram

Sound	Characteristics	Related factors
Swoosh Swoop	Sound quality does not change when rotational speed changes (dirt). Sound quality changes when rotational speed changes (Flaw).	Dirt. Surfaces of raceway, balls or rollers is rough. Damage of raceway, balls or roller surface.
Sssss	Small bearing	Surface roughness of raceway, balls or rollers.
Hiss	Produced intermittently as a rule.	Contact with labyrinth. Contact with cage and seal.
Growl (Moaning sound)	Size and height changes when rotational speed changes. Loud sound is produced at certain rpm. Sound becomes louder and softer. Sounds sometimes like siren or whistle.	Resonance, improper fit (improper shaft shape). Deformation of bearing rings. Chatter of raceway surface, balls or rollers (in the case of large bearings, a small amount of chatter is normal).
Scratch	Sensed when turned manually.	Scratching of raceway surface (regular). Scratching of balls or rollers (irregular). Dirt, deformation of bearing rings (negative clearance in places).
Roll Rumble	Large bearings, Small bearings: Continuous sound according to high speed.	Scratching of raceway surface, surface of balls or rollers.
Whirr	Stops as soon as power is turned off.	Electromagnetic sound of motor.
Crackle	Occurs irregularly (Doesn't change when rotational speed is altered). Primarily applies to small bearings.	Dirt in bearing.
Pitter-patter, Flap flap, Flutter	Tapered roller bearings, Large bearings, Small bearings: Regular continuous sound at high speed.	Clear sound from cage is normal. Improper grease at low temperature → grease should be soft. Operation with cage pocket wear, insufficient lubrication, insufficient bearing load.
Click Clack	Noticeable at low speed. Continuous sound at high speed.	Sound of impact in cage pocket; insufficient lubrication. Eliminated by decreasing clearance or applying preload. Mutual impact of full complement rollers.
Crack Clang	Loud metallic impact sound. Low-speed, thin-wall large bearings (TTB), etc.	Sound of rolling elements popping.
Urrr	Primarily cylindrical roller bearings; changes when rotational speed is altered. Sounds metallic if loud. Stops temporarily when grease is replenished.	Large consistency of lubricant (grease). Excessive radial clearance. Insufficient lubrication.
Squeak Screech	Sound of crunching between metals. High-pitched sound.	Crunching between rollers and rib surface of roller bearings. Insufficient lubrication
Pip pop	Occurs irregularly in small bearings.	Sound of air bubbles in the grease being smashed.
Krak	Squeaking sound produced irregularly.	Sliding of fit sections. Squeaking of mounting surfaces.
Sound pressure is generally too large.		Surface of raceway, balls or roller is rough. Deformation of raceway surface, balls or rollers due to wear. Clearance has been enlarged due to wear.

11

12. Lubrication

The objective of lubricating a bearing is to form a film of oil on the rolling and sliding surfaces to prevent metal parts from making direct contact with each other. Lubrication provides the following effects.

- Reduces friction and wear
- Discharges friction heat
- Extends bearing life
- Prevents rust
- Prevents foreign material from getting inside

In order to get the most from the lubricant, you must choose a lubricant and lubrication method that suits your usage conditions, and must make use of sealing devices for preventing dirt from getting in and lubricant from leaking out.

12.1 Grease Lubrication

Grease is widely used because it is easy to handle, it facilitates sealing device design, and is the most economical lubricant. Lubrication methods include sealed bearings where the grease is sealed inside the bearing in advance, and the method of filling an open bearing and housing with grease, and replenishing or replacing the grease at fixed intervals.

(1) Types of grease

Grease is hardened to a semi-solid by adding thickener to base oil (mineral oil or synthetic fluid), and then augmented by additives such as oxidation stabilizers, extreme-pressure additives and rust-preventive agents.

The nature of the grease therefore varies according to the types and combinations.

An example is given in **Table 12.1**.

Table 12.1 Grease Types and Characteristics

Name	Lithium grease			Non-soap grease	
Thickener	Li soap			Bentone, silica gel, urea, carbon black, fluorine compounds, etc.	
Base oil	Mineral oil	Diester oil	Silicon oil	Mineral oil	Synthetic oil
Dropping point (˚C)	170 ～ 190	170 ～ 190	200 ～ 250	250 or more	250 or more
Operating temperature range (˚C)	-30 ～ +130	-50 ～ +130	-50 ～ +160	-10 ～ +130	-50 ～ +200
Mechanical stability	Superior	Good	Good	Good	Good
Pressure resistance	Good	Good	Poor	Good	Good
Water resistance	Good	Good	Good	Good	Good
Applications	Largest range of applications. All-purpose grease for rolling bearings.	Superior low-temperature and friction characteristics. Suitable for small and miniature bearings.	Suitable for high and low temperatures. Has low oil film strength, and is therefore not suitable for large loads.	Can be used in a wide range of temperatures, from low to high. Exhibits superior heat, cold and chemical resistance characteristics through proper combination of base oil and thickener. All-purpose grease for rolling bearings.	

Consistency is the standard used by JIS for expressing softness of grease. The smaller the consistency number, the softer and more fluid is the grease. (See **Table 12.2**)

Main grease brands and nature table are given in **Table 12.3** on page 60. Nature is lost by mixing greases of different types. This must be avoided.

NLGI consistency No.	JIS (ASTM) 60-times mixing consistency	Application
0	355～385	Concentrated greasing
1	310～340	Concentrated greasing
2	265～295	General purpose, sealed bearings
3	220～250	General purpose, high temperature
4	175～205	Special purpose

■**Solid grease (for polylube bearing)**

Solid grease is a mixture of ultra high polymer polyethylene and lubricating grease, which is hardened by heating after sealing in the bearing. The lubricant is maintained inside polyethylene, so there is minimal leaking of the lubricant. The lubricant itself has no fluidity, so spot-pack specifications are characterized by small torque. This is also connected with preventing dirt from entering and soiling of the surrounding area by grease discharge. If used at high temperatures, however, discharge of oil increases, thus shortening lubrication life. Precautions therefore must be taken for high-speed operation or when using in high temperatures. Packing examples are shown in **Figs. 12.1** and **12.2**. **Photographs 12.1** and **12.2** were taken with the aid of an electron microscope.

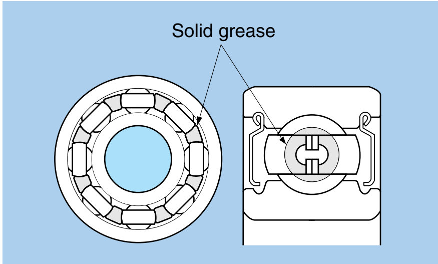


Fig. 12.1 Deep groove ball bearing spot pack specifications

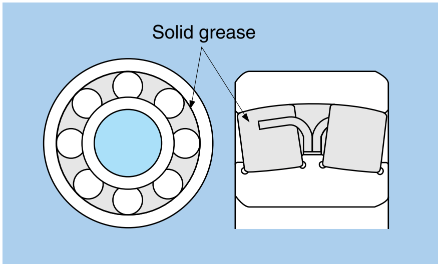
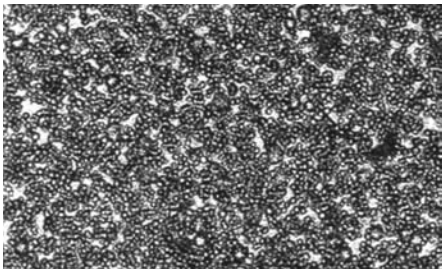
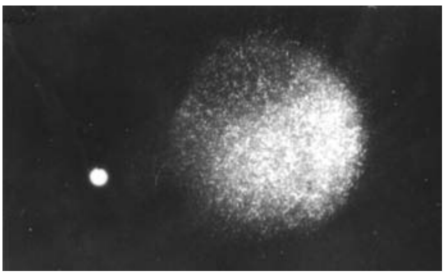


Fig. 12.2 Full pack specifications for self-aligning roller bearings



Photograph 12.1 Unhardened state photographed through electron microscope



Photograph 12.2 Heated polyethylene particle in oil

The white spot on the left is the size of the polyethylene particle prior to heating

12

(2) Grease filling and replacement

The amount of grease it takes to fill the bearing differs according to housing design, space volume, rotational speed, and grease type. The standard for filling is 30 to 40% of the bearing space volume, and 30 to 60% of space volume for the housing.

Use less grease if rotational speed is high, or you want to hold down the temperature. Too much grease could cause temperature to rise, grease to leak, or performance to decrease due to deterioration. Be careful not to overfill the bearing with grease. Approximate value for space volume in the bearing is calculated by equation 12.1.

$$V = K \cdot W \quad \cdots\cdots (12.1)$$

Where:

V : Space volume of an open bearing (approximate value) (cm^3)

K : Bearing space factor (see **Table 12.4**)

W : Bearing mass (kg)

Performance of grease deteriorates with the passing of time. Grease must therefore be replenished at suitable intervals. Replenishment interval differs according to bearing type, dimensions, rotational speed, temperature and type of grease. The standard is given in **Fig. 12.3**. This is however under normal operating conditions. Grease is also largely affected by temperature. When the bearing temperature rises above 80˚C, make the replenishment interval 1/1.5.

Table 12.4 Bearing Space Factor K

Bearing type	Cage type	K
Deep groove ball bearing ❶	Pressed cage	61
NU type cylindrical roller bearing ❷	Pressed cage Machined cage	50 36
N type cylindrical roller bearing ❸	Pressed cage Machined cage	55 37
Tapered roller bearing	Pressed cage	46
Self-aligning roller bearing	Pressed cage Machined cage	35 28

❶ 160 Series bearings not included.
❷ NU4 Series bearings not included.
❸ N4 Series bearings not included.

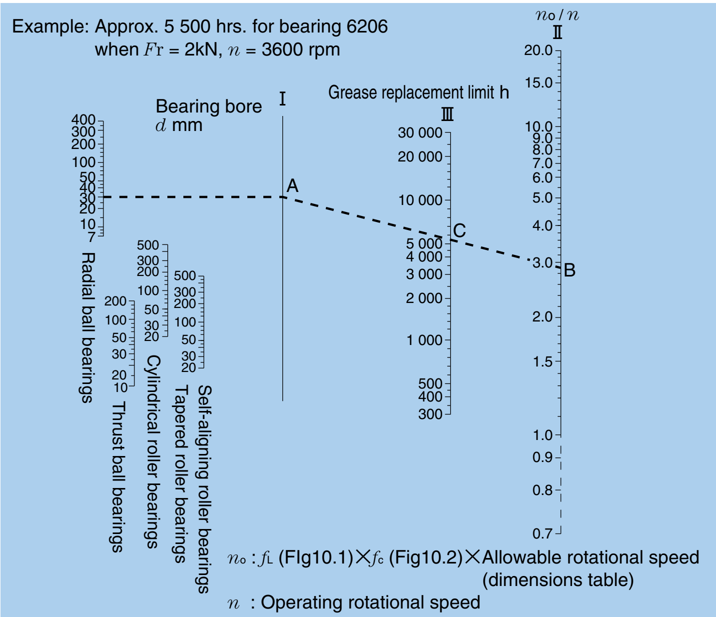


Fig. 12.3 Diagram for Determining Grease Replenishment Interval

Table 12.3 Grease Brands and Nature Table

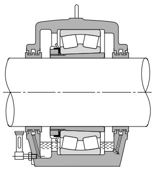
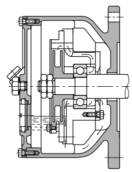
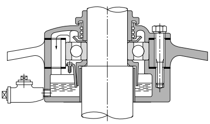
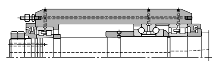
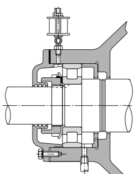
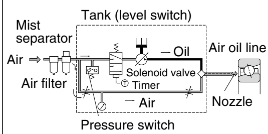
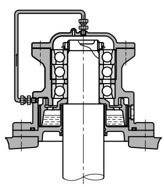
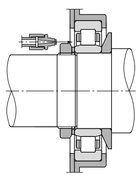
Maker	Brand	NTN No.	Thickener	Base oil
Showa Shell Sekiyu	Alvania Grease 2	2A	Lithium	Mineral oil
	Alvania Grease 3	3A	Lithium	Mineral oil
	Alvania Grease RA	4A	Lithium	Mineral oil
	Alvania EP Grease 2	8A	Lithium	Mineral oil
	Aeroshell Grease 7	5S	Micro gel	Diester oil
Kyodo Yushi	Multemp PS No.2	1K	Lithium	Diester oil
	Multemp SRL	5K	Lithium	Tetraesterdiester oil
	Multemp PSK	7K	Lithium	Diester mineral oil
	E5	L417	Urea	Ether
Esso Sekiyu	Andok C	1E	Natrium compound	Synthetic hydrocarbon
	TEMPREX N3/Unirex N3	2E	Lithium compound	Synthetic hydrocarbon
	BEACON 325	3E	Lithium	Diester oil
NOK CLUBER	Isoflex Super LDS 18	6K	Lithium	Diester oil
	Barrierta JFE552	LX11	Fluorine	Fluorine oil
	Grease J	L353	Urea	Ester
Toray, Dow Corning, Silicone	SH33L	3L	Lithium	Methyl/phenol oil
	SH44M	4M	Lithium	Methyl/phenol oil
Nippon Oil	Multinoc Wide No.2	6N	Lithiumnatrium	Diester mineral oil
	U-4	L412	Urea	Synthetic hydrocarbon + dialkyl diphenyl ether
Nippon Grease	MP-1	L448	Diurea	PAO+Ester
Idemitsukosan	Apolloil Autolex A	5A	Lithium	Mineral oil
Mobil Sekiyu	Bobil Grease 28	9B	Bentone	Synthetic hydrocarbon
Cosmo Oil	Cosmo Wide Grease WR3	2M	Na terephthalate	Diester mineral oil
Daikin Industries	Demnum L200	LX23	PTFE	Fluorine oil

Base oil viscosity		Consistency	Dropping point (˚C)	Operating temperature (˚C)	Color	Characteristics
37.8˚C	140mm²/s	273	181	−25～120	Amber	All-purpose grease
37.8˚C	140mm²/s	232	183	−25～135	Amber	All-purpose grease
37.8˚C	45mm²/s	252	183	−40～120	Amber	For low temperatures
98.9˚C	15.3mm²/s	276	187	−20～110	Brown	All-purpose extreme-pressure
98.9˚C	3.1mm²/s	288	Min. 260	−73～149	Tan	MIL-G-23827
37.8˚C	15.3mm²/s	265～295	190	−55～130	White	For low temperatures low torque
40˚C	26mm²/s	250	192	−40～150	White	Wide range
37.8˚C	42.8mm²/s	270	190	−40～130	White	1K improved rust prevention
40˚C	72.3mm²/s	300	240	−30～180	White	For high temperatures
40˚C	97mm²/s	205	260	−20～120	Brown	Min. grease leak, retainer noise
40˚C	113mm²/s	220～250	Min. 300	−30～160	Green	For high temperatures
40˚C	11.5mm²/s	265～295	177	−60～120	Brown	For low temperatures low torque
40˚C	16.0mm²/s	265～295	Min. 180	−60～130	Yellow-green	For low temperatures low torque
40˚C	400mm²/s	290	—	−35～250	White	—
40˚C	75mm²/s	—	280	−20～180	Off-white	For high temperatures
25˚C	100mm²/s	300	200	−70～160	Reddish gray	Does not lubricate well at low temperatures
40˚C	32mm²/s	260	210	−40～180	Brown	Does not lubricate well at high temperatures
37.8˚C	30.9mm²/s	265～295	215	−40～135	Light tan	Wide range
40˚C	58mm²/s	255	260	−40～180	Milk	For high temperatures
40˚C	40.6mm²/s	243	254	−40～150	Light tan	Wide range
37.8˚C	50mm²/s	265～295	192	−25～150	Yellow	All-purpose grease
40˚C	28mm²/s	315	Min. 260	−62～177	Red	MIL-G-81322C Wide range
37.8˚C	30.1mm²/s	265～295	Min. 230	−40～150	Light tan	Wide range
40˚C	200mm²/s	280	—	−60～300	White	—

12.2 Oil Lubrication

Along with facilitating lubrication of rolling and sliding parts inside the bearing, oil lubrication functions to eliminate heat produced from inside and outside the bearing. There are various methods of providing oil lubrication. The main ones are given in **Table 12.5**.

Table 12.5 Oil Lubrication Method

Lubrication method	Example	Lubrication method	Example
Oil bath lubrication ● Oil bath lubrication is the most common method of lubrication and is widely used for low to moderate rotation speed applications. ● For horizontal shaft applications, oil level should be maintained at approximately the center of the lowest rolling element, according to the oil gauge, when the bearing is at rest. For vertical shafts at low speeds, oil level should be maintained at 50 - 80% submergence of the rolling elements.		Disc lubrication ● With this method, part of the disc mounted on the shaft is submerged in oil, and the bearing is lubricated by oil springing upward.	
Oil spray lubrication ● With this method, an impeller or similar device mounted on the shaft draws up oil and sprays it on the bearing. This method can be used at considerably high speeds.		Oil mist lubrication ● The bearing is lubricated by oil mist propelled by pressurized air. ● Low resistance of lubricating oil makes this method suitable for high-speed rotation. ● Produces a lot of atmospheric pollution.	
Drip lubrication ● With this method, oil collected above the bearing is allowed to drip down into the bearing where it changes to a mist as it comes in contact with the rolling elements in the housing. Another version allows only a slight amount of oil to pass through the bearing. ● Used at relatively high speeds for light to moderate loads. ● In most cases, oil volume is a few drops per minute.		Air-oil lubrication ● With this method, the minimum required amount of oil is measured out and fed by compressed air to each bearing at the optimal interval. ● Bearing temperature can be minimized by constant supply of fresh lubricating oil to the bearing, coupled with the cooling effect of compressed air. ● Only an extremely small amount of oil is required, resulting in less pollution released into the atmosphere.	
Circulating lubrication ● Used for bearing cooling applications or for automatic oil supply systems in which oil supply is centrally located to many portions. ● Features clean maintenance of lubricating oil if the lubrication system is provided with a cooler to cool the lubricating oil, or a filter is used. ● Provided on mutually opposing side relative to the oil inlet and outlet of the bearing so that the oil reliably lubricates the bearing.		Oil jet lubrication ● Lubricates by high-pressure injection of oil from the side of the bearing. Provides high reliability under harsh conditions such as high speeds and high temperatures. ● Used for lubricating main bearings in jet engines, gas turbines and other high-speed equipment. ● Under-race lubrication for machine tools is one example of this type of lubrication.	

12

(1) Selection of lubricating oil

Various mineral oils such as spindle oil, machine oil and turbine oil are used as lubricating oil. For high temperature of 150˚C and above, and low temperatures of -30˚C and below, however, synthetic oils such as diester oil, silicone oil and fluorocarbon oil are used. Viscosity of lubricating oil is an important characteristic that determines lubricating performance. If viscosity is too low, oil film does not form sufficiently, resulting in damage to the bearing surface. On the other hand, if viscosity is too high, viscosity resistance becomes large, causing temperature to rise and friction loss to increase. Generally, the higher the rotational speed, the lower the viscosity should be, and the heavier the load is, the higher viscosity should be.

The viscosity required for lubrication of rolling bearings at this operating temperature is given in **Table 12.6**. The correlation of viscosity and temperature is given in **Fig. 12.4**. **Table 12.7** gives standards for selecting lubricating oil viscosity according to bearing operating conditions.

Table 12.6 Viscosity Required for Bearings

Bearing type	Viscosity mm^2/s
Ball bearings, cylindrical roller bearings, needle roller bearings	13
Self-aligning roller bearings, tapered roller bearings, thrust needle roller bearings	20
Self-aligning thrust roller bearings	30

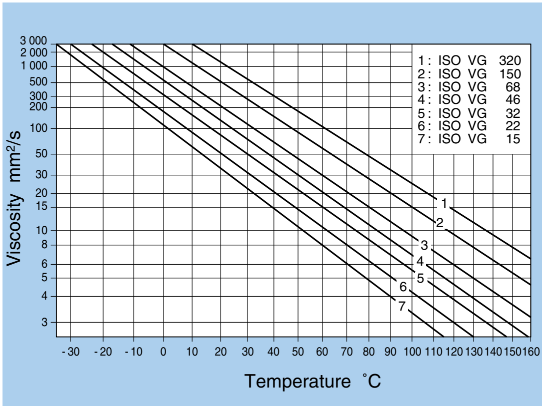


Fig. 12.4 Correlation of Temperature and Viscosity of Lubricating Oil

Table 12.7 Standard for Selecting Lubricating Oil

Bearing operating temperature ˚C	*dn* Value	ISO viscosity grade of lubricating oil (VG)		Applicable bearings
		Normal load	Heavy or shock load	
—30～ 0	Up to allowable rpms	22, 32	46	All types
0～ 60	15 000 Up to	46, 68	100	All types
	15 000 ～80 000	32, 46	68	All types
	80 000 ～150 000	22, 32	32	All bearings except thrust ball bearings
	150 000～500 000	10	22, 32	Single row radial ball bearings, cylindrical roller bearings
60～100	15 000 Up to	150	220	All types
	15 000 ～80 000	100	150	All types
	80 000 ～150 000	68	100, 150	All bearings except thrust ball bearings
	150 000～500 000	32	68	Single row radial ball bearings, cylindrical roller bearings
100 ～150	Up to allowable rpms	320		All types
0～ 60	Up to allowable rpms	46, 68		Self-aligning roller bearings
60～100	Up to allowable rpms	150		

Remarks 1: When the lubrication method is oil bath or circulating lubrication.

(2) Oil quantity

When lubrication is forcibly fed to the bearing, the amount of heat generated from the bearing, etc. equals the sum of the radiant heat given off by the housing and heat given off by the oil. The quantity of oil required for a standard housing is calculated by the equation 12.2.

$$Q=K\cdot q \quad \cdots\cdots\cdots\cdots\cdots\cdots (12.2)$$

Where

Q : Quantity of oil supplied per bearing (cm³/min)

K : Allowable oil temperature rise factor (see **Table 12.8**)

q : Oil quantity according to diagram (cm³/min) (**Fig. 12.5**)

In the case of actual operation, it is safe to adjust the oil supply quantity to meet the amount that is adequate for the actual situation because the sum of the radiant heat varies depending on the housing shape by referring to the calculated value as a guideline. Assuming that the oil carries away all the generated heat in **Fig. 12.5**, the oil supply quantity should be calculated as the shaft diameter d = 0.

The oil replacement limit in the oil bath lubrication may vary depending on the using condition, oil quantity or lubricant type. It is recommended to replace the oil around once a year if the oil is used in the range lower than 50˚C, and at least every three months in the case of range between 80 and 100˚C.

Discharge oil temperature minus supplied oil temperature (˚C)	K
10	1.5
15	1
20	0.75
25	0.6

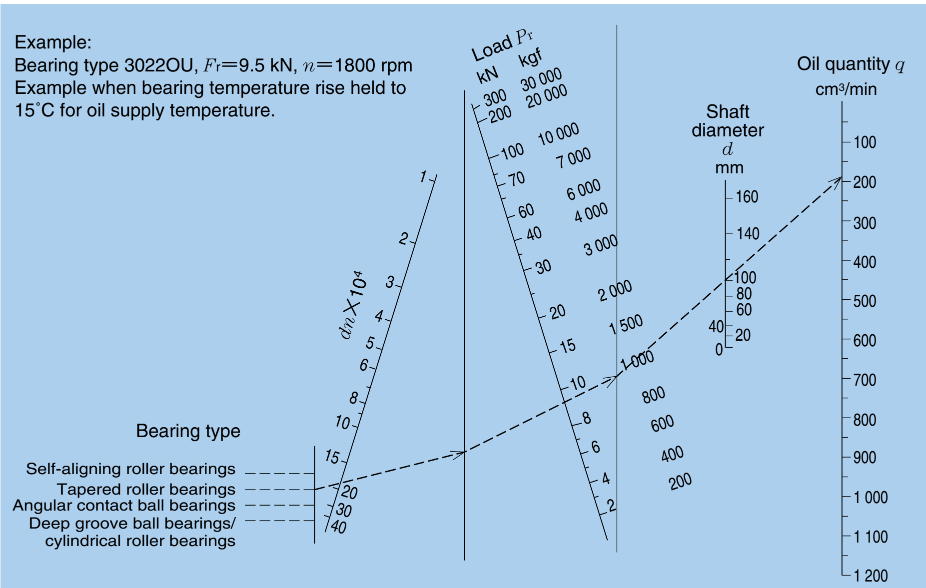
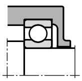
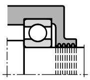
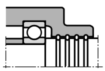
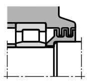
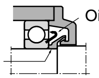
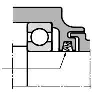
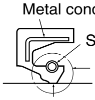
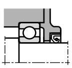
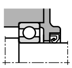
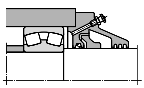


Fig. 12.5 Oil Supply Quantity Diagram

13. External Bearing Sealing Devices

The objective of sealing devices is to prevent lubricant from leaking out of the bearing and prevent dirt and water from getting inside the bearing. Sealing devices work well to seal and make the bearing dust-proof for various operating conditions. Sealing devices are durable - they produce little friction and no abnormal heat. They are also good for applications requiring ease of assembly.

Sealing devices are roughly divided into non-contact seals and contact seals. Seals can also be used in various combinations, the most common of which are given in **Table 13.1**.

Type	Seal construction	Name	Seal characteristics
Non-contact seal		Clearance seal	Extremely simple seal design with small radial clearance.
		Oil groove seal (Oil grooves on housing side)	Several concentric oil grooves are provided on the housing inner diameter to greatly improve the sealing effect. When the grooves are filled with lubricant, the intrusion of contaminants from the outside is prevented.
		Oil groove seal (Oil grooves on shaft and housing side)	Oil grooves are provided on both the shaft outer diameter and housing inner diameter to form a more efficient seal.
		Radial labyrinth seal	Seal where labyrinth passages are formed in the radial direction. Used for housing vertically divided in two. Provides better sealing than axial labyrinth seals.
		Internal slinger in housing	The housing is provided with a slinger. The centrifugal force of the turning slinger prevents lubricant from leaking out.
Contact seal		Z grease seal	Contact seal has a Z-shaped cross-section. The hollow portion is packed with grease to form a grease seal. Often used for plummer blocks.
	  	Oil seal	Contact seals are generally used as oil seals. The type and dimensions are standardized by ISO 6194 (JIS B 2402). Sealing effect is enhanced by a ring-shaped spring mounted on the lip of the oil seal, which presses the lip edge against the shaft surface. If the bearing and oil seal are close to each other, heat produced from the oil seal may cause internal clearance of the bearing to be insufficient. Select bearing internal clearance with proper regard for heat produced from the oil seal due to peripheral speed. Depending upon orientation, the seal functions to prevent lubricant from leaking out the bearing, or foreign matter from getting inside.
Combination seals		Oil groove seal + slinger + Z grease seal	In order to enhance performance, some Z grease seals include an oil groove seal and slinger. The figure on the left shows triple seal construction for prevention intrusion of foreign matter by seal orientation. Used for mining equipment and plummer blocks and other places exposed to excessive dust.

14. Bearing Materials

14.1 Bearing ring and Rolling element materials

When a rolling bearing turns while receiving a load, a lot of stress is repeatedly placed on the small contact surface of the bearing rings and rolling elements, and the bearing must maintain high precision while rotating. That means bearing materials must satisfy the following demands.

- Must be hard.
- Rolling fatigue life must be long.
- Wear must be slight.
- Must be shock-resistant.
- Dimensions must not vary largely with the passing of time.
- Must be economical and easy to machine.

Among the things that affect rolling fatigue life most are non-metallic debris in steel. Various steel manufacturing methods have been developed to reduce non-metallic debris, which have contributed to enhancing life.

The same materials are generally used for bearing rings and rolling elements, especially high carbon chrome bearing steel. The chemical constituents of the various types of steel have been standardized by ISO 683 (JIS G 4805). The composition table for the most frequently used material, SUJ2, is given in **Table 14.1**.

Table 14.1 High Carbon Chrome Bearing Steel (ISO 683 (JIS G 4805))

Steel type code	Chemical composition %					
	C	Si	Mn	P	S	Cr
SUJ2	0.95~ 1.10	0.15~ 0.35	Max. 0.50	Max. 0.025	Max. 0.025	1.30~ 1.60

In addition to this, there is shock-resistant carburized steel whereby the surface is carbon tempered and the core softened to provide it with toughness, high-speed steel used at high temperatures, stainless steel which emphasizes corrosion resistance, ceramics with small specific gravity for ultra high speed, and plastics used in liquids, each of which is used according to objective.

Dimensions of the same bearing steel are subject to change in high temperatures in excess of 120˚C. Development of all kinds of bearings including bearings that are treated to resist dimension change and those whose life has been extended by modified heat treatment and carbon-nitride surface treatment.

14.2 Cage materials

Cages function to correctly retain rolling elements as the bearing turns, but they must also be strong enough to withstand vibration and shock loads while turning, and must be able to withstand operating temperature of the bearing. The cages must also be lightweight and produce little friction between rolling elements and bearing rings.

Pressed cages of cold or hot-rolled steel sheets are often used for small and medium-sized bearings, but stainless steel is also used, depending upon the purpose. Machine structure carbon steel, high strength brass and aluminum alloys are also used for machined cages such as large-sized bearings. If cage strength is required, heat-treated materials of nickel chrome molybdenum (SNCM) are used, and copper and silver plating is used for enhancing lubrication characteristics. In recent years injection molded heat-resistant polyamide reinforced with glass or carbon fibers have come to be used. Plastic cages are lightweight, corrosion-resistant, and have superior attenuation and lubrication characteristics. Teflon cages are sometimes used for high temperatures.

15. Shaft and Housing Design

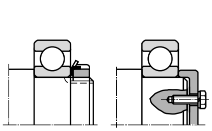
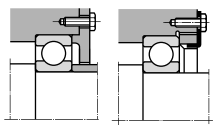
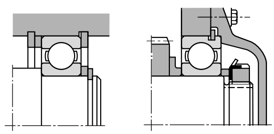
Bearing performance is largely affected by inclination, deformation and creep according to shaft and housing design. The following are therefore very important.

- Bearing arrangement selection and method of fastening the bearing suited to the selected arrangement
- Suitable shaft and housing fillet radius and shoulder height dimensions, squareness, runout
- Dimensions, shape precision and roughness of fitted parts
- Outer diameter of shaft and housing (including thickness variation)

15.1 Fixing of Bearings

When fastening a bearing to the shaft or housing, the bearing must be fixed in the axial direction as well as fastening by interference with some exceptions. In the case of an axial load, bearing rings may move due to shaft flexure when cylindrical roller bearings are used as the floating side bearing, and must therefore be fixed in the axial direction. Shaft shoulder height should not exceed groove bottom.

The most common methods of fastening are shown in **Fig. 15.1**.

Inner ring fixing	Outer ring fixing	Fixing with snap ring
		
The most common fixing method is to fasten the edge of the bearing ring to the shaft or housing shoulder by nuts or bolts.		Construction is simplified by using a snap ring, but dimensions related to bearing mounting such as interference with chamfers must be considered. Snap rings are not suitable if high precision is required and a large axial load is applied to the snap ring.

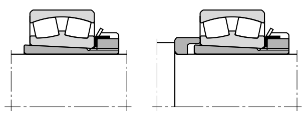
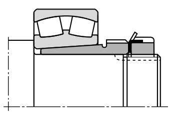
Fixing by adapter sleeve	Fixing by withdrawal sleeve
	
When mounting on a cylindrical shaft using an adapter sleeve or withdrawal sleeve, the bearing can be fixed in the axial direction. In the case of an adapter sleeve, the bearing is fixed in place by frictional force between the inside of the sleeve and the shaft.	

Fig. 15.1 Examples of Bearing Fixing Methods

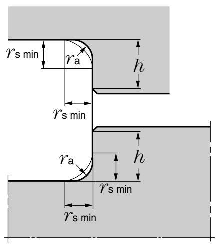
15.2 Bearing Fitting Dimensions

The shaft and housing shoulder height (h) should be larger than the bearing's maximum allowable chamfer dimensions ($r_{s\,max}$), and the shoulder should be designed so that it directly contacts the flat part of the bearing end face. The fillet radius must be smaller than the bearing's minimum allowable chamfer dimension ($r_{s\,min}$) so that it does not interfere with bearing seating. Dimensions are given in **Table 15.1**.

If shaft fillet R is increased in order to enhance shaft strength, and the shaft shoulder dimension is too small, mount with a spacer between the shaft shoulder and bearing. (See **Fig. 15.2**)

Grinding undercut is needed if the shaft is to be grind-finished. Undercut dimensions are given in **Table 15.2**.

Table 15.1 Shoulder Height and Fillet Radius



Unit: mm

$r_{s\,min}$	$r_{as\,max}$	h (Min.) General ❶	h (Min.) Special ❷
0.05	0.05	0.3	
0.08	0.08	0.3	
0.1	0.1	0.4	
0.15	0.15	0.6	
0.2	0.2	0.8	
0.3	0.3	1.25	1
0.6	0.6	2.25	2
1	1	2.75	2.5
1.1	1	3.5	3.25
1.5	1.5	4.25	4
2	2	5	4.5
2.1	2	6	5.5
2.5	2	6	5.5
3	2.5	7	6.5
4	3	9	8
5	4	11	10
6	5	14	12
7.5	6	18	16
9.5	8	22	20
12	10	27	24
15	12	32	29
19	15	42	38

❶ If a large axial load is applied, shoulder height larger than this value is required.
❷ Used when axial load is small. The values are not suitable for tapered roller bearings, angular contact ball bearings, and self-aligning roller bearings.
Reference: $r_{as\,max}$ is the maximum allowable value for fillet radius.

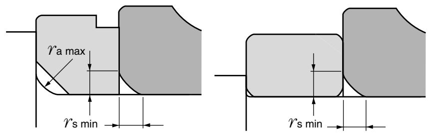
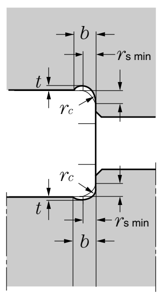


Fig. 15.2 Method Using Spacer

Table 15.2 Grinding Undercut Dimensions

$r_{s\,min}$	Undercut dimensions b	t	r_c
1	2	0.2	1.3
1.1	2.4	0.3	1.5
1.5	3.2	0.4	2
2	4	0.5	2.5
2.1	4	0.5	2.5
2.5	4	0.5	2.5
3	4.7	0.5	3
4	5.9	0.5	4
5	7.4	0.6	5
6	8.6	0.6	6
7.5	10	0.6	7



15

15.3 Shaft and Housing Precision

Precision required for normal operating conditions is given in **Table 15.3**, and allowable bearing misalignment for various types of bearings is given in **Table 15.4**.

Using bearings in excess of these limits, bearing life decreases and could damage the cage, etc. Pay special attention to rigidity of the shaft and housing, mounting error resulting from machining precision, and then select bearing type carefully.

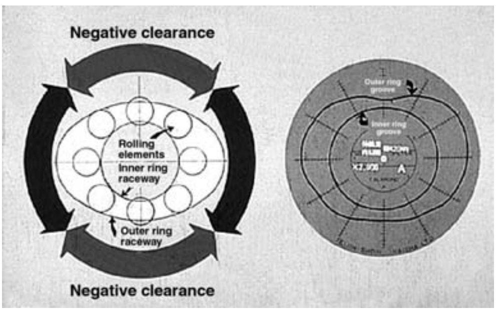
Table 15.3 Shaft and Housing Precision

Item		Shaft	Housing
Dimension precision		IT6 (IT5)	IT7 (IT5)
Circularity (max) Cylindricity		IT3	IT4
Shoulder runout tolerance		IT3	IT3
Fit surface roughness	Small bearings	0.8a	1.6a
	Medium to large bearings	1.6a	3.2a

Reference: In the case of precision bearings (precision given on P4 and P5), precision must be kept down to approx. 1/2 for circularity and cylindricity.

Table 15.4 Allowable Bearing Misalignment

Allowable misalignment	
Deep groove ball bearings	1/1 000～1/300
Angular contact ball bearings	
Single row	1/1 000
Double row	1/10 000
Back-to-back	1/10 000
Face-to-face	1/1 000
Cylindrical roller bearings	
Bearing Series 2, 3, 4	1/1 000
Bearing Series 22, 23, 49, 30	1/2 000
Tapered roller bearings	
Single row and back-to-back	1/2 000
Face-to-face	1/1 000
Needle roller bearings	1/2 000
Thrust bearings (excluding self-aligning thrust roller bearings)	1/10 000
Allowable alignment	
Self-aligning ball bearings	1/20
Self-aligning roller bearings	1/50～1/30
Self-aligning thrust roller bearings	1/30



15

16. Handling

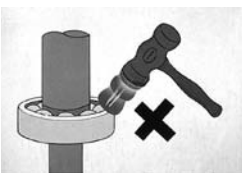
Rolling bearings are precision parts, and must be handled with care to ensure their precision. The following care should be taken:

- Bearings must be kept clean. Dirt affects wear and noise. Be careful of dirt in the air as well.
- Do not expose to strong shocks. Doing so could cause dents or crack the raceway surface. Do not drop or strike with a hammer.
- In order to prevent rust, do not handle with your bare hands. Should be coated with rust preventative, and stored in package in max. relative humidity of 60%.

16.1 Mounting

Remove all dirt, spurs, metal shavings, etc., from the shaft, housing, related parts and mounting fixtures before mounting the bearing. Check the dimension precision, shape precision, and roughness of the mounting section and make sure they are within tolerance. Leave the bearing in its packaging until you are ready to mount it.

In the case of oil lubrication, or even when using grease lubrication, if there is danger of destroying effectiveness of the lubricant by mixing with rust preventatives, remove the rust preventative with detergent oil prior to mounting. If you plan to apply grease after cleaning the bearing, you should dry the bearing somewhat before applying grease. If the bearing is to be inserted on the shaft or in the housing, you must apply equal pressure to the entire circumference of the bearing rings (inner and outer) while inserting. Inserting while applying force to just one part will cause the ring to become cocked to one side. If you apply force to the ring that is not to be inserted, load is applied via the rolling elements. This could dent the raceway surface, and should absolutely be avoided. Inserting bearing rings by striking directly with a hammer could crack or break the ring, as well as dent it.



(1) Mounting cylindrical bore bearings

As shown in **Fig. 16.1**, bearings with comparatively low interference are press or hammered into place while applying an equal load to the entire circumference of the bearing by positioning the guide on the edge of the bearing ring to be fit. If mounting the inner and outer rings simultaneously, press fit evenly using a metal block as shown in **Fig. 16.2**. In either case, be careful the bearing does not become misaligned when you begin mounting. In some cases a guide is used to prevent misalignment. If interference of the

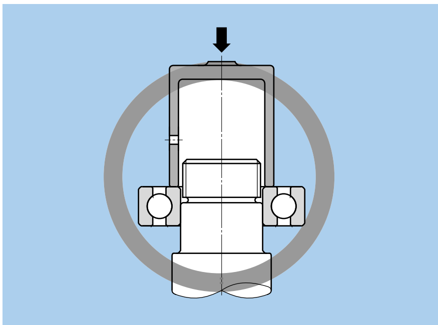


Fig. 16.1 Inner Ring Press Fitting

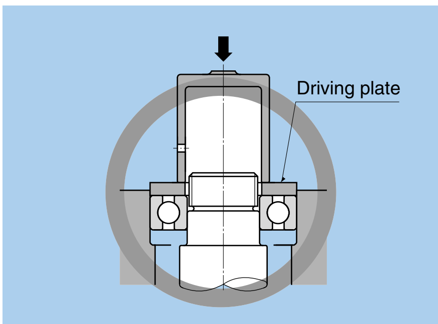


Fig. 16.2 Inner/Outer Ring Simultaneous Press Fitting

16

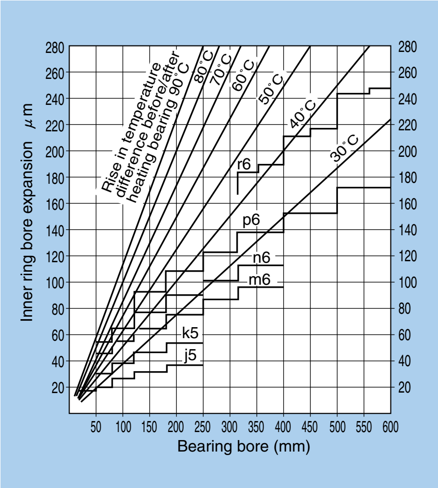


Fig. 16.3 Heating Temperature Required for Heat Fit of Inner Ring

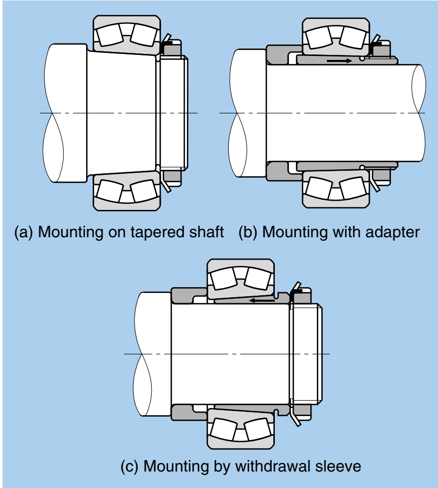


Fig. 16.4 Mounting by Locknut

inner ring is large, the bearing is generally heated to make the inner ring expand can easily be inserted on the shaft. The amount of expansion according to temperature difference of the bearing bore is shown in **Fig. 16.3**.

Dipping in clean heated oil is the most common method of heating the bearing (this cannot be done with grease sealed bearings). You must also be careful not to heat the bearing in excess of 120˚C. In addition to this there is heating in air in a thermostatic chamber, and inductance heaters are used for inner ring separation (required demagnetization) such as cylindrical rollers. After inserting the heated bearing on the shaft, the inner ring must be pressed against the shaft shoulder until the bearing cools in order to prevent clearance from developing.

(2) Mounting tapered bore bearings

A tapered shaft or adapter/withdrawal sleeve is used for small bearings with tapered bore. The bearings are driven into place with a locknut. (See **Fig. 16.4**)

Large bearings require a lot of driving force,

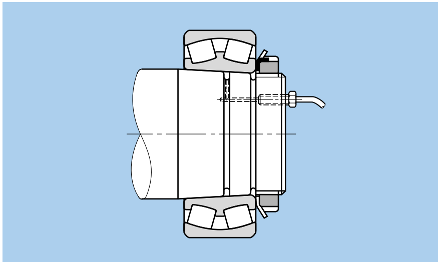


Fig. 16.5 Mounting by Oil Injection

and are mounted by hydraulic pressure. **Fig. 16.5** shows the bearing directly mounted on a tapered shaft. With this method, high-pressure oil is sent to the fit surface (oil injection) in order to reduce friction of the fitting surface and tightening torque of the nut. In addition to this, bearings can be mounted by a hydraulic nut or sleeve using hydraulic pressure. In the case of bearings mounted in this fashion, interference is increased and radial internal clearance is decreased by driving the tapered surface in the axial direction. You can estimate interference by measuring the amount the clearance decreases. To measure radial internal clearance of self-aligning roller bearings, let the roller settle into their correct positions and insert a thickness gauge in between the rollers and outer ring where there is no load (**Fig. 16.6**). At this time, it is important to measure with the rollers still. You can also obtain the proper interference by measuring the amount of drive in the axial direction instead of the amount of radial internal clearance reduction.

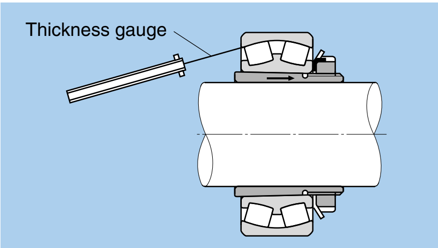


Fig. 16.6 Measuring Internal Clearance of Self-Aligning Roller Bearings

(3) Mounting outer rings

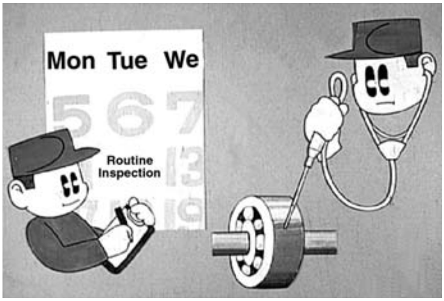
If the outer ring is interference-fit into the housing and the interference is large, depending upon the dimensions and shape of the housing, the housing can be heated to accommodate the outer ring, but cold fitting is generally used. With this method, the outer ring is shrunk using a coolant such as dry ice. With cold fitting, however, moisture in the atmosphere tends to condense on the bearing surface, thus necessitating suitable measures for preventing rust and frostbite.

16.2 Post-Installation Running Test

After mounting, the bearings must be checked to make sure they are properly installed. First, turn the shaft or housing with your hand to make sure there is no looseness, the torque isn't too great, or anything else out of the ordinary. If you don't notice anything unusual, run the equipment at low speed without a load. Gradually increase speed and load while checking rotation. If you notice any unusual noise, vibration or temperature increase, stop operation and check out the problem. If necessary, remove and inspect the bearing. You can check the sound volume and the tone of the turning bearing by placing a stethoscope on the housing (see **Table 11.2**).

If there is a lot of vibration, it is possible to infer the source of the problem by measuring amplitude and frequency. Bearing temperature rises along with rotation time, and then stabilizes after a certain period of time elapses. If temperature rises sharply and does not stabilize no matter how much time elapses, you must stop operation and investigate the cause of the problem.

Possible causes include too much lubricant, too much seal interference, insufficient clearance, and too much pressure. It is best to measure bearing temperature by touching the measurement probe to the outer ring, but temperature is sometimes measured from the housing surface, or if there is no problem with doing so, by feeling the housing with the hand.



16.3 Bearing Removal

Bearings are removed for routine inspection and parts replacement. The shaft and housing are usually always reused, and in many cases the bearing itself can be reused. It is therefore important to be careful not to damage the bearing when removing. In order to do so, a structural design that facilitates removal and the use of proper tools are required. When removing a bearing ring mounted with interference, withdrawal load must be placed on that ring only. Never attempt to remove a bearing ring via the rolling elements.

(1) Cylindrical bore bearing removal

As shown in **Figs. 16.7** and **16.8**, a press or puller are often used to remove small bearings. Design must also take removal into consideration as shown in **Figs. 16.9** - **16.11**. Removal of large interference-fit bearings used for an extended period of time require a large load. Such bearings should be designed for removal by hydraulic means such as shown in **Fig. 16.12**. Inductance heaters can be used to remove cylindrical roller bearings with separable inner and outer rings.

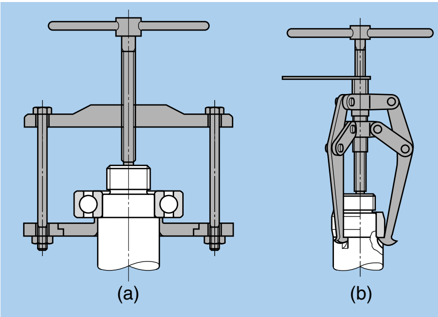


Fig. 16.7 Removal by Puller

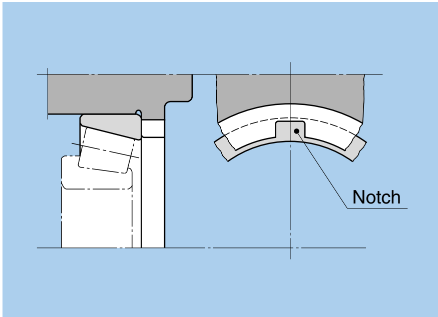


Fig. 16.10 Notch for Outer Ring Removal

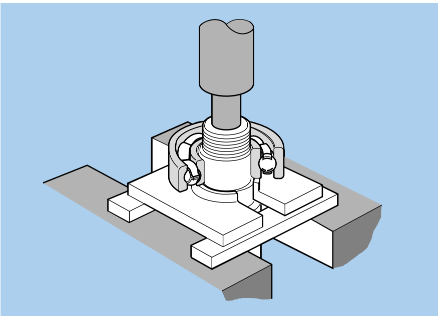


Fig. 16.8 Removal by Press

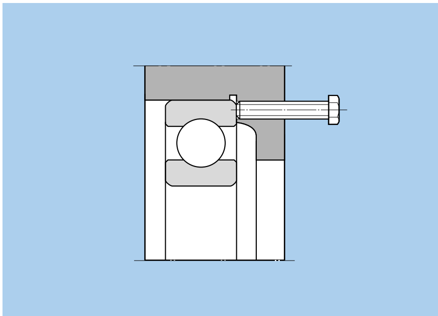


Fig. 16.11 Bolt for Outer Ring Removal

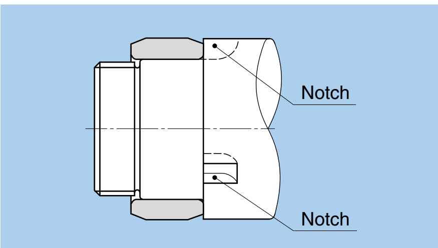


Fig. 16.9 Notch for Removal

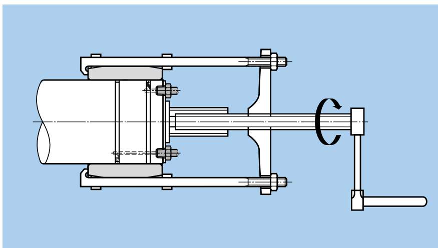


Fig. 16.12 Removal by Hydraulic Means

16

(2) Tapered bore bearing removal

Small bearings mounted using an adapter sleeve are removed by loosening the fastening nut, placing a metal block on the inner ring as shown in **Fig. 16.13**, and tapping with a hammer.

The task of removing large bearings mounted on a tapered shaft using an adapter sleeve or withdrawal sleeve is facilitated by using a hydraulic means of removal. (See **Figs. 16.14** and **16.15**)

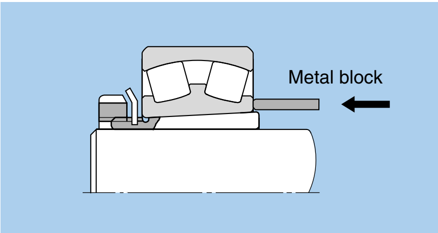


Fig. 16.13 Removal of Bearing W/Adapter Sleeve

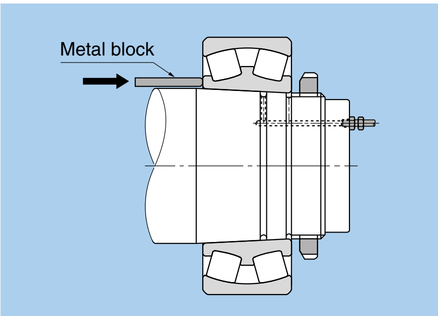


Fig. 16.14 Removal of Bearing by Hydraulic Means

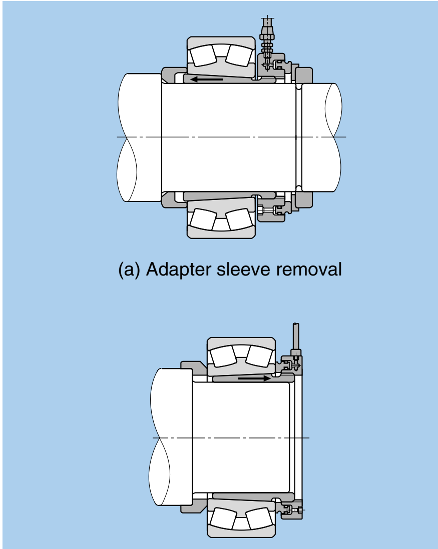


Fig. 16.15 Removal by Hydraulic Nut

16.4 Press Fit and Pullout Force

The force required to press fit or remove a bearing on/from a shaft or in/from a housing is calculated by the following equations.

For shaft and inner ring:

$$K_d = \mu \cdot P \cdot \pi \cdot d \cdot B \quad \cdots\cdots\cdots\cdots\cdots (16.1)$$

For housing and outer ring:

$$K_D = \mu \cdot P \cdot \pi \cdot D \cdot B \quad \cdots\cdots\cdots\cdots\cdots (16.2)$$

Where:

K_d : Inner ring press fit or withdrawal force N {kgf}
K_D : Outer ring press fit or withdrawal force N {kgf}
P : Fit surface pressure MPa {kgf／mm²}

Inner ring $P = \frac{E}{2} \frac{\Delta_{deff}}{d} \frac{(1-k^2)(1-k_0^2)}{1-k^2 k_0^2}$

Outer ring $P = \frac{E}{2} \frac{\Delta D_{eff}}{D} \frac{(1-h^2)(1-h_0^2)}{1-h^2 h_0^2}$

Where:

$k = \frac{d}{d_i}$ $\quad k_0 = \frac{d_0}{d}$ $\quad h = \frac{D_e}{D}$ $\quad h_0 = \frac{D}{D_0}$

d : Inner ring bore (shaft diameter) mm
d_i : Inner ring raceway diameter mm
d_0 : Hollow shaft bore ($d_0 = 0$ for solid shaft) mm
Δ_{deff} : Inner ring effective interference mm
D : Outer ring outer diameter (housing inner diameter) mm
D_e : Outer ring raceway diameter mm
D_0 : Housing outer diameter mm
ΔD_{eff} : Outer ring effective interference mm
E : Modulus of longitudinal elasticity 2.07×10^6 MPa {21 200kgf／mm²}
μ : Friction factor (see **Table 16.1**)
B : Width of inner ring or outer ring mm

Table 16.1 Friction Factor for Press Fitting and Withdrawal

Applications	μ
When inner (outer) ring is press-fitted on/into cylindrical shaft (hole)	0.12
When inner (outer) ring is withdrawn from cylindrical shaft (hole)	0.18
When inner ring is press-fitted onto tapered shaft or sleeve	0.17
When inner ring is withdrawn from tapered shaft	0.14
When sleeve is press-fitted onto shaft/bearing	0.30
When sleeve is withdrawn from shaft/bearing	0.33

16

17. Bearing damage and corrective measures

As long as they are handled properly, bearings can usually be used the entire extent of their rolling fatigue life. Premature damage is usually the result of improper bearing selection, handling, lubrication or sealing device. Because there are so many factors involved, it is almost impossible to infer the cause from the appearance of the damage. It is however important to know the type of machine used, the location and conditions of usage and construction surrounding the bearing, etc., and infer the cause from the situation when the damage occurred and the type of damage to prevent reoccurrence. Primary causes and corrective measures for bearing damage are given in **Table 17.1 (a), (b), (c), (d)** and **(e)**.

Table 17.1 (a) Bearing damage and corrective measures

Description	Causes	Corrective measures
●Flaking  Flakes form on the surfaces of the raceway and roller elements. When the flakes fall off, the surface becomes rough and uneven.	● Excessive loads, fatigue life, improper handling ● Improper mounting ● Insufficient precision of shaft or housing ● Insufficient clearance ● Contamination ● Rust ● Improper lubrications ● Softening due to abnormal temperature rise	● Select another type of bearing. ● Reconsider internal clearance. ● Improve precision of shaft or housing. ● Improve operating conditions. ● Improve method of assembly and handling. ● Check bearing periphery. ● Reconsider lubricant and lubrication method.
●Seizure  Bearing heats up, becomes discolored and eventually seizes up.	● Insufficient clearance (including clearances made smaller by local deformation) ● Insufficient lubrication, improper lubricant ● Excessive load (excessive preload) ● Roller skew ● Softening due to abnormal temperature rise	● Reconsider lubricant type and quantity. ● Reconsider internal clearance (enlarge internal clearance). ● Prevent misalignment. ● Reconsider operating conditions. ● Improve method of assembly and handling.

17

Table 17.1 (b) Bearing damage and corrective measures

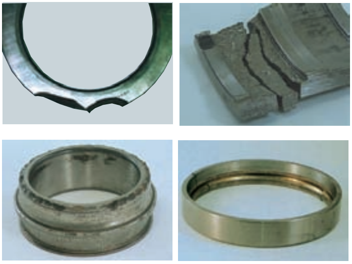
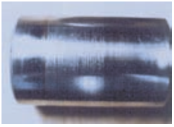
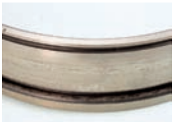
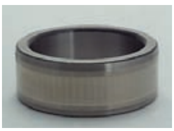
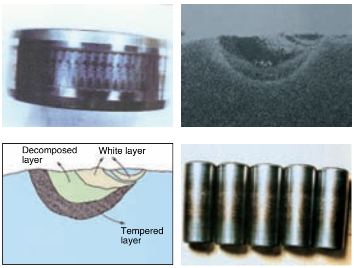
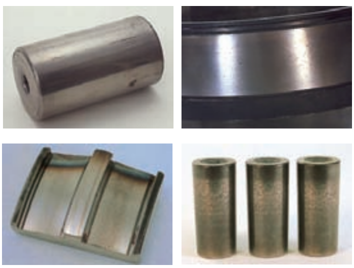
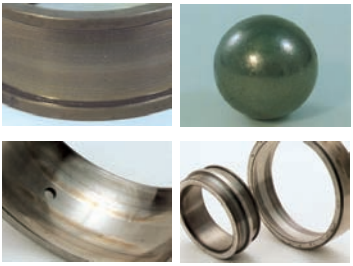
Description	Causes	Corrective measures
●Cracking and notching  Localized flaking and cracking.	● Excessive shock load ● Improper handling (use of steel hammer and impact of large foreign particles) ● Surface deformation due to improper lubrication ● Excessive interference ● Large flaking ● Friction cracks ● Insufficient precision of counterpart (fillet radius too large)	● Reconsider lubricant (prevent friction cracks). ● Reconsider proper interference and material. ● Reconsider operating conditions. ● Improve method of assembly and handling.
●Cage damage  Rivets become loose or break off. Cage becomes damaged.	● Excessive moment load ● High-speed rotation or excessive rotation fluctuation ● Improper lubrication ● Impact of foreign matter ● Excessive vibration ● Improper mounting (misalignment)	● Reconsider lubricant and lubrication method. ● Select a different type of cage. ● Investigate rigidity of shaft and housing. ● Reconsider operating conditions. ● Improve method of assembly and handling.
●Meandering wear patterns  Meandering or irregular wear of raceway surface by rolling elements	● Insufficient precision of shaft or housing. ● Improper mounting ● Insufficient rigidity of shaft and housing ● Shaft sling due to excessive internal clearance	● Re-check internal clearance. ● Reconsider machining precision of shaft or housing. ● Reconsider rigidity of shaft and housing.

Table 17.1(c) Bearing damage and corrective measures

Description	Causes	Corrective measures
●Smearing and scuffing     Surface becomes rough with small deposits. "Scuffing" generally refers to roughness of the bearing ring ribs and roller end faces.	● Improper lubrication ● Invasion of foreign matter ● Roller skew due to bearing misalignment ● No oil on rib surface due to excessive axial load ● Excessive surface roughness ● Excessive sliding of rolling elements	● Reconsider lubricant and lubrication method. ● Improve sealing performance. ● Reconsider preload. ● Reconsider operating conditions. ● Improve method of assembly and handling.
●Rust and corrosion     Surface becomes partially or fully rusted. Rust may also develop on rolling element pitch lines.	● Improper storage ● Improper packaging ● Insufficient rust preventative ● Invasion of moisture, acid, etc. ● Handling with bare hands	● Take measure to prevent rusting while in storage. ● Inspect lubricant on regular basis. ● Improve sealing performance. ● Improve method of assembly and handling.
●Fretting   There are two types of fretting: the type where rust-colored wear powder forms on fitting surfaces, and the type where brinneling indentation forms on the raceway along the pitch of the rolling elements.	● Insufficient interference ● Small bearing oscillation angle ● Insufficient lubrication (unlubricated) ● Fluctuating load ● Vibration during transport or when not operating	● Select a different type of bearing. ● Reconsider lubricant and lubrication method. ● Reconsider interference and apply lubricant to fitting surface. ● Package inner and outer rings separately for transport.

Description	Causes	Corrective measures
●Wear  The surface becomes worn, resulting in dimension change. Wear is often accompanied by roughness and damage.	● Foreign matter in the lubricant ● Insufficient lubrication ● Roller skew	● Reconsider lubricant and lubrication method. ● Improve sealing performance. ● Prevent misalignment.
●Electrolytic corrosion  Pits form on raceway and develop into ripples.	● Electric current flowing through raceway	● Create a bypass for current. ● Insulate the bearing.
●Dents and scratches  Impact of solid foreign matter. Scoring during assembly, gouges in surface due to impact.	● Solid foreign matter ● Dents caused by flakes ● Impact or dropping due to improper handling ● Misalignment when assembling	● Improve method of assembly and handling. ● Improve sealing performance (to prevent foreign matter from getting inside). ● Check bearing periphery (when caused by metal shavings).

Description	Causes	Corrective measures
●Creep  Surface becomes mirror finished due to slipping of the inner and outer surfaces. Sometimes accompanied by discoloration or scuffing.	● Insufficient interference of fitted parts ● Insufficient sleeve tightening ● Abnormal temperature rise ● Excessive load	● Reconsider interference. ● Reconsider operating conditions. ● Reconsider machining precision of shaft and housing.
●Surface matting  Surface luster disappears, and surface becomes matted and rough. Surface becomes covered with tiny dents.	● Foreign matter ● Improper lubrication	● Reconsider lubricant and lubrication method. ● Improve sealing devices ● Clean lubricating oil (with filter)
●Peeling  Patches of minute peeling (approx. 10 μm). Accompanied by innumerable cracks that have not yet peeled. (Tends to form on roller bearings.)	● Foreign matter ● Improper lubrication	● Reconsider lubricant and lubrication method. ● Improve sealing performance (prevent foreign matter from getting in). ● Perform warm-up operation prior to work.

One-Point Advice

Bearing Tips

●Transition of NTN Technology (Introduction of "Technical Review")

NTN technology has developed along with advancements in various industries based on rolling bearings. There is practically no industry that can exist without the use of bearings, beginning with the steel industry in the postwar reconstruction period, and including railway cars, automobiles, aircraft, high-speed communications and environment-related industries. Some of these are covered in **NTN** TECHNICAL REVIEW (formerly "Bearing Engineer").

Inaugural Issue
October, 1950

No. 10
December, 1954

No. 20
December, 1959
High-speed bearings

No. 29
December, 1964

No. 42
May, 1972
Aircraft bearings

No. 72
October, 2004
Machine tool bearings &
Precision apparatus products

No. 73
October, 2005
Automotive products

No. 74
November, 2006
Products for industrial
machinery

No. 75
October, 2007
Automotive environmental
technologies

No. 76
October, 2008
Elemental technologies

No. 77
December, 2009
Efforts for the environment

No. 78
October, 2010
Products for industrial machinery
& elemental technologies

No. 79
November, 2011
Automotive technologies

Reference material

Abbreviation	Standards
JIS	Japanese Industrial Standards
BAS	The Japan Bearing Industrial Association Standards
ISO	International Organization for Standardization
DIN	Deutsche Industrie Normen
ANSI	American National Standards
ABMA	The American Bearing Manufacturers Association
BS	British Standards
MIL	Military Specifications and Standards
SAE	Society of Automotive Engineers
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
JGMA	Japan Gear Manufactures Association

NAME

ADDRESS PHONE

OFFICE PHONE

For New Technology Network

HUB BEARINGS

CAT. No. 4601/E

NTN Hub Bearings

NTN hub bearings realize efficient traveling and improved fuel consumption. Aiming for higher quality, NTN is involved in creating and developing element technologies.

GEN 1
(First Generation)

GEN 2
(Second Generation)

GEN 3
(Third Generation)

C O N T E N T S

1 Hub bearing types and configurations

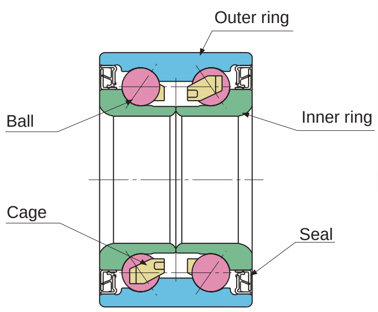
Hub bearings are classified as ball type or roller type. The ball type includes GEN 1, GEN 2 and GEN 3, and the roller type GEN 1 and GEN 2. The bearings are further classified according to application as bearings for driven wheel and non driven wheel.

Hub bearing

Ball type

GEN 1

For driven wheel **For non driven wheel**



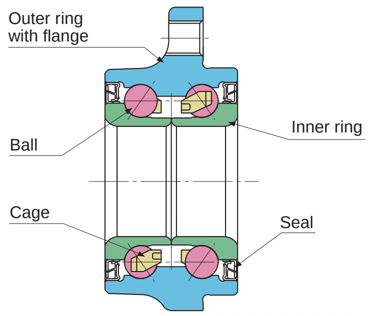
Fixed

Rotating

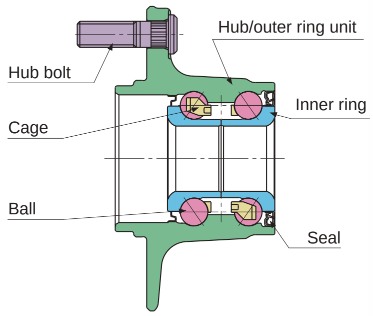
GEN 2

For driven wheel

For non driven wheel **Inner ring rotating type**



For non driven wheel **Outer ring rotating type**

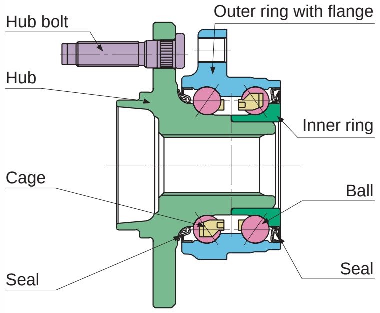


Hub bearing

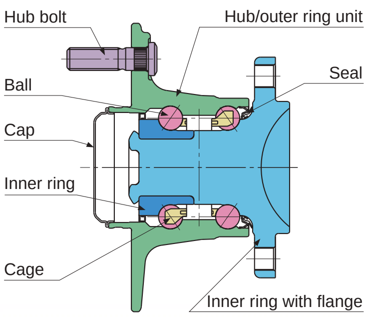
Roller type

GEN 3

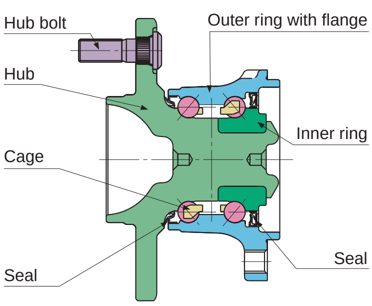
For driven wheel



For non driven wheel | Outer ring rotating type

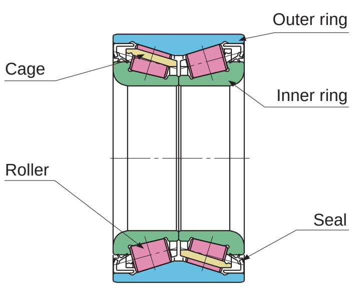


For non driven wheel | Inner ring rotating type



GEN 1

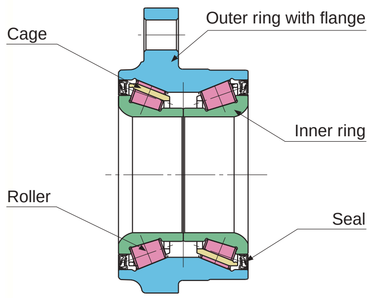
For driven wheel | For non driven wheel



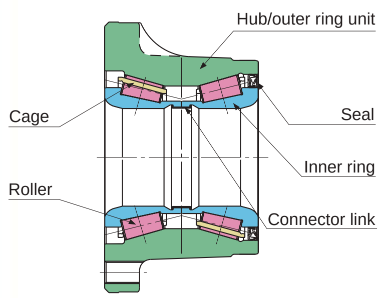
GEN 2

For driven wheel

For non driven wheel | Inner ring rotating type



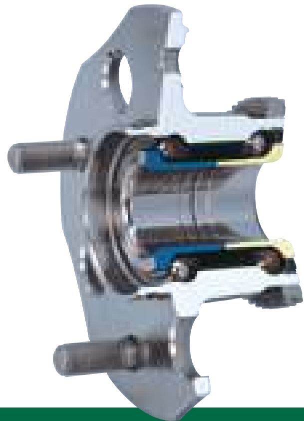
For non driven wheel | Outer ring rotating type

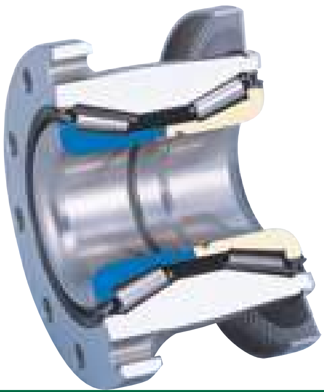


2 Bearing number

GEN 1 ball type

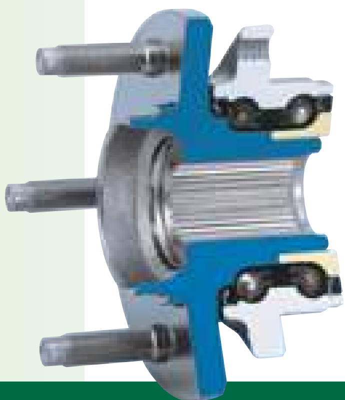
GEN 1 roller type

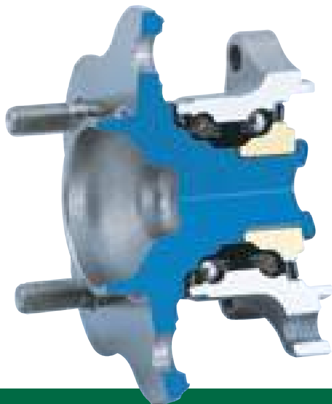




GEN 2 ball type

GEN 2 roller type





GEN 3 ball type (driven wheel)

GEN 3 ball type (non driven wheel)

Bearing type	Code name	Bearing number	Configuration
GEN 1 Ball type	AU	AU 08 04—1 LL ／L260 L260: Grease code LL: Seal code 1: Sequential number 08: Inner diameter No. AU: Type code	Consists of inner ring, outer ring, balls, cage and seal.
GEN 1 Roller type	TU	TU 08 11—1 LXL ／L244 L244: Grease code LXL: Seal code 11—1: Sequential number 08: Inner diameter No. TU: Type code	Consists of inner ring, outer ring, rollers, cage and seal.
GEN 2 Ball type	HUB	HUB 227—1 227—1: Sequential number HUB: Type code	Consists of inner ring, outer ring, balls, cage and seal. Outer ring rotating type: Brake disc and wheel mounted on hub/outer ring unit. Inner ring rotating type: Outer ring with flange fastened to vehicle body.
GEN 2 Roller type	HUR	HUR 040—2 040—2: Sequential number HUR: Type code	Consists of inner ring, outer ring, rollers, cage and seal. Outer ring rotating type: Brake disc and wheel mounted on hub/outer ring unit. Inner ring rotating type: Outer ring with flange fastened to vehicle body.
GEN 3 Ball type	HUB___T	HUB 005T—1 005T—1: Sequential number HUB: Type code	Consists of inner ring, outer ring, balls, cage and seal. Outer ring rotating type: Brake disc and wheel mounted on hub/outer ring unit, outer ring with flange fastened to vehicle body. Inner ring rotating type: Outer ring with flange fastened to vehicle body, Brake disc and wheel mounted on hub.

3 Hub bearing selection

3.1 Selection overview

Hub bearings are very important part in terms of vehicle safety. Selecting the type of bearing most suited to the vehicle ensures safety and is very important for exhibiting the required performance. To select the best bearing, one must consider and evaluate the bearings from a variety of angles. The procedure for selecting hub bearings is provided in the form of a flowchart.

Hub bearing selection flowchart

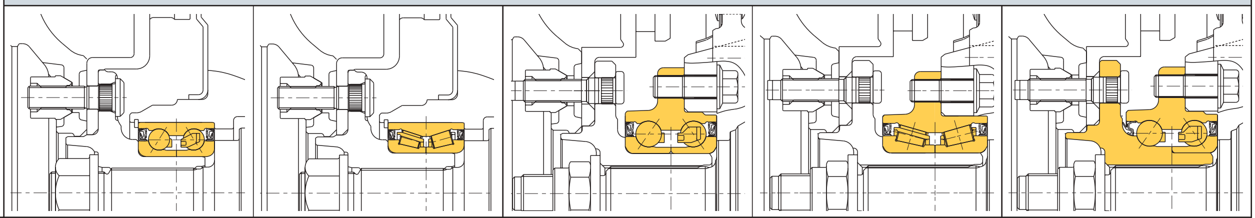
Order	Check, study and evaluation items
Usage conditions check ↓	● Vehicle model ● Front/rear ● Vehicle specifications ● Custom specifications ● Configuration of area surrounding bearing ● Driven / non driven wheel ● Traveling conditions ● Evaluation test items / determination standards
Bearing type selection ↓	● Allowable space for bearing ● Rigidity ● Whether or not equipped with ABS sensor ● Cost ● Inner/outer ring rotation ● Whether or not equipped with seal ● Ease of assembly, serviceability
Bearing type study ↓	● Life calculation ● Shoulder protrusion (ball type) ● Flange PV value (roller type) ● Seal type ● Tone wheel ● Magnetic encoder ● Allowable stress ● Rigidity/strength ● Bearing materials ● Grease ● ABS sensor
Initial axial clearance study ↓	● Axle/housing material and shape ● Fitting ● Nut fastening torque / axial force ● Axial clearance reduction amount calculation (preload setting)
Sample fabrication ↓	● Quality check
Evaluation by various tests	● Fitting test ・Axial clearance reduction amount measurement (verification of set preload) ● Bearing bench test ・Life evaluation test / seizure resistance evaluation test ・Seal performance evaluation test ● Actual vehicle test

3.2 Hub bearing characteristics

3.2.1 Driven wheel

Superiority ranking order ☆☆☆> ☆☆> ☆

For driven wheel

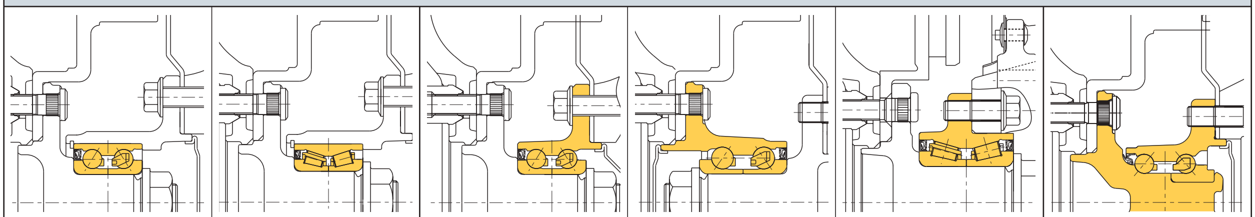


Type	GEN 1		GEN 2		GEN 3
Rotation type	Inner ring rotation		Inner ring rotation		Inner ring rotation
Ease of assembly line assembly	☆		☆☆		☆☆☆
Serviceability	☆		☆☆		☆☆☆
Reliability when service is performed	☆		☆☆		☆☆☆
Compactness	☆		☆☆		☆☆☆
Rigidity	☆	☆☆	☆	☆☆☆	☆☆☆
Knuckle material applicability	☆		☆☆ Light alloy possible		☆☆ Light alloy possible
Integrated seal	☆☆	☆☆	☆☆	☆☆	☆☆
Integrated ABS	☆	☆	☆☆	☆☆	☆☆☆
Preload management	☆	☆	☆☆	☆☆	☆☆☆
Application	Passenger vehicle/RV	Passenger vehicle/RV/truck	Passenger vehicle/RV	Passenger vehicle/RV/truck	Passenger vehicle/RV

3.2.2 Non driven wheel

Superiority ranking order ☆☆☆> ☆☆> ☆

For non driven wheel

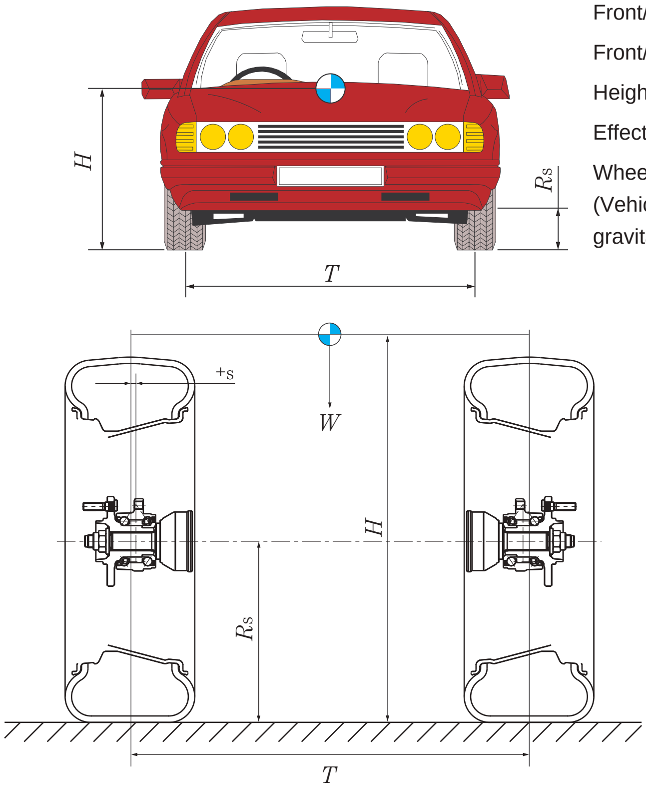


Type	GEN 1		GEN 2			GEN 3
Rotation type	Inner ring rotation		Inner ring rotation	Outer ring rotation	Inner ring rotation	Inner ring rotation
Ease of assembly line assembly	☆		☆☆			☆☆☆
Serviceability	☆		☆☆			☆☆☆
Reliability when service is performed	☆		☆☆			☆☆☆
Compactness	☆		☆☆			☆☆☆
Rigidity	☆	☆☆	☆	☆☆☆	☆☆☆	☆☆☆
Knuckle material applicability	☆		☆☆ Light alloy possible	☆	☆	☆☆ Light alloy possible
Integrated seal	☆☆	☆☆	☆☆	☆☆	☆☆	☆☆
Integrated ABS	☆	☆	☆☆	☆☆	☆☆	☆☆☆
Preload management	☆	☆	☆☆	☆☆	☆☆	☆☆☆
Application	Passenger vehicle	Passenger vehicle/truck/trailer	Passenger vehicle	Passenger vehicle	Passenger vehicle/truck/trailer	Passenger vehicle

3.3 Life calculation

Life of hub bearings is calculated by inputting reaction force (radial load and axial load) on the wheel given as set traveling conditions as load. Each bearing is a "unit bearing" consisting of two rows of bearings. Life of the bearings is calculated separately for the each of the bearings. Bearing life is calculated for the outer and inner bearings. The shorter of the calculated values is considered the calculated life of hub bearings.

1) Vehicle specifications



Front/rear wheel axle static load ···W (N)
Front/rear wheel tread ··················T (mm)
Height of gravitational center ·········H (mm)
Effective radius of tires ···············Rs (mm)
Wheel offset ·································S (mm)
(Vehicle outside positive relative to gravitational center of bearing)

2) Calculation of road reaction force

First, we calculate road reaction force applied to the wheel by the road. Road reaction force in the axial and radial directions is calculated by the following formula.

$$W_r = f_w\,(W/2 + G \cdot W \cdot H/T)$$
$$W_t = G \cdot W_r$$

W_r : Road reaction force in the radial direction (N)
W_t : Road reaction force in the axial direction
f_w : Load coefficient
G : Turning acceleration (positive in case of turning outer wheel, negative in case of turning inner wheel)

3) Calculation of bearing load

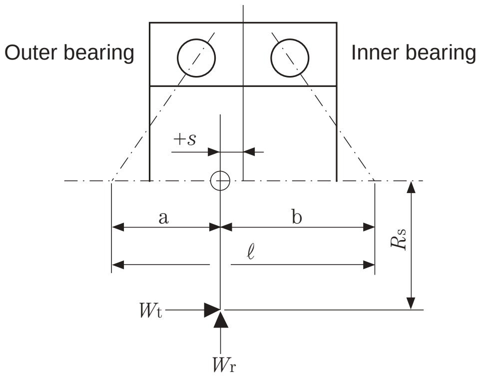
Next, we calculate bearing load (radial/axial load) applied by road reaction force on the wheel.

(1) Radial load

Radial load applied to outer/inner bearing is determined by the following formula:

$$F_{ro} = | b/\ell \times W_r - R_s/\ell \times W_t |$$
$$F_{ri} = | a/\ell \times W_r + R_s/\ell \times W_t |$$

F_{ro} : Outer bearing radial load (N)
F_{ri} : Inner bearing radial load (N)
ℓ : Distance between pressure cone apexes (mm)
a : Distance from pressure cone apex of outer bearing to wheel center (mm)
b : Distance from pressure cone apex of inner bearing to wheel center (mm)



(2) Axial load

If an axial load is applied to the hub bearing, induced thrust is produced by the radial load. Induced thrust load when there is no clearance (no preload) is determined by the following formula. Induced thrust can be calculated by altering the clearance (preload), but such is extremely complicated. You may leave the calculation up to **NTN** in this case.

$F_{ro}/(2Y)$: Outer bearing induced thrust load (N)
$F_{ri}/(2Y)$: Inner bearing induced thrust load (N)
Y : Axial load coefficient
(For the Y coefficient, use the value of $F_a/F_r > e$ of **tables 1** and **2**.)

Next, we compare large and small values of induced thrust load produced for the inner and outer bearings. In this case, you must take note of the direction of the induced thrust load and direction of outside force axial load.

Example: Axial load in the case of turning outer wheel (and $F_{ri}/(2Y) + W_t > F_{ro}/(2Y)$) is as follows:
Outer bearing axial load: $F_{ao} = F_{ri}/(2Y) + W_t$
Inner bearing axial load: F_{ai} = O

3) Equivalent radial load

Equivalent radial load if the inner and outer bearings is determined by the following formula:

$$P_r = XF_r + YF_a$$

At this time, X and Y are called the radial load coefficient and axial load coefficient respectively, and use a different value for each type of bearing. The X and Y coefficients are given in **tables 1** and **2**.

Table 1 X and Y coefficients of radial ball type

Contact angle α	X		Y		e
	$F_a/F_r \leqq e$	$F_a/F_r > e$	$F_a/F_r \leqq e$	$F_a/F_r > e$	
35	1	0.37	0	0.66	0.95
40	1	0.35	0	0.57	1.14

X=1 and Y=0 are used in the case of $F_a/F_r \leqq e$.

Table 2 X and Y coefficients of radial roller type

Contact angle α	X		Y		e
	$F_a/F_r \leqq e$	$F_a/F_r > e$	$F_a/F_r \leqq e$	$F_a/F_r > e$	
$\alpha \neq 0$	1	0.4	0	0.4cotα	1.5tanα

4) Bearing life calculation

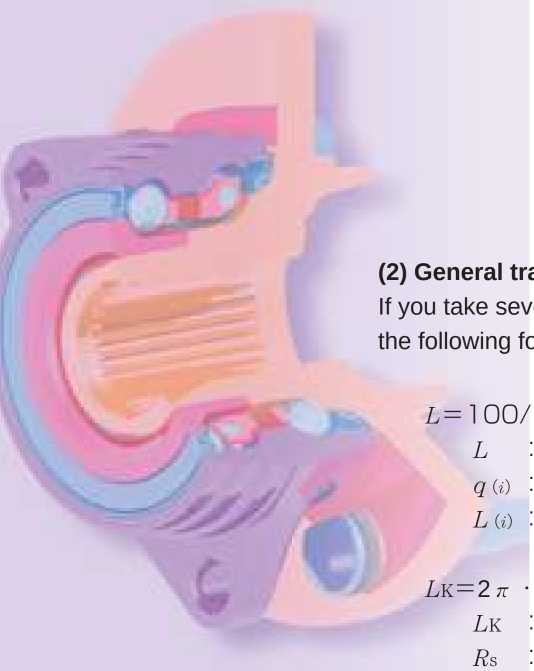
(1) Rated life

Rated bearing life is determined by the following equation.

$$L_{10} = (C_r/P_r)^p$$

L_{10} : Rated bearing life ($\times 10^6$ rotations)
p : Constant (3 in case of ball type, 10/3 in case of roller type)
C_r : Basic load rating (N) of radial bearing (single row)
P_r : Equivalent radial load (N)

Hub bearing selection



(2) General travel distance life

If you take several travel conditions into consideration, you can determine general travel distance life by the following formula integrating the respective calculated lives.

$$L=100/\Sigma\ [q_{(i)}/L_{(i)}]$$

L : General life (×10^6 rotations)

$q_{(i)}$: Frequency of each traveling condition (%)

$L_{(i)}$: Calculated life of each traveling condition (×10^6 rotations)

$$L_K=2\pi\cdot R_s\cdot L/10^6$$

L_K : General travel distance life (km)

R_s : Effective tire radius

An example of life calculation results is provided in **Fig. 1** for your reference.

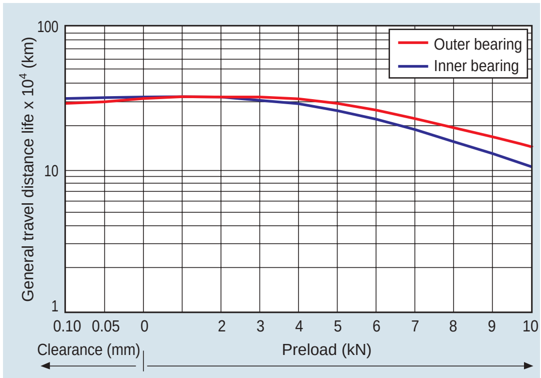


Fig. 1 Example of life calculation results

3.4 Allowable stress and shoulder protrusion

1) Allowable stress

When a load is placed on a bearing, contact stress at the center of the rolling elements and raceway where the maximum stress is received should be no greater than the following values:

Ball type : 4,200 MPa

Roller type: 4,000 MPa

2) Shoulder protrusion

The contact surface of the rolling elements and raceway is generally elliptical in shape. If the radius of the major axis of the contact ellipse protrudes from the shoulder of the inner or outer ring, concentrated stress is produced at the shoulder. Because it could result in early damage, take measure to prevent the contact ellipse from protruding from the shoulders.

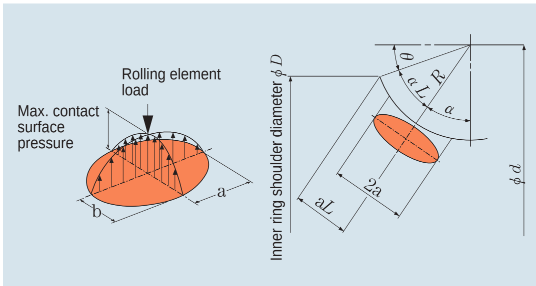


Fig. 2

3.5 Rigidity

Moment load is placed on hub bearings when the vehicle turns, which produces an inclination in the tire mounting surface. Variation in the angle of incline is called "rigidity" of the hub bearing.

Rigidity of the hub bearing is determined by the amount of elastic distortion of the rolling elements, hub or hub with outer ring. The amount of distortion is calculated by structural analysis (FEM).

Elastic distortion of the rolling elements is affected by internal clearance of the hub bearing. A comparison of angle of housing incline for clearance and preload (negative clearance) is given in **Fig. 3**.

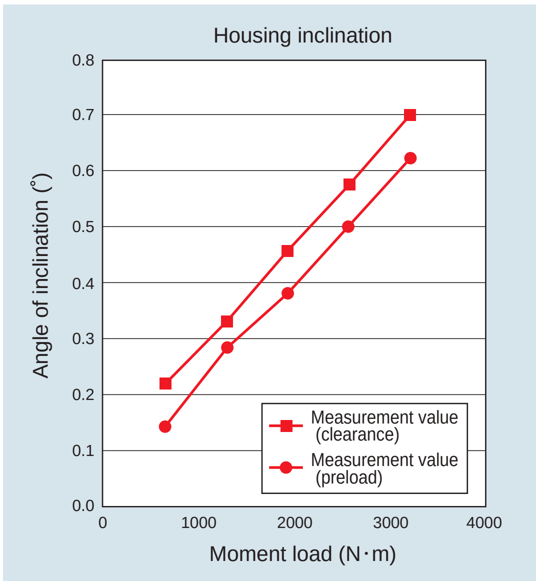


Fig. 3: Housing incline rigidity measurement example

3.6 Strength

When inclination rigidity and strength of a hub bearing is analyzed by FEM, the optimal shape taking weight reduction into account must be decided.
Fig. 4 gives an example of housing strength analysis and **Fig. 5** gives an example of a study of weight reduction.

3.7 Fitting and preload

Bearings are generally provided with a slight internal clearance during operation. Hub bearings use the preload method whereby a negative axial clearance is provided after assembly. The effects of preload are as follows:

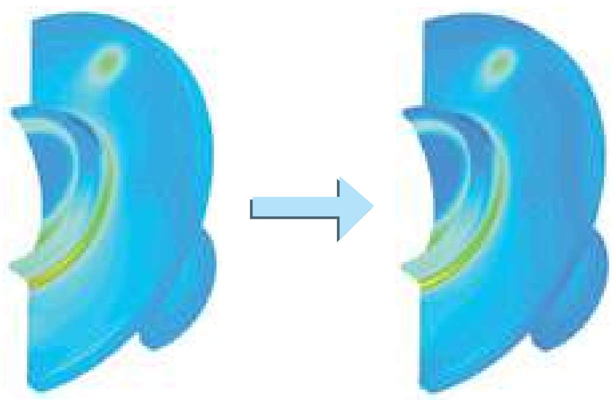
(1) Internal clearance does not tend to be produced by elastic distortion when a load is placed on the bearing and rigidity is high.
(2) Axle run-out is suppressed and rotation precision is enhanced.
(3) Prevents fretting from being produced on the raceway by external vibration.

If excessive preload is applied, however, it can invite reduction of life, abnormal heating, or increase in rotational torque. With hub bearings, therefore, fitting and initial axial clearance are decided to produce suitable preload.

Axial clearance of hub bearings is reduced by fitting with other parts and nut fastening. This reduction in clearance is taken into account when initial axial clearance is established. The amount of reduction is confirmed by fitting test using the actual parts. If fastening due to fitting of the bearing inner ring is too tight, undesired conditions such as galling of the press fitting surface, distortion and inner ring cracking may be produced. Fitting is decided by calculating maximum stress on the inner ring when fitting.
For fitting and stress, you should consult with **NTN**.
Recommended fitting for each type of bearing is given in **Table 3**.

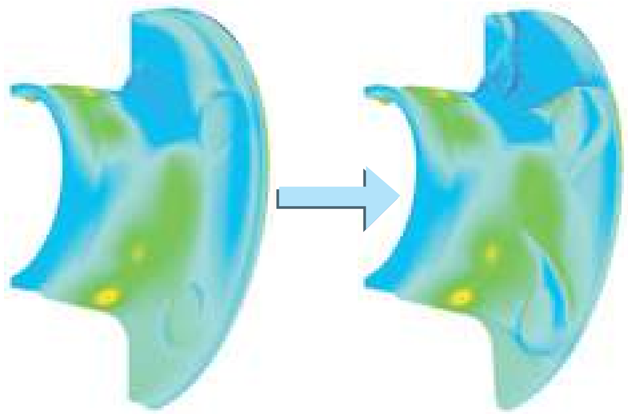
Table 3 Recommended fitting

Bearing type		Axle	Housing
GEN 1	Inner ring rotation	m6	R7
	Outer ring rotation	m6	R7
GEN 2	Inner ring rotation	m6	—
	Outer ring rotation	Loose	—



The corner R dimension is decided by studying housing corner R stress.

Fig. 4 Example of strength analysis of housing



Weight is reduced without excessively reducing strength by changing type of flange for hub with outer ring.

Small Large

Fig. 5 Example of weight reduction

4. Hub bearing materials

4.1 Raceway and rolling element materials

Innovations in steel manufacturing technologies such as vacuum gas removal, out-of-furnace smelting and continuous casting have notably reduced harmful non-metallic inclusion, thus realizing longer bearing life. **NTN** selects quality materials that best suit each type of bearing.

(1) NKJ65M

Based on carbon steel, NKJ65M was developed as a substitute for SUJ2. NKJ65M is high quality clean carbon steel that offers lower cost and better rolling fatigue life.
NKJ65M is used for the inner and outer rings of the GEN 1 and inner rings of the GEN 2 and GEN 3 ball types.

(2) SUJ2 (equivalent of SAE52100)

The most commonly used material, SUJ2 is a quality material having minimal non-metallic inclusion.
SUJ2 is used for balls, the inner and outer rings of the GEN 1 and balls and inner rings of the GEN 2 and GEN 3 ball types.

(3) S53C (equivalent of SAE1053)

Raceways are made of induction hardened S53C, a highly forgeable carbon steel. S53C offers superior characteristics such as rotational bending fatigue strength and impact resistance as well as long rolling fatigue life.
S53C is used for the hub, outer ring of GEN 2 and GEN 3 ball types and outer ring of GEN 2 roller type.

(4) ET material (equivalent of SCr4435)

Hardened from the surface to a suitable depth, ET material forms a comparatively soft core. Offering a combination of hardness and toughness, ET material is long-life case hardened steel with superior impact resistance.
ET material is used for the rollers, inner and outer rings of the GEN 1 roller type, and the rollers and inner ring of the GEN 2 roller type.

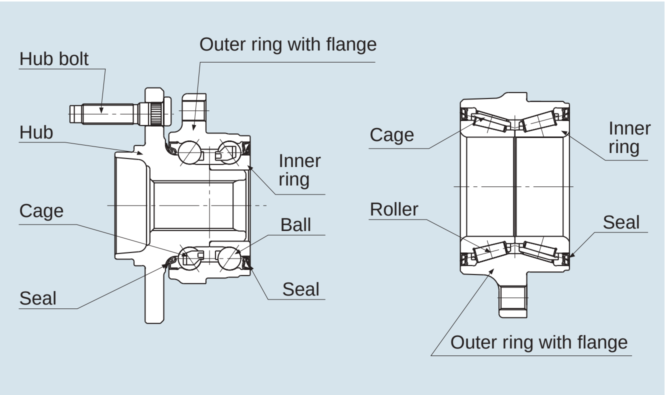


Fig. 6 Material part names

(5) ETA material

ETA material is a long-life case hardened steel that is specially heat-treated (carbonitriding) to enhance toughness of the surface layer structure. It is particularly effective for suppressing cracking caused by contaminated lubrication.
ETA material is used for the rollers, inner and outer rings of the GEN 1 roller type, and the inner ring of the GEN 2 roller type.

4.2 Cage material

Cages are made of polyamide resin reinforced with fiberglass, except the roller type for use in high temperature environments, which is made of cold rolled steel.

5. Lubrication

The objective of lubricating bearings is to form a film of oil on rolling or sliding surfaces to prevent the metals from making direct contact with each other. Lubrication has the following effects:

(1) Reduces friction and wear.
(2) Extends bearing life.
(3) Prevents rusting.
(4) Prevents penetration of foreign matter.

Fretting wear particularly tends to occur on the raceway of hub bearings during transport of finished automobiles. Fretting resistance must therefore be taken into account for hub bearings.
Grease is used for hub bearings because it is economical, easy to use, and it facilitates design of sealed equipment.
Table 4 gives characteristics of greases currently used for hub bearings.

Table 4 Characteristics of grease

Characteristics	Resists fretting, enhances rust prevention performance.	Resists fretting, extends life at high temperatures.
Maker	Nisseki Mitsubishi	Kyodo Yushi
Name	PYRONOC Universal N6C	Raremax 9B367
Thickener	Urea	Urea
Base oil	Mineral oil	Mineral oil and synthetic oil
Working temperature (˚)	-30 to 150	-30 to 150
Color	Cream	Yellow
Remarks	Recommended grease for passenger vehicles	HUR/TU recommended grease for trucks and passenger vehicles.

6. Seals

Hub bearing seals prevent water ingress and have low torque. The shape and characteristics of currently used seals are given in **Table 5**.

7. Orbital forming

Nuts were used to fasten the inner ring of the GEN 3 ball type, but we have recently switched to forming the end of the hub with cold plastic working (orbital forming) to fasten the inner ring. This method is more reliable than fastening with nuts. It also weighs less, costs less, and is more compact.
Fig. 7 shows the orbital forming method and **Fig. 8** gives examples of the forming structures for the driven and non driven wheels.

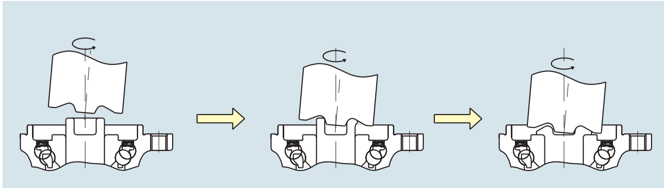


Fig. 7: Orbital forming method

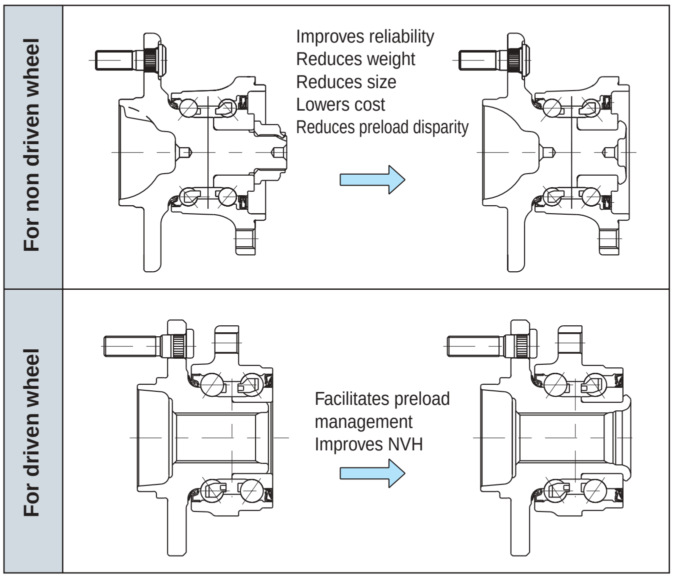
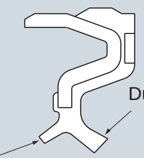
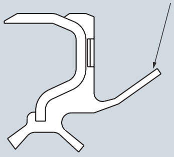
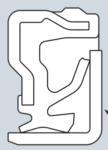


Fig. 8: Examples of fastening configuration for driven/non driven wheel inner ring forming

Table 5 Seal shape and characteristics

Superiority ranking order ☆☆☆>☆☆>☆

Shape / Characteristics					
					
Design specifications	Name		2-lip seal	3-lip seal	Highpack seal
Design specifications	Features		2-lip seals consist of a grease lip and a dust lip. The outer diameter is fitted with rubber/metal to provide tight sealing and disattachment resistance.	A side lip is added to the 2-lip seal; dramatically enhances sealing performance.	A stainless steel slinger is added to the 3-lip seal sliding part; dramatically enhances rust resistance of the sliding part of the lips.
Design specifications	Rubber material ∗1)	Ordinary	Nitrile rubber (NBR)	←	←
Design specifications	Rubber material ∗1)	High temperature	Hydrogenated nitrile rubber (HNBR) Fluorine rubber (FKM)	←	←
Performance	Resistance to water ingress (number of cycles) ∗2)		☆ (3 to 5 cycles)	☆☆☆ (15 to 20 cycles)	☆☆☆ (15 to 20 cycles)
Performance	Grease leakage		☆☆☆	☆☆☆	☆☆☆
Performance	Torque characteristics		☆☆☆	☆☆	☆☆
Performance	Rust resistance		☆	☆	☆☆☆
Cost			☆☆☆	☆☆	☆

∗1) Consult with **NTN** if rubber must be conductive.

∗2) Dirty water test conditions
Rotational speed: 1,100 min^{-1}
1 cycle: Running with water injected + dry stop
Dirty water: Kanto loam powder JIS 8 type 10 wt%

Hub bearing for active ABS sensor

8. Hub bearing for active ABS sensor

8.1 Magnetic encoder for active sensor

In the past electromagnetic sensors and magnetic tone wheels (passive type) have been used to detect wheel rotational speed for antilock brake systems (ABS). In recent years, however, makers have begun to use sensors equipped with a semiconductor element that can detect extremely low speed ranges (active type).
Some active type semiconductor sensors are equipped with a built-in bias magnet and some are not. The former uses a conventional tone wheel, and the latter requires a multipolar magnetized encoder.

(1) Types

There are two types of magnetized encoder: axial and radial type according to sensing direction (see **Fig. 9**).

(2) Features

Conventional sintered tone wheels are designed with a large diameter. Magnetic encoders enable smaller outer diameter and more compact size. **Fig. 10** shows an example of more compact construction.

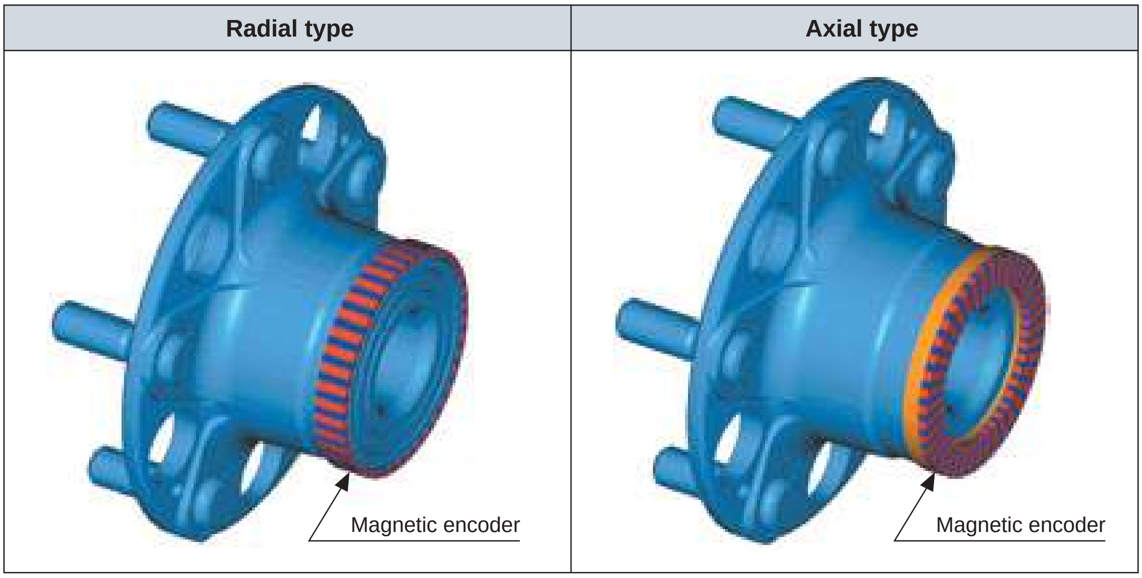


Fig. 9 Configuration of radial and axial type encoders

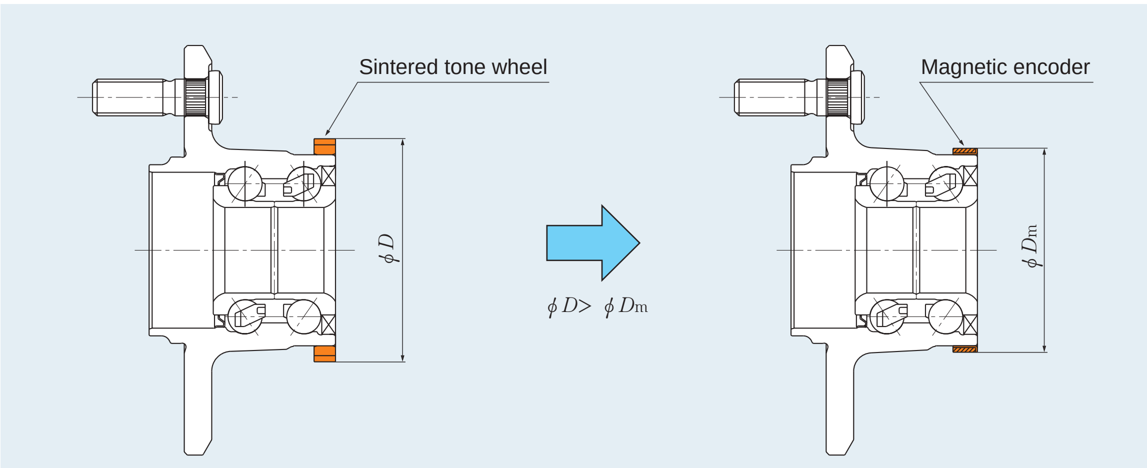


Fig. 10 More compact construction (comparison with GEN 2 ball type for non driven wheel)

8.2 Hub bearing with integrated ABS sensor

(1) Configuration

With GEN 2 and GEN 3 hub bearings, the ABS sensor and magnetic encoder can be unified with the axle. The ones for the driven wheel are provided with the ABS sensor and magnetic encoder between two rows of raceway surfaces, and the ones for the non driven wheel are provided with the ABS sensor and magnetic encoder on the inner side, and are unified with the bearing as a single unit.

Fig. 11 shows examples of the configuration of the GEN 3 ball type with integrated ABS sensor.

(2) Features

1. Less weight, more compact: Unifying the magnetic encoder and seal as a single unit enables more compact configuration in the axial direction.
2. Enhanced reliability relative to the outside environment: Housing the ABS sensor and magnetic encoder within the bearing prevents damage from small stones and rust due to dirty water or saltwater and enhances reliability.
3. Doesn't require air gap adjustment: Housing the ABS sensor and magnetic encoder within the bearing eliminates the need to adjust the air gap (distance between ABS sensor and magnetic encoder) when mounting the bearing.

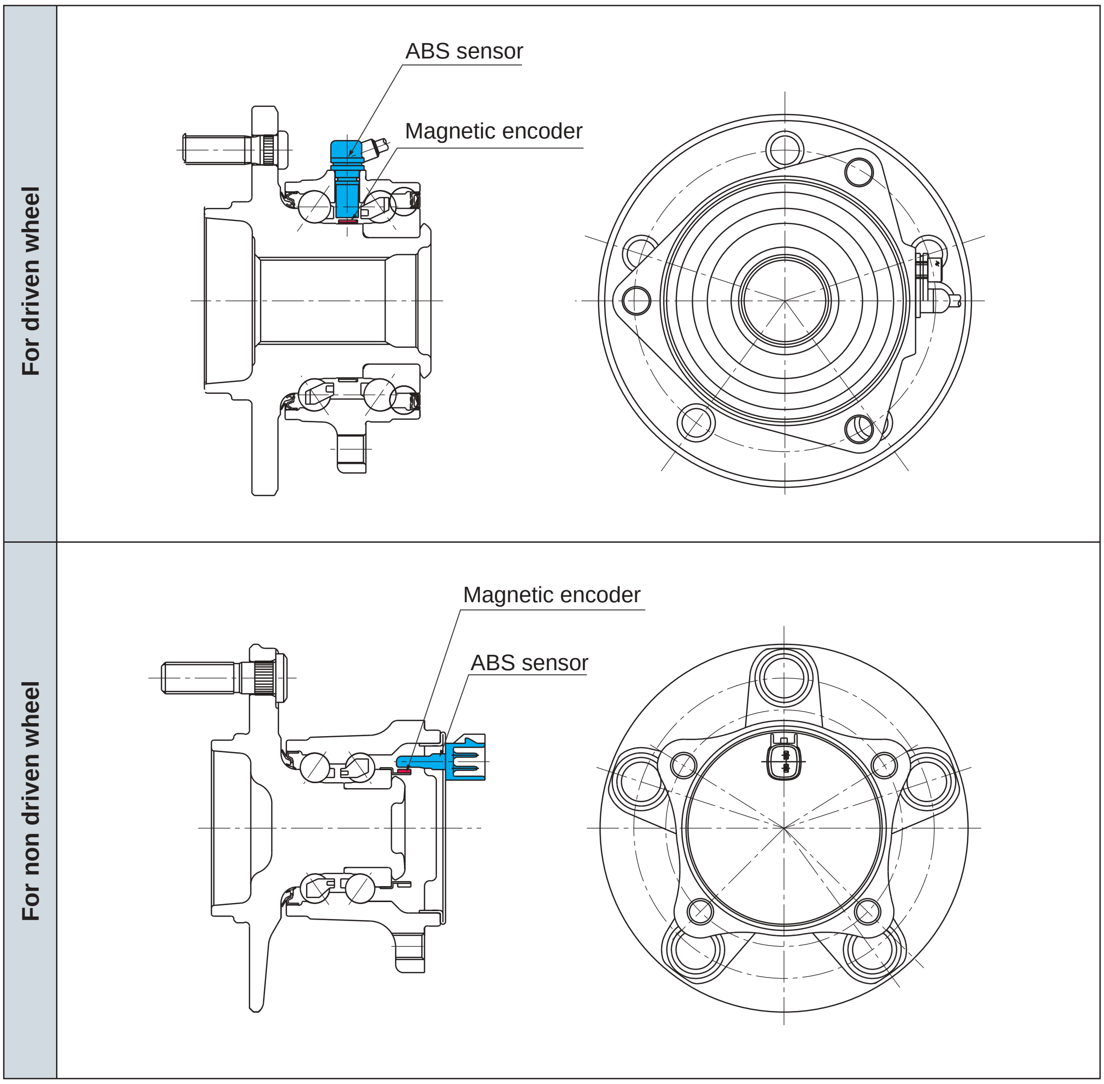
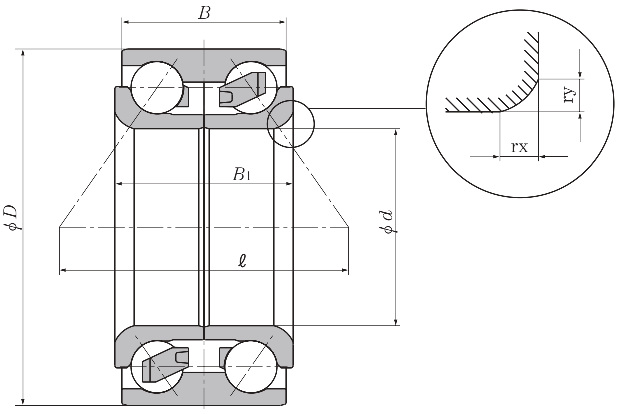


Fig. 11 Example configuration of GEN 3 ball type with integrated ABS sensor

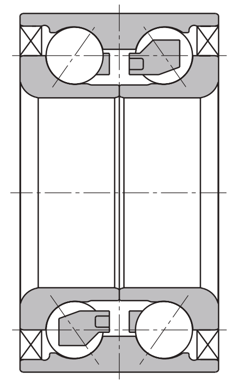
Hub bearing dimensions

GEN 1 ball type

For driven/non driven wheel



Type without seal

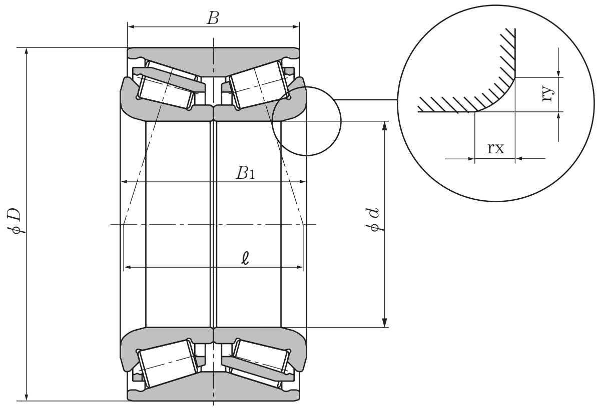

Type with integrated seal

Main dimensions (mm)						Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Type with integrated seal	Mass (kg) (Reference)
d	D	B	B1	rx (min.)	ry (min.)			C	C0		
25	52	42	42	3.5	2.5	50.6	AU0501-4L/L260	19.1	12.7	○	0.36
27	60	50	50	3.5	3.5	50.7	DE0565LZCS34PX1/L244	26.2	16.5	○	0.57
30	50	20	20	1.5	1.5	38.3	DE0678CS12/5A	12.4	9.85	×	0.13
	54	24	24	1.8	1.3	42.4	DE0681CS18PX1/L260	17.4	12.9	×	0.20
	68	45	45	4.6	4.6	53.5	DE0690LZCS12PX1/L244	35.5	23.7	○	0.73
32	67	40	40	3.5	2.5	53.6	AU0603-2LLX/L260	26.9	19.9	○	0.61
34	64	34	34	3.5	3	51.8	DE0776CS46/5A	24.3	18.5	×	0.43
	64	37	37	3.5	2.5	52.8	AU0701-4LL/L588	24.3	18.5	○	0.47
	68	36	37	4	3	50.8	DE0745LLCS32PX1/5A	28.2	21.6	○	0.56
	68	42	42	3.5	3	52.9	DE0787LLCS54/5A	29.3	20.9	○	0.61
35	61.8	40	40	3.5	3.5	54.7	AU0706-3LXL/L260	21.5	17	○	0.43
	64	37	37	4	3.3	50.8	AU0704-1LL/L260	24.3	18.5	○	0.39
	65	37	35	3.5	3.2	55.4	2B-DE07A34CS30/L260	24.2	18.6	×	0.44
	72	34	34	3	2.8	55.1	DE0763CS46PX1/5A	32	25	×	0.58
36	65	48	52	3.5	3	70.2	TM-DE08A74CS10PX1/L260	23.2	19.5	×	0.58
	72	34	34	3	3	55.1	DE0769CS46PX1/5A	32	25	×	0.57
	72	42	42	3.5	3	60.4	2B-DE07A37CS22/L260	33.5	23.9	×	0.72
37	74	45	45	2.4	2.4	59.3	DE07A02LLCS46/L109	36.5	28.3	○	0.79
38	70	38	38	4	3.3	54.0	7B-DE08A32LLX3CS30/L260	28	21.8	○	0.55
	72	34	34	3	3	55.1	DE0869CS46PX2/5A	32	25	×	0.54
	72	40	40	3.5	2.5	54.7	AU0810-1LXL/L260	32.5	24.9	○	0.60
	73	40	40	3.5	2.5	54.7	AU0811-6LXL/588	32.5	24.9	○	0.69
	74	33	36	3.5	3.5	53.2	2B-DE08A33CS38PX1/L260	33	20.8	×	0.61
	74	36	36	4.5	3.5	54.7	AU0814-1LLX/L260	32	25.1	○	0.63
	74	40	40	3.5	2.5	56.8	AU0818-1LXL/L260	35	26.1	○	0.71
	74	50	50	4.5	3.6	57.4	DE0892LLCS43/L244	36	26.8	○	0.85
	79	45	45	5	4	76.7	AU0826-1LL/L588	32.5	27.9	○	0.99
39	68	37	37	3.8	3.8	55.6	DE0819LLCS38/5C	25.1	20.2	○	0.46
40	74	36	36	4	3	62.7	AU0817-5LL/L260	30.5	23.9	○	0.62
	74	40	40	3.8	3.8	56.5	DE08A78LLCS56PX1/L260	32	25.1	○	0.67
	76	28	33	4.1	3.9	41.3	TM-DE0863LLCS43PX1/L260	36.5	29.3	○	0.54
	76	37	37	4.5	4.5	56.4	TM-DE08A63LLCS88/L260	35	26.4	○	0.66
	76	38	41	3	1.8	56.8	DE0891LLCS32PX2/5A	35	26.4	○	0.70
	80	34	36	2.6	2.6	59.7	AU0823-1/L588	36.5	28.9	×	0.76
	80	40	40	4	3	69.5	AU0822-2LL/L588	39	30.5	○	0.88
42	76	35	38	3.5	3.5	61.7	AU0815-2/L260	33.5	27.2	×	0.65
	76	37	40	3.5	3.5	55.9	AU0816-1LL/L260	33.5	27.2	○	0.66
	78	38	38	3.5	3	59.2	DE08A06LLCS58PX2/5A	36.5	28.7	○	0.69
	78	38	41	4	3	58.7	DE0829LLCS32PX1/5A	36.5	28.8	○	0.75
	80	42	42	2.6	2.6	63.5	DE08A30LLCS67PX2/L170	39	30	○	0.82
	80	45	45	3.8	3.8	62.4	AU0804-4LL/L260	41	32.5	○	0.90
43	76	43	43	5	4	72.5	AU0908-3LLX2/L260	31.5	25.9	○	0.73
	79	38	41	4	3.5	58.7	AU0907-7LXL/588	27.5	22.4	○	0.76
	79	45	45	5	3.1	76.2	AU0911-3LL/L260	32.5	27.9	○	0.84
44	84	40	42	3.5	3	62.2	DE0978LLCS64PX1/L260	43.5	34	○	0.91
45	83	45	45	3.8	3.8	63.7	2B-DE0989LLCS28/L260	41	32.5	○	0.60
	84	40	42	4.5	3.5	62.9	AU0901-12LL/L260	41	32.5	○	0.94
48	89	42	44	3.5	2.5	67.2	AU1001-5LLX/L260	45.5	37	○	1.07
65	110	46	46	5	4	86.3	DE1353LLACS41PX1/L260	51.5	50.5	○	1.62

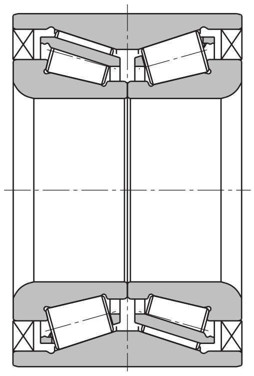
※Old bearing number given in blue.

GEN 1 roller type

For driven/non driven wheel



Type without seal



Type with integrated seal

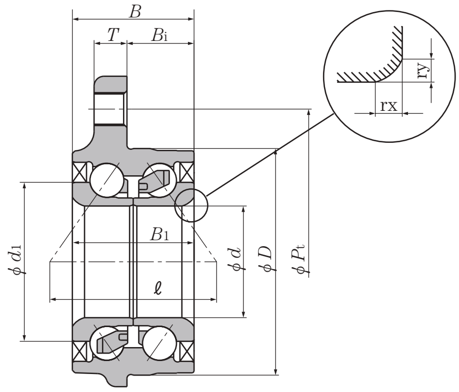
Main dimensions (mm)						Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Multiple rows		Type with integrated seal	Mass (kg) (Reference)
d	D	B	B1	rx (min.)	ry (min.)			C	C0		
25	52	37	37	2	2	25.3	**4T-CRI-0574LLCS150/L260**	35	38	○	0.36
27	52	43	45	3.5	3.5	35.4	**4T-CRI-0569CS83/5A**	32	38.5	×	0.40
30	55	56	56	0.6	0.6	45.3	**TU0601-1LL/L260**	37.5	46	○	0.54
	58	42	42	2	2	32	**ET-CRI-0678LLCS70/L260**	38.5	44	○	0.49
32	58	57	65	1	1	59.5	**4T-CRI-0685CS110**	37	46.5	×	0.64
35	64	37	37	4.75	3.66	30.2	**4T-CRI-0760LLCS200/5C**	34	41	○	0.50
36	64	42	42	2.5	2.5	34.5	**ET-CRI-0787LLCS90/L260**	34	41	○	0.56
38	65	48	52	3	3	48.7	**4T-CRI-08A05CS95/L244**	35	45	×	0.64
	76	40	43	5	4	39.2	**TU0808-1/L260**	53	69.5	×	0.93
39	68	37	37	3.8	3.8	33.2	**4T-CRI-0868LLCS150/L260**	36	45.5	○	0.54
40	80	38	38	3.5	3.5	34.2	**TU0807-1/L244**	55.5	68.5	×	0.89
42	72	35	38	4.75	3.56	36.5	**4T-CRI-08A01CS110/L244**	43.5	52.5	×	0.58
	72	38	38	3.8	3.8	33.8	**4T-CRI-0822LLXCS145/L260**	44	52.5	○	0.60
	72	48	52	3.5	3.5	53.3	**4T-CRI-08A02CS96/L244**	33.5	40	×	0.75
	73	38	38	3.5	3.5	34.2	**4T-CRI-08A24CS175/L260**	55	68.5	×	0.82
	76	39	39	3.8	3.8	35.2	**TU0802-4LLX/L588**	48	56.5	○	0.73
43	73	41	45	4.75	3.76	42.4	**TU0902-2/L260**	43.5	52.5	×	0.67
	76	40	43	4.75	3.56	39.3	**TU0904-1/L260**	55.5	69	×	0.75
45	90	51	54	1	1	44.2	**4T-CRI-0966CS130PX1/L260**	90	112	×	1.53
46	77	41	45	4.75	3.76	42.5	**4T-CRI-0992CS136/L260**	46.5	62	×	0.81
	78	49	49	4.9	3.8	43.5	**4T-CRI-0988LLXCS98/L260**	54.5	74	○	0.91
	80	40	43	3.5	3.5	39.4	**4T-CRI-0994CS176/L260**	54.5	74	×	0.91

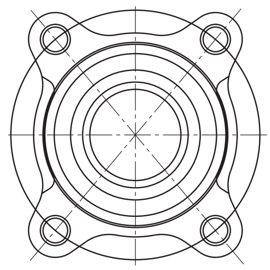
※Old bearing number given in blue.

Hub bearing dimensions

GEN 2 ball type

Inner ring rotating type for driven wheel

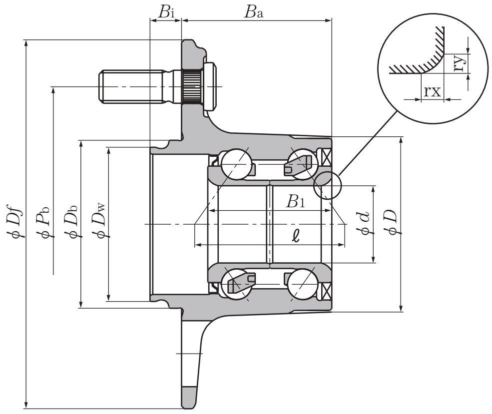




Main dimensions (mm)										Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of tapped holes in outer ring	Mass (kg) (Reference)
d	*D*	*B*	B_1	d_1	*T*	B_i	P_t	rx (min.)	ry (min.)			*C*	C_0		
28	62	40.5	42.5	43	8	21	86.1	3.5	2.5	53.7	**HUB003-1**	23.4	17.0	-	0.85
	65	37	37	42.9	10	20	91.214	3	2	54.0	**HUB204-5**	26.6	17.5	4	0.70
29	62	40.5	42.5	43	8	21	86.1	3.5	2.5	53.5	**HUB009-2**	23.4	17.0	-	0.84
34	69	37	37	48.4	10	20.4	93	3.5	2.5	50.7	**HUB212-5**	27.2	19.1	4	0.75
39	75	62.8	46.8	52.5	13.3	14.4	-	3.5	2.5	61.5	**HUB166-4**	32.5	24.9	4	1.80
	75	62.8	46.8	52.5	14.1	8.5	120	3.5	2.5	61.5	**HUB147-28**	32.5	24.9	3	1.70
	75	62.8	46.8	52.5	14.1	9.6	120	3.5	2.5	61.5	**HUB223-6**	32.5	24.9	3	1.69
	80.6	65.3	46.8	52.5	14.1	11	120	3.5	2.5	61.5	**HUB147-32**	32.5	24.9	3	1.86
40	84	49.5	43	55.4	10	10	-	2.6	2.6	58.5	**HUB111**	32.0	25.1	4	1.23
	84	56	56	59.3	12	13	-	4.5	3.5	76.3	**HUB175-14**	36.5	28.9	4	1.51
42	84	39.5	41	59.4	13	15	106	5	4	58.7	**HUB089-11**	36.5	28.8	-	1.74
43	80.6	66	46.5	59.4	14.1	11	120	4	3	64.2	**HUB189-2**	36.5	28.8	3	1.89
	83	42.5	44	59.4	14	16.5	102	5	3.5	58.7	**HUB081-45**	36.5	28.8	4	1.22
	83	47.5	49	59.4	14	21.5	102	5	3.5	63.7	**HUB100-7**	36.5	28.8	4	1.29
	84	56	56	58.6	15	11	110.009	4.5	3.5	67.7	**HUB030-20**	36.5	28.9	4	1.55
45	86	47.5	49	62	14	21.5	105	5	3.5	65.0	**HUB132-2**	41.0	32.5	4	1.39
46	90	49	49	65.1	14	19	151.38	4.5	3.5	65.8	**HUB098-14**	43.5	34.0	4	1.91

GEN 2 ball type

Outer ring rotating type for driven wheel

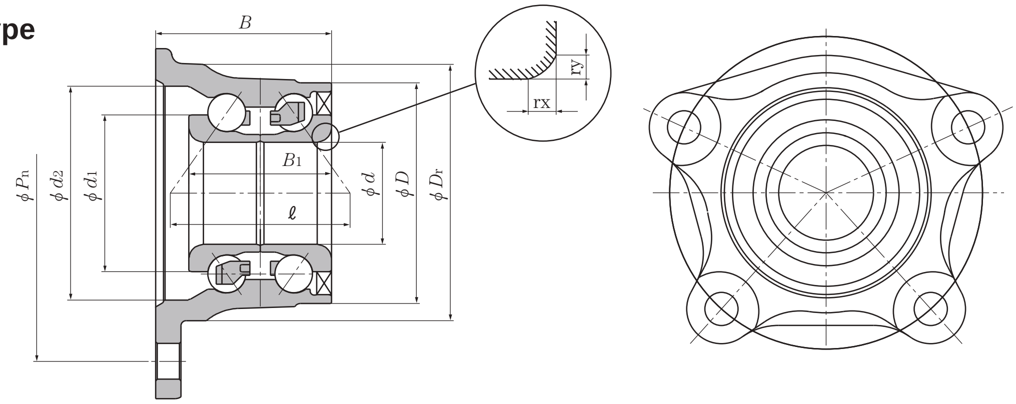


Main dimensions (mm)											Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of hub bolts	Mass (kg) (Reference)
d	D	Bi	B1	Ba	Df	Dw	Db	Pb	rx (min.)	ry (min.)			C	C0		
23	55.5	11.5	40	49.5	134	56	61	100	3.5	2.5	46.1	**HUB214-9**	21.1	13.3	4	1.33
25	61	11.5	40	49.5	134	56	61	100	3.5	2.5	47.6	**HUB002-6**	26.1	16.1	4	1.44
	61	14.5	54	51.5	122	59	60	100	3.1	2.6	58.8	**HUB076-9**	29.5	18.2	4	1.54
	62	18	40	48	134	60	64	114.3	3.5	2.5	47.6	**HUB109-4**	26.1	16.1	4	1.53
27	63	15	40	45	134	59	61	100	4.5	3.5	47.2	**HUB048-35**	22.3	15.1	4	1.39
	64.8	15	50	52.5	134	59	68	100	4.5	3.5	57.9	**HUB080-26**	24.4	16.0	4	1.45
	65.4	15.5	50	52.5	148	66	68	114.3	4.5	3.5	57.9	**HUB184-4**	24.4	16.0	4	1.50
28	62	13.5	47	54	122	54	55	100	3.8	3.8	54.5	**HUB200-5**	24.4	16.1	4	1.62
	63.5	11.5	40	49.5	134	56	61	100	3.5	2.5	49.5	**HUB008-48**	26.2	16.5	4	1.56
	64	16	40	49.5	120	54	58	100	3.5	2.5	49.7	**HUB254-3**	26.2	16.5	4	1.41
	64	18	40	49.5	130	54	58	100	3.5	2.5	49.7	**HUB144-11**	26.2	16.5	4	1.59
	64	18	40	49.5	134	60	64	114.3	3.5	2.5	49.7	**HUB065-14**	26.2	16.5	4	1.64
30	64.5	14.5	59	64.5	126	56	58	100	3.5	2.5	62.8	**HUB038-30**	27.9	18.5	5	1.83
	66	13.5	47	56	122	54	55	100	3.7	3.5	52.2	**HUB053-50**	27.9	18.5	4	1.50
	66	14.5	47	56	140	67	72	114.3	3.7	3.4	52.2	**HUB122-12**	27.9	18.5	5	1.97
	66.8	15.5	55	57.5	148	66	68	114.3	4.5	3.5	62.8	**HUB145-9**	27.9	18.5	4	1.70
	67	11.5	40	54.5	136	56	61	100	3.5	2.5	51.4	**HUB005-36**	27.9	18.5	4	1.67
	67	11.5	41	54.5	136	56	61	100	3.5	2.5	51.4	**HUB005-64**	27.9	18.5	4	1.79
	67	11.5	41	59.7	139	64	64	114.3	3.5	2.5	51.4	**HUB082-13**	27.9	18.5	4	1.75
	67	11.5	41	56	152	64	64	114.3	3.5	2.5	51.4	**HUB083-64**	27.9	18.5	4	1.60
	67	11.5	46	56	152	64	64	114.3	3.5	2.5	56.4	**HUB167-9**	27.9	18.5	5	1.75
	67	11.5	51	55	136	56	61	100	3.5	2.5	61.4	**HUB155-5**	27.9	18.5	4	1.64
	67	11.5	56	56	139	56	61	100	3.5	2.5	66.4	**HUB227-24**	29.5	20.2	4	1.71
	67	11.5	56	71	152	64	64	114.3	3.5	2.5	66.4	**HUB112-14**	27.9	18.5	5	2.33
	67	12.5	51	56	139	64	64	114.3	3.5	2.5	61.4	**HUB157-17**	27.9	18.5	4	1.77
	67	12.5	51	56	139	64	64	114.3	3.5	2.5	61.4	**HUB186-6**	29.5	20.2	5	1.80
	67	12.5	51	56	152	64	64	114.3	3.5	2.5	61.4	**HUB156-37**	27.9	18.5	4	1.89
	67	12.5	51	56	152	64	64	114.3	3.5	2.5	61.4	**HUB156-39**	27.9	18.5	5	1.86
	67	12.5	59	56	152	64	64	114.3	3.5	2.5	69.4	**HUB181-29**	29.5	20.2	4	1.96
	67	12.5	59	56	152	64	64	114.3	3.5	2.5	69.4	**HUB195-7**	29.5	20.2	5	1.96
	67	12.5	59	63	152	64	64	114.3	3.5	2.5	69.4	**HUB208-3**	29.5	20.2	5	2.08
	67	12.5	59	71	152	64	64	114.3	3.5	2.5	69.4	**HUB199-13**	29.5	20.2	4	2.14
	67	12.5	59	71	152	64	64	114.3	3.5	2.5	69.4	**HUB199-14**	29.5	20.2	5	2.13
	71	12.5	59	56	152	64	64	114.3	3.5	2.5	69.6	**HUB215-9**	33.5	23.2	5	2.24
	73.3	15.5	48	49	148	59	68	100	4.5	3.5	56.1	**HUB042-47**	37.0	23.8	4	1.95
	73.3	15.5	48	49	148	66	68	114.3	4.5	3.5	56.1	**HUB042-55**	37.0	23.8	4	2.08
31.77	75	13.3	52	58.56	139	63.22	64.38	107.95	2	2	63.4	**HUB059-70**	39.5	26.8	5	2.17
33	73	14.5	51	59	140	67	72	114.3	3.7	3.5	60.1	**HUB066-46**	35.5	24.0	5	2.14
34	72	11.5	42	56	152	64	64	114.3	3.5	2.5	56.7	**HUB094-19**	29.3	20.9	4	2.17
	72	15	42	55	139	64	64	114.3	3.5	2.5	56.7	**HUB028-16**	29.3	20.9	4	2.08
	74	12	58	62	152	64	64	114.3	3.5	2.5	72.1	**HUB198-7**	37.5	26.3	5	2.23
	74	13	48	62	146.5	64	70	114.3	3.5	2.5	62.0	**HUB142-11**	33.5	23.6	5	2.33
	74	13	58	62	146.5	64	64	114.3	3.5	2.5	72.0	**HUB249-4**	33.5	23.6	5	2.29
	74	13	58	62	146.5	64	70	114.3	3.5	2.5	72.0	**HUB150-5**	33.5	23.6	5	2.37
	76	17.7	53	58.8	140	66	68	114.3	4.5	3.5	65.4	**HUB161-11**	33.5	23.6	5	1.97
	79	17.7	53	58.8	148	66	68	114.3	5.5	4.5	67.3	**HUB182-4**	39.5	27.0	5	2.19
36	80	18.7	62	61	140	67	72	114.3	3.7	3.5	72.2	**HUB226-3**	39.5	27.3	5	2.69
38	76	15	52	62	146.5	70	70	114.3	3.5	2.5	63.9	**HUB091-18**	32.0	25.0	5	2.35

Hub bearing dimensions

GEN 2 ball type

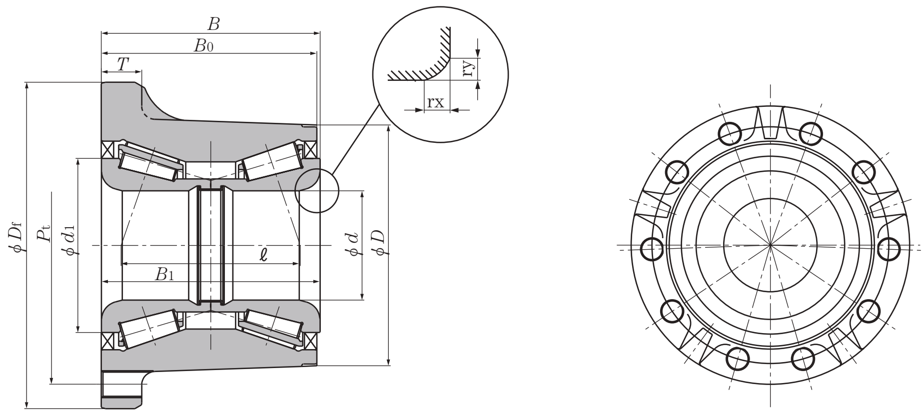
Inner ring rotating type for non driven wheel



Main dimensions (mm)										Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of outer ring holes	Mass (kg) (Reference)
d	D	B	B_1	D_r	d_1	d_2	P_h	rx (min.)	ry (min.)			C	C_0		
30	65	51.8	42	76	46.2	63	99	3.7	3.6	53.0	**HUB121-4**	29.5	20.4	4	1.00

GEN 2 roller type

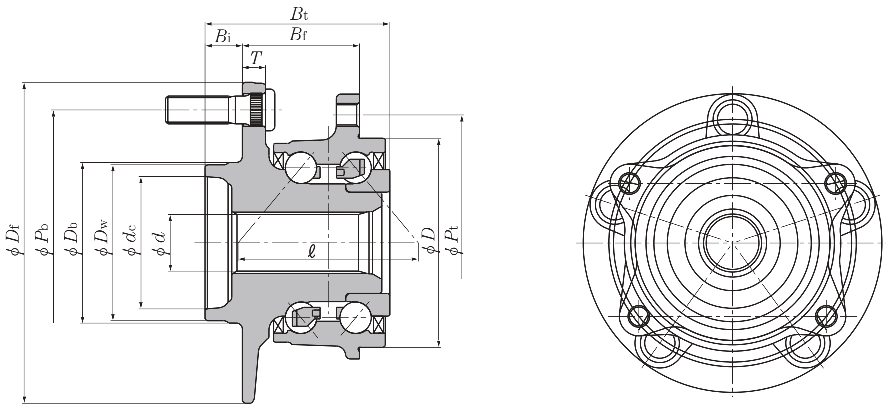
Inner ring rotating type for non driven wheell



Main dimensions (mm)											Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of tapped holes in outer ring	Mass (kg) (Reference)
d	D	B	B_1	d_1	T	B_0	P_t	D_f	rx (min.)	ry (min.)			C	C_0		
65	143.1	130	130	103.5	24	128	165	194	12	11	107	**HUR042-27**	21.9	31	10	13.9
70	141.5	110	110	100	25	110	165	194	12	7	84.2	**HUR040-11**	19.3	27.9	10	11.3

GEN 3 ball type

Inner ring rotating type for driven wheel

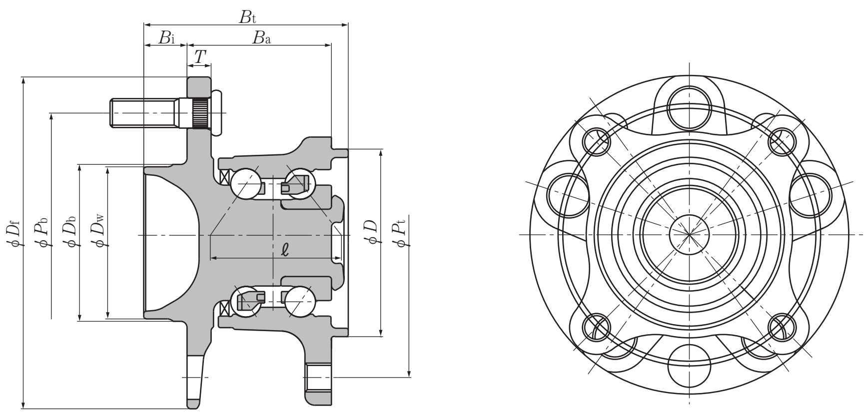


Main dimensions (mm)												Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of hub bolts	Number of tapped holes in outer ring	Mass (kg) (Reference)
d	D	B_t	B_f	d_c	D_w	D_b	T	B_i	P_b	P_t	D_f			C	C_0			
24.4	84	94.3	65.5	50	56	58	10	14	100	107	124	75.3	**HUB266-1**	27.6	22.3	5	4	3.65
	90	84.2	60.4	57	67	69	10	16	114.3	110	138	69.9	**HUB267-1**	27.7	24.9	5	4	3.64
26.4	87	74.5	38.5	57	67	69	11.5	15.5	114.3	112	139	74.6	**HUB251-4**	43.5	34.5	5	4	3.2
27.52	85.5	79.83	35.9	56.9	63.23	70.97	11	17.83	107.95	112	139	67.2	**HUB211-7**	44	33.5	5	3	2.8
28.4	84	95.5	69	58	66	68	10.5	15.5	114.3	107.004	148	80.8	**HUB012T-1**	40.5	33.5	5	4	3.41

※Old bearing number given in blue.

GEN 3 ball type

Inner ring rotating type for non driven wheell



Main dimensions (mm)									Distance between pressure cone apexes ℓ (mm)	Bearing No.	Basic rated load (kN) Single row		Number of hub bolts	Number of tapped holes in outer ring	Mass (kg) (Reference)
D_w	D	D_b	B_a	T	B_i	P_b	P_t	D_f			C	C_0			
64	74	64	58.8	8	12.5	114.3	-	139.5	68.8	**HUB262-8**	29.4	20.8	5	4	2.92
	76	64	53	10	12	114.3	100	146.5	78.5	**HUB270-1**	32.5	24.9	5	4	3.81
66	84	68	69	10.5	15.5	114.3	107.004	148	70.4	**HUB231-10**	30.5	23.7	5	4	3.08
	84	68	40.7	10	17.7	114.3	107.004	136	64.4	**HUB232-8**	35.5	25.3	5	4	2.97
67	90	69	60.4	10	16	114.3	110	138	69.9	**HUB004T-1**	27.7	25	5	4	3.4

※Old bearing number given in blue.

Spherical Roller Bearings ULTAGE Series

[Type EA, Type EM]

CAT.No.3033-5/E

CAT.No.3033-5/E 22.05.005 DS/DS

Up to
3.7 times
longer
service life

【Type EA· Type EM】

ULTAGE™

Up to
20 % higher
allowable
speed

Longer service life and higher rotational speed improve ease-of-use while contributing to more eco-friendly operation.

ULTAGE Series spherical roller bearings are products developed to provide longer service life, higher rotational speed, and improved ease-of-use required for any industrial machinery.

Longer Service Life

- Larger rollers provide the industry's highest load capacity.
- Extended maintenance intervals
- Lighter and more compact design
- Withstands operating temperatures up to 200℃.

Higher Rotational Speed

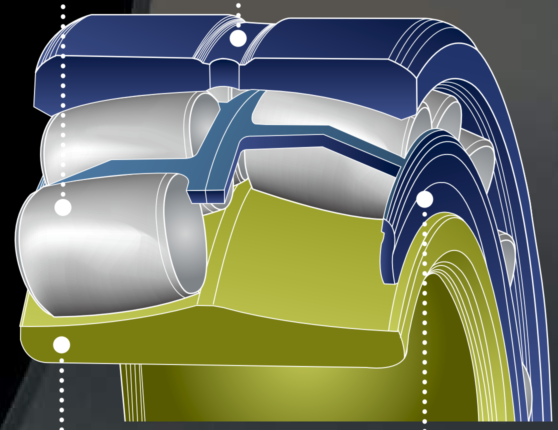
- The industry's highest allowable rotational speed
- Type EA has a simple window-type configuration employs a pressed steel cage.

Improved Ease-of-Use

- Unique structure readily accepts lubricant.
- Improved application of grease

Rollers
- Larger rollers
- Maximum number of rollers

Outer ring
- With oil inlets and oil groove
- Optimal curvature



【Type EA】

Inner ring
- No rib
- Optimal curvature

Cage
- Window-type pressed steel cage
- Cage end faces function as guides.

INDEX

ULTAGE "ULTAGE" (a name created from the combination of "ultimate," signifying refinement, and "stage," signifying NTN's intention that this series of products be employed in diverse applications) is the general name for NTN's new generation of bearings that are noted for their industry-leading performance.

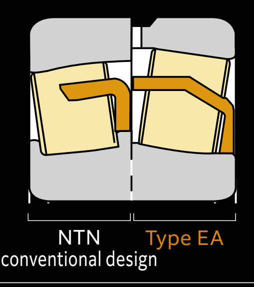
ULTAGE™ The ULTAGE Advantage【Type EA】

1 The industry's highest load capacity

These bearings have a significantly increased roller diameter and incorporate the maximum number of rollers, thus achieving both a high load capacity and a longer service life. Maintenance intervals can also be extended.

① Basic dynamic load rating: up to 50 % greater than the NTN conventional design
② Basic static load rating: up to 35 % greater than the NTN conventional design
③ Service life: up to 3.7 times longer than the NTN conventional design

Figure 1



2 The industry's highest allowable speed

The new pressed steel cage results in allowable rotational speed up to 20 % greater than NTN's conventional design.

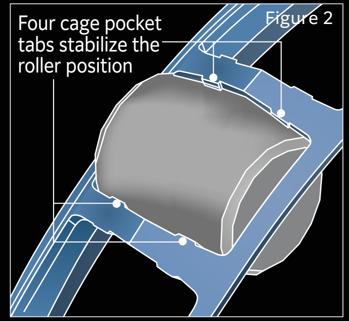


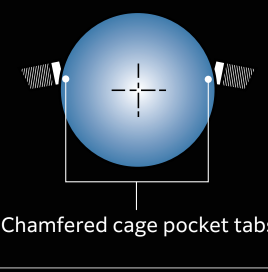
Figure 2

3 Pressed steel cage provided as standard.

The window-type pressed steel cage provides higher rigidity. Each roller pocket is provided with four tabs.

① The guide system employs a back-to-back cage system.
② Four tabs in each cage pocket stabilize the roller position.
③ The innovative cage pocket shape ensures a stable supply of lubricating oil or grease into the bearing.
④ A special surface treatment enhances wear resistance.

Figure 3



4 Compact, lightweight design

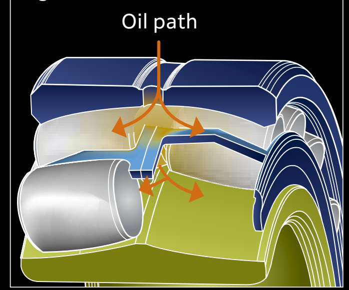
The increased load capacity contributes to a lighter and more compact design.

Benchmarks

Model No.	Load rating (kN)		Boundary dimensions (mm)	Bearing volume (cm³)	Mass (kg)
	C_r	C_{0r}			
22220B	350	415	ϕ100×ϕ180×46	810	4.95
22218EA	384	398	ϕ90×ϕ160×40	550	3.34

Results in approximately a 30 % reduction in volume ratio and mass ratio

Figure 4



5 Improved ease-of-use

Adoption of a simple window-type pressed steel cage improves ease of assembly/disassembly and grease application.

① Improved application of grease to the roller surface
② Improved roller retention contributes to easier assembly/disassembly

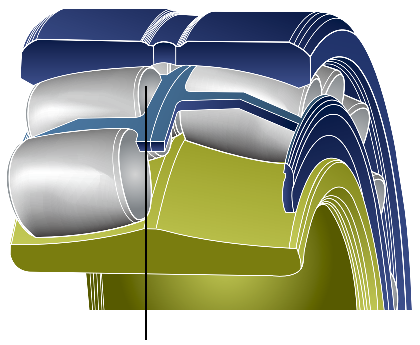
【Bearing Number】

222 20 EA K D1 C3

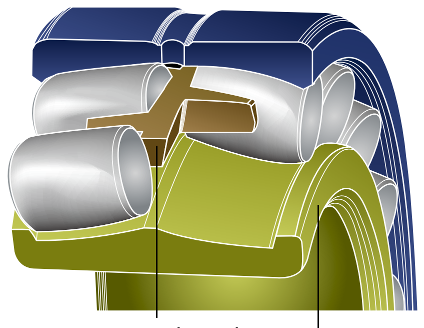
- **222** — Dimension series code
- **20** — Bore diameter code
- **EA** — Type code
  EA: Window-type pressed steel cage
  EM: One-piece machined high-tension brass cage
- **K** — Raceway configuration code
  No code: Cylindrical bore
  K: Tapered bore
- **D1** — Oil inlet/oil groove code
  D1: With oil inlet/oil groove
  W33: With oil inlet/oil groove (Made in Europe)
- **C3** — Internal clearance code
  No code: Normal clearance
  C3: C3 clearance

For applications that expose bearings to severe vibration and impact, we recommend Type EM bearings, which incorporate a high-tension brass cage machined from a single piece. (Type EM differs from Type EA in the shape of the inner ring.)

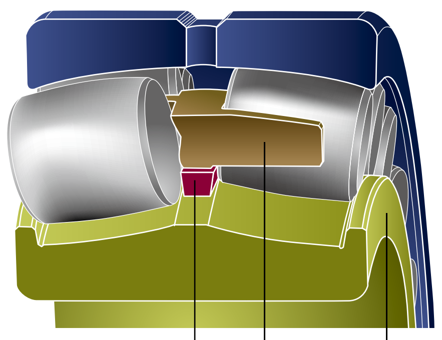
Type EA



Type EM



Type EM (Large size)



【Allowable Misalignment】

- Normal or heavy load ……… 1/115
- Light load ……………………… 1/30

*If the installed misalignment is greater than recommended, there is a risk of roller/cage protrusion and impact to surrounding components.

1 Bearing Tolerances

1.1 Dimensional accuracy and running accuracy

(1) Inner ring

unit : μm

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter in single plane Δ_{dmp} Class 0		Radial runout K_{ia} Class 0	Width deviation Δ_{Bs} Class 0		Width variation V_{Bs} Class 0
Over	Including	High	Low	Max	High	Low	Max
-	30	0	-10	13	0	-120	20
30	50	0	-12	15	0	-120	20
50	80	0	-15	20	0	-150	25
80	120	0	-20	25	0	-200	25
120	150	0	-25	30	0	-250	30
150	180	0	-25	30	0	-250	30
180	250	0	-30	40	0	-300	30
250	315	0	-35	50	0	-350	35
315	400	0	-40	60	0	-400	40
400	500	0	-45	65	0	-450	50

(2) Outer ring

unit : μm

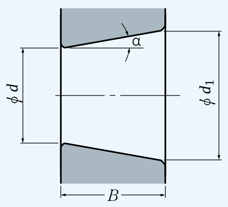
Nominal outside diameter D mm		Dimensional tolerance of mean outside diameter in single plane Δ_{Dmp} Class 0		Radial runout K_{ea} Class 0	Width deviation Δ_{Cs} Class 0		Width variation V_{Cs} Class 0
Over	Including	High	Low	Max	High	Low	Max
50	80	0	-13	25	Same as Δ_{Bs} and V_{Bs} of bearings of same nominal bore diameterd.		
80	120	0	-15	35			
120	150	0	-18	40			
150	180	0	-25	45			
180	250	0	-30	50			
250	315	0	-35	60			
315	400	0	-40	70			
400	500	0	-45	80			
500	630	0	-50	100			

1.2 Tolerance of tapered bore

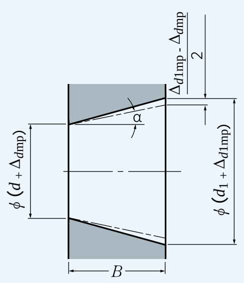
(1) Taper ratio 1:12 (Class 0)

unit : μm

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter in single plane Δ_{dmp}		Δ_{d1mp} - Δ_{dmp}		Bore diameter variation V_{dsp}
Over	Including	High	Low	High	Low	Max
-	30	+33	0	+21	0	13
30	50	+39	0	+25	0	16
50	80	+46	0	+30	0	19
80	120	+54	0	+35	0	22
120	180	+63	0	+40	0	40
180	250	+72	0	+46	0	46
250	315	+81	0	+52	0	52
315	400	+89	0	+57	0	57
400	500	+97	0	+63	0	63



Theoretical tapered bore



Tapered bore with dimensional tolerance of mean bore diameter in single plane

(2) Taper ratio 1:30 (Class 0)

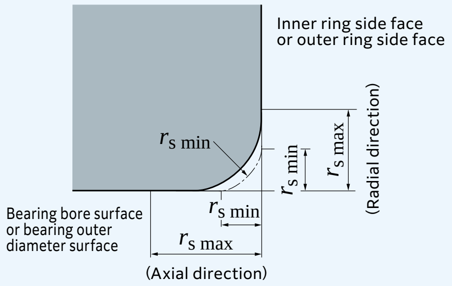
unit : μm

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter in single plane Δ_{dmp}		Δ_{d1mp} - Δ_{dmp}		Bore diameter variation V_{dsp}
Over	Including	High	Low	High	Low	Max
80	120	+20	0	+35	0	22
120	180	+25	0	+40	0	40
180	250	+30	0	+46	0	46
250	315	+35	0	+52	0	52
315	400	+40	0	+57	0	57
400	500	+45	0	+63	0	63

2 Chamfer Dimensions

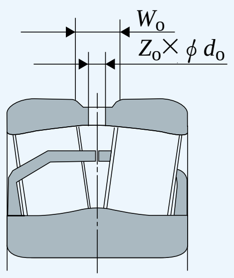
unit：mm

$r_{s\,min}$	Nominal bore diameter d Over	Including	$r_{s\,max}$ Radial direction	Axial direction
1	-	50	1.5	3
	50	-	1.9	3
1.1	-	120	2	3.5
	120	-	2.5	4
1.5	-	120	2.3	4
	120	-	3	5
2	-	80	3	4.5
	80	220	3.5	5
	220	-	3.8	6
2.1	-	280	4	6.5
	280	-	4.5	7
2.5	-	100	3.8	6
	100	280	4.5	6
	280	-	5	7
3	-	280	5	8
	280	-	5.5	8
4	-	-	6.5	9
5	-	-	8	10
6	-	-	10	13



3 Number of Oil Inlets for Outer Ring Outside Diameter

Nominal outside diameter D mm Min	Less than	Number of oil inlets D1 Z_o	W33 (Made in Europe) Z_o
-	320	4	3
320	600	8	3



Note:See the dimension table for information on the oil groove width W_o and oil inlet diameter d_o.

4 Internal Clearance

(1) Data for cylindrical bore bearings

unit：μm

Nominal bore diameter d mm Over	Including	C2 Min	C2 Max	CN Min	CN Max	C3 Min	C3 Max	C4 Min	C4 Max
-	30	15	25	25	40	40	55	55	75
30	40	15	30	30	45	45	60	60	80
40	50	20	35	35	55	55	75	75	100
50	65	20	40	40	65	65	90	90	120
65	80	30	50	50	80	80	110	110	145
80	100	35	60	60	100	100	135	135	180
100	120	40	75	75	120	120	160	160	210
120	140	50	95	95	145	145	190	190	240
140	160	60	110	110	170	170	220	220	280
160	180	65	120	120	180	180	240	240	310
180	200	70	130	130	200	200	260	260	340
200	225	80	140	140	220	220	290	290	380
225	250	90	150	150	240	240	320	320	420
250	280	100	170	170	260	260	350	350	460
280	315	110	190	190	280	280	370	370	500
315	355	120	200	200	310	310	410	410	550
355	400	130	220	220	340	340	450	450	600
400	450	140	240	240	370	370	500	500	660

(2) Data for tapered bore bearings

unit：μm

Nominal bore diameter d mm Over	Including	C2 Min	C2 Max	CN Min	CN Max	C3 Min	C3 Max	C4 Min	C4 Max
-	30	20	30	30	40	40	55	55	75
30	40	25	35	35	50	50	65	65	85
40	50	30	45	45	60	60	80	80	100
50	65	40	55	55	75	75	95	95	120
65	80	50	70	70	95	95	120	120	150
80	100	55	80	80	110	110	140	140	180
100	120	65	100	100	135	135	170	170	220
120	140	80	120	120	160	160	200	200	260
140	160	90	130	130	180	180	230	230	300
160	180	100	140	140	200	200	260	260	340
180	200	110	160	160	220	220	290	290	370
200	225	120	180	180	250	250	320	320	410
225	250	140	200	200	270	270	350	350	450
250	280	150	220	220	300	300	390	390	490
280	315	170	240	240	330	330	430	430	540
315	355	190	270	270	360	360	470	470	590
355	400	210	300	300	400	400	520	520	650
400	450	230	330	330	440	440	570	570	720

5 Installing Tapered Bore Bearings

unit：mm

Nominal bore diameter d Over	Including	Reduction in radial internal clearance Min	Max	Axial displacement drive-up Taper ratio 1:12 Min	Max	Taper ratio 1:30 Min	Max	Nut rotation angle, deg. (approx.) Taper ratio 1:12 Min	Max	Taper ratio 1:30 Min	Max	Minimum residual radial internal clearance CN	C3	C4
24	30	0.010	0.015	0.15	0.20	—	—	36	48	—	—	0.015	0.025	0.040
30	40	0.015	0.020	0.25	0.30	—	—	60	72	—	—	0.015	0.030	0.045
40	50	0.020	0.025	0.35	0.40	—	—	84	96	—	—	0.020	0.035	0.055
50	65	0.025	0.030	0.40	0.45	—	—	72	81	—	—	0.025	0.045	0.065
65	80	0.035	0.040	0.50	0.60	—	—	90	108	—	—	0.030	0.055	0.080
80	100	0.040	0.050	0.60	0.70	—	—	108	126	—	—	0.030	0.060	0.090
100	120	0.055	0.065	0.80	0.90	1.80	2.30	144	162	324	414	0.035	0.070	0.105
120	140	0.065	0.075	0.90	1.00	1.95	2.70	162	180	351	486	0.045	0.085	0.125
140	150	0.075	0.090	1.00	1.20	2.35	3.10	180	216	423	558	0.040	0.090	0.140
150	160	0.075	0.090	1.00	1.20	2.35	3.10	120	144	282	372	0.040	0.090	0.140
160	180	0.080	0.100	1.10	1.40	2.80	3.55	132	168	336	426	0.040	0.100	0.160
180	200	0.090	0.110	1.20	1.50	3.20	3.95	144	180	384	474	0.050	0.110	0.180
200	225	0.110	0.130	1.50	1.80	3.85	4.60	135	162	347	414	0.050	0.120	0.190
225	250	0.120	0.140	1.60	1.90	4.20	4.95	144	171	378	446	0.060	0.130	0.210
250	280	0.130	0.160	1.60	2.10	4.25	5.40	144	189	383	486	0.060	0.140	0.230
280	305	0.150	0.180	1.90	2.40	4.45	5.70	171	216	401	513	0.060	0.150	0.250
305	315	0.150	0.180	1.90	2.40	4.45	5.70	137	173	320	410	0.060	0.150	0.250
315	355	0.160	0.190	2.10	2.50	5.10	6.10	151	180	367	439	0.080	0.170	0.280
355	400	0.180	0.220	2.30	3.00	5.75	7.50	166	216	414	540	0.080	0.180	0.300
400	450	0.210	0.250	3.00	3.60	—	—	216	259	—	—	0.080	0.190	0.320

Note: The nut rotation angle may only be applied when a nut having the same inner diameter code as the bearing is used.

6 Bearing Fits

(1) Tolerance class of normally used shaft

Conditions		Shaft diameter (mm) Over	Shaft diameter (mm) Including	Tolerance zone of shaft	Remarks
Cylindrical bore bearing (class 0)					
Rotating inner ring load or indefinite-direction load	Light load[1)] or normal load[1)] or varying load	18	25	k5	
		25	40	m5	
		40	60	n5	
		60	100	n6	
		100	200	p6	
		200	500	r6	
	Heavy load[1)] or impact load	50	70	n5	Use a bearing with an internal clearance greater than the CN clearance.
		70	140	p6	
		140	200[2)]	r6	
Static inner ring load	Inner ring should slide smoothly on shaft.	All shaft diameters		g6	For larger bearings, tolerance zone f6 may be applied to ensure the bearing slides smoothly on the shaft.
	Inner ring need not slide smoothly on shaft.	All shaft diameters		h6	
Tapered bore bearing (Class 0; complete with adaptor or removable sleeve.)					
All types of loads		All shaft diameters		h9/IT5 [3)]	h10/IT7[3)] will suffice for power transmitting shafts.

1) Criteria for light loads, normal loads, and heavy loads.
- Light loads : Dynamic equivalent radial loads $\leq 0.05C_r$
- Normal loads : $0.05C_r$ < Dynamic equivalent radial loads $\leq 0.10C_r$
- Heavy loads : $0.10C_r$ < Dynamic equivalent radial loads

2) When using shaft diameter over 200 mm with heavy load or impact load, please contact **NTN** Engineering.
3) "IT5" or "IT7" means that the shaft form tolerance (circularity, cylidricity, etc.) must satisfy tolerance class IT5 or IT7.

Note 1 : The above table applies to solid steel shafts.

2 : When calculating the necessary interference, use the following expressions. Determine the value to 1/1000 the shaft diameter at maximum:
- When $F_r \leq 0.3C_{0r}$ Necessary interference Δd_F (μm) is $\Delta d_F = 0.08\ (d \cdot F_r/B)^{1/2}$
- When $F_r > 0.3C_{0r}$ $\Delta d_F = 0.02\ (F_r/B)$

(where, d: bearing bore diameter mm, B: inner ring width mm, F_r: radial load N, C_{0r}: basic static load rating N)

When taking into account the difference between the ambient temperature and the temperature of a running bearing, consider adopting the necessary temperature-difference-dependent effective interference Δd_T (μm).

$\Delta d_T = 0.0015 \cdot d \cdot \Delta T$

(where, ΔT: difference between bearing temperature and ambient temperature in ℃)

(2) Tolerance class of normally used housing bore

Conditions: Housing	Conditions: Load type, etc.		Conditions: Axial movement of outer ring	Tolerance class of housing bore	Remarks
One-piece housing or two-piece housing	Static outer ring load	All types of loads	Movable	H7	When a large bearing is used or a large temperature difference exists across the outer ring and housing, tolerance zone G7 may be applied.
		Light load[1)] or normal load[1)]	Movable	H8	——
		Shaft and inner ring become very hot.	Easily movable	G7	When a large bearing is used or a large temperature difference exists across the outer ring and housing, tolerance zone F7 may be applied.
One-piece housing		Precision rotation must be possibleunder light or normal load.	Generally immovable	K6	——
			Movable	JS6	——
		Quiet running required.	Movable	H6	——
	Indefinite-direction load	Light or normal load	Movable	JS7	——
		Normal or heavy load [1)]	Generally immovable	K7	——
		High-impact load	Immovable	M7	——
	Rotating outer ring load	Light or varying load	Immovable	M7	——
		Normal or heavy load	Immovable	N7	——
		Heavy or high-impact loads on thin-walled housings	Immovable	P7	——

1) Criteria for light loads, normal loads, and heavy loads.
- Light loads : Dynamic equivalent radial loads $\leq 0.05C_r$
- Normal loads : $0.05C_r$ < Dynamic equivalent radial loads $\leq 0.10C_r$
- Heavy loads : $0.10C_r$ < Dynamic equivalent radial loads

Note : The above table applies to steel or cast iron housings.

7 Allowable Axial Load

Spherical roller bearings carry a radial load, a bidirectional axial load, or a combination of both. They are suitable for applications involving vibration and impact loads. However , if spherical roller bearings are mounted on a vertical shaft or under an excessive axial load, the load on the rollers of the row not receiving the axial load will be reduced and the rollers in this row move with a sliding motion, possibly leading to lubrication failure and other problems. In case that the ratio of axial load to radial load exceeds Constant e which is in the dimension table ($F_a/F_r>e$), please contact **NTN** Engineering.

F_a : Axial load. F_r : Radial load. e : Constant (See dimension table)

8 Fatigue Load Limit (C_u)

The fatigue load limit is the applied load on a bearing that results in just reaching the fatigue stress limit at the maximum loaded raceway contact. This depends on the bearing type, internal specifications, quality, and material strength. In ISO 281:2007, 1.5 GPa is recommended as the fatigue stress limit corresponding to C_u for bearings made of commonly used high quality material and good manufacturing quality. Values for the fatigue load limit with respect to the **NTN** bearing numbers are provided in the dimensional table. The life modification factor, a_{ISO}, should be evaluated considering the fatigue load limit. For details see catalog "Ball and Roller Bearings (CAT. No.2203/E) section 3.4 Modified rating life".

9 Allowable Speed

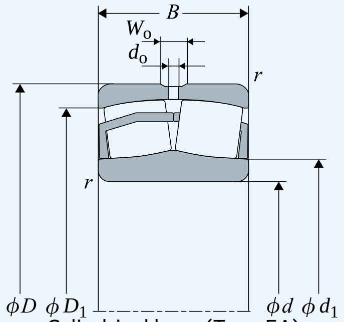
Higher rotational speed results in higher bearing temperatures caused by friction. When the bearing temperature exceeds a specific limit, lubricant performance deteriorates significantly, leading to abnormally high temperatures and bearing seizure.
The limiting factors that affect allowable rotational speed include the following:
(1) Bearing type
(2) Bearing size
(3) Lubrication system (grease, circulating lubrication, oil bath, etc.)
(4) Bearing internal clearance (internal clearance of running bearing)
(5) Bearing load
(6) Dimensional accuracy with shaft, housing, etc.
The allowable speeds indicated in the bearing dimension table are for reference only and apply only when bearings are lubricated and heat is efficiently drawn away from the bearing. The allowable speeds in this catalog are categorized as follows:

【Oil-lubricated bearings】
The rotational speed at which the outer ring temperature reaches 80 ℃ when the bearing is allowed to run at 5 % basic static load rating C_{0r} while lubricated with oil (viscosity ISO VG32) which is assimilated to room temperature and fed at a rate of 1 liter/min (circulating lubrication)

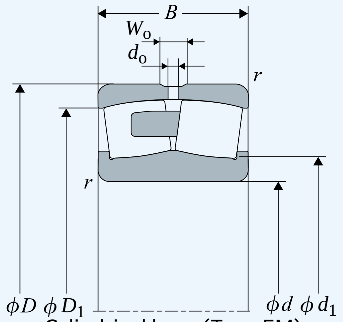
【Grease-lubricated bearings】
The rotational speed at which the outer ring temperature reaches 80 ℃ when the bearing, which has undergone running-in operation, is allowed to run at 5 % basic static load rating C_{0r} with the bearing's internal free volume 20 to 30 % pre-filled with lithium grease (consistency: NLGI3)
With either lubrication system, the bearing temperature rise profile varies with the operating conditions (operating load, rotational speed, lubricating conditions, etc.) in which the bearing is used. Therefore, select the optimal bearing by allowing sufficient margin for the allowable speed for that particular bearing as indicated in the catalog.
Contact **NTN** Engineering for technical assistance if the rotational speed in the intended application exceeds 80 % of the allowable speed indicated in the bearing dimension table, or if the intended bearing is to be used under severe operating conditions involving vibration and impact.

10 Dimension Table

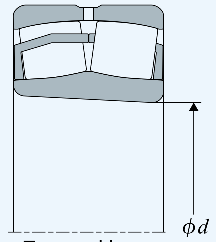
Type EA･Type EM



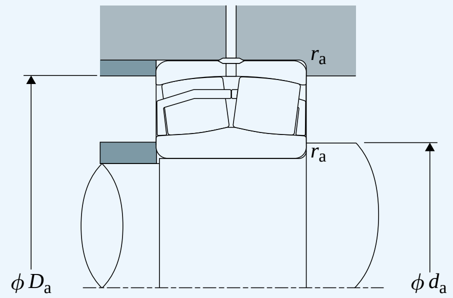
Cylindrical bore (Type EA)



Cylindrical bore (Type EM)



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

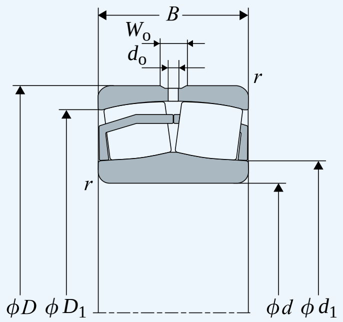
For values e, Y_1, Y_2 and Y_0 see the following table.

Boundary dimensions mm						Basic dynamic load rating kN	Basic static load rating kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing number		Abutment and fillet dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d	D	B	$r_{s\,min}$ 2)	W_o	d_o	C_r	C_{0r}	C_u	Grease	Oil	Cylindrical bore	Tapered bore 1)	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
25	52	18	1	3	1.5	57.3	46.1	3.23	10 400	13 000	22205EAW33	22205EAKW33	30	30	46	46	1	0.34	2.00	2.98	1.96	0.173	0.169
	52	18	1	3	1.5	57.3	46.1	3.23	10 400	13 000	22205EMW33	22205EMKW33	30	30	46	46	1	0.34	2.00	2.98	1.96	0.174	0.171
30	62	20	1	4	2	75.7	64.5	4.58	8 800	11 000	22206EAW33	22206EAKW33	37	36	56	55	1	0.31	2.15	3.20	2.10	0.278	0.272
	62	20	1	4	2	75.7	64.5	4.58	8 800	11 000	22206EMW33	22206EMKW33	37	36	56	55	1	0.31	2.15	3.20	2.10	0.281	0.275
35	72	23	1.1	5	2	100	92.0	6.11	7 500	9 400	22207EAW33	22207EAKW33	45	42	65	63	1.1	0.31	2.21	3.29	2.16	0.438	0.43
	72	23	1.1	5	2	100	92.0	6.11	7 500	9 400	22207EMW33	22207EMKW33	45	42	65	63	1.1	0.31	2.21	3.29	2.16	0.442	0.433
40	80	23	1.1	5	2.5	116	105	7.78	6 800	8 500	22208EAD1	22208EAKD1	50	47	73	71	1.1	0.27	2.47	3.67	2.41	0.528	0.518
	80	23	1.1	5	2.5	110	98.0	7.29	6 800	8 500	22208EMD1	22208EMKD1	50	47	73	71	1.1	0.27	2.47	3.67	2.41	0.529	0.519
	90	33	1.5	6	3	169	152	9.36	5 400	6 600	22308EAD1	22308EAKD1	52	49	81	78	1.5	0.36	1.87	2.79	1.83	1.02	1
	90	33	1.5	6	3	169	152	9.36	5 400	6 600	22308EMD1	22308EMKD1	52	49	81	78	1.5	0.36	1.87	2.79	1.83	1.03	1.01
45	85	23	1.1	6	2.5	121	113	8.76	6 100	7 700	22209EAD1	22209EAKD1	54	52	78	76	1.1	0.26	2.64	3.93	2.58	0.572	0.561
	85	23	1.1	6	2.5	116	106	8.24	6 100	7 700	22209EMD1	22209EMKD1	54	52	78	76	1.1	0.26	2.64	3.93	2.58	0.577	0.566
	100	36	1.5	6	3	206	187	11.8	4 600	5 700	22309EAD1	22309EAKD1	58	54	91	87	1.5	0.36	1.90	2.83	1.86	1.37	1.34
	100	36	1.5	6	3	206	187	11.8	4 600	5 700	22309EMD1	22309EMKD1	58	54	91	87	1.5	0.36	1.90	2.83	1.86	1.38	1.35
50	90	23	1.1	6	2.5	130	124	10.1	5 700	7 200	22210EAD1	22210EAKD1	59	57	83	81	1.1	0.24	2.84	4.23	2.78	0.614	0.602
	90	23	1.1	6	2.5	125	117	9.54	5 700	7 200	22210EMD1	22210EMKD1	59	57	83	81	1.1	0.24	2.84	4.23	2.78	0.616	0.604
	110	40	2	7	3.5	250	232	14.0	4 300	5 300	22310EAD1	22310EAKD1	63	61	99	95	2	0.36	1.87	2.79	1.83	1.82	1.79
	110	40	2	7	3.5	250	232	14.0	4 300	5 300	22310EMD1	22310EMKD1	63	61	99	95	2	0.36	1.87	2.79	1.83	1.84	1.8
55	100	25	1.5	6	3	155	148	12.6	5 300	6 700	22211EAD1	22211EAKD1	66	64	91	90	1.5	0.23	2.95	4.40	2.89	0.83	0.814
	100	25	1.5	6	3	148	140	11.9	5 300	6 700	22211EMD1	22211EMKD1	66	64	91	90	1.5	0.23	2.95	4.40	2.89	0.827	0.811
	120	43	2	8	3.5	296	274	17.4	3 900	4 800	22311EAD1	22311EAKD1	68	66	109	104	2	0.36	1.87	2.79	1.83	2.31	2.26
	120	43	2	8	3.5	296	274	17.4	3 900	4 800	22311EMD1	22311EMKD1	68	66	109	104	2	0.36	1.87	2.79	1.83	2.34	2.29
60	110	28	1.5	7	3	187	181	15.4	4 800	6 000	22212EAD1	22212EAKD1	71	69	101	99	1.5	0.24	2.84	4.23	2.78	1.14	1.12
	110	28	1.5	7	3	179	171	14.6	4 800	6 000	22212EMD1	22212EMKD1	71	69	101	99	1.5	0.24	2.84	4.23	2.78	1.15	1.13
	130	46	2.1	9	4	340	319	20.3	3 600	4 600	22312EAD1	22312EAKD1	75	72	118	113	2.1	0.35	1.95	2.90	1.91	2.86	2.8
	130	46	2.1	9	4	340	319	20.3	3 600	4 600	22312EMD1	22312EMKD1	75	72	118	113	2.1	0.35	1.95	2.90	1.91	2.91	2.85
65	120	31	1.5	8	3.5	226	224	18.2	4 400	5 500	22213EAD1	22213EAKD1	78	74	111	107	1.5	0.24	2.79	4.15	2.73	1.52	1.49
	120	31	1.5	8	3.5	217	212	17.2	4 400	5 500	22213EMD1	22213EMKD1	78	74	111	107	1.5	0.24	2.79	4.15	2.73	1.53	1.5
	140	48	2.1	9	4	369	343	23.4	3 300	4 100	22313EAD1	22313EAKD1	81	77	128	122	2.1	0.33	2.06	3.06	2.01	3.48	3.41
	140	48	2.1	9	4	369	343	23.4	3 300	4 100	22313EMD1	22313EMKD1	81	77	128	122	2.1	0.33	2.06	3.06	2.01	3.5	3.43
70	125	31	1.5	7	3.5	235	240	20.1	4 100	5 200	22214EAD1	22214EAKD1	84	79	116	113	1.5	0.22	3.01	4.48	2.94	1.61	1.58
	125	31	1.5	7	3.5	235	240	20.1	4 100	5 200	22214EMD1	22214EMKD1	84	79	116	113	1.5	0.22	3.01	4.48	2.94	1.64	1.6
	150	51	2.1	10	5	420	396	26.0	3 000	3 800	22314EAD1	22314EAKD1	85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.25	4.16
	150	51	2.1	10	5	420	396	26.0	3 000	3 800	22314EMD1	22314EMKD1	85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.31	4.22
75	130	31	1.5	7	3.5	244	249	21.1	4 000	5 000	22215EAD1	22215EAKD1	88	84	121	118	1.5	0.22	3.14	4.67	3.07	1.67	1.64
	130	31	1.5	7	3.5	244	249	21.1	4 000	5 000	22215EMD1	22215EMKD1	88	84	121	118	1.5	0.22	3.14	4.67	3.07	1.71	1.67
	160	55	2.1	10	5	491	467	29.8	2 900	3 600	22315EAD1	22315EAKD1	91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.18	5.07
	160	55	2.1	10	5	491	467	29.8	2 900	3 600	22315EMD1	22315EMKD1	91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.27	5.16
80	140	33	2	8	3.5	278	287	24.0	3 700	4 600	22216EAD1	22216EAKD1	94	91	129	127	2	0.22	3.14	4.67	3.07	2.09	2.05
	140	33	2	8	3.5	267	272	22.8	3 700	4 600	22216EMD1	22216EMKD1	94	91	129	127	2	0.22	3.14	4.67	3.07	2.11	2.07
	170	58	2.1	10	5	541	522	32.5	2 700	3 400	22316EAD1	22316EAKD1	98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.12	5.99
	170	58	2.1	10	5	541	522	32.5	2 700	3 400	22316EMD1	22316EMKD1	98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.28	6.15
85	150	36	2	8	3.5	324	330	27.1	3 400	4 300	22217EAD1	22217EAKD1	100	96	139	137	2	0.22	3.07	4.57	3.00	2.59	2.54
	150	36	2	8	3.5	324	330	27.1	3 400	4 300	22217EMD1	22217EMKD1	100	96	139	137	2	0.22	3.07	4.57	3.00	2.67	2.62
	180	60	3	11	5	599	604	36.4	2 600	3 200	22317EAD1	22317EAKD1	107	99	166	157	3	0.32	2.09	3.11	2.04	7.18	7.04
	180	60	3	11	5	599	604	36.4	2 600	3 200	22317EMD1	22317EMKD1	107	99	166	157	3	0.32	2.09	3.11	2.04	7.29	7.15

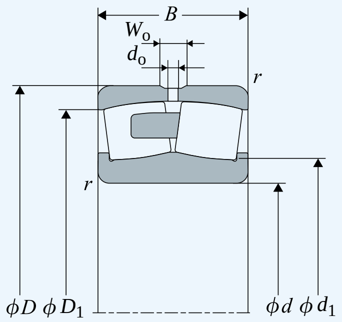
1) "K" indicates bearings have taperd bore with a taper ratio of 1:12.
2) Smallest allowable dimension for chamfer dimension r.

10 Dimension Table

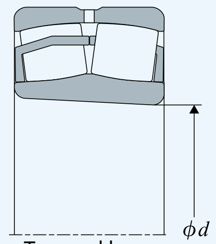
Type EA·Type EM



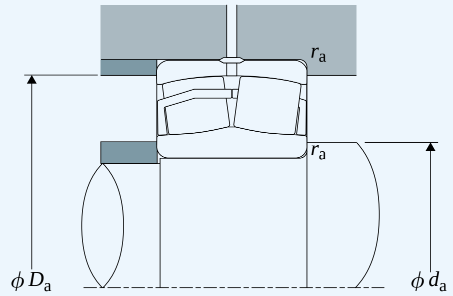
Cylindrical bore (Type EA)



Cylindrical bore (Type EM)



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

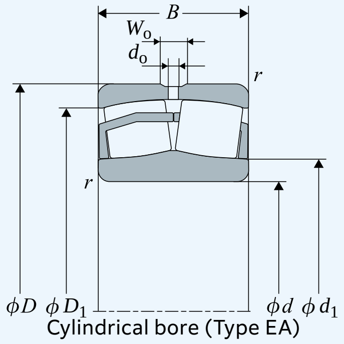
For values e, Y_1, Y_2 and Y_0 see the following table.

Boundary dimensions mm						Basic dynamic load rating kN	Basic static load rating kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing number		Abutment and fillet dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d	D	B	$r_{s\,min}$[2]	W_o	d_o	C_r	C_{0r}	C_u	Grease	Oil	Cylindrical bore	Tapered bore[1]	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
90	160	40	2	10	4.5	384	398	30.2	3 200	4 000	22218EAD1	22218EAKD1	105	101	149	144	2	0.23	2.90	4.31	2.83	3.34	3.27
	160	40	2	10	4.5	384	398	30.2	3 200	4 000	22218EMD1	22218EMKD1	105	101	149	144	2	0.23	2.90	4.31	2.83	3.43	3.37
	160	52.4	2	9	4	467	513	30.0	2 600	3 200	23218EMD1	23218EMKD1	104	101	149	141	2	0.30	2.25	3.34	2.20	4.43	4.31
	190	64	3	12	5	668	652	40.0	2 500	3 000	22318EAD1	22318EAKD1	110	104	176	166	3	0.33	2.06	3.06	2.01	8.42	8.25
	190	64	3	12	5	668	652	40.0	2 500	3 000	22318EMD1	22318EMKD1	110	104	176	166	3	0.33	2.06	3.06	2.01	8.53	8.35
95	170	43	2.1	10	4.5	416	417	33.4	3 000	3 800	22219EAD1	22219EAKD1	110	107	158	153	2.1	0.23	2.95	4.40	2.89	3.98	3.9
	170	43	2.1	10	4.5	416	417	33.4	3 000	3 800	22219EMD1	22219EMKD1	110	107	158	153	2.1	0.23	2.95	4.40	2.89	4.06	3.98
	200	67	3	12	6	732	751	43.4	2 300	2 800	22319EAD1	22319EAKD1	120	109	186	174	3	0.32	2.09	3.11	2.04	9.91	9.71
	200	67	3	12	6	732	751	43.4	2 300	2 800	22319EMD1	22319EMKD1	120	109	186	174	3	0.32	2.09	3.11	2.04	10	9.82
100	165	52	2	8	4	464	563	30.7	2 400	3 000	23120EAD1	23120EAKD1	114	111	154	147	2	0.28	2.39	3.56	2.34	4.37	4.24
	165	52	2	8	4	480	590	32.1	2 400	3 000	23120EMD1	23120EMKD1	114	111	154	147	2	0.28	2.39	3.56	2.34	4.45	4.32
	180	46	2.1	11	5	472	495	36.9	2 800	3 600	22220EAD1	22220EAKD1	118	112	168	161	2.1	0.24	2.84	4.23	2.78	4.9	4.8
	180	46	2.1	11	5	472	495	36.9	2 800	3 600	22220EMD1	22220EMKD1	118	112	168	161	2.1	0.24	2.84	4.23	2.78	5.02	4.93
	180	60.3	2.1	9	4.5	586	661	36.3	2 300	2 900	23220EMD1	23220EMKD1	118	112	168	159	2.1	0.31	2.18	3.24	2.13	6.51	6.33
	215	73	3	13	6	827	844	50.1	2 100	2 600	22320EAD1	22320EAKD1	127	114	201	187	3	0.34	1.98	2.94	1.93	12.6	12.3
	215	73	3	13	6	827	844	50.1	2 100	2 600	22320EMD1	22320EMKD1	127	114	201	187	3	0.34	1.98	2.94	1.93	12.9	12.7
110	170	45	2	8	3.5	417	517	32.1	2 600	3 300	23022EAD1	23022EAKD1	123	119	161	155	2	0.23	2.95	4.40	2.89	3.66	3.55
	170	45	2	8	3.5	417	517	32.1	2 600	3 300	23022EMD1	23022EMKD1	123	119	161	155	2	0.23	2.95	4.40	2.89	3.66	3.55
	180	56	2	9	4	547	669	36.2	2 200	2 800	23122EAD1	23122EAKD1	125	121	169	161	2	0.28	2.43	3.61	2.37	5.66	5.49
	180	56	2	9	4	547	669	36.2	2 200	2 800	23122EMD1	23122EMKD1	125	121	169	161	2	0.28	2.43	3.61	2.37	5.53	5.36
	180	69	2	8	4	622	769	35.7	2 200	2 700	24122EMD1	24122EMK30D1	121	121	169	158	2	0.36	1.90	2.83	1.86	6.75	6.65
	200	53	2.1	12	6	602	643	45.0	2 600	3 300	22222EAD1	22222EAKD1	130	122	188	179	2.1	0.25	2.69	4.00	2.63	7.1	6.95
	200	53	2.1	12	6	602	643	45.0	2 600	3 300	22222EMD1	22222EMKD1	130	122	188	179	2.1	0.25	2.69	4.00	2.63	7.3	7.15
	200	69.8	2.1	11	5	752	869	43.9	2 100	2 600	23222EMD1	23222EMKD1	130	122	188	176	2.1	0.32	2.12	3.15	2.07	9.41	9.14
	240	80	3	16	7	975	972	59.0	2 000	2 400	22322EAD1	22322EAKD1	139	124	226	209	3	0.32	2.09	3.11	2.04	17	16.6
	240	80	3	16	7	975	972	59.0	2 000	2 400	22322EMD1	22322EMKD1	139	124	226	209	3	0.32	2.09	3.11	2.04	17.4	17.1
120	180	46	2	8	3.5	446	577	35.8	2 400	3 100	23024EAD1	23024EAKD1	134	129	171	165	2	0.22	3.14	4.67	3.07	4.02	3.9
	180	46	2	8	3.5	446	577	35.8	2 400	3 100	23024EMD1	23024EMKD1	134	129	171	165	2	0.22	3.14	4.67	3.07	4.02	3.9
	180	60	2	8	3.5	526	726	34.4	2 100	2 600	24024EMD1	24024EMK30D1	132	129	171	161	2	0.29	2.32	3.45	2.26	5.28	5.21
	200	62	2	10	4.5	663	820	43.4	2 000	2 500	23124EAD1	23124EAKD1	138	131	189	179	2	0.28	2.43	3.61	2.37	7.72	7.49
	200	62	2	10	4.5	663	820	43.4	2 000	2 500	23124EMD1	23124EMKD1	138	131	189	179	2	0.28	2.43	3.61	2.37	7.77	7.54
	200	80	2	10	4.5	756	991	41.3	1 900	2 500	24124EMD1	24124EMK30D1	136	131	189	173	2	0.37	1.84	2.74	1.80	10	9.87
	215	58	2.1	12	6	688	753	49.9	2 400	3 000	22224EAD1	22224EAKD1	141	132	203	193	2.1	0.25	2.74	4.08	2.68	8.88	8.68
	215	58	2.1	12	6	688	753	49.9	2 400	3 000	22224EMD1	22224EMKD1	141	132	203	193	2.1	0.25	2.74	4.08	2.68	9.01	8.82
	215	76	2.1	11	5	857	998	49.8	1 900	2 400	23224EMD1	23224EMKD1	139	132	203	190	2.1	0.32	2.09	3.11	2.04	11.7	11.3
	260	86	3	18	8	1 170	1 280	68.4	1 800	2 200	22324EAD1	22324EAKD1	156	134	246	225	3	0.32	2.09	3.11	2.04	22.3	21.9
	260	86	3	18	8	1 170	1 280	68.4	1 800	2 200	22324EMD1	22324EMKD1	156	134	246	225	3	0.32	2.09	3.11	2.04	22.7	22.2
130	200	52	2	9	4	565	721	44.2	2 200	2 900	23026EAD1	23026EAKD1	145	139	191	183	2	0.22	3.01	4.48	2.94	5.88	5.71
	200	52	2	9	4	565	721	44.2	2 200	2 900	23026EMD1	23026EMKD1	145	139	191	183	2	0.22	3.01	4.48	2.94	5.9	5.73
	200	69	2	9	4	682	936	42.2	1 900	2 400	24026EMD1	24026EMK30D1	143	139	191	178	2	0.31	2.20	3.27	2.15	7.82	7.71
	210	64	2	10	4.5	710	906	47.1	1 900	2 400	23126EAD1	23126EAKD1	148	141	199	189	2	0.27	2.51	3.74	2.45	8.45	8.19
	210	64	2	10	4.5	710	906	47.1	1 900	2 400	23126EMD1	23126EMKD1	148	141	199	189	2	0.27	2.51	3.74	2.45	8.51	8.25
	210	80	2	10	4.5	803	1 080	45.0	1 800	2 400	24126EMD1	24126EMK30D1	146	141	199	183	2	0.34	1.96	2.92	1.92	10.7	10.5
	230	64	3	13	6	808	898	56.6	2 200	2 800	22226EAD1	22226EAKD1	151	144	216	206	3	0.25	2.69	4.00	2.63	11	10.7
	230	64	3	13	6	808	898	56.6	2 200	2 800	22226EMD1	22226EMKD1	151	144	216	206	3	0.25	2.69	4.00	2.63	11.1	10.9
	230	80	3	12	5	958	1 130	55.4	1 700	2 300	23226EMD1	23226EMKD1	150	144	216	203	3	0.32	2.12	3.15	2.07	13.8	13.4
	280	93	4	19	9	1 330	1 400	77.8	1 600	2 000	22326EAD1	22326EAKD1	164	147	263	243	4	0.33	2.06	3.06	2.01	27.2	26.6
	280	93	4	19	9	1 330	1 400	77.8	1 600	2 000	22326EMD1	22326EMKD1	164	147	263	243	4	0.33	2.06	3.06	2.01	28	27.5

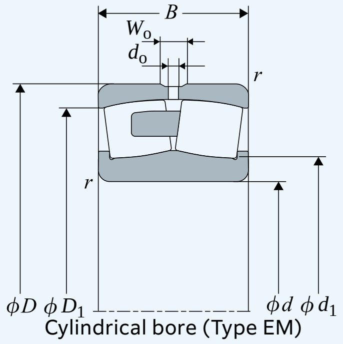
1) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings append with "K30" have a tapered bore ratio 1:30.
2) Smallest allowable dimension for chamfer dimension r.

10 Dimension Table

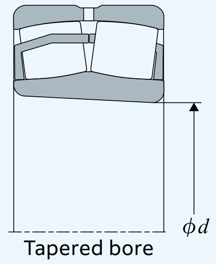
Type EA·Type EM



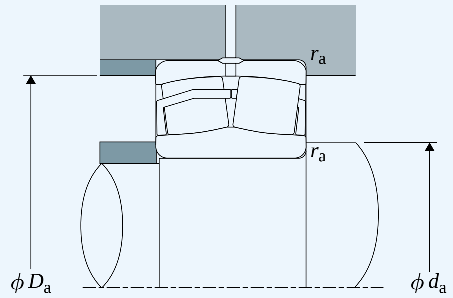
Cylindrical bore (Type EA)



Cylindrical bore (Type EM)



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

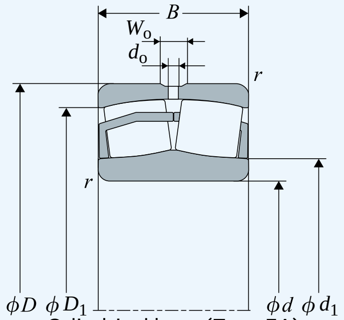
For values e, Y_1, Y_2 and Y_0 see the following table.

Boundary dimensions mm						Basic dynamic load rating kN	Basic static load rating kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing number		Abutment and fillet dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d	D	B	$r_{s\,min}$ 2)	W_0	d_0	C_r	C_{0r}	C_u	Grease	Oil	Cylindrical bore	Tapered bore 1)	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
140	210	53	2	9	4	597	783	47.5	2 100	2 700	23028EAD1	23028EAKD1	155	149	201	193	2	0.22	3.14	4.67	3.07	6.32	6.13
	210	53	2	9	4	597	783	47.5	2 100	2 700	23028EMD1	23028EMKD1	155	149	201	193	2	0.22	3.14	4.67	3.07	6.37	6.18
	210	69	2	9	4	709	990	46.0	1 800	2 200	24028EMD1	24028EMK30D1	153	149	201	188	2	0.28	2.37	3.53	2.32	8.27	8.15
	225	68	2.1	11	5	802	1 030	53.1	1 800	2 200	23128EAD1	23128EAKD1	159	152	213	203	2.1	0.26	2.55	3.80	2.50	10.3	9.94
	225	68	2.1	11	5	802	1 030	53.1	1 800	2 200	23128EMD1	23128EMKD1	159	152	213	203	2.1	0.26	2.55	3.80	2.50	10.3	10
	225	85	2.1	10	4.5	951	1 280	53.3	1 700	2 200	24128EMD1	24128EMK30D1	156	152	213	198	2.1	0.34	1.98	2.94	1.93	12.9	12.8
	250	68	3	14	7	912	1 010	65.8	2 000	2 500	22228EAD1	22228EAKD1	163	154	236	224	3	0.25	2.74	4.08	2.68	13.9	13.6
	250	68	3	14	7	912	1 010	65.8	2 000	2 500	22228EMD1	22228EMKD1	163	154	236	224	3	0.25	2.74	4.08	2.68	14.2	13.9
	250	88	3	13	6	1 140	1 370	64.2	1 600	2 100	23228EMD1	23228EMKD1	162	154	236	220	3	0.33	2.06	3.06	2.01	18.2	17.7
	300	102	4	19	9	1 540	1 720	88.8	1 500	1 900	22328EAD1	22328EAKD1	181	157	283	261	4	0.33	2.03	3.02	1.98	34.4	33.7
	300	102	4	19	9	1 540	1 720	88.8	1 500	1 900	22328EMD1	22328EMKD1	181	157	283	261	4	0.33	2.03	3.02	1.98	35.4	34.7
150	225	56	2.1	10	4.5	660	893	52.9	2 000	2 500	23030EAD1	23030EAKD1	167	161	214	207	2.1	0.21	3.20	4.77	3.13	7.68	7.45
	225	56	2.1	10	4.5	660	893	52.9	2 000	2 500	23030EMD1	23030EMKD1	167	161	214	207	2.1	0.21	3.20	4.77	3.13	7.73	7.5
	225	75	2.1	10	4.5	789	1 140	51.2	1 700	2 100	24030EMD1	24030EMK30D1	165	161	214	202	2.1	0.29	2.32	3.45	2.26	10.4	10.3
	250	80	2.1	13	6	1 060	1 350	65.1	1 600	2 000	23130EAD1	23130EAKD1	171	162	238	223	2.1	0.29	2.35	3.50	2.30	15.7	15.2
	250	80	2.1	13	6	1 060	1 350	65.1	1 600	2 000	23130EMD1	23130EMKD1	171	162	238	223	2.1	0.29	2.35	3.50	2.30	15.8	15.3
	250	100	2.1	12	6	1 180	1 590	62.8	1 600	2 000	24130EMD1	24130EMK30D1	168	162	238	216	2.1	0.36	1.85	2.76	1.81	19.7	19.4
	270	73	3	15	7	1 080	1 220	74.4	1 800	2 300	22230EAD1	22230EAKD1	177	164	256	242	3	0.25	2.74	4.08	2.68	17.6	17.3
	270	73	3	15	7	1 080	1 220	74.4	1 800	2 300	22230EMD1	22230EMKD1	177	164	256	242	3	0.25	2.74	4.08	2.68	18	17.7
	270	96	3	14	6	1 340	1 620	74.0	1 500	1 900	23230EMD1	23230EMKD1	174	164	256	237	3	0.33	2.03	3.02	1.98	23.6	22.9
	320	108	4	20	9	1 740	1 890	98.9	1 400	1 700	22330EMD1	22330EMKD1	188	167	303	279	4	0.34	2.00	2.98	1.96	42.2	41.3
160	220	45	2	9	4	455	683	45.6	1 900	2 400	23932EMD1	23932EMKD1	175	169	211	205	2	0.17	3.90	5.81	3.81	5.09	4.94
	240	60	2.1	11	5	748	1 000	59.1	1 800	2 300	23032EAD1	23032EAKD1	177	171	229	221	2.1	0.21	3.20	4.77	3.13	9.32	9.03
	240	60	2.1	11	5	748	1 000	59.1	1 800	2 300	23032EMD1	23032EMKD1	177	171	229	221	2.1	0.21	3.20	4.77	3.13	9.37	9.09
	240	80	2.1	10	5	901	1 290	56.8	1 600	2 000	24032EMD1	24032EMK30D1	175	171	229	215	2.1	0.29	2.32	3.45	2.26	12.6	12.4
	270	86	2.1	14	6	1 220	1 580	73.6	1 500	1 900	23132EAD1	23132EAKD1	185	172	258	240	2.1	0.29	2.35	3.50	2.30	20.1	19.5
	270	86	2.1	14	6	1 220	1 580	73.6	1 500	1 900	23132EMD1	23132EMKD1	185	172	258	240	2.1	0.29	2.35	3.50	2.30	20.2	19.6
	270	109	2.1	14	6	1 360	1 860	70.6	1 500	1 800	24132EMD1	24132EMK30D1	181	172	258	232	2.1	0.37	1.83	2.72	1.79	25.4	25.1
	290	80	3	17	8	1 220	1 390	84.1	1 700	2 100	22232EAD1	22232EAKD1	190	174	276	260	3	0.25	2.69	4.00	2.63	22.3	21.8
	290	80	3	17	8	1 220	1 390	84.1	1 700	2 100	22232EMD1	22232EMKD1	190	174	276	260	3	0.25	2.69	4.00	2.63	22.9	22.4
	290	104	3	15	7	1 550	1 890	83.8	1 400	1 800	23232EMD1	23232EMKD1	187	174	276	254	3	0.33	2.03	3.02	1.98	29.6	28.8
	340	114	4	20	10	1 950	2 210	109	1 300	1 600	22332EMD1	22332EMKD1	205	177	323	296	4	0.33	2.03	3.02	1.98	50.5	49.5
170	230	45	2	9	4.5	468	723	48.8	1 800	2 300	23934EMD1	23934EMKD1	185	179	221	215	2	0.16	4.11	6.12	4.02	5.39	5.23
	260	67	2.1	12	5	914	1 240	68.8	1 700	2 200	23034EAD1	23034EAKD1	190	181	249	238	2.1	0.22	3.07	4.57	3.00	12.7	12.3
	260	67	2.1	12	5	914	1 240	68.8	1 700	2 200	23034EMD1	23034EMKD1	190	181	249	238	2.1	0.22	3.07	4.57	3.00	12.8	12.4
	260	90	2.1	11	5	1 100	1 600	66.3	1 500	1 900	24034EMD1	24034EMK30D1	186	181	249	231	2.1	0.30	2.23	3.32	2.18	17.2	16.9
	280	88	2.1	14	6	1 270	1 700	77.3	1 400	1 800	23134EAD1	23134EAKD1	195	182	268	250	2.1	0.28	2.39	3.56	2.34	21.5	20.9
	280	88	2.1	14	6	1 270	1 700	77.3	1 400	1 800	23134EMD1	23134EMKD1	195	182	268	250	2.1	0.28	2.39	3.56	2.34	21.6	20.9
	280	109	2.1	14	6	1 410	1 990	74.4	1 400	1 700	24134EMD1	24134EMK30D1	193	182	268	243	2.1	0.35	1.91	2.85	1.87	26.7	26.3
	310	86	4	18	8	1 400	1 610	94.7	1 600	2 000	22234EMD1	22234EMKD1	201	187	293	277	4	0.26	2.60	3.87	2.54	28.3	27.7
	310	110	4	16	8	1 700	2 070	94.6	1 300	1 700	23234EMD1	23234EMKD1	199	187	293	272	4	0.33	2.03	3.02	1.98	35.8	34.8
	360	120	4	20	10	2 200	2 630	121	1 200	1 500	22334EMD1	22334EMKD1	223	187	343	313	4	0.32	2.09	3.11	2.04	60.3	59.1

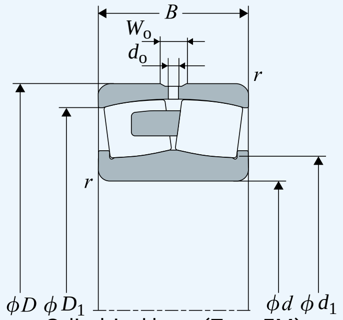
1) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings append with "K30" have a tapered bore ratio 1:30.
2) Smallest allowable dimension for chamfer dimension r.

10 Dimension Table

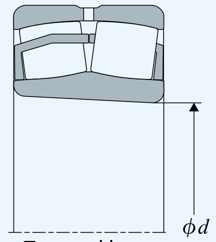
Type EA・Type EM



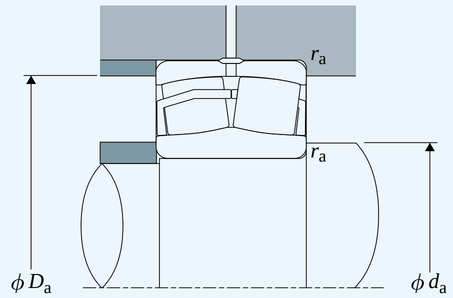
Cylindrical bore (Type EA)



Cylindrical bore (Type EM)



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

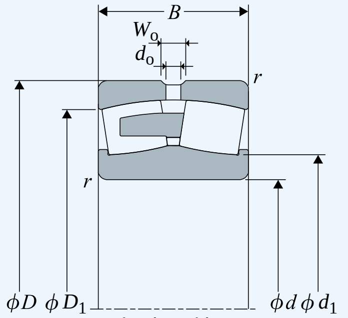
For values e, Y_1, Y_2 and Y_0 see the following table.

Boundary dimensions mm						Basic dynamic load rating kN	Basic static load rating kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing number		Abutment and fillet dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d	D	B	$r_{s\,min}$ 2)	W_o	d_o	C_r	C_{0r}	C_u	Grease	Oil	Cylindrical bore	Tapered bore 1)	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
180	250	52	2	10	5	573	869	57.2	1 700	2 100	23936EMD1	23936EMKD1	199	189	241	232	2	0.17	3.90	5.81	3.81	7.79	7.56
	280	74	2.1	13	6	1 080	1 450	78.6	1 600	2 000	23036EAD1	23036EAKD1	201	191	269	255	2.1	0.23	2.95	4.40	2.89	16.8	16.3
	280	74	2.1	13	6	1 080	1 450	78.6	1 600	2 000	23036EMD1	23036EMKD1	201	191	269	255	2.1	0.23	2.95	4.40	2.89	16.9	16.4
	280	100	2.1	13	6	1 310	1 880	76.0	1 400	1 800	24036EMD1	24036EMK30D1	199	191	269	248	2.1	0.31	2.15	3.20	2.10	22.8	22.4
	300	96	3	15	7	1 490	1 960	88.7	1 300	1 700	23136EAD1	23136EAKD1	205	194	286	267	3	0.29	2.32	3.45	2.26	27.2	26.4
	300	96	3	15	7	1 490	1 960	88.7	1 300	1 700	23136EMD1	23136EMKD1	205	194	286	267	3	0.29	2.32	3.45	2.26	27.4	26.5
	300	118	3	15	7	1 660	2 290	85.5	1 300	1 600	24136EMD1	24136EMK30D1	202	194	286	259	3	0.36	1.87	2.79	1.83	33.5	33
	320	86	4	18	8	1 450	1 660	101	1 500	1 900	22236EMD1	22236EMKD1	209	197	303	287	4	0.25	2.74	4.08	2.68	29.3	28.7
	320	112	4	16	8	1 800	2 270	101	1 200	1 600	23236EMD1	23236EMKD1	210	197	303	282	4	0.33	2.06	3.06	2.01	38.2	37.1
	380	126	4	21	10	2 420	2 810	132	1 100	1 400	22336EMD1	22336EMKD1	229	197	363	329	4	0.32	2.09	3.11	2.04	70.2	68.7
190	260	52	2	10	5	603	935	62.8	1 600	2 000	23938EMD1	23938EMKD1	209	199	251	243	2	0.17	4.05	6.04	3.96	8.20	7.96
	290	75	2.1	13	6	1 140	1 570	83.5	1 500	1 900	23038EAD1	23038EAKD1	213	201	279	266	2.1	0.22	3.01	4.48	2.94	17.8	17.3
	290	75	2.1	13	6	1 140	1 570	83.5	1 500	1 900	23038EMD1	23038EMKD1	213	201	279	266	2.1	0.22	3.01	4.48	2.94	17.9	17.4
	290	100	2.1	13	6	1 360	2 000	80.7	1 300	1 700	24038EMD1	24038EMK30D1	209	201	279	258	2.1	0.30	2.23	3.32	2.18	23.8	23.4
	320	104	3	17	8	1 670	2 250	100	1 200	1 600	23138EMD1	23138EMKD1	221	204	306	284	3	0.29	2.32	3.45	2.26	34.3	33.2
	320	128	3	16	8	1 900	2 700	96.8	1 200	1 500	24138EMD1	24138EMK30D1	216	204	306	275	3	0.37	1.84	2.74	1.80	42.1	41.5
	340	92	4	20	9	1 620	1 870	112	1 400	1 800	22238EMD1	22238EMKD1	222	207	323	305	4	0.25	2.74	4.08	2.68	35.6	34.9
	340	120	4	18	8	1 990	2 480	109	1 200	1 500	23238EMD1	23238EMKD1	220	207	323	299	4	0.33	2.03	3.02	1.98	46.1	44.7
	400	132	5	21	10	2 600	3 120	145	1 000	1 300	22338EMD1	22338EMKD1	247	210	380	346	5	0.32	2.12	3.15	2.07	81.5	79.9
200	280	60	2.1	12	6	766	1 190	71.8	1 500	1 900	23940EMD1	23940EMKD1	221	211	269	260	2.1	0.18	3.76	5.59	3.67	12	11.6
	310	82	2.1	15	7	1 310	1 790	94.1	1 400	1 800	23040EMD1	23040EMKD1	223	211	299	283	2.1	0.23	2.95	4.40	2.89	22.8	22.1
	310	109	2.1	14	7	1 570	2 280	91.1	1 200	1 600	24040EMD1	24040EMK30D1	221	211	299	275	2.1	0.31	2.18	3.24	2.13	30.2	29.7
	340	112	3	18	8	1 890	2 510	110	1 100	1 400	23140EMD1	23140EMKD1	231	214	326	301	3	0.30	2.25	3.34	2.20	41.9	40.6
	340	140	3	17	8	2 130	2 930	105	1 100	1 400	24140EMD1	24140EMK30D1	224	214	326	291	3	0.39	1.74	2.59	1.70	51.5	50.7
	360	98	4	20	10	1 810	2 100	124	1 400	1 700	22240EMD1	22240EMKD1	234	217	343	323	4	0.25	2.74	4.08	2.68	42.7	41.8
	360	128	4	19	9	2 250	2 840	120	1 100	1 300	23240EMD1	23240EMKD1	232	217	343	315	4	0.34	1.98	2.94	1.93	55.2	53.6
	420	138	5	21	10	2 830	3 530	158	950	1 200	22340EMD1	22340EMKD1	265	220	400	364	5	0.31	2.15	3.20	2.10	94.6	92.7
220	300	60	2.1	12	6	789	1 260	79.4	1 400	1 700	23944EMD1	23944EMKD1	241	231	289	280	2.1	0.17	4.05	6.04	3.96	12.5	12.1
	340	90	3	15	7	1 530	2 110	109	1 300	1 600	23044EMD1	23044EMKD1	246	233	327	310	3	0.23	2.95	4.40	2.89	29.9	29.1
	340	118	3	15	7	1 850	2 720	106	1 100	1 400	24044EMD1	24044EMK30D1	243	233	327	302	3	0.31	2.20	3.27	2.15	39.2	38.6
	370	120	4	19	9	2 190	2 940	128	1 000	1 300	23144EMD1	23144EMKD1	252	237	353	328	4	0.30	2.28	3.39	2.23	52.3	50.7
	370	150	4	19	9	2 540	3 620	124	1 000	1 300	24144EMD1	24144EMK30D1	247	237	353	317	4	0.38	1.78	2.65	1.74	65.2	64.3
	400	108	4	21	11	2 210	2 690	149	1 200	1 500	22244EMD1	22244EMKD1	264	237	383	358	4	0.25	2.74	4.08	2.68	59.6	58.4
	400	144	4	20	10	2 890	3 830	147	1 000	1 200	23244EMD1	23244EMKD1	261	237	383	349	4	0.34	2.00	2.98	1.96	79.4	77.1
240	320	60	2.1	12	6	815	1 350	87.7	1 300	1 600	23948EMD1	23948EMKD1	262	251	309	301	2.1	0.15	4.40	6.56	4.31	13.5	13.1
	360	92	3	16	8	1 630	2 350	120	1 100	1 400	23048EMD1	23048EMKD1	267	253	347	329	3	0.22	3.07	4.57	3.00	32	31.7
	360	118	3	16	8	1 940	2 980	116	1 000	1 300	24048EMD1	24048EMK30D1	264	253	347	322	3	0.28	2.37	3.53	2.32	42.2	41.6
	400	128	4	20	9	2 510	3 500	147	960	1 200	23148EMD1	23148EMKD1	276	257	383	356	4	0.29	2.32	3.45	2.26	65.1	63.1
	400	160	4	19	9	2 910	4 290	142	960	1 200	24148EMD1	24148EMK30D1	270	257	383	344	4	0.37	1.82	2.70	1.78	81	79.8
260	360	75	2.1	14	7	1 130	1 940	105	1 100	1 400	23952EMD1	23952EMKD1	292	271	349	335	2.1	0.17	3.90	5.81	3.81	23.9	23.1
	400	104	4	18	8	2 060	2 910	144	1 000	1 300	23052EMD1	23052EMKD1	291	275	385	366	4	0.23	2.95	4.40	2.89	47.8	46.3
	400	140	4	18	8	2 520	3 820	139	960	1 200	24052EMD1	24052EMK30D1	286	275	385	354	4	0.31	2.16	3.22	2.12	63.6	62.6
280	380	75	2.1	14	7	1 180	2 050	115	1 000	1 300	23956EMD1	23956EMKD1	310	291	369	356	2.1	0.16	4.16	6.20	4.07	25.2	24.4
	420	106	4	18	8	2 170	3 150	155	960	1 200	23056EMD1	23056EMKD1	310	295	405	386	4	0.22	3.07	4.57	3.00	51.3	49.7
	420	140	4	18	8	2 620	4 060	150	880	1 100	24056EMD1	24056EMK30D1	306	295	405	376	4	0.29	2.30	3.42	2.25	67.3	66.3

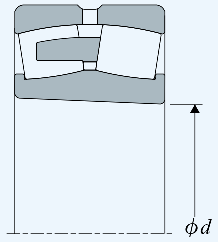
1) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings append with "K30" have a tapered bore ratio 1:30.
2) Smallest allowable dimension for chamfer dimension r.

10 Dimension Table

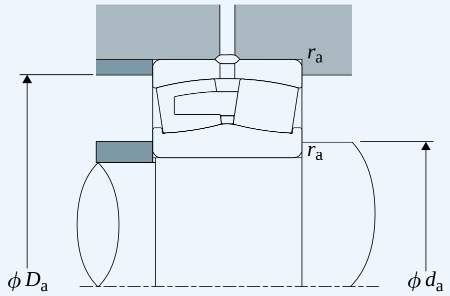
Type EM (Large size)



Cylindrical bore



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values e, Y_1, Y_2 and Y_0 see the following table.

Boundary dimensions mm						Basic dynamic load rating kN	Basic static load rating kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing number		Abutment and fillet dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d	D	B	$r_{s\,min}$ 2)	W_0	d_0	C_r	C_{0r}	C_u	Grease	Oil	Cylindrical bore	Tapered bore 1)	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
220	460	145	5	20	12	3 010	3 560	163	850	1 090	22344EMD1	22344EMKD1	277	240	440	388	5	0.32	2.10	3.13	2.06	119	116
240	440	120	4	16	10	2 470	3 110	159	1 060	1 350	22248EMD1	22248EMKD1	288	257	423	383	4	0.27	2.53	3.77	2.47	82.6	80.9
	440	160	4	20	12	3 140	4 260	156	850	1 090	23248EMD1	23248EMKD1	284	257	423	372	4	0.36	1.86	2.77	1.82	108	105
	500	155	5	20	12	3 500	4 170	193	780	1 000	22348EMD1	22348EMKD1	299	260	480	421	5	0.32	2.12	3.15	2.07	149	146
260	440	144	4	20	12	2 780	4 020	160	860	1 090	23152EMD1	23152EMKD1	302	277	423	380	4	0.31	2.15	3.20	2.10	92.2	89.5
	440	180	4	27	16	3 290	4 880	147	850	1 090	24152EMD1	24152EMK30D1	295	277	423	371	4	0.40	1.69	2.52	1.65	111	109
	480	130	5	20	12	2 890	3 680	183	970	1 240	22252EMD1	22252EMKD1	312	280	460	415	5	0.27	2.53	3.77	2.47	108	105
	480	174	5	27	16	3 650	5 050	180	780	1 000	23252EMD1	23252EMKD1	310	280	460	405	5	0.36	1.87	2.79	1.83	143	139
	540	165	6	27	16	4 020	4 830	221	720	920	22352EMD1	22352EMKD1	324	286	514	456	6	0.31	2.16	3.22	2.12	186	183
280	460	146	5	20	12	2 980	4 400	182	810	1 030	23156EMD1	23156EMKD1	322	300	440	403	5	0.30	2.23	3.32	2.18	98.4	95.3
	460	180	5	27	16	3 550	5 450	167	810	1 030	24156EMD1	24156EMK30D1	316	300	440	394	5	0.38	1.78	2.65	1.74	118	117
	500	130	5	20	12	3 010	3 920	198	920	1 180	22256EMD1	22256EMKD1	333	300	480	437	5	0.25	2.69	4.00	2.63	113	111
	500	176	5	27	16	3 770	5 340	193	740	950	23256EMD1	23256EMKD1	331	300	480	426	5	0.35	1.95	2.90	1.91	152	148
	580	175	6	27	16	4 490	5 450	249	670	860	22356EMD1	22356EMKD1	349	306	554	489	6	0.31	2.18	3.24	2.13	228	223
300	420	90	3	14	8	1 600	2 620	145	890	1 140	23960EMD1	23960EMKD1	329	313	407	387	3	0.20	3.42	5.09	3.34	40.1	39.2
	460	118	4	16	10	2 400	3 610	176	890	1 130	23060EMD1	23060EMKD1	338	315	445	413	4	0.24	2.81	4.19	2.75	72.9	70.9
	460	160	4	20	12	3 150	5 190	166	760	970	24060EMD1	24060EMK30D1	332	315	445	401	4	0.33	2.04	3.04	2.00	98	96.9
	500	160	5	20	12	3 540	5 170	205	750	950	23160EMD1	23160EMKD1	345	320	480	436	5	0.31	2.20	3.27	2.15	129	125
	500	200	5	27	16	4 270	6 610	198	750	950	24160EMD1	24160EMK30D1	340	320	480	425	5	0.39	1.74	2.59	1.70	159	157
	540	140	5	20	12	3 470	4 590	232	860	1 080	22260EMD1	22260EMKD1	358	320	520	469	5	0.25	2.69	4.00	2.63	134	131
	540	192	5	27	16	4 520	6 280	228	690	880	23260EMD1	23260EMKD1	352	320	520	461	5	0.35	1.92	2.86	1.88	194	188
320	440	90	3	14	8	1 670	2 820	154	840	1 080	23964EMD1	23964EMKD1	350	333	427	407	3	0.19	3.62	5.39	3.54	42.1	40.8
	480	121	4	20	12	2 540	4 020	191	850	1 070	23064EMD1	23064EMKD1	360	335	465	433	4	0.23	2.92	4.35	2.86	78.9	76.6
	480	160	4	20	12	3 250	5 400	184	720	920	24064EMD1	24064EMK30D1	352	335	465	423	4	0.31	2.15	3.20	2.10	104	102
	540	176	5	27	16	4 020	6 020	227	700	880	23164EMD1	23164EMKD1	373	340	520	468	5	0.31	2.15	3.20	2.10	169	164
	540	218	5	33	20	5 010	7 720	225	690	880	24164EMD1	24164EMK30D1	363	340	520	457	5	0.39	1.71	2.54	1.67	204	201
	580	150	5	20	12	3 950	5 100	261	800	1 020	22264EMD1	22264EMKD1	383	340	560	510	5	0.25	2.69	4.00	2.63	177	174
	580	208	5	33	20	5 230	7 370	259	640	820	23264EMD1	23264EMKD1	376	340	560	493	5	0.35	1.91	2.85	1.87	245	238
340	460	90	3	14	8	1 710	2 980	162	800	1 020	23968EMD1	23968EMKD1	370	353	447	427	3	0.18	3.80	5.66	3.72	44.5	43.1
	520	133	5	20	12	2 990	4 690	219	790	1 000	23068EMD1	23068EMKD1	384	358	502	466	5	0.24	2.87	4.27	2.80	98.5	95.5
	520	180	5	27	16	3 910	6 510	206	670	860	24068EMD1	24068EMK30D1	377	358	502	456	5	0.33	2.06	3.06	2.01	140	137
	580	190	5	27	16	4 670	6 870	257	650	830	23168EMD1	23168EMKD1	393	360	560	500	5	0.32	2.12	3.15	2.07	213	206
	580	243	5	33	20	5 980	9 340	254	650	830	24168EMD1	24168EMK30D1	385	360	560	486	5	0.41	1.65	2.46	1.61	266	262
360	480	90	3	14	8	1 750	3 090	171	760	970	23972EMD1	23972EMKD1	390	373	467	447	3	0.17	4.00	5.96	3.91	46.2	44.8
	540	134	5	20	12	3 070	4 910	232	750	950	23072EMD1	23072EMKD1	405	378	522	488	5	0.23	2.98	4.44	2.92	111	108
	540	180	5	27	16	4 040	6 840	220	640	820	24072EMD1	24072EMK30D1	398	378	522	478	5	0.31	2.16	3.22	2.12	147	145
380	520	106	4	16	10	2 340	4 000	205	710	910	23976EMD1	23976EMKD1	412	395	505	481	4	0.18	3.66	5.46	3.58	68	65.9
	560	135	5	20	12	3 230	5 270	247	720	910	23076EMD1	23076EMKD1	425	398	542	509	5	0.22	3.07	4.57	3.00	117	113
	560	180	5	27	16	4 140	7 280	240	610	780	24076EMD1	24076EMK30D1	420	398	542	499	5	0.30	2.25	3.34	2.20	154	151
400	540	106	4	16	10	2 370	4 170	215	680	870	23980EMD1	23980EMKD1	433	415	525	501	4	0.18	3.80	5.66	3.72	71.4	69.2
420	560	106	4	16	10	2 390	4 320	230	650	830	23984EMD1	23984EMKD1	454	435	545	522	4	0.17	3.95	5.88	3.86	74.9	72.6

1) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings append with "K30" have a tapered bore ratio 1:30.
2) Smallest allowable dimension for chamfer dimension r.

NTN corporation

◀ Sales Network

NOTE : The appearance and specifications may be changed without prior notice if required to improve performance. Although care has been taken to assure the accuracy of the data compiled in this catalog, **NTN** does not assume any liability to any company or person for errors or omissions.

NTN®

Spherical Roller Bearings with High-strength Cage

[EMA Type]

ULTAGE®

CAT. No. 3036/E

ULTAGE®

Life	Basic dynamic load rating	Cage strength	Temperature rise
Max. 2x	Max. 20% up	Max. 55% up	Max. 10% down

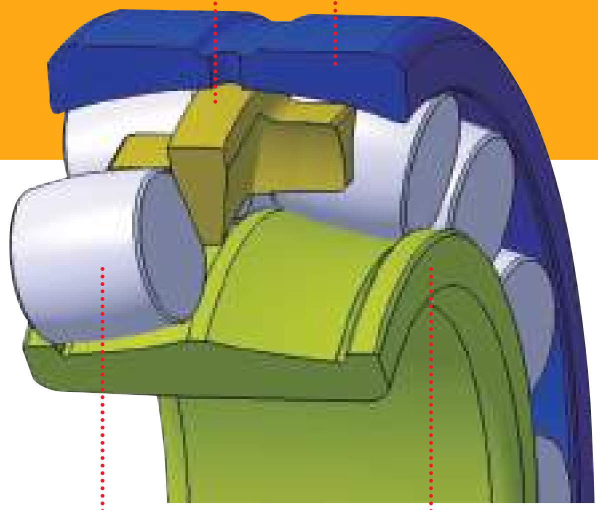
Spherical Roller Bearings with High-strength Cage

【EMA Type】

Industrial machineries are typically used under extremely severe operating conditions (eccentric rotation and impact load, for example). ULTAGE® series spherical roller bearings with a high-strength cage [EMA type] are our new standard series bearings developed to satisfy the needs of such heavy-duty machineries for improvements in "long life", "vibration resistance”, and "low temperature rise" characteristics.

Cage
- One-piece machined cage with staggered pockets
- Outer-ring-guided

Outer ring
- Optimum curvature
- Oil groove/hole provided



Rollers
- Large-diameter rollers
- The largest number of rollers

Inner ring
- Optimum curvature
- No inner ring flange

Improved vibration resistance
- High strength cage
- Outer-ring-guided cage more resistant to vibration and eccentric rotation
- Special specification available for vibration screens

Long life
- Load capacity of the world's highest level
- Extended maintenance intervals
- Downsizing and light-weighting opportunities
- Heat resistant up to 200˚C

Reduced temperature rise
- Permitted rotational speed of the world’s highest level
- Optimized internal bearing design including curvature

"ULTAGE®" (a name created from the combination of **"Ultimate,"** signifying refinement,and **"Stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

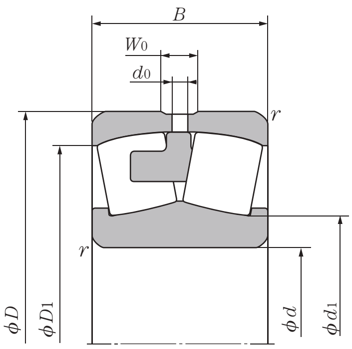
Accuracy and Clearance (Vibration Screen Specification)

This is a bearing specification for vibration screen applications. Inner and outer diameter tolerances and radial internal clearance are adjusted to set adequate running internal clearance levels.
For information about bearing specifications (accuracy, clearance, etc.) for other applications than vibration screens, please see CAT. No. 3033/E: ULTAGE® series spherical roller bearings [EA type] and [EM type].

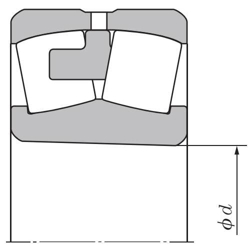
Unit: mm

Single plane mean bore diameter deviation				Single plane mean outside diameter deviation				Radial internal clearance (cylindrical bore)					
Nominal bearing bore diameter		VS1, VS2		Nominal bearing outside diameter		VS1, VS2		Nominal bearing bore diameter		VS1		VS2	
over	incl.	high	low	over	incl.	high	low	over	incl.	min.	max.	min.	max.
	80	0	-0.010		150	-0.005	-0.013		65	0.075	0.090	0.100	0.120
80	120	0	-0.013	150	180	-0.005	-0.018	65	80	0.090	0.110	0.120	0.145
120	180	0	-0.015	180	315	-0.010	-0.023	80	100	0.110	0.135	0.150	0.180
180	200	0	-0.018	315	400	-0.013	-0.028	100	120	0.135	0.160	0.180	0.210
				400	420	-0.014	-0.030	120	140	0.160	0.190	0.205	0.240
								140	160	0.190	0.220	0.240	0.280
								160	180	0.200	0.240	0.260	0.310
								180	200	0.220	0.260	0.285	0.340

List of Bearing Dimensions



Cylindrical bore (EMA type)



Tapered bore (EMA type)

Baundary dimension mm						Basic load ratings				Allowable speed min-1	Bearing number
						dynamic kN	static kN	dynamic kgf	static kgf		
d	D	B	$r_{s\,min}$	W_0	d_0	C_r	C_{0r}	C_r	C_{0r}	Oil lubrication	Cylindrical bore
70	150	51	2.1	10	5	397	368	40 500	37 500	4 700	**22314EMAD1**
75	160	55	2.1	10	5	464	434	47 400	44 200	4 400	**22315EMAD1**
80	170	58	2.1	10	5	512	485	52 200	49 400	4 100	**22316EMAD1**
85	180	60	3	11	5	538	524	54 900	53 400	3 900	**22317EMAD1**
90	190	64	3	12	5	632	605	64 500	61 700	3 700	**22318EMAD1**
95	200	67	3	12	6	658	650	67 000	66 300	3 500	**22319EMAD1**
100	215	73	3	13	6	743	731	75 700	74 600	3 300	**22320EMAD1**
110	240	80	3	16	7	869	833	88 600	84 900	3 000	**22322EMAD1**
120	260	86	3	18	8	1 060	1 120	108 000	114 000	2 700	**22324EMAD1**
130	280	93	4	19	9	1 260	1 310	129 000	134 000	2 500	**22326EMAD1**
140	300	102	4	19	9	1 400	1 500	142 000	153 000	2 400	**22328EMAD1**
150	320	108	4	20	9	1 570	1 640	160 000	167 000	2 200	**22330EMAD1**
160	340	114	4	20	10	1 760	1 940	180 000	198 000	2 100	**22332EMAD1**
170	360	120	4	20	10	2 010	2 320	205 000	237 000	1 900	**22334EMAD1**
180	380	126	4	21	10	2 190	2 460	223 000	250 000	1 800	**22336EMAD1**
190	400	132	5	21	10	2 370	2 750	242 000	281 000	1 700	**22338EMAD1**
200	420	138	5	21	10	2 590	3 140	265 000	320 000	1 600	**22340EMAD1**

❶ Minimal allowable dimension for chamfer dimension r .

Allowable Axial Load

● $F_a / F_r \leqq e$

F_a : axial load, F_r : radial load, e : constant (ref. the list of dimensions)

If the bearing is used under excessive axial load, the rollers receive smaller radial load in the row not subjected to the axial load, which may cause the rollers to slide and eventually damage the bearing. When the ratio of axial load to radial load exceeds constant e in the list of bearing dimensions (i.e., $F_a/F_r > e$), please consult with **NTN**.

Allowable Self-aligning Angle

● $0.06C_r <$ dynamic equivalent radial load: 0.009rad (0.5°)

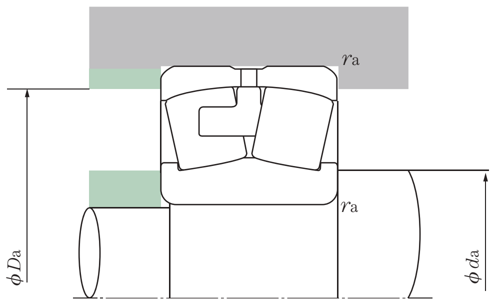
● Dynamic equivalent radial load $\leqq 0.06C_r$: 0.035rad (2°)

＊If self-aligning angle is too large, the rollers may stick out of the outer ring and hit against nearby parts. Special attention should be paid when setting self-aligning angles.

Bearing number

2 23 20 EMA K D1 VS1

- VS1: Vibration screen specification, no code means general bearing clearance and accuracy
- D1: Oil hole/groove code (D1: oil hole/ groove provided)
- K: Raceway shape code (no code: cylindrical bore, K: tapered bore)
- EMA: Type code (EMA: high strength cage)
- 20: Bore diameter number (20: 100mm)
- 23: Dimension series number
- 2: Bearing type code (2: spherical roller bearing)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2, and Y_0 see the table below.

Bearing number	Abutment and fillet dimensions					constant	Axial load factor			Mass (approx.) kg	
	mm									Cylindrical bore	Tapered bore
Tapered bore	d_1	d_a min	D_a max	D_1	r_{as} max	e	Y_1	Y_2	Y_0		
22314EMAKD1	85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.34	4.25
22315EMAKD1	91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.30	5.19
22316EMAKD1	98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.32	6.19
22317EMAKD1	107	99	166	157	3	0.32	2.09	3.11	2.04	7.19	7.05
22318EMAKD1	110	104	176	166	3	0.33	2.06	3.06	2.01	8.58	8.41
22319EMAKD1	120	109	186	174	3	0.32	2.09	3.11	2.04	9.80	9.60
22320EMAKD1	127	114	201	187	3	0.34	1.98	2.94	1.93	12.8	12.5
22322EMAKD1	139	124	226	209	3	0.32	2.09	3.11	2.04	17.3	16.9
22324EMAKD1	156	134	246	225	3	0.32	2.09	3.11	2.04	22.5	22.0
22326EMAKD1	164	147	263	243	4	0.33	2.06	3.06	2.01	28.4	27.8
22328EMAKD1	181	157	283	261	4	0.33	2.03	3.02	1.98	34.6	33.8
22330EMAKD1	188	167	303	279	4	0.34	2.00	2.98	1.96	41.9	41.0
22332EMAKD1	205	177	323	296	4	0.33	2.03	3.02	1.98	50.1	49.1
22334EMAKD1	223	187	343	313	4	0.32	2.09	3.11	2.04	59.7	58.5
22336EMAKD1	229	197	363	329	4	0.32	2.09	3.11	2.04	69.3	67.9
22338EMAKD1	247	210	380	346	5	0.32	2.12	3.15	2.07	81.0	79.4
22340EMAKD1	265	220	400	364	5	0.31	2.15	3.20	2.10	94.1	92.2

Features

1. Load capacity of the world's highest level

Maximizing the size and the number of the rollers achieved high load capacity and long life.

- Basic dynamic load rating: max. **20% up** (vs. our conventional bearing)
- Long life: max. **2X** (vs. our conventional bearing)

2. High strength cage

Modifying its shape and incorporating staggered pockets increased cage strength.

- Cage strength: max. **55% up** (vs. our conventional bearing)

3. Low heat-generation

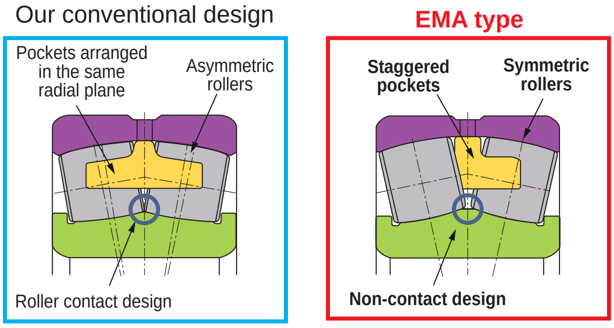
Optimizing internal bearing design including curvature reduced temperature rise.

- Temperature rise: max. **10% down** (vs. our conventional bearing)

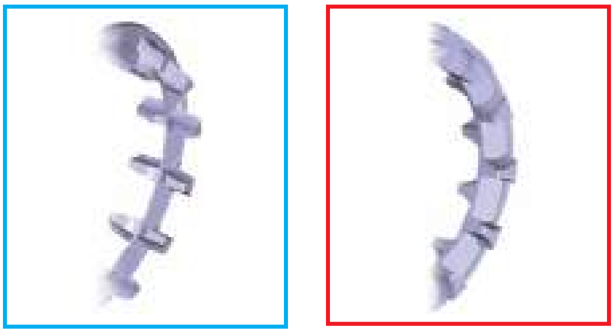
4. Heat resistant up to 200˚C

Being heat-treated by a special method, these bearings exhibit excellent dimensional stability at high temperatures, contributing to extended service life.

※Our conventional design refers to UA type bearings



Sectional views of bearings



3D views of cages

Performance Test Data

Temperature rise test

[**Test conditions**]

- Bearing number: **22316** (80D X 170D X 58)
- Vibrational acceleration: 10G
- Rotational speed: 800 to 2,400min^{-1}
- Operating time: up to the point where temperature rise stabilizes
- Lubrication: oil lubrication
- Testing machine: please see **Fig. 1**

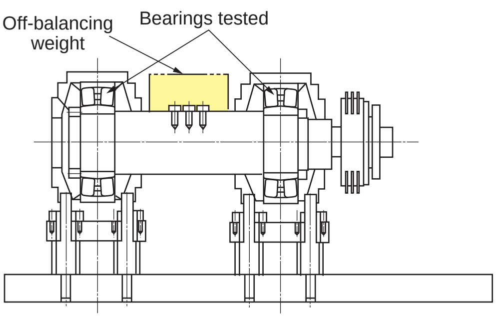
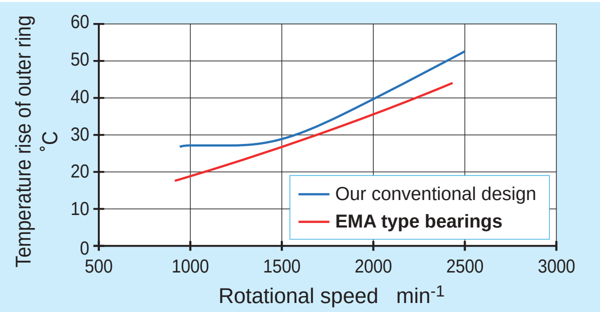


Fig. 1 Structure of testing machine

[**Test results**]

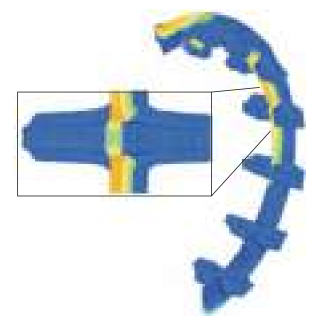


Cage strength analysis

[**Analysis conditions**]

- Bearing number: **22316** (80D X 170D X 58)
- Vibrational acceleration: 100G

＊This cage strength analysis is designed to predict the stress generated in the cage when vibrational acceleration of 100G is exerted on the bearing as impact load.

Bearing	Analysis model	Cage strength
Our conventional design		1
EMA type bearings		1.55

＊The cage strength of each bearing is expressed in terms of the cage strength of our conventional bearing taken as 1.

For New Technology Network

NTN corporation

Ball Bearings

Shield and Seal Types

CAT. No. 3015-Ⅲ／E

Warranty

NTN warrants, to the original purchaser only, that the delivered product which is the subject of this sale (a) will conform to drawings and specifications mutually established in writing as applicable to the contract, and (b) be free from defects in material or fabrication. The duration of this warranty is one year from date of delivery. If the buyer discovers within this period a failure of the product to conform to drawings or specifications, or a defect in material or fabrication, it must promptly notify **NTN** in writing. In no event shall such notification be received by **NTN** later than 13 months from the date of delivery. Within a reasonable time after such notification, **NTN** will, at its option, (a) correct any failure of the product to conform to drawings, specifications or any defect in material or workmanship, with either replacement or repair of the product, or (b) refund, in part or in whole, the purchase price. Such replacement and repair, excluding charges for labor, is at **NTN**'s expense. All warranty service will be performed at service centers designated by **NTN**. These remedies are the purchaser's exclusive remedies for breach of warranty.

NTN does not warrant (a) any product, components or parts not manufactured by **NTN**, (b) defects caused by failure to provide a suitable installation environment for the product, (c) damage caused by use of the product for purposes other than those for which it was designed, (d) damage caused by disasters such as fire, flood, wind, and lightning, (e) damage caused by unauthorized attachments or modification, (f) damage during shipment, or (g) any other abuse or misuse by the purchaser.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

In no case shall **NTN** be liable for any special, incidental, or consequential damages based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory,and in no case shall total liability of **NTN** exceed the purchase price of the part upon which such liability is based. Such damages include, but are not limited to, loss of profits, loss of savings or revenue, loss of use of the product or any associated equipment, cost of capital, cost of any substitute equipment, facilities or services, downtime, the claims of third parties including customers, and injury to property. Some states do not allow limits on warranties, or on remedies for breach in certain transactions. In such states, the limits in this paragraph and in paragraph (2) shall apply to the extent allowable under case law and statutes in such states.

Any action for breach of warranty or any other legal theory must be commenced within 15 months following delivery of the goods.

Unless modified in a writing signed by both parties, this agreement is understood to be the complete and exclusive agreement between the parties, superceding all prior agreements, oral or written, and all other communications between the parties relating to the subject matter of this agreement. No employee of **NTN** or any other party is authorized to make any warranty in addition to those made in this agreement.

This agreement allocates the risks of product failure between **NTN** and the purchaser. This allocation is recognized by both parties and is reflected in the price of the goods. The purchaser acknowledges that it has read this agreement, understands it, and is bound by its terms.

NTN Ball Bearings

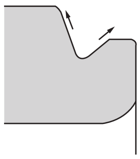
Shield and Seal Types

Machinery is being made smaller and more compact; the same is demanded of bearings.
NTN seal and shield type ball bearings are built to meet these trends.
They simplify shaft design, are maintenance-free, and are the bearing of choice for an increasing number of applications.

INDEX

1 Grooved Type Sealing figure for Excellent Performance〔all models〕

A v-shaped groove is cut around the inner ring. Under centrifugal force, the outer surface of the v acts to keep out dirt; the inner surface of the v acts to seal in the grease.

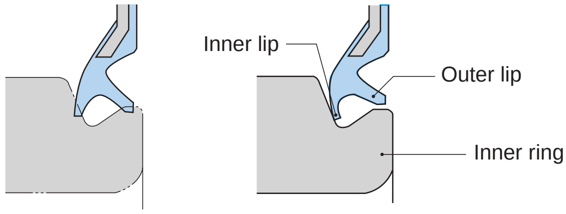


2 Rust Resistant Shield〔ZZ spec〕

In order to obtain rust resistant properties, the shield is made of a strip steel covered by a hard surface-coating. This assures long bearing service life and minimal noise levels.

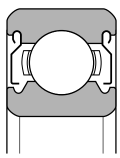
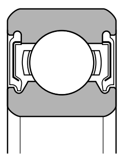
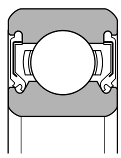
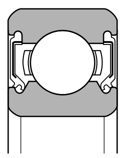
3 Double-lip Seal Adjusts for Wear〔LLU spec〕

The inner lip of a double-lip seal is pressed against the inside surface of the V-groove; the outer lip is spread open by the elastic force of rubber to create a small gap between the outer lip and the inner ring. Should the inner lip wear, the contact pressure will decrease; however, the outer lip will get closer to the inner ring. In effect, a constant degree of sealing will be maintained; and, as a result, bearing service life will be noticeably lengthened.



1. Bearing Design and Features, Seal/Shield Bearing Types and Selection

Table 1 Bearing design and futures

Type, code no.		Shield type	Seal type		
		Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Construction					
		• Metal shield plate is affixed to outside ring; inner ring incorporates a V-groove and labyrinth clearance.	• Outer ring incorporates synthetic rubber molded to a steel plate; seal edge is aligned with V-groove along inner ring surface with labyrinth clearance.	• Outer ring incorporates synthetic rubber molded to a steel plate; seal edge contacts V-groove along inner ring surface.	• Basic construction the same as LU type, but specially designed lip on edge of seal prevents penetration by foreign matter; low torque construction.
Performance comparison	Torque	Very Low	Very Low	Medium	Low
	Dust proofing	Good	Very Good	Best	Excellent
	Water proofing	Poor	Poor	Very good	Good
	High speed capacity	Same as open type	Same as open type	Limited by contact seals	Better than LLU-type
	Allowable temp.range ❶	Depends on lubricant	-25 ℃～120 ℃	-25 ℃～110 ℃	-25 ℃～120 ℃

❶ Please consult **NTN** Engineering about applications which exceed the allowable temperature range of products listed on this table.
Note : This chart lists double shielded and double sealed bearings, but single shielded (Z) and single sealed (LB, LU, LH) are also available.
Grease lubrication should be used with single shielded and single sealed bearings.

2. Test Data for Seal Performance

Friction torque and temperature rise test

Test Conditions
Bearings :6305
Grease :Shell Alvania 3,3.5g packed
Revolution :1800 r/min
Time :20 minutes
Load :radial load 29 N
Quantity tested :5 pcs. each

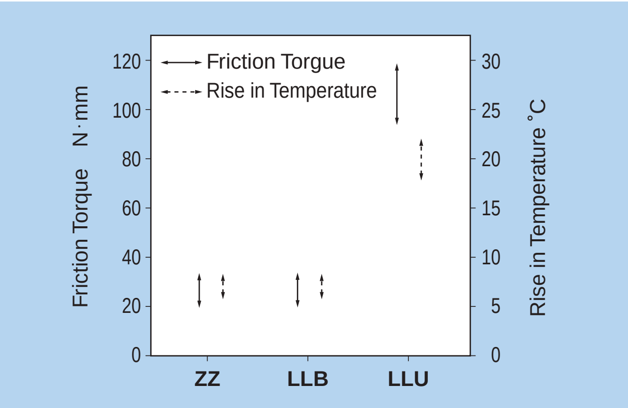
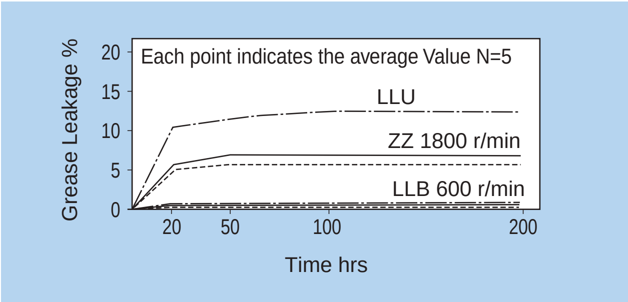


Figure 1. Friction torque and temperature rise test data

Grease leakage test

Test Conditions
Bearings :6305
Grease :Shell Alvania 3,3.5g packed
Revolution :1800 r/min, 600 r/min
Atmospheric temperature :80℃
Time :200 hrs
Quantity tested :5 pcs. each



The larger grease leakage with the LLU at 1800 rpm is due to bearing temperature rise.

Figure 2. Grease leakage test data

Dust test

Test Conditions
Bearings :6305
Grease :Shell Alvania 3,3.5g packed
Revolution :1800 r/min
Load :radial load 29 N
Volume of testing machine :40 liter
Dust :Oxidized ferrous powder (2kg) + lime (1.0kg) mixture
Time :1 hour

Table 3 Dust resistance test data

Type	1	2	3	4	average
ZZ	2.5	2	2	2.5	2.25
LLB	2.5	3	2.5	2.5	2.62
LLU	3	3	3	3	3.00

Ratings 3 : Complete absence of dust
2 : Slight presence of dust observed
1 : Presence of dust clearly observed

Muddy water splash test

Test Conditions
Bearings :6304
Grease :Shell Alvania 3,2g packed
Revolution :3000 r/min
Muddy water :5 wt% of class 8 of JIS Z 8901 Kanto loam powder
Muddy water flow :30 cc/min
Test time :10 cycles over 240 hrs (Each cycle consists of 3 hours of spraying and 21 hours of drying)

Table 4 Muddy water splash test data

Type	1	2	3	4	5	average
LLU	3	2	2	4	3	2.8
LLB	2	1	1	2	2	1.6

Ratings 4 : No penetration whatsoever
3 : Very slight penetration of muddy water is apparent
2 : Some penetration of muddy water is apparent
1 : Considerable penetration of muddy water is apparent

3. Service Life of Prelubricating Grease

The service life of filled grease is influenced by many factors: operating conditions, temperature, atmosphere, etc. There is even a considerable difference by grease brands. Keeping this in mind, **Figure 3** presents a scale for determining grease service life. It is based on actual and experimental data; and applies to high-quality grease used in ball bearings under normal operating conditions.

As the working temperature increases, the grease life, of course, becomes shorter. Although not accurate for all greases, **Figure 3** is valid, in general, for working temperatures up to 80˚C; for working temperatures over 80˚C. service life decreases to about two-thirds for every 10˚ over 80˚C. (Please note that this does not apply to calcium-soap and aluminum-soap greases.)

Example

The following method is used to obtain the grease life of deep groove ball bearing 6206ZZ at a radial load of 1520 N and a operating speed, n, of 3600 r/min. From the appropriate Dimension Table we find that the standard load rating, Cr, for a 6206ZZ bearings is 19500 N and the limiting speed is 11000 r/min. (Use the value for ZZ or LLB even if the bearings of LLU specifications).

Divide Cr by the equivalent radial load, Pr. You will obtain 12.8 (19500/1520≈12.8). Next go to **Figure 4** to determine the value for f_L. (For Cr/Pr=12.8. f_L=1). Find $f_L \cdot n_0/n$. (1.0・11000/3600≈3.1).

With your value of $f_L \cdot n_0/n$' (3.1 in this example) go to **Figure 3** and find this value on Scale Ⅱ. Call this point B. The bore diameter, d, of the bearing is 30. Find this value on Scale Ⅰ and call this point A. Draw a straight line between Points A and B. The line will intersect Scale Ⅲ at some point which will be Called Point C. In this example, Point C is 17000 hours. This is the expected grease life of the bearing which is what we were looking for.

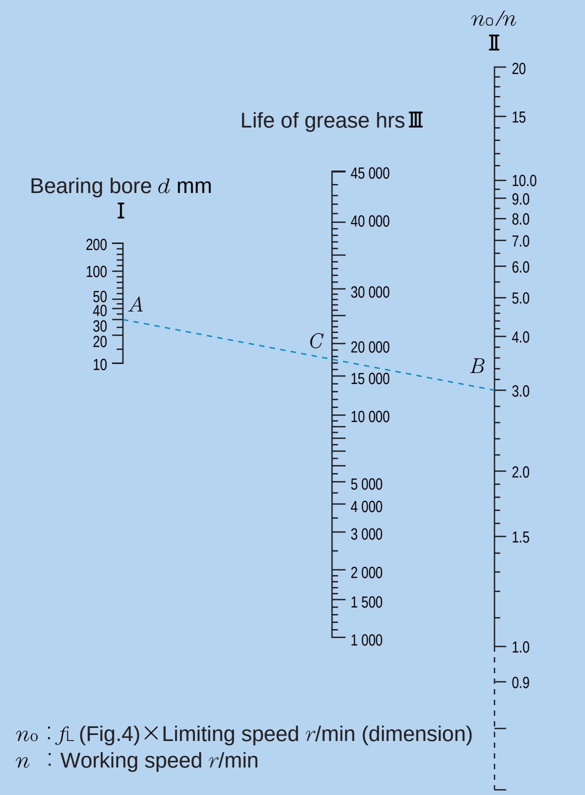


Figure 3

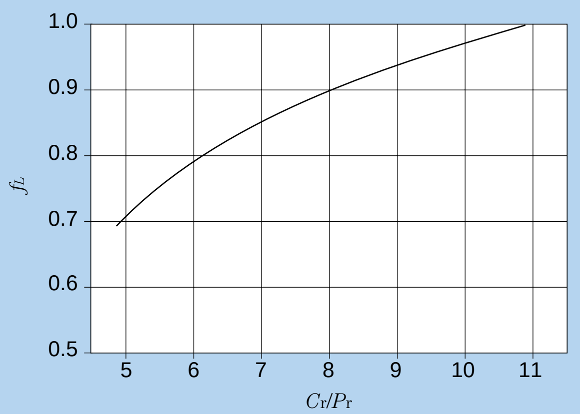


Figure 4 Correction coefficient f_L as a function of bearing load Cr/Pr

Note that **NTN** can also manufacture shield and seal type small diameter ball bearings of dimensions other than those shown on the subsequent dimension tables. Contact **NTN** for more information.

- **Use under high or low temperature**
- **Low torque is required**
- **High speeds are required**
- **Grease leakage must be avoided**
- **Use under other special conditions**

Also note that the performance of prelubricated ball bearings is affected by operating conditions and grease type. For information on performance under special conditions, please contact **NTN**.

4. Bearing Precision

Inner ring

d = Nominal bore diameter
Δ_{dmp} = Single plane mean bore diameter deviation
V_{dp} = Single radial plane bore diameter variation
V_{dmp} = Mean single plane bore diameter variation
K_{ia} = Inner ring radial runout
S_{d} = Face runout with bore
S_{ia} = Inner ring axial runout (with side)
Δ_{Bs} = Inner ring width deviation
V_{Bs} = Inner ring width varietion

Outer ring

D = Nominal outside diameter
Δ_{Dmp} = Single plane mean outside diameter deviation
V_{Dp} = Single radial plane outside diameter variation
V_{Dmp} = Mean single plane outside diameter variation
K_{ea} = Outer ring radial runout
S_{D} = Outside surface inclination
S_{ea} = Outside ring axial runout
Δ_{Cs} = Outer ring width deviation
V_{Cs} = Outer ring width variation

(1) Inner ring tolerance

Unit μm

d (mm)		Δ_{dmp}								V_{dp}												V_{dmp}				K_{ia}				S_d		S_{ia}		Δ_{Bs}				V_{Bs}			
										Bearing series 68, 69				Bearing series 60				Bearing series 62, 63																							
		Class 0		Class 6		Class 5		Class❶ 4		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 0,6		Class 5,4		Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	high	low	high	low	max				max				max				max				max				max		max		high	low	high	low	max			
2.5	10	0	−8	0	−7	0	−5	0	−4	10	9	5	4	8	7	4	3	6	5	4	3	6	5	3	2	10	6	4	2.5	7	3	7	3	0	−120	0	−40	15	15	5	2.5
10	18	0	−8	0	−7	0	−5	0	−4	10	9	5	4	8	7	4	3	6	5	4	3	6	5	3	2	10	7	4	2.5	7	3	7	3	0	−120	0	−80	20	20	5	2.5
18	30	0	−10	0	−8	0	−6	0	−5	13	10	6	5	10	8	5	4	8	6	5	4	8	6	3	2.5	13	8	4	3	8	4	8	4	0	−120	0	−120	20	20	5	2.5
30	50	0	−12	0	−10	0	−8	0	−6	15	13	8	6	12	10	6	5	9	8	6	5	9	8	4	3	15	10	5	4	8	4	8	4	0	−120	0	−120	20	20	5	3
50	80	0	−15	0	−12	0	−9	0	−7	19	15	9	7	19	15	7	5	11	9	7	5	11	9	5	3.5	20	10	5	4	8	5	8	5	0	−150	0	−150	25	25	6	4
80	120	0	−20	0	−15	0	−10	0	−8	25	19	10	8	25	19	8	6	15	11	8	6	15	11	5	4	25	13	6	5	9	5	9	5	0	−200	0	−200	25	25	7	4
120	180	0	−25	0	−18	0	−13	0	−10	31	23	13	10	31	23	10	8	19	14	10	8	19	14	7	5	30	18	8	6	10	6	10	7	0	−250	0	−250	30	30	8	5

❶ The dimensional difference Δ_{ds} of bore diameter to applied for class 4 and 2 is the same as the tolerance of dimentional difference Δ_{dmp} of average bore diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and to all the diameter series against Class 2.

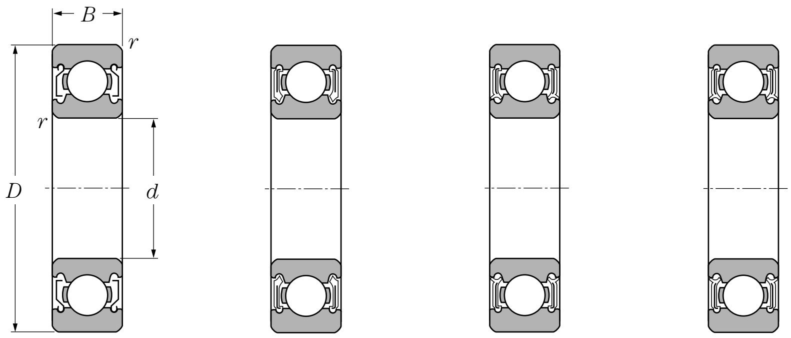
(2) Outer ring tolerance

Unit μm

D (mm)		Δ_{Dmp}								V_{Dp}		V_{Dmp}				K_{ea}				S_D		S_{ea}		Δ_{Cs}		V_{Cs}			
										Bearing series 62,63	Bearing series 60,62,63																		
		Class 0		Class 6		Class 5		Class❷ 4		Class 0	Class 6	Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	all type		Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	high	low	high	low	max		max				max				max		max		high	low	max			
18	30	0	−9	0	−8	0	−6	0	−5	12	10	7	6	3	2.5	15	9	6	4	8	4	8	5	Identical to Δ_{Bs} of inner ring of same bearing		Identical to Δ_{Bs} and V_{Bs} of inner ring of same bearing		5	2.5
30	50	0	−11	0	−9	0	−7	0	−6	16	13	8	7	4	3	20	10	7	5	8	4	8	5					5	2.5
50	80	0	−13	0	−11	0	−9	0	−7	20	16	10	8	5	3.5	25	13	8	5	8	4	10	5					6	3
80	120	0	−15	0	−13	0	−10	0	−8	26	20	11	10	5	4	35	18	10	6	9	5	11	6					8	4
120	150	0	−18	0	−15	0	−11	0	−9	30	25	14	11	6	5	40	20	11	7	10	5	13	7					8	5
150	180	0	−25	0	−18	0	−13	0	−10	38	30	19	14	7	5	45	23	13	8	10	5	14	8					8	5
180	250	0	−30	0	−20	0	−15	0	−11	45	35	23	15	8	6	50	25	15	10	11	7	15	10					10	7

❷ Same as ❶ but Δ_{Ds}+Δ_{Dmp} rather than Δ_{ds}+Δ_{dmp}

5. Dimension Tables

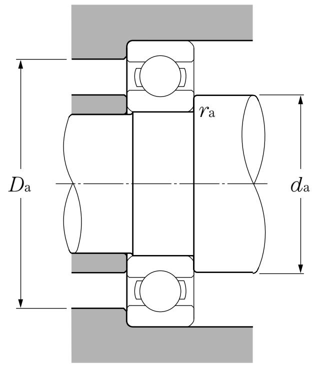


Shielded type (ZZ)　Non-contact sealed type (LLB)　Low torque sealed type (LLH)　Contact sealed type (LLU)

d 10～25mm

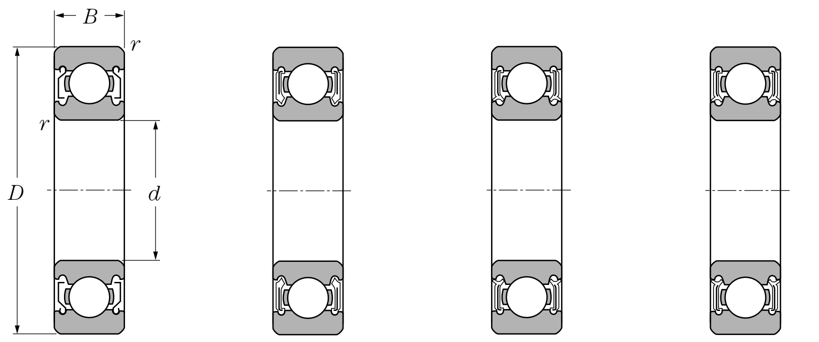
Boundary dimensions				Basic load ratings				Limiting speeds		
				dynamic	static	dynamic	static			
mm				kN		kgf		rpm		
								grease		
d	*D*	*B*	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	ZZ LLB	LLH	LLU
10	19	5	0.3	1.83	0.925	187	94	32 000	—	24 000
	22	6	0.3	2.7	1.27	275	129	30 000	—	21 000
	26	8	0.3	4.55	1.96	465	200	29 000	25 000	21 000
	30	9	0.6	5.10	2.39	520	244	25 000	21 000	18 000
	35	11	0.6	8.20	3.50	835	355	23 000	20 000	16 000
12	21	5	0.3	1.92	1.04	195	106	29 000	—	20 000
	24	6	0.3	2.89	1.46	295	149	27 000	—	19 000
	28	8	0.3	5.10	2.39	520	244	26 000	21 000	18 000
	32	10	0.6	6.10	2.75	620	280	22 000	20 000	16 000
	37	12	1	9.70	4.20	990	425	20 000	19 000	15 000
15	24	5	0.3	2.08	1.26	212	128	26 000	—	17 000
	28	7	0.3	3.65	2.00	375	204	24 000	—	16 000
	32	9	0.3	5.60	2.84	570	289	22 000	18 000	15 000
	35	11	0.6	7.75	3.60	790	365	19 000	18 000	15 000
	42	13	1	11.4	5.45	1 170	555	17 000	15 000	12 000
17	26	5	0.3	2.23	1.46	227	149	24 000	—	15 000
	30	7	0.3	4.65	2.58	475	263	22 000	—	14 000
	35	10	0.3	6.80	3.35	695	345	20 000	16 000	14 000
	40	12	0.6	9.60	4.60	980	465	18 000	15 000	12 000
	47	14	1	13.5	6.55	1 380	665	16 000	14 000	11 000
20	32	7	0.3	4.00	2.47	410	252	21 000	—	13 000
	37	9	0.3	6.40	3.70	650	375	19 000	—	12 000
	42	12	0.6	9.40	5.05	955	515	18 000	13 000	11 000
	47	14	1	12.8	6.65	1 310	680	16 000	12 000	10 000
	52	15	1.1	15.9	7.90	1 620	805	14 000	12 000	10 000
22	44	12	0.6	9.40	5.05	955	515	17 000	13 000	10 000
	50	14	1	12.9	6.80	1 320	690	14 000	12 000	9 700
	56	16	1.1	18.4	9.25	1 880	945	13 000	11 000	9 200
25	37	7	0.3	4.30	2.95	435	300	18 000	—	10 000
	42	9	0.3	7.05	4.55	715	460	16 000	—	9 800
	47	12	0.6	10.1	5.85	1 030	595	15 000	11 000	9 400
	52	15	1	14.0	7.85	1 430	800	13 000	11 000	8 900
	62	17	1.1	21.2	10.9	2 160	1 110	12 000	9 700	8 100

❶ Smallest allowable dimension for chamfer dimension *r*.



Bearing numbers ❷				Abutment and fillet dimensions (mm)				Mass (kg)
Sealed type	Non-contact type	Low torque type	Contact type	d_a ❸ min	d_a ❸ max	D_a ❸ max	r_{as} max	(approx.)
6800ZZ	6800LLB	—	6800LLU	12	12.5	17	0.3	0.005
6900ZZ	6900LLB	—	6900LLU	12	13	20	0.3	0.009
6000ZZ	6000LLB	6000LLH	6000LLU	12	13.5	24	0.3	0.019
6200ZZ	6200LLB	6200LLH	6200LLU	14	16	26	0.6	0.032
6300ZZ	6300LLB	6300LLH	6300LLU	14	17	31	0.6	0.053
6801ZZ	6801LLB	—	6801LLU	14	14.5	19	0.3	0.006
6901ZZ	6901LLB	—	6901LLU	14	15	22	0.3	0.011
6001ZZ	6001LLB	6001LLH	6001LLU	14	16	26	0.3	0.021
6201ZZ	6201LLB	6201LLH	6201LLU	16	17	28	0.6	0.037
6301ZZ	6301LLB	6301LLH	6301LLU	17	18.5	32	1	0.06
6802ZZ	6802LLB	—	6802LLU	17	17.5	22	0.3	0.007
6902ZZ	6902LLB	—	6902LLU	17	17.5	26	0.3	0.016
6002ZZ	6002LLB	6002LLH	6002LLU	17	19	30	0.3	0.03
6202ZZ	6202LLB	6202LLH	6202LLU	19	20	31	0.6	0.045
6302ZZ	6302LLB	6302LLH	6302LLU	20	23	37	1	0.082
6803ZZ	6803LLB	—	6803LLU	19	19.5	24	0.3	0.008
6903ZZ	6903LLB	—	6903LLU	19	20	28	0.3	0.018
6003ZZ	6003LLB	6003LLH	6003LLU	19	21	33	0.3	0.039
6203ZZ	6203LLB	6203LLH	6203LLU	21	23	36	0.6	0.066
6303ZZ	6303LLB	6303LLH	6303LLU	22	25	42	1	0.115
6804ZZ	6804LLB	—	6804LLU	22	22.5	30	0.3	0.019
6904ZZ	6904LLB	—	6904LLU	22	24	35	0.3	0.036
6004ZZ	6004LLB	6004LLH	6004LLU	24	26	38	0.6	0.069
6204ZZ	6204LLB	6204LLH	6204LLU	25	28	42	1	0.106
6304ZZ	6304LLB	6304LLH	6304LLU	26.5	28.5	45.5	1	0.144
60/22ZZ	60/22LLB	60/22LLH	60/22LLU	26	26.5	40	0.6	0.074
62/22ZZ	62/22LLB	62/22LLH	62/22LLU	27	29.5	45	1	0.117
63/22ZZ	63/22LLB	63/22LLH	63/22LLU	28.5	31	49.5	1	0.176
6805ZZ	6805LLB	—	6805LLU	27	28	35	0.3	0.022
6905ZZ	6905LLB	—	6905LLU	27	29	40	0.3	0.042
6005ZZ	6005LLB	6005LLH	6005LLU	29	30.5	43	0.6	0.08
6205ZZ	6205LLB	6205LLH	6205LLU	30	32	47	1	0.128
6305ZZ	6305LLB	6305LLH	6305LLU	31.5	35	55.5	1	0.232

❷ Single sealed and shielded bearings are also available.
❸ This dimension applies to sealed and shielded bearings.

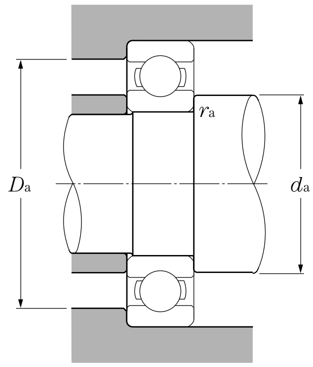


Shielded type (ZZ) | Non-contact sealed type (LLB) | Low torque sealed type (LLH) | Contact sealed type (LLU)

d 28～55mm

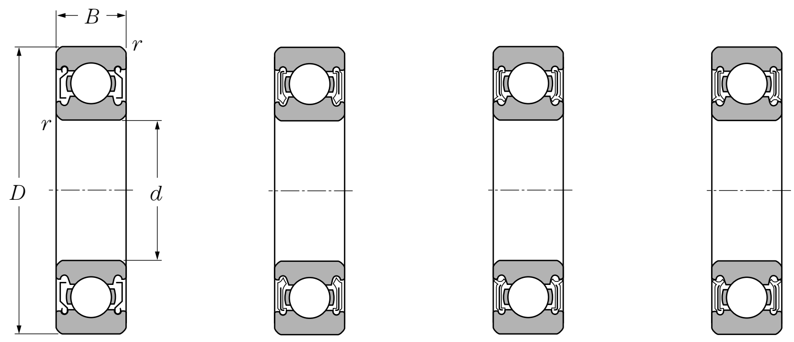
Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Limiting speeds (rpm)		
d	D	B	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	grease ZZ LLB	LLH	LLU
28	52	12	0.6	12.5	7.40	1 270	755	14 000	10 000	8 400
	58	16	1	17.9	9.75	1 830	995	12 000	9 700	8 100
	68	18	1.1	26.7	14.0	2 730	1 430	11 000	8 900	7 400
30	42	7	0.3	4.70	3.65	480	370	15 000	—	8 800
	47	9	0.3	7.25	5.00	740	510	14 000	—	8 400
	55	13	1	13.2	8.3	1 350	845	13 000	9 200	7 700
	62	16	1	19.5	11.3	1 980	1 150	11 000	8 800	7 300
	72	19	1.1	26.7	15.0	2 720	1 530	10 000	7 900	6 600
32	58	13	1	11.8	8.05	1 200	820	12 000	8 700	7 200
	65	17	1	20.7	11.6	2 110	1 190	11 000	8 400	7 100
	75	20	1.1	29.8	16.9	3 050	1 730	9 500	7 700	6 500
35	47	7	0.3	4.90	4.05	500	410	13 000	—	7 600
	55	10	0.6	9.55	6.85	975	695	12 000	—	7 100
	62	14	1	16.0	10.3	1 630	1 050	12 000	8 200	6 800
	72	17	1.1	25.7	15.3	2 620	1 560	9 800	7 600	6 300
	80	21	1.5	33.5	19.1	3 400	1 950	8 800	7 300	6 000
40	52	7	0.3	5.10	4.40	520	445	12 000	—	6 700
	62	12	0.6	12.2	8.90	1 240	910	11 000	—	6 300
	68	15	1	16.8	11.5	1 710	1 170	10 000	7 300	6 100
	80	18	1.1	29.1	17.8	2 970	1 820	8 700	6 700	5 600
	90	23	1.5	40.5	24.0	4 150	2 450	7 800	6 400	5 300
45	58	7	0.3	5.35	4.95	550	500	11 000	—	5 900
	68	12	0.6	13.1	10.4	1 330	1 060	9 800	—	5 600
	75	16	1	21.0	15.1	2 140	1 540	9 200	6 500	5 400
	85	19	1.1	32.5	20.4	3 350	2 080	7 800	6 200	5 200
	100	25	1.5	53.0	32.0	5 400	3 250	7 000	5 600	4 700
50	65	7	0.3	6.60	6.10	670	620	9 600	—	5 300
	72	12	0.6	13.4	11.2	1 370	1 140	8 900	—	5 100
	80	16	1	21.8	16.6	2 230	1 690	8 400	6 000	5 000
	90	20	1.1	35.0	23.2	3 600	2 370	7 100	5 700	4 700
	110	27	2	62.0	38.5	6 300	3 900	6 400	5 000	4 200
55	72	9	0.3	8.80	8.10	900	825	8 700	—	4 800

❶ Smallest allowable dimension for chamfer dimension r.



Bearing numbers ❷				Abutment and fillet dimensions				Mass
				mm				kg
Sealed type	Non-contact type	Low torque type	Contact type	d_a ❸ min	d_a ❸ max	D_a ❸ max	r_{as} max	(approx.)
60/28ZZ	60/28LLB	60/28LLH	60/28LLU	32	34	48	0.6	0.098
62/28ZZ	62/28LLB	62/28LLH	62/28LLU	33	35.5	53	1	0.171
63/28ZZ	63/28LLB	63/28LLH	63/28LLU	34.5	38.5	61.5	1	0.284
6806ZZ	6806LLB	—	6806LLU	32	33	40	0.3	0.026
6906ZZ	6906LLB	—	6906LLU	32	34	45	0.3	0.048
6006ZZ	6006LLB	6006LLH	6006LLU	35	37	50	1	0.116
6206ZZ	6206LLB	6206LLH	6206LLU	35	39	57	1	0.199
6306ZZ	6306LLB	6306LLH	6306LLU	36.5	43	65.5	1	0.36
60/32ZZ	60/32LLB	60/32LLH	60/32LLU	37	39	53	1	0.129
62/32ZZ	62/32LLB	62/32LLH	62/32LLU	37	40	60	1	0.226
63/32ZZ	63/32LLB	63/32LLH	63/32LLU	38.5	43.5	68.5	1	0.382
6807ZZ	6807LLB	—	6807LLU	37	38	45	0.3	0.029
6907ZZ	6907LLB	—	6907LLU	39	40	51	0.6	0.074
6007ZZ	6007LLB	6007LLH	6007LLU	40	42	57	1	0.155
6207ZZ	6207LLB	6207LLH	6207LLU	41.5	45	65.5	1	0.288
6307ZZ	6307LLB	6307LLH	6307LLU	43	47	72	1.5	0.457
6808ZZ	6808LLB	—	6808LLU	42	43	50	0.3	0.033
6908ZZ	6908LLB	—	6908LLU	44	45	58	0.6	0.11
6008ZZ	6008LLB	6008LLH	6008LLU	45	47	63	1	0.19
6208ZZ	6208LLB	6208LLH	6208LLU	46.5	51	73.5	1	0.366
6308ZZ	6308LLB	6308LLH	6308LLU	48	54	82	1.5	0.63
6809ZZ	6809LLB	—	6809LLU	47	48	56	0.3	0.04
6909ZZ	6909LLB	—	6909LLU	49	51	64	0.6	0.128
6009ZZ	6009LLB	6009LLH	6009LLU	50	52.5	70	1	0.237
6209ZZ	6209LLB	6209LLH	6209LLU	51.5	55.5	78.5	1	0.398
6309ZZ	6309LLB	6309LLH	6309LLU	53	61.5	92	1.5	0.814
6810ZZ	6810LLB	—	6810LLU	52	54	63	0.3	0.052
6910ZZ	6910LLB	—	6910LLU	54	55.5	68	0.6	0.132
6010ZZ	6010LLB	6010LLH	6010LLU	55	57.5	75	1	0.261
6210ZZ	6210LLB	6210LLH	6210LLU	56.5	60	83.5	1	0.454
6310ZZ	6310LLB	6310LLH	6310LLU	59	68.5	101	2	1.07
6811ZZ	6811LLB	—	6811LLU	57	59	70	0.3	0.083

❷ Single sealed and shielded bearings are also available.
❸ This dimension applies to sealed and shielded bearings.

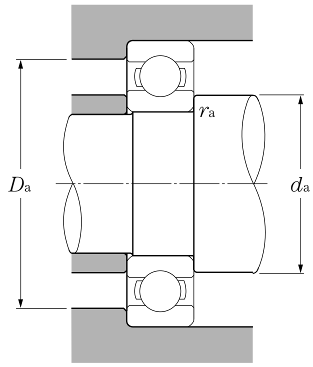


Shielded type (ZZ) | Non-contact sealed type (LLB) | Low torque sealed type (LLH) | Contact sealed type (LLU)

d 55～85mm

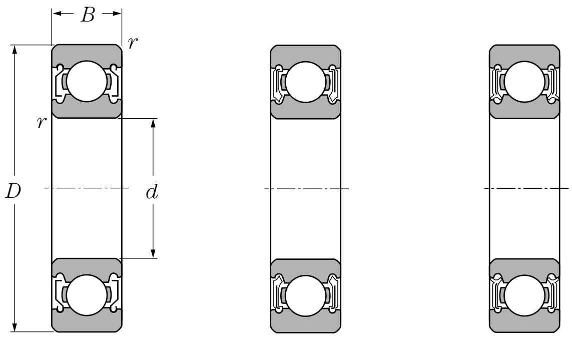
Boundary dimensions (mm)				Basic load ratings dynamic (kN)	static (kN)	dynamic (kgf)	static (kgf)	Limiting speeds (rpm) grease		
d	*D*	*B*	$r_{s\,min}$ ❶	C_r	C_{or}	C_r	C_{or}	ZZ LLB	LLH	LLU
55	80	13	1	16.0	13.3	1 630	1 350	8 200	—	4 600
	90	18	1.1	28.3	21.2	2 880	2 170	7 700	—	4 500
	100	21	1.5	43.5	29.2	4 450	2 980	6 400	—	4 300
	120	29	2	71.5	45.0	7 300	4 600	5 800	—	3 900
60	78	10	0.3	11.5	10.6	1 170	1 080	8 000	—	4 400
	85	13	1	16.4	14.3	1 670	1 450	7 600	—	4 300
	95	18	1.1	29.5	23.2	3 000	2 370	7 000	—	4 100
	110	22	1.5	52.5	36.0	5 350	3 700	6 000	—	3 800
	130	31	2.1	82.0	52.0	8 350	5 300	5 400	—	3 600
65	85	10	0.6	11.6	11.0	1 180	1 120	7 400	—	4 100
	90	13	1	17.4	16.1	1 770	1 640	7 000	—	4 000
	100	18	1.1	30.5	25.2	3 100	2 570	6 500	—	3 900
	120	23	1.5	57.5	40.0	5 850	4 100	5 500	—	3 600
	140	33	2.1	92.5	60.0	9 450	6 100	4 900	—	3 300
70	90	10	0.6	12.1	11.9	1 230	1 220	6 900	—	3 800
	100	16	1	23.7	21.2	2 420	2 160	6 500	—	3 700
	110	20	1.1	38.0	31.0	3 900	3 150	6 100	—	3 600
	125	24	1.5	62.0	44.0	6 350	4 500	5 100	—	3 400
	150	35	2.1	104	68.0	10 600	6 950	4 600	—	3 100
75	95	10	0.6	12.5	12.9	1 280	1 310	6 400	—	3 600
	105	16	1	24.4	22.6	2 480	2 300	6 100	—	3 500
	115	20	1.1	39.5	33.5	4 050	3 400	5 700	—	3 300
	130	25	1.5	66.0	49.5	6 750	5 050	4 800	—	3 200
	160	37	2.1	113	77.0	11 600	7 850	4 300	—	2 900
80	100	10	0.6	12.7	13.3	1 290	1 360	6 000	—	3 400
	110	16	1	24.9	24.0	2 540	2 450	5 700	—	3 200
	125	22	1.1	47.5	40.0	4 850	4 050	5 300	—	3 100
	140	26	2	72.5	53.0	7 400	5 400	4 500	—	3 000
	170	39	2.1	123	86.5	12 500	8 850	4 000	—	2 700
85	110	13	1	18.7	19.0	1 910	1 940	5 700	—	3 100
	120	18	1.1	32.0	29.6	3 250	3 000	5 400	—	3 000
	130	22	1.1	49.5	43.0	5 050	4 400	5 000	—	2 900
	150	28	2	83.5	64.0	8 500	6 500	4 200	—	2 800

❶ Smallest allowable dimension for chamfer dimension *r*.



Bearing numbers [2]				Abutment and fillet dimensions (mm)				Mass (kg)
Sealed type	Non-contact type	Low torque type	Contact type	d_a [3] min	d_a [3] max	D_a [3] max	r_{as} max	(approx.)
6911ZZ	6911LLB	—	6911LLU	60	61.5	75	1	0.18
6011ZZ	6011LLB	—	6011LLU	61.5	64	83.5	1	0.388
6211ZZ	6211LLB	—	6211LLU	63	67	92	1.5	0.601
6311ZZ	6311LLB	—	6311LLU	64	74	111	2	1.37
6812ZZ	6812LLB	—	6812LLU	62	64.5	76	0.3	0.106
6912ZZ	6912LLB	—	6912LLU	65	66.5	80	1	0.193
6012ZZ	6012LLB	—	6012LLU	66.5	69	88.5	1	0.414
6212ZZ	6212LLB	—	6212LLU	68	75	102	1.5	0.783
6312ZZ	6312LLB	—	6312LLU	71	80.5	119	2	1.73
6813ZZ	6813LLB	—	6813LLU	69	70	81	0.6	0.128
6913ZZ	6913LLB	—	6913LLU	70	71.5	85	1	0.206
6013ZZ	6013LLB	—	6013LLU	71.5	73	93.5	1	0.421
6213ZZ	6213LLB	—	6213LLU	73	80.5	112	1.5	0.99
6313ZZ	6313LLB	—	6313LLU	76	86	129	2	2.08
6814ZZ	6814LLB	—	6814LLU	74	75.5	86	0.6	0.137
6914ZZ	6914LLB	—	6914LLU	75	77.5	95	1	0.334
6014ZZ	6014LLB	—	6014LLU	76.5	80.5	103.5	1	0.604
6214ZZ	6214LLB	—	6214LLU	78	85	117	1.5	1.07
6314ZZ	6314LLB	—	6314LLU	81	92.5	139	2	2.52
6815ZZ	6815LLB	—	6815LLU	79	80	91	0.6	0.145
6915ZZ	6915LLB	—	6915LLU	80	82.5	100	1	0.353
6015ZZ	6015LLB	—	6015LLU	81.5	85.5	108.5	1	0.649
6215ZZ	6215LLB	—	6215LLU	83	90.5	122	1.5	1.18
6315ZZ	6315LLB	—	6315LLU	86	99	149	2	3.02
6816ZZ	6816LLB	—	6816LLU	84	85	96	0.6	0.154
6916ZZ	6916LLB	—	6916LLU	85	88	105	1	0.373
6016ZZ	6016LLB	—	6016LLU	86.5	91.5	118.5	1	0.854
6216ZZ	6216LLB	—	6216LLU	89	95.5	131	2	1.4
6316ZZ	6316LLB	—	6316LLU	91	105	159	2	3.59
6817ZZ	6817LLB	—	6817LLU	90	91	105	1	0.27
6917ZZ	6917LLB	—	6917LLU	91.5	94	113.5	1	0.536
6017ZZ	6017LLB	—	6017LLU	91.5	97	123.5	1	0.89
6217ZZ	6217LLB	—	6217LLU	94	103	141	2	1.79

[2] Single sealed and shielded bearings are also available.
[3] This dimension applies to sealed and shielded bearings.

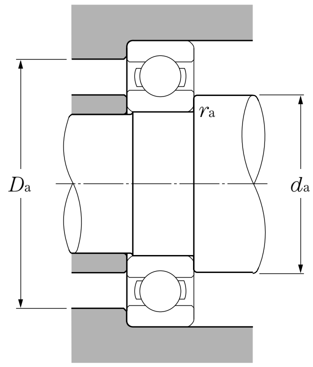


Shielded type (ZZ)　Non-contact sealed type (LLB)　Contact sealed type (LLU)

d 85～160mm

	Boundary dimensions mm			Basic load ratings dynamic kN	static kN	dynamic kgf	static kgf	Limiting speeds rpm grease ZZ LLB	LLU
d	D	B	$r_{s\,min}$ ❶	C_r	C_{0r}	C_r	C_{0r}	ZZ LLB	LLU
85	180	41	3	133	97.0	13 500	9 850	3 800	2 600
90	115	13	1	19.0	19.7	1 940	2 010	5 400	3 000
	125	18	1.1	33.0	31.5	3 350	3 200	5 100	2 900
	140	24	1.5	58.0	49.5	5 950	5 050	4 700	2 800
	160	30	2	96.0	71.5	9 800	7 300	4 000	2 600
	190	43	3	143	107	14 500	10 900	3 600	2 400
95	120	13	1	19.3	20.5	1 970	2 090	5 000	2 800
	130	18	1.1	33.5	33.5	3 450	3 400	4 800	2 800
	145	24	1.5	60.5	54.0	6 150	5 500	4 500	2 600
	170	32	2.1	109	82.0	11 100	8 350	3 700	2 500
	200	45	3	153	119	15 600	12 100	3 300	2 300
100	125	13	1	19.6	21.2	2 000	2 160	4 800	2 700
	140	20	1.1	41.0	39.5	4 200	4 050	4 500	2 600
	150	24	1.5	60.0	54.0	6 150	5 500	4 200	2 600
	180	34	2.1	122	93.0	12 500	9 450	3 500	2 300
	215	47	3	173	141	17 600	14 400	3 200	2 200
105	145	20	1.1	42.5	42.0	4 300	4 300	4 300	2 500
	160	26	2	72.5	65.5	7 400	6 700	4 000	2 400
	190	36	2.1	133	105	13 600	10 700	3 400	2 300
	225	49	3	184	153	18 700	15 700	3 000	2 100
110	150	20	1.1	43.5	44.5	4 450	4 550	4 100	2 400
	170	28	2	82.0	73.0	8 350	7 450	3 800	2 300
	200	38	2.1	144	117	14 700	11 900	3 200	2 200
	240	50	3	205	179	20 900	18 300	2 900	1 900
120	180	28	2	85.0	79.5	8 650	8 100	3 500	2 100
	215	40	2.1	155	131	15 900	13 400	2 900	2 000
130	200	33	2	106	101	10 800	10 300	3 200	1 900
140	210	33	2	110	109	11 200	11 100	3 000	1 800
150	225	35	2.1	126	126	12 800	12 800	2 800	1 700
160	240	38	2.1	143	144	14 500	14 700	2 600	1 600

❶ Smallest allowable dimension for chamfer dimension r.



Bearing numbers ❷			Abutment and fillet dimensions				Mass
			mm				kg
	Non-contact	Contact	d_a ❸		D_a ❸	r_{as}	
Sealed type	type	type	min	max	max	max	(approx.)
6317ZZ	6317LLB	6317LLU	98	112	167	2.5	4.23
6818ZZ	6818LLB	6818LLU	95	96	110	1	0.285
6918ZZ	6918LLB	6918LLU	96.5	99	118.5	1	0.554
6018ZZ	6018LLB	6018LLU	98	102	132	1.5	1.02
6218ZZ	6218LLB	6218LLU	99	109	151	2	2.15
6318ZZ	6318LLB	6318LLU	103	118	177	2.5	4.91
6819ZZ	6819LLB	6819LLU	100	101	115	1	0.3
6919ZZ	6919LLB	6919LLU	101.5	104	123.5	1	0.579
6019ZZ	6019LLB	6019LLU	103	109	137	1.5	1.08
6219ZZ	6219LLB	6219LLU	106	116	159	2	2.62
6319ZZ	—	6319LLU	108	125	187	2.5	5.67
6820ZZ	6820LLB	6820LLU	105	106	120	1	0.313
6920ZZ	6920LLB	6920LLU	106.5	110	133.5	1	0.785
6020ZZ	6020LLB	6020LLU	108	110	142	1.5	1.15
6220ZZ	6220LLB	6220LLU	111	122	169	2	3.14
6320ZZ	—	6320LLU	113	133	202	2.5	7
6921ZZ	6921LLB	6921LLU	111.5	115	138.5	1	0.816
6021ZZ	6021LLB	6021LLU	114	119	151	2	1.59
6221ZZ	—	6221LLU	116	125	179	2	3.7
6321ZZ	—	6321LLU	118	134	212	2.5	8.05
6922ZZ	6922LLB	6922LLU	116.5	120	143.5	1	0.849
6022ZZ	6022LLB	6022LLU	119	126	161	2	1.96
6222ZZ	—	6222LLU	121	132	189	2	4.36
6322ZZ	—	6322LLU	123	149	227	2.5	9.54
6024ZZ	6024LLB	6024LLU	129	136	171	2	2.07
6224ZZ	—	6224LLU	131	143	204	2	5.15
6026ZZ	—	6026LLU	139	148	191	2	3.16
6028ZZ	—	6028LLU	149	158	201	2	3.35
6030ZZ	—	6030LLU	161	169	214	2	4.08
6032ZZ	—	6032LLU	171	183	229	2	5.05

❷ Single sealed and shielded bearings are also available.
❸ This dimension applies to sealed and shielded bearings.

NTN®

Thrust Spherical Roller Bearing

ULTAGE

ULTAGE®

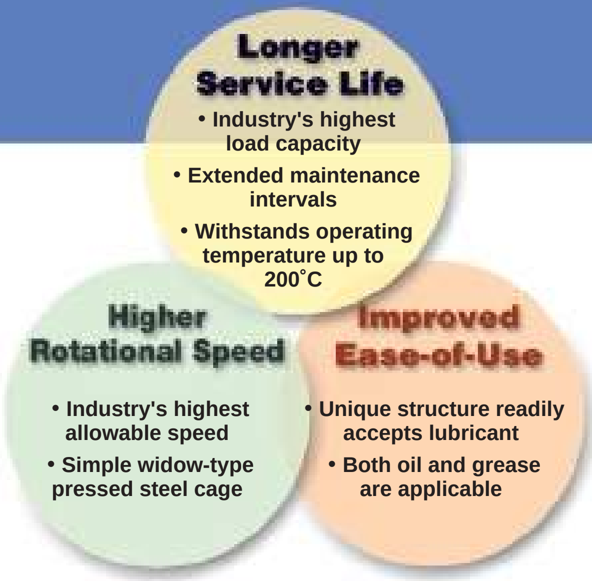
CAT. No.3034/E

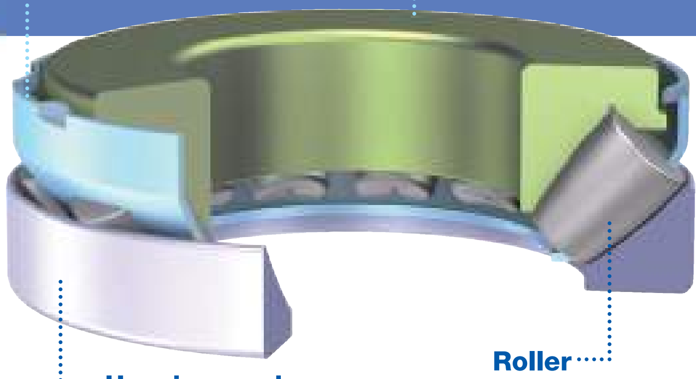
ULTAGE®

Up to Six times longer service life | **Up to 70% higher load capacity** | **Up to 20% higher allowable speed**

Thrust Spherical Roller Bearing

"ULTAGE series Thrust Spherical Roller Bearing" is a new series developed to satisfy customers' needs such as "longer service life", "higher rotational speed", "improved ease-of-use" required for all industrial applications.



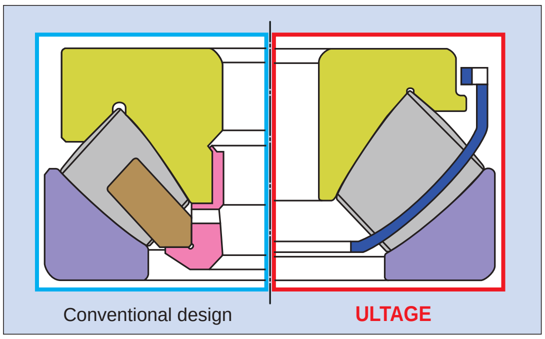


Advantages

1. Industry's highest load capacity

These bearings have a significantly increased roller diameter and incorporate the maximum number of rollers, thus achieving both a high load capacity and a longer service life.

- Basic dynamic load rating: **up to 70% greater** (vs. conventional design)
- Service life : **up to 6 times longer** (vs. conventional design)



2. Industry's highest allowable speed

The new pressed steel cage results in allowable speed up to **20% greater**. (vs. **NTN** conventional type)

3. Window-type pressed steel cage

With the new window-type pressed steel cage, both oil and grease lubrication are applicable.

4. Withstands operating temperature up to 200˚C

By adoption a special heat treatment, dimensional stability is achieved at high temperatures.

ULTAGE® **"ULTAGE® "** (a name created from the combination of **"ultimate,"** signifying refinement,and **"stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

Bearing Tolerances

1) Shaft washer

Unit μm

Nominal bore diameter d mm over	incl.	Single plane mean bore diameter deviation Δd_{mp} high	low	Single radial plane bore diameter variation V_{dp} max	Face runout with bore S_d max	Height deviation of single direction thrust bearing ΔT_s high	low
60	80	0	-15	11	25	+150	-150
80	120	0	-20	15	25	+200	-200
120	160	0	-25	19	30	+250	-250

2) Housing washer

Unit μm

Nominal outside diameter D mm over	incl.	Single plane mean outside diameter deviation ΔD_{mp} high	low
130	180	0	-25
180	250	0	-30
250	315	0	-35
315	320	0	-40

Bearing Fits (standard fits for ISO 199 normal class thrust bearings)

1) Shaft fits

Load conditions		Fit	Shaft diameter mm over	incl	Tolerance class
Combined load	Inner ring static load	Transition fit	All sizes		js6
	Inner ring rotating load or direction indeterminate load	Transition fit	–	200	k6 or js6

2) Housing fits

Load conditions		Fit	Tolerance class	Remarks
Combined load	Outer ring static load	Loose fit	H7	
	Direction Indeterminate load or outer ring rotating load	Transition fit	K7	Normal operating conditions
			M7	For relatively large radial loads

Note) Above tables shall be applied to steel or cast iron housing.

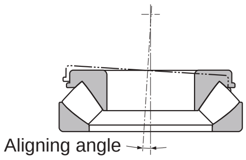
Bearing Number

294 20 E

- E — Type code
- 20 — Bore diameter code
- 294 — Dimension series code

Allowable Misalignment

● 1～2°



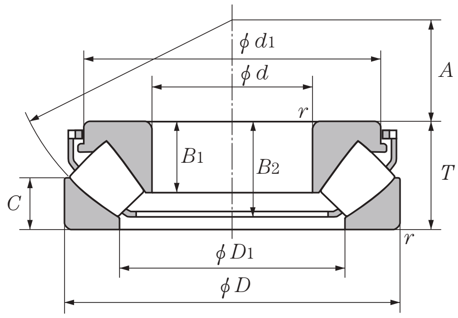
Allowable Radial Load

● $F_r / F_a \leqq 0.55$

F_r : Radial load
F_a : Axial load

Dimensional Table

● Bore diameter φ 60～160mm



Bearing numbers	Boundary dimensions mm d	D	T	r_s min ❶	Basic load ratings dynamic kN C_a	static kN C_{0a}	dynamic kgf C_a	static kgf C_{0a}	Allowable speed min⁻¹ Oil lubrication	Grease lubrication
29412E	60	130	42	0.5	451	928	45 900	94 700	3 050	1 650
29413E	65	140	45	2	531	1 120	54 200	114 000	2 850	1 530
29414E	70	150	48	2	608	1 290	62 000	132 000	2 650	1 420
29415E	75	160	51	2	675	1 470	68 800	150 000	2 500	1 330
29416E	80	170	54	2.1	788	1 690	80 400	173 000	2 350	1 250
29417E	85	180	58	2.1	820	1 860	83 600	190 000	2 200	1 170
29418E	90	190	60	2.1	934	2 050	95 200	209 000	2 100	1 110
29420E	100	210	67	3	1 170	2 570	119 000	262 000	1 850	1 000
29422E	110	230	73	3	1 380	3 100	141 000	316 000	1 700	900
29424E	120	250	78	4	1 520	3 550	155 000	362 000	1 550	830
29426E	130	270	85	4	1 770	4 270	181 000	435 000	1 450	760
29428E	140	280	85	4	1 850	4 350	188 000	443 000	1 400	710
29430E	150	300	90	4	2 200	5 270	225 000	537 000	1 300	660
29432E	160	320	95	5	2 410	5 790	246 000	590 000	1 200	620

❶ Smallest allowable dimension for chamfer dimension r.

Allowable Speed

- The allowable speeds indicated in the bearing dimension table are for reference only and applied only when bearings are lubricated and heat is efficiently drawn away from the bearing.The allowable speeds in this catalog are categorized as follows:

【Oil lubricated bearings】

The bearing rotational speed at which housing washer temperature reaches 80˚C when the bearing is running under the load of 5% of basic static load rating C_{0a} while lubricated with oil (viscosity VG32) which is assimilated to room temperature and fed at a rate of 1 liter/min (circulating lubrication).

【Grease lubricated bearings】

The bearing rotational speed at which housing washer temperature reaches 80˚C when the bearing is running under the load of 5% of basic static load rating C_{0a} after the running in with the Lithium grease of which amount is 100% of the bearing internal free value (consistency : NLGI3).

With either lubrication system, the bearing temperature rise profile varies with operating conditions (load, speed, lubrication, etc.). Therefore, select the bearing with sufficient margin from allowable speed in the catalog.

Please contact **NTN** Engineering for technical assistance if the bearing speed might exceeds 80% of the allowable speed indicated in the catalog.

Lubricating methods

- Due to the nature of the design in thrust spherical roller bearings, lubrication may not be distributed thoroughly between the inner ring and the large end roller side face. So, it is imperative to supply sufficient lubricant to the bearing.
For grease lubrication, fill the bearings' and hougings' effective space with grease (ref. **Fig.1** and **Fig. 2**).

[Vertical shaft]
Bearing : 100% of effective space (**Fig.1** -①)
Housing : 100% of the volume (**Fig.1** -②③)

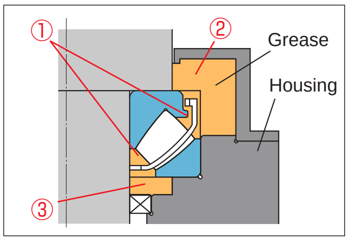


Fig.1 Grease lubrication for vertical shaft

[Horizontal shaft]
Bearing : 100% of effective space (**Fig.2** -①)
Housing : 100% of the volume of shaft washer (**Fig.2** -②)

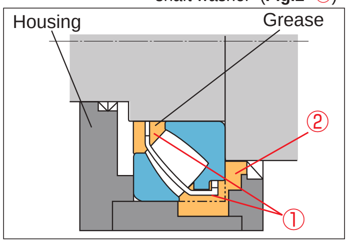
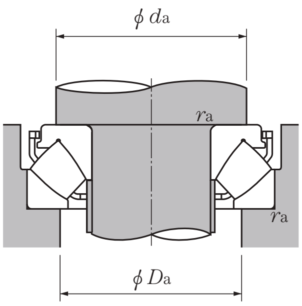
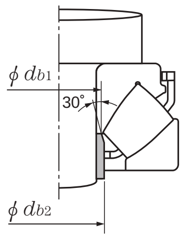


Fig.2 Grease lubrication fo horizontal shaft





Dynamic equivalent axial load
$P_a = F_a + 1.2F_r$

Static equivalent axial load
$P_{0a} = F_a + 2.7F_r$
here $F_r/F_a \leqq 0.55$

Dimensions mm				Abutment and fillet dimensions mm							Mass (approx.) kg	Effective space of the bearing (approx.) cm³
B_1	B_2	C	A	d_1	d_a min.	d_{b1} max.	d_{b2} max.	D_1	D_a max.	r_{as} max.		
27	37	20.5	38	110	90	65	67	85	108	1.5	2.50	83.2
29.3	40	22.5	42	116	100	70	72	95	115	2	3.10	98.6
31.3	43	23.7	44	125	105	75	77	100	125	2	3.75	122
35.4	46	23.9	47	135	115	79	83	104	132	2	4.56	143
35.3	49	26.5	50	143	120	87	87	114	140	2	5.47	173
38.6	51	27.8	54	152	130	92	95	121	150	2	6.54	216
40.5	55	27	56	162	135	95	102	126	157	2	7.51	251
44	58.9	32	62	181	150	107	114	141	175	2.5	10.3	340
48.5	65	35	69	199	165	118	125	156	190	2.5	13.1	439
52.7	71	35.9	74	218	180	128	135	171	205	3	16.7	563
58.5	74	39.6	81	238	195	138	146	180	225	3	21.4	695
56	74.5	42	86	244	205	149	158	196	235	3	22.3	739
60.5	81	43.2	92	264	220	158	168	204	250	3	27.4	838
63	84.9	45.5	99	280	230	170	182	221	265	4	32.5	1050

Performance Test Data

Temperature rise

(1) Vertical shaft

[Test conditions]

- Bearing : 29418E
  (**ULTAGE Thrust Spherical Roller Bearing**)
- Load : Axial 98kN (0.05C_a)
- Rotational speed : 1000～2200min^{-1}
- Lubrication : oil (circulating oil)
- Structure of the test rig : **Fig.3**

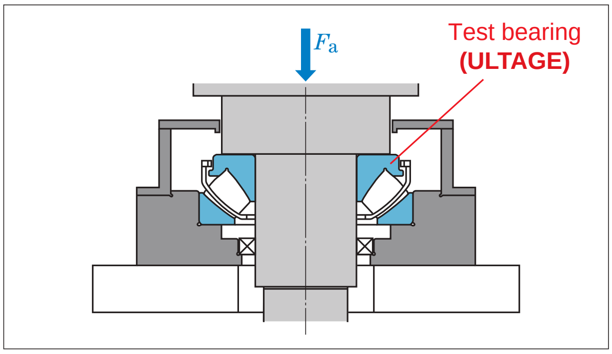
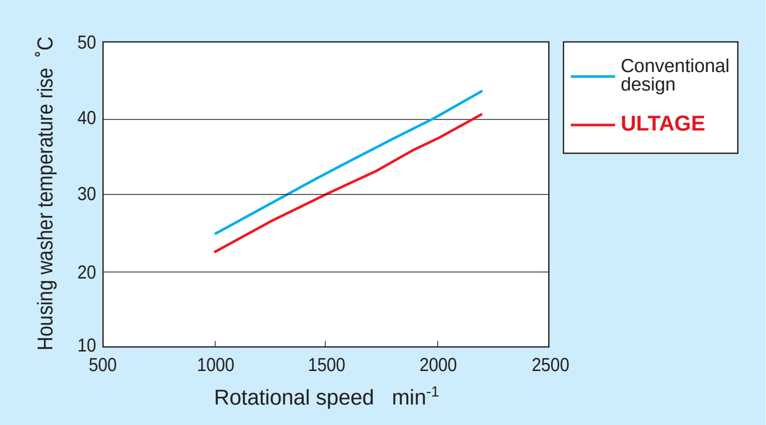


Fig.3 Structure of the test rig

[Test results]



(2) Horizontal shaft

[Test conditions]

- Bearing : 29418E
  (**ULTAGE Thrust Spherical Roller Bearing**)
- Load : Axial 98kN (0.05C_a)
- Rotational speed : 1000～2200min^{-1}
- Lubrication : oil (circulating oil)
- Structure of the test rig : **Fig.4**

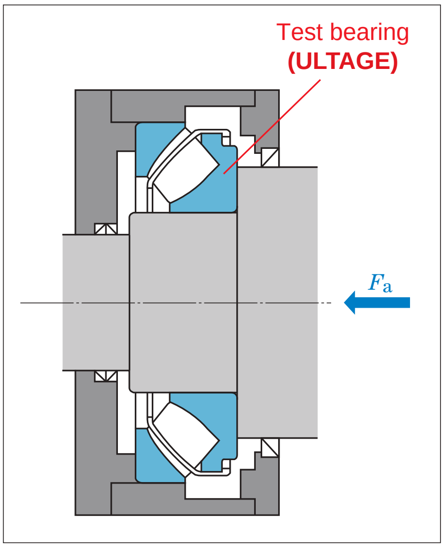
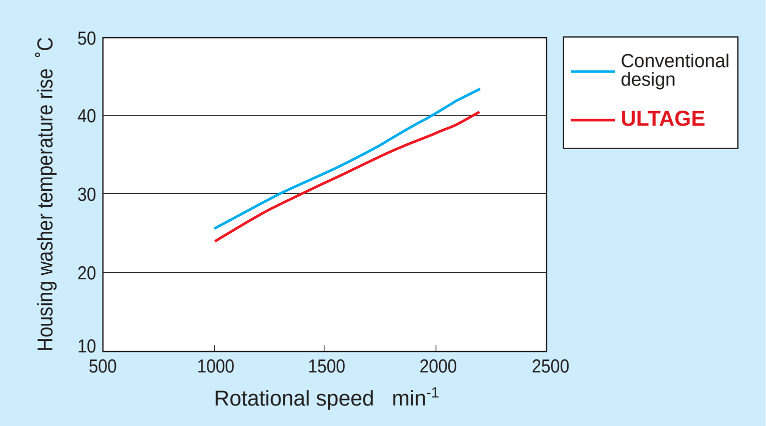


Fig.4 Structure of the test rig

[Test results]



NTN®

Cylindrical Roller Bearings
ULTAGE Series

CAT.No.3037-3/E

ULTAGE™

Rating life +20 % (max.) | **Basic dynamic load rating +7 % (max.)** | **Allowable speed +20 % (max.)**

ULTAGE™

Cylindrical Roller Bearings ULTAGE Series

Cylindrical roller bearings of ULTAGE series are products developed to provide longer service life, increase of load capability, and higher rotational speed required for any industrial machinery.

Higher Reliability

- Greater load capacity by optimizing internal specifications
- Extended maintenance intervals

Increase of Load Capability

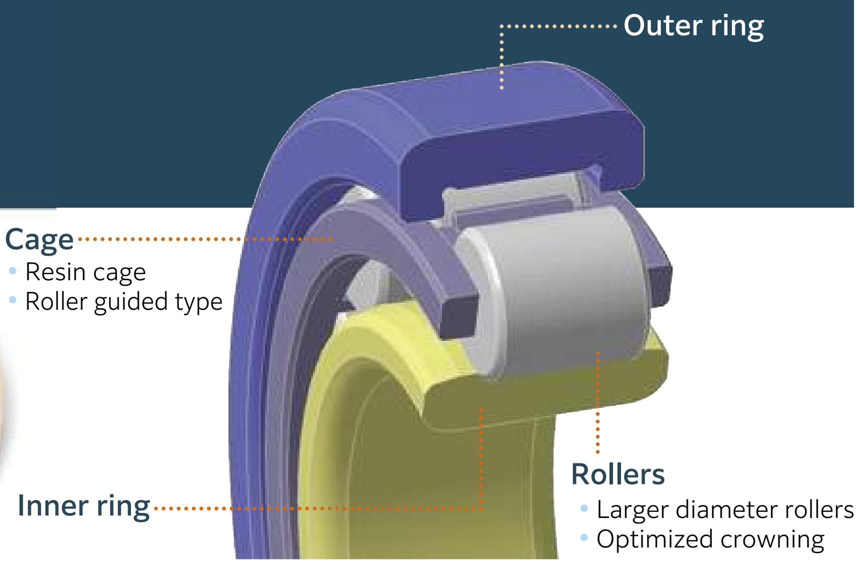
- Allowable misalignment 1/500

※Under conditions of $F_r \leq 0.20\ C_r$
F_r : Radial load

Higher Limiting Speed

- max. 20 % increase of allowable speed by optimizing internal specifications

※With oil lubrication



Features

1. World's highest level load carrying capacity

Higher load carrying capacity and longer rating life by optimizing internal specifications

(1) Rating life : max. +20 % (compared to conventional NTN E type)

(2) Basic dynamic load rating : max. +7 % (compared to conventional NTN E type)

2. Allowable misalignment (see Fig. 1)

Allowable misalignment : 1/500

Optimized crowning allows combination of $0.20C_r$ and misalignment up to 1/500 to be used. When the radial load exceeds $0.20C_r$, please ask **NTN**. *Minimum required load: $0.04C_{0r}$.
C_r means basic dynamic load rating, and C_{0r} means basic static load rating listed in this catalog.

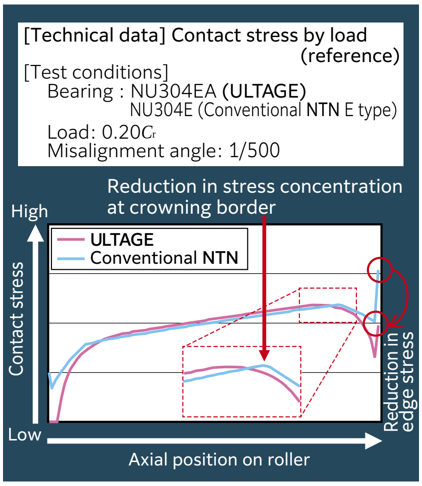


Fig. 1

3. Allowable speed

max. +20 % with oil lubrication (compared to conventional **NTN** E type)

4. Adopted resin cage as standard (see Fig. 2)

(1) Standard use of integrated polyamide resin cage results in higher limiting speed and longer life of grease.

(2) Resin cage material: polyamide reinforced with glass fiber.

*If machined cage for high speed is required, please ask **NTN**.

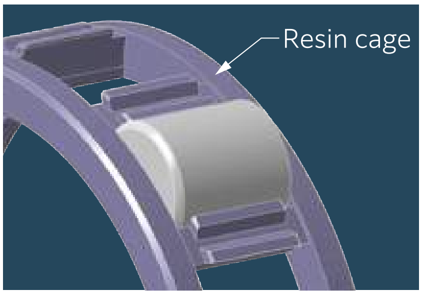


Fig. 2

5. Interchangeability

Boundary dimensions comply with ISO 15, JIS B 1533, DIN 5412, and the dimensions of these bearings are also same as conventional **NTN** E type.

6. Allowable axial load

Same as conventional **NTN** E type.

7. Allowable temperature

Allowable temperature of bearings : 120 ˚C (instantaneous), 100 ˚C (continuous)

ULTAGE™ "ULTAGE" (a name created from combination of "**Ultimate**", signifying refinement, and "**Stage**", signifying NTN's intention that this series of products be employed in diverse applications) is the general name for NTN's new generation of bearings that are noted for their industry leading performance.

Allowable axial load

Cylindrical roller bearings with ribs on the inner and outer rings are capable of simultaneously bearing a radial load (F_r) and a certain degree of axial load (F_a). Unlike basic dynamic load ratings based on rolling fatigue, allowable axial load (F_a max) is defined by the following two methods. When determining the actual allowable axial load, the smaller value out of P_t and F_{ar} determined with formula (1) and formula (2) is used.

① Allowable axial load P_t based on allowable surface pressure of rib

This is the allowable axial load that is determined by factors such as the amount of heat produced on the sliding surface between the ends of the rollers and rib, seizure and wear. The allowable axial load P_t based on allowable surface pressure of rib when center axial load is applied is approximately determined by formula (1), which is based upon experience and testing.

$$P_t = k_1 \cdot d^2 \cdot P_z \quad \cdots\cdots (1)$$

Where:

P_t : Allowable axial load based on allowable surface pressure of rib N

k_1 : Factor determined by internal design of bearing (see **Table 1**)

d : Bearing bore mm

P_z : Allowable surface pressure of rib MPa (see **Fig. 3**)

② Allowable axial load F_{ar} based on radial load

If the ratio of the axial load to the radial load is large, the rollers will not rotate properly. The allowable axial load F_{ar} based on the radial load is determined by formula (2).

$$F_{ar} = k_2 \cdot F_r \quad \cdots\cdots (2)$$

Where:

F_{ar} : Allowable axial load based on radial load N

k_2 : Factor determined by internal design of bearing (see **Table 1**)

F_r : Radial load N

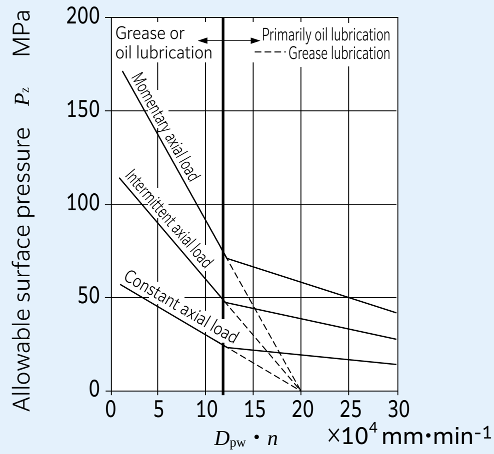
The following are also important to operate the bearing smoothly under axial load:

(1) Do not make the internal radial clearance any larger than necessary.

(2) Use lubricant with extreme pressure additive.

(3) Make the shoulder of the housing and shaft high enough for the rib of the bearing.

(4) If the bearing is to support an extreme axial load, mounting precision should be improved and the bearing should rotate slowly before actual use.



D_{pw} : Roller pitch diameter mm

$D_{pw} \approx$ (bearing bore + bearing outside diameter)/2 mm

n : Rotational speed min^{-1}

Fig. 3 Allowable surface pressure of rib

Table 1 Factors k_1 and k_2

Bearing series	k_1	k_2
NJ, NUP, NF2EA	0.050	0.4
NJ, NUP, NF22EA		
NJ, NUP, NF3EA	0.080	0.4
NJ, NUP, NF23EA		

Fatigue Load Limit(C_u)

The fatigue load limit is the applied load on a bearing that results in just reaching the fatigue stress limit at the maximum loaded raceway contact. This depends on the bearing type, internal specifications, quality, and material strength. In ISO 281:2007, 1.5 GPa is recommended as the fatigue stress limit corresponding to C_u for bearings made of commonly used high quality material and good manufacturing quality. Values for the fatigue load limit with respect to the **NTN** bearing numbers are provided in the dimensional table. The life modification factor, a_{ISO}, should be evaluated considering the fatigue load limit. For details see catalog “Ball and Roller Bearings (CAT. No.2203/E) section 3.4 Modified rating life”.

Allowable speed

Higher bearing speeds result in higher bearing temperatures caused by friction. When the bearing temperature exceeds a specific limit, the lubricant performance deteriorates significantly, leading to abnormally high temperature and bearing seizure. The factors that affect the allowable bearing speed include the followings:

(1) Bearing type
(2) Bearing size
(3) Lubrication system (grease, circulating lubrication, oil bath, etc.)
(4) Bearing internal clearance (internal clearance of running bearing)
(5) Bearing load
(6) Dimensional accuracy with shaft, housing, etc.

The allowable speeds indicated in the bearing dimension table are for reference only and apply only when bearings are lubricated and heat is efficiently draw away from the bearing. The allowable speeds in this catalog are categorized as follows:

【Oil-lubricated bearings】

The bearing speed at which the outer ring temperature reaches 80 °C when the bearing is allowed to run at 5 % basic static load rating C_{0r} while lubricated with oil (viscosity ISO VG32) which is assimilated to room temperature and fed at a rate of 1 liter/min (circulating lubrication)

【Grease-lubricated bearings】

The bearing speed at which the outer ring temperature reaches 80 °C when the bearing, which has undergone running-in operation, is allowed to run at 5 % basic static load rating C_{0r} with the bearing’s internal free volume 20 to 30 % pre-filled with lithium grease (consistency: NLGI3)

With either lubrication system, the bearing temperature rise profile varies with the operating conditions (operating load, running speed pattern, lubricating conditions, etc.) in which the bearing is used. Therefore, select the optimal bearing by allowing sufficient margin for the allowable speed for that particular bearing as indicated in the catalog. Contact **NTN** for technical assistance if the bearing speed in the intended application exceeds 80 % of the allowable speed indicated in the bearing dimension table, or if the intended bearing is to be used under severe operating conditions involving vibration and impact.

Allowable misalignment

Allowable misalignment: 1/500

∗Under conditions of: $F_r \leq 0.20C_r$ C_r means basic dynamic load rating listed in this catalog.

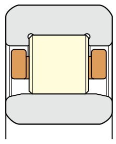
Bearing number

NU 22 04 EA T2X C3

- Radial internal clearance : C3
- Cage code : resin cage
- Type code : ULTAGE
- Nominal bore diameter : 20 mm
- Dimension series : 22
- Bearing series : cylindrical roller bearing NU type

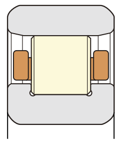
∗ Suffix "U" is added at the end of bearing number for NUP type.

Bearing series



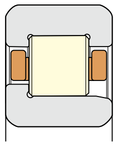
Components of NU type
- Outer ring (with double ribs)
- Rollers
- Cage
- Inner ring

Assembly of outer ring, rollers and cage can be separated from inner ring.



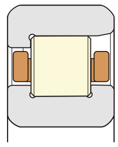
Components of N type
- Outer ring
- Rollers
- Cage
- Inner ring (with double ribs)

Assembly of inner ring, rollers and cage can be separated from outer ring.



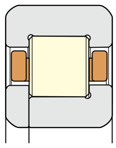
Components of NJ type
- Outer ring (with double ribs)
- Rollers
- Cage
- Inner ring (with single rib)

Assembly of outer ring, rollers and cage can be separated from inner ring.



Components of NF type
- Outer ring (with single rib)
- Rollers
- Cage
- Inner ring (with double ribs)

Assembly of inner ring, rollers and cage can be separated from outer ring.



Components of NUP type
- Outer ring (with double ribs)
- Rollers
- Cage
- Inner ring (with single rib)
- Inner ring collar ring

Assembly of outer ring, rollers and cage can be separated from inner ring and collar ring.

Accuracy

Table 2 Inner rings

Unit: μm

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter within plane Δ_{dmp}				Bore diameter variation within plane V_{dsp}		Mean bore diameter variation V_{dmp}		Inner ring radial runout K_{ia}		Inner ring width deviation Δ_{Bs} class 0 class 6		Inner ring width variation V_{Bs}
		class 0		class 6		class 0	class 6	class 0	class 6	class 0	class 6			class 0, class 6
over	incl.	high	low	high	low	max.		max.		max.		high	low	max.
18	30	0	-10	0	-8	8	6	8	6	13	8	0	-120	20
30	50	0	-12	0	-10	9	8	9	8	15	10	0	-120	20
50	80	0	-15	0	-12	11	9	11	9	20	10	0	-150	25
80	120	0	-20	0	-15	15	11	15	11	25	13	0	-200	25

Table 3 Outer rings

Unit: μm

Nominal outside diameter D mm		Dimensional tolerance of mean outside diameter within plane Δ_{Dmp}				Outside diameter variation within plane V_{Dsp}		Mean outside diameter variation V_{Dmp}		Outer ring radial runout K_{ea}		Outer ring width deviation Δ_{Cs}	Outer ring width variation V_{Cs}
		class 0		class 6		class 0	class 6	class 0	class 6	class 0	class 6	all type	class 0, class 6
over	incl.	high	low	high	low	max.		max.		max.			max.
30	50	0	-11	0	-9	8	7	8	7	20	10	Depends on tolerance of Δ_{Bs} in relation to d of same bearing	Depends on tolerance of V_{Bs} in relation to d of same bearing
50	80	0	-13	0	-11	10	8	10	8	25	13		
80	120	0	-15	0	-13	11	10	11	10	35	18		
120	150	0	-18	0	-15	14	11	14	11	40	20		
150	180	0	-25	0	-18	19	14	19	14	45	23		
180	250	0	-30	0	-20	23	15	23	15	50	25		

Chamfer measurements

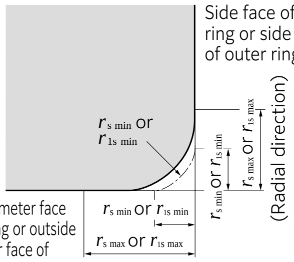


Table 4 Allowable critical-value of bearing chamfer

Unit: mm

$r_{s\,min}$ [1] or $r_{1s\,min}$	Nominal bore diameter d		$r_{s\,max}$ or $r_{1s\,max}$	
	over	incl.	Radial direction	Axial direction
0.6	–	40	1	2
1	–	50	1.5	3
1.1	–	120	2	3.5
1.5	–	120	2.3	4
2	–	80	3	4.5
	80	220	3.5	5
2.1	–	280	4	6.5

Note 1) These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Radial internal clearance

Table 5 interchangeable radial internal clearance

Unit: μm

Nominal bore diameter d mm		C2		(CN) [1]		C3		C4		C5	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220

Table 6 Radial internal clearance for electric motor

Unit: μm

Nominal bore diameter d mm		CM [2]	
over	incl.	min.	max.
24	30	15	30
30	40	15	30
40	50	20	35
50	65	25	40
65	80	30	45
80	100	35	55
100	120	35	60

Table 7 Non-interchangeable radial internal clearance

Unit: μm

Nominal bore diameter d mm		C1NA		C2NA		NA [3]		C3NA		C4NA		C5NA	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
18	24	5	10	10	20	20	30	35	45	45	55	65	75
24	30	5	10	10	25	25	35	40	50	50	60	70	80
30	40	5	12	12	25	25	40	45	55	55	70	80	95
40	50	5	15	15	30	30	45	50	65	65	80	95	110
50	65	5	15	15	35	35	50	55	75	75	90	110	130
65	80	10	20	20	40	40	60	70	90	90	110	130	150
80	100	10	25	25	45	45	70	80	105	105	125	155	180
100	120	10	25	25	50	50	80	95	120	120	145	180	205

Note 1) "CN" is not indicated on bearing number
2) Non-interchangeable clearance
3) For bearings with normal clearance, only NA is added to bearing numbers. Example: NU310EAT2XNA

Bearing Fits

General standards of bearing fits for each condition of use are shown in **Table 8** to **Table 10**.

Table 8 Tolerance class of shafts commonly used for cylindrical roller bearings (classes 0 and 6)

Conditions		Shaft diameter (mm) over	Shaft diameter (mm) incl.	Shaft tolerance class	Remarks
Inner ring rotational load or load of undermind direction	Light load[1] or fluctuating load	—	40	js6	When greater accuracy is required js5, k5, and m5 may be substituted for js6, k6, and m6.
		40	140	k6	
	Ordinary load[1]	—	40	k5	—
		40	100	m5	
		100	140	m6	
	Heavy load[1] or impact load	50	140	n6	Use bearings with larger internal clearances than CN clearance bearings.
Inner ring static load	Inner ring must move easily over shaft	Overall shaft diameter		g6	When greater accuracy is required use g5. For large bearings, f6 will suffice for to facilitate movement.
	Inner does not have to move easily over shaft	Overall shaft diameter		h6	When greater accuracy is required use h5.
Center axial load		Overall shaft diameter		js6	Generally, shaft and inner rings are not fixed using interference.

Note All values and fits listed in the above tables are for solid steel shafts.

Table 9 Tolerance class of housing bore commonly used for cylindrical roller bearings (classes 0 and 6)

Conditions: Housing	Conditions: Types of load		Conditions: Outer ring axial direction movement[2]	Tolerance class of housing bore	Remarks
Single housing or split housing	Outer ring static load	All types of loads	Yes	H7	G7 can be used for large bearings or bearings with large temperature differential between the outer ring and housing.
		Light load[1] or ordinary load[1]	Yes	H8	—
		Shaft and inner ring become hot.	Easily	G7	F7 can be used for large bearings or bearings with large temperature differential between the outer ring and housing.
Single housing		Requires precise rotation under light or ordinary loads	As a rule, cannot move.	K6	Primarily applies to roller bearings.
			Yes	JS6	—
		Requires low noise operation	Yes	H6	—
	Indeterminate load	Light or ordinary load	Yes	JS7	If high accuracy is required, JS6 and K6 are used in place of JS7 and K7
		Ordinary load or heavy load[1]	As a rule, cannot move.	K7	
		High impact load	No	M7	—
	Outer ring rotational load	Light or fluctuating load	No	M7	—
		Ordinary or heavy load	No	N7	—
		Heavy load or large impact load with thin wall housing	No	P7	Primarily applies to roller bearings.

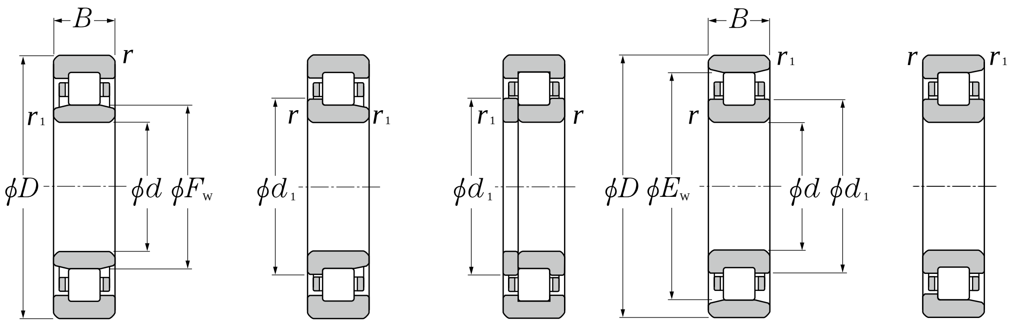
Remarks ●All values and fits listed in the above tables are for cast iron or steel housings.
●If only center axial load is applied of the bearings, select a tolerance class provides clearance for the outer ring in the axial direction.

Note 1) Standards for light loads, normal loads, and heavy loads
Light loads : equivalent radial load $\leq 0.05\ C_r$
Normal loads : $0.05\ C_r <$ equivalent radial load $\leq 0.10\ C_r$
Heavy loads : $0.10\ C_r <$ equivalent radial load
2) Indicates whether or not outer ring axial movement is possible with non-separable type bearings.

Table 10 Fits for electric motor bearings

Bearing Type	Shaft fits: Shaft diameter mm over	Shaft fits: Shaft diameter mm incl.	Shaft fits: Tolerance class	Housing fits: Housing bore diameter	Housing fits: Tolerance class
Cylindrical roller bearings	—	40	k5	All sizes	H6 or J6
	40	160	m5		

Dimension table

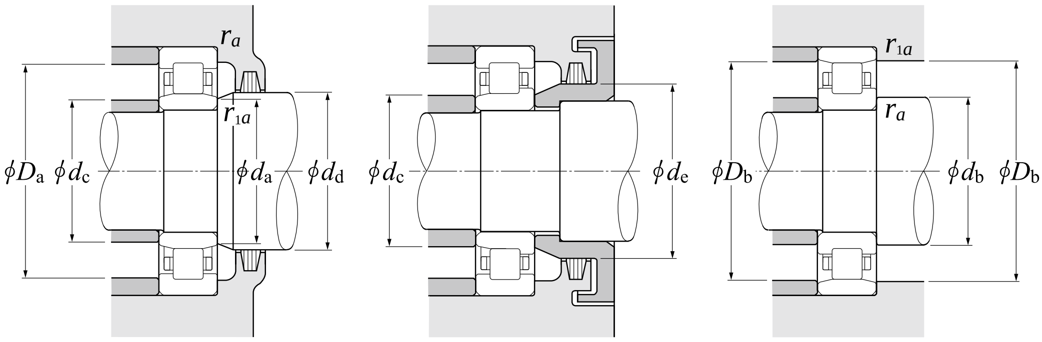


NU type NJ type NUP type N type NF type

d 20-50 mm

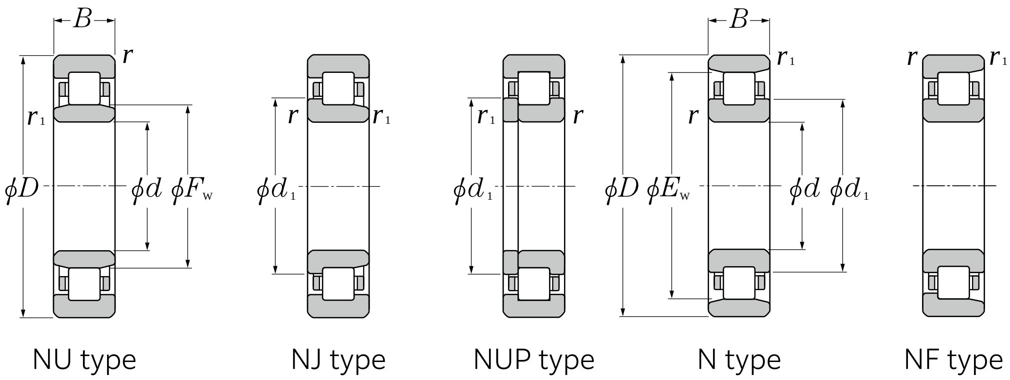
Boundary dimensions mm					Basic load rating dynamic / static kN		Fatigue load limit kN	Allowable speed [2] min⁻¹		Bearing number				
d	*D*	*B*	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	NU type	NJ type	NUP type	N type	NF type
20	47	14	1	0.6	32.5	24.7	3.00	15 000	21 600	NU204EA	NJ	NUP	N	NF
	47	18	1	0.6	38.5	31.0	3.75	14 000	19 200	NU2204EA	NJ	NUP	N	NF
	52	15	1.1	0.6	37.5	26.9	3.25	13 000	18 000	NU304EA	NJ	NUP	N	NF
	52	21	1.1	0.6	49.5	39.0	4.75	12 000	16 800	NU2304EA	NJ	NUP	N	NF
25	52	15	1	0.6	34.5	27.7	3.40	13 000	18 000	NU205EA	NJ	NUP	N	NF
	52	18	1	0.6	41.5	34.5	4.25	11 000	15 600	NU2205EA	NJ	NUP	N	NF
	62	17	1.1	1.1	49.0	37.5	4.55	11 000	15 600	NU305EA	NJ	NUP	N	NF
	62	24	1.1	1.1	67.5	56.0	6.85	9 700	13 200	NU2305EA	NJ	NUP	N	NF
30	62	16	1	0.6	46.0	37.5	4.55	11 000	15 600	NU206EA	NJ	NUP	N	NF
	62	20	1	0.6	58.0	50.0	6.10	9 700	13 200	NU2206EA	NJ	NUP	N	NF
	72	19	1.1	1.1	63.0	50.0	6.15	9 300	13 200	NU306EA	NJ	NUP	N	NF
	72	27	1.1	1.1	88.0	77.5	9.45	8 300	11 600	NU2306EA	NJ	NUP	N	NF
35	72	17	1.1	0.6	59.5	50.0	6.10	9 500	13 200	NU207EA	NJ	NUP	N	NF
	72	23	1.1	0.6	73.0	65.5	7.95	8 500	12 000	NU2207EA	NJ	NUP	N	NF
	80	21	1.5	1.1	83.5	71.0	8.65	8 100	11 500	NU307EA	NJ	NUP	N	NF
	80	31	1.5	1.1	117	109	13.3	7 200	10 200	NU2307EA	NJ	NUP	N	NF
40	80	18	1.1	1.1	66.0	55.5	6.75	8 500	12 000	NU208EA	NJ	NUP	N	NF
	80	23	1.1	1.1	85.5	77.5	9.45	7 600	10 700	NU2208EA	NJ	NUP	N	NF
	90	23	1.5	1.5	98.5	81.5	9.95	7 200	10 200	NU308EA	NJ	NUP	N	NF
	90	33	1.5	1.5	135	122	14.9	6 400	9 000	NU2308EA	NJ	NUP	N	NF
45	85	19	1.1	1.1	74.5	66.5	8.10	7 600	10 800	NU209EA	NJ	NUP	N	NF
	85	23	1.1	1.1	90.0	84.5	10.3	6 800	9 600	NU2209EA	NJ	NUP	N	NF
	100	25	1.5	1.5	115	98.5	12.0	6 500	9 100	NU309EA	NJ	NUP	N	NF
	100	36	1.5	1.5	162	153	18.7	5 700	8 200	NU2309EA	NJ	NUP	N	NF
50	90	20	1.1	1.1	81.5	76.5	9.30	6 900	9 700	NU210EA	NJ	NUP	N	NF
	90	23	1.1	1.1	98.5	97.0	11.9	6 200	8 800	NU2210EA	NJ	NUP	N	NF
	110	27	2	2	130	113	13.8	5 900	8 300	NU310EA	NJ	NUP	N	NF
	110	40	2	2	192	187	22.7	5 200	7 300	NU2310EA	NJ	NUP	N	NF

Note 1) Smallest allowable dimension for chamfer dimension *r* or r_1.
2) The value for standard type cage
3) Does not apply to the sides of the outer ring rib of NF type bearings.



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

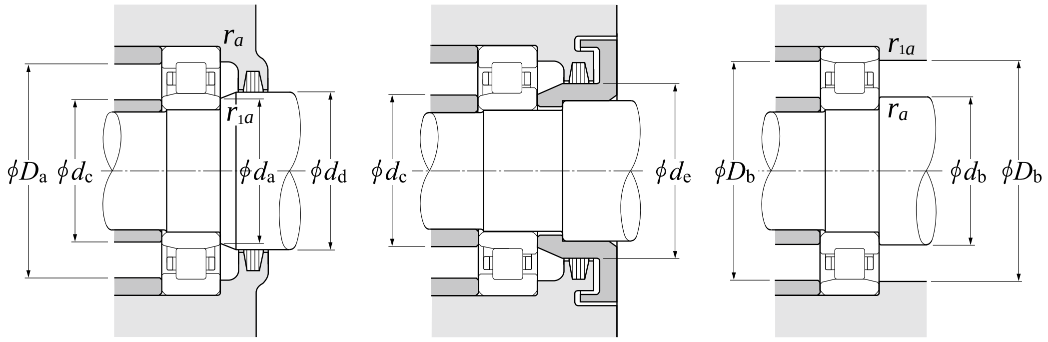
Dimensions			Abutment and fillet dimensions										Mass (approx.)	
mm			mm										kg	
F_w	E_w	d_1	d_a min.	d_b min.	d_c max.	d_d min.	d_e min.	D_a max.	D_b max.	D_b min. 3)	r_{as} max.	r_{1as} max.	NU type	N type
26.5	41.5	29.5	24	25	26	29	32	42	42	42	1	0.6	0.115	0.11
26.5	41.5	29.5	24	25	26	29	32	42	42	42	1	0.6	0.146	0.144
27.5	45.5	31.1	24	26.5	27	30	33	45.5	45.5	45.5	1	0.6	0.176	0.147
27.5	45.5	31.1	24	26.5	27	30	33	45.5	45.5	45.5	1	0.6	0.242	0.212
31.5	46.5	34.5	29	30	31	34	37	47	47	47	1	0.6	0.151	0.13
31.5	46.5	34.5	29	30	31	34	37	47	47	47	1	0.6	0.186	0.163
34	54	38	31.5	31.5	33	37	40	55.5	55.5	55	1	1	0.275	0.242
34	54	38	31.5	31.5	33	37	40	55.5	55.5	55	1	1	0.386	0.345
37.5	55.5	41.1	34	35	37	40	44	57	57	56.5	1	0.6	0.226	0.205
37.5	55.5	41.1	34	35	37	40	44	57	57	56.5	1	0.6	0.297	0.259
40.5	62.5	44.9	36.5	36.5	40	44	48	65.5	65.5	64	1	1	0.398	0.353
40.5	62.5	44.9	36.5	36.5	40	44	48	65.5	65.5	64	1	1	0.58	0.526
44	64	48	39	41.5	43	46	50	65.5	65.5	65.5	1	0.6	0.327	0.294
44	64	48	39	41.5	43	46	50	65.5	65.5	65.5	1	0.6	0.455	0.405
46.2	70.2	51	41.5	43	45	48	53	72	72	71.5	1.5	1	0.545	0.483
46.2	70.2	51	41.5	43	45	48	53	72	72	71.5	1.5	1	0.78	0.737
49.5	71.5	53.9	46.5	46.5	49	52	56	73.5	73.5	72.5	1	1	0.426	0.365
49.5	71.5	53.9	46.5	46.5	49	52	56	73.5	73.5	72.5	1	1	0.552	0.491
52	80	57.6	48	48	51	55	60	82	82	81.5	1.5	1.5	0.754	0.658
52	80	57.6	48	48	51	55	60	82	82	81.5	1.5	1.5	1.06	0.952
54.5	76.5	58.9	51.5	51.5	54	57	61	78.5	78.5	77.5	1	1	0.495	0.423
54.5	76.5	58.9	51.5	51.5	54	57	61	78.5	78.5	77.5	1	1	0.6	0.533
58.5	88.5	64.5	53	53	57	60	66	92	92	90.5	1.5	1.5	0.996	0.865
58.5	88.5	64.5	53	53	57	60	66	92	92	90.5	1.5	1.5	1.41	1.3
59.5	81.5	63.9	56.5	56.5	58	62	67	83.5	83.5	82.5	1	1	0.503	0.47
59.5	81.5	63.9	56.5	56.5	58	62	67	83.5	83.5	82.5	1	1	0.587	0.584
65	97	71.4	59	59	63	67	73	101	101	99	2	2	1.3	1.12
65	97	71.4	59	59	63	67	73	101	101	99	2	2	1.9	1.75



d 55-110 mm

Boundary dimensions mm					Basic load rating dynamic static kN		Fatigue load limit kN	Allowable speed [2] min^{-1}		Bearing number				
d	D	B	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	NU type	NJ type	NUP type	N type	NF type
55	100	21	1.5	1.1	102	98.5	12.0	6 300	8 900	NU211EA	NJ	NUP	N	NF
	100	25	1.5	1.1	120	122	14.8	5 600	7 900	NU2211EA	NJ	NUP	N	NF
	120	29	2	2	162	143	17.4	5 300	7 600	NU311EA	NJ	NUP	N	NF
	120	43	2	2	238	233	28.4	4 700	6 700	NU2311EA	NJ	NUP	N	NF
60	110	22	1.5	1.5	115	107	13.1	5 800	8 200	NU212EA	NJ	NUP	N	NF
	110	28	1.5	1.5	155	157	19.1	5 200	7 300	NU2212EA	NJ	NUP	N	NF
	130	31	2.1	2.1	177	157	19.1	4 900	7 000	NU312EA	NJ	NUP	N	NF
	130	46	2.1	2.1	263	262	32.0	4 400	6 200	NU2312EA	NJ	NUP	N	NF
65	120	23	1.5	1.5	127	119	14.5	5 400	7 600	NU213EA	NJ	NUP	N	NF
	120	31	1.5	1.5	176	181	22.1	4 800	6 700	NU2213EA	NJ	NUP	N	NF
	140	33	2.1	2.1	213	191	23.1	4 600	6 500	NU313EA	NJ	NUP	N	NF
	140	48	2.1	2.1	293	287	34.5	4 100	5 800	NU2313EA	NJ	NUP	N	NF
70	125	24	1.5	1.5	140	137	16.7	5 000	7 100	NU214EA	NJ	NUP	N	NF
	125	31	1.5	1.5	184	194	23.7	4 500	6 200	NU2214EA	NJ	NUP	N	NF
	150	35	2.1	2.1	242	222	26.2	4 200	6 000	NU314EA	NJ	NUP	N	NF
	150	51	2.1	2.1	325	325	38.0	3 800	5 300	NU2314EA	NJ	NUP	N	NF
75	130	25	1.5	1.5	154	156	18.9	4 700	6 600	NU215EA	NJ	NUP	N	NF
	130	31	1.5	1.5	191	207	25.0	4 200	5 900	NU2215EA	NJ	NUP	N	NF
	160	37	2.1	2.1	284	263	30.5	4 000	5 600	NU315EA	NJ	NUP	N	NF
	160	55	2.1	2.1	390	395	45.5	3 500	4 900	NU2315EA	NJ	NUP	N	NF
80	140	26	2	2	165	167	19.7	4 400	6 100	NU216EA	NJ	NUP	N	NF
	140	33	2	2	220	243	28.7	3 900	5 500	NU2216EA	NJ	NUP	N	NF
85	150	28	2	2	198	199	23.0	4 100	5 800	NU217EA	NJ	NUP	N	NF
	150	36	2	2	257	279	32.5	3 700	5 200	NU2217EA	NJ	NUP	N	NF
90	160	30	2	2	215	217	24.7	3 900	5 500	NU218EA	NJ	NUP	N	NF
	160	40	2	2	286	315	35.5	3 500	4 900	NU2218EA	NJ	NUP	N	NF
95	170	32	2.1	2.1	260	265	29.6	3 600	5 200	NU219EA	NJ	NUP	N	NF
100	180	34	2.1	2.1	295	305	33.5	3 500	4 900	NU220EA	NJ	NUP	-	-
	180	36	2.1	2.1	395	445	49.0	3 100	4 300	NU2220EA	NJ	NUP	-	-
110	200	38	2.1	2.1	345	365	39.0	3 100	4 400	NU222EA	NJ	NUP	-	-

Note 1) Smallest allowable dimension for chamfer dimension *r* or r_1.
2) The value for standard type cage
3) Does not apply to the sides of the outer ring rib of NF type bearings.



Dynamic equivalent radial load
$P_r = F_r$

Static equivalent radial load
$P_{0r} = F_r$

Dimensions			Abutment and fillet dimensions										Mass (approx.)	
mm			mm										kg	
F_w	E_w	d_1	d_a min.	d_b min.	d_c max.	d_d min.	d_e min.	D_a max.	D_b max.	D_b min. 3)	r_{as} max.	r_{1as} max.	NU type	N type
66	90	70.8	61.5	63	65	68	73	92	92	91	1.5	1	0.675	0.635
66	90	70.8	61.5	63	65	68	73	92	92	91	1.5	1	0.807	0.805
70.5	106.5	77.7	64	64	69	72	80	111	111	108.5	2	2	1.65	1.43
70.5	106.5	77.7	64	64	69	72	80	111	111	108.5	2	2	2.37	2.23
72	100	77.6	68	68	71	75	80	102	102	101	1.5	1.5	0.923	0.798
72	100	77.6	68	68	71	75	80	102	102	101	1.5	1.5	1.21	1.08
77	115	84.6	71	71	75	79	86	119	119	117	2	2	2.05	1.77
77	115	84.6	71	71	75	79	86	119	119	117	2	2	2.96	2.73
78.5	108.5	84.5	73	73	77	81	87	112	112	110	1.5	1.5	1.21	1.01
78.5	108.5	84.5	73	73	77	81	87	112	112	110	1.5	1.5	1.6	1.44
82.5	124.5	91	76	76	81	85	93	129	129	127	2	2	2.54	2.2
82.5	124.5	91	76	76	81	85	93	129	129	127	2	2	3.48	3.25
83.5	113.5	89.5	78	78	82	86	92	117	117	115	1.5	1.5	1.3	1.13
83.5	113.5	89.5	78	78	82	86	92	117	117	115	1.5	1.5	1.7	1.52
89	133	98	81	81	87	92	100	139	139	136	2	2	3.1	2.75
89	133	98	81	81	87	92	100	139	139	136	2	2	4.25	3.95
88.5	118.5	94.5	83	83	87	90	96	122	122	120	1.5	1.5	1.41	1.28
88.5	118.5	94.5	83	83	87	90	96	122	122	120	1.5	1.5	1.79	1.61
95	143	104.6	86	86	93	97	106	149	149	146	2	2	3.74	3.28
95	143	104.6	86	86	93	97	106	149	149	146	2	2	5.25	4.85
95.3	127.3	101.7	89	89	94	97	104	131	131	128.5	2	2	1.67	1.56
95.3	127.3	101.7	89	89	94	97	104	131	131	128.5	2	2	2.12	2.02
100.5	136.5	107.7	94	94	99	104	110	141	141	138	2	2	2.11	1.93
100.5	136.5	107.7	94	94	99	104	110	141	141	138	2	2	2.68	2.52
107	145	114.6	99	99	105	109	116	151	151	147	2	2	2.44	2.37
107	145	114.6	99	99	105	109	116	151	151	147	2	2	3.33	3.2
112.5	154.5	121	106	106	111	116	123	159	159	156.5	2	2	3.02	2.85
119	-	128	111	-	117	122	130	169	-	-	2	2	3.66	-
119	-	128	111	-	117	122	130	169	-	-	2	2	5.01	-
132.5	-	142.1	121	-	130	135	144	189	-	-	2	2	4.27	-

NTN corporation

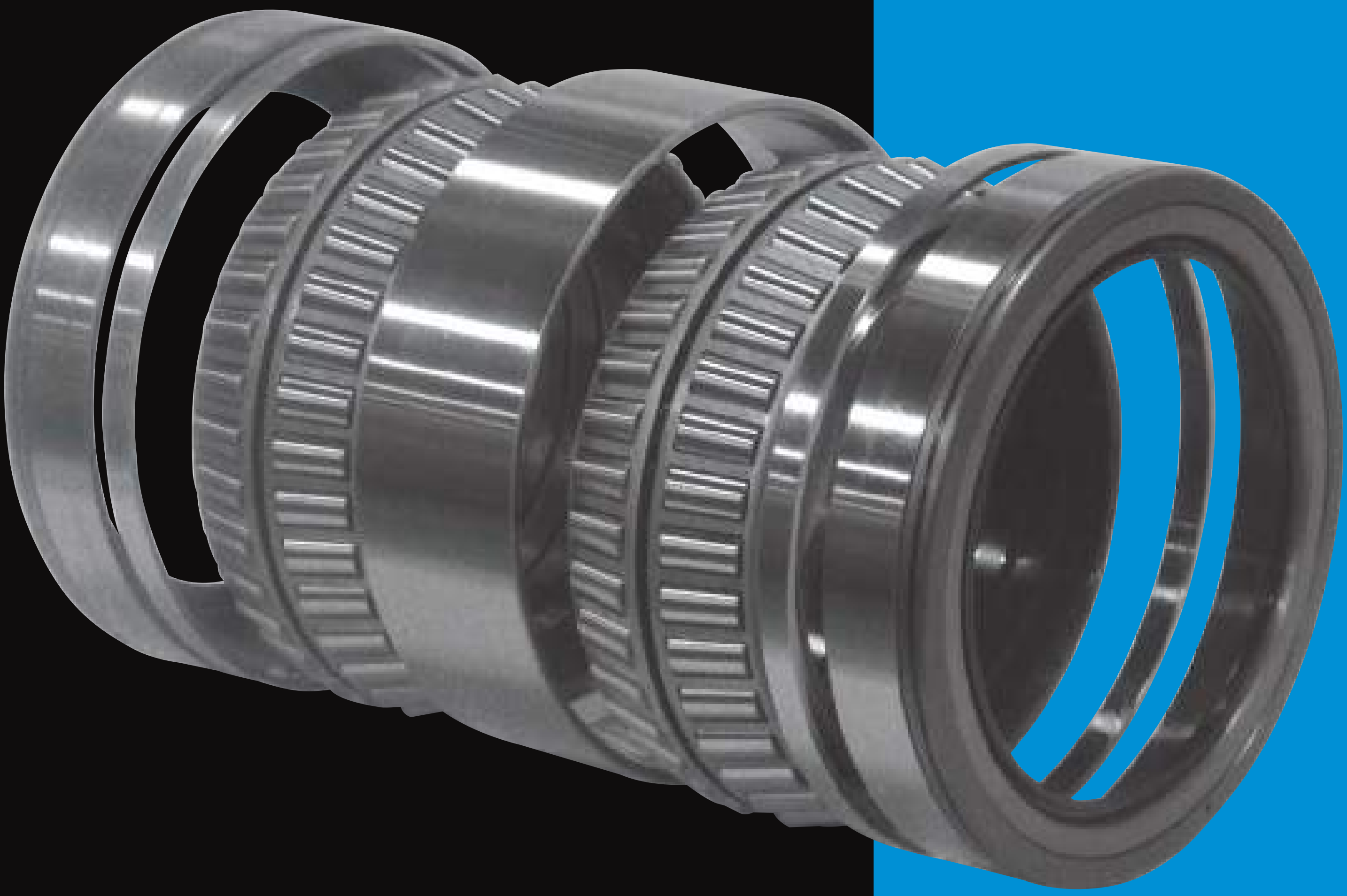
◀ Sales Network

NOTE : The appearance and specifications may be changed without prior notice if required to improve performance. Although care has been taken to assure the accuracy of the data compiled in this catalog, **NTN** does not assume any liability to any company or person for errors or omissions.

CAT.No.3037-3/E 22.03.005 DS/DS

Sealed Four Row Tapered Roller Bearings for Rolling Mill Roll-Necks

[CROU..LL Type]



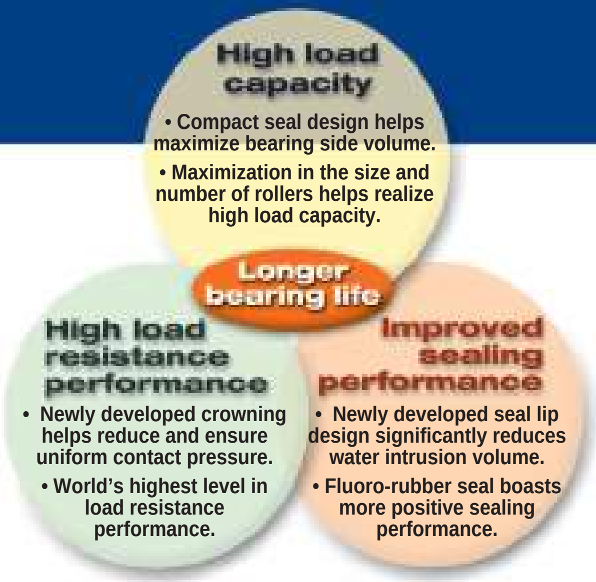
ULTAGE®

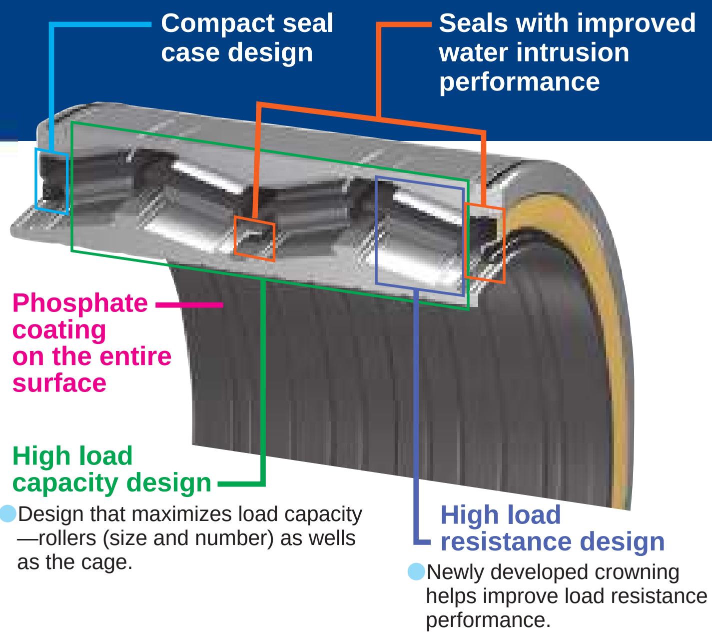
CAT. No. 3801/E

Load capacity 40% increase | Load resistance Twice as great | Sealing performance 50% reduction in water intrusion volume

Sealed Four Row Tapered Roller Bearings for Rolling Mill Roll-Necks [CROU..LL Type]

The ULTAGE series sealed four row tapered roller bearings (CROU..LL type) are new standard series products especially developed to satisfy the "high load capacity", "high load resistance performance" and "high sealing performance" required for steel mill roll-neck applications and to improve reliability through long life design.





Features

1. High load capacity design —the world's highest level

Maximum size and number of rollers help realize high load capacity and longer life.

2. High load resisting design —the world's highest level

Patent pending

Assurance of uniform contact pressure on rolling elements within bearings and against outside loads has helped greatly enhance load resistance performance.

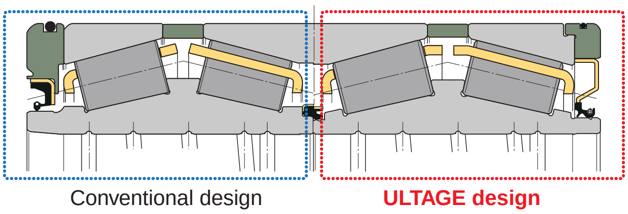
3. Compact high sealing design

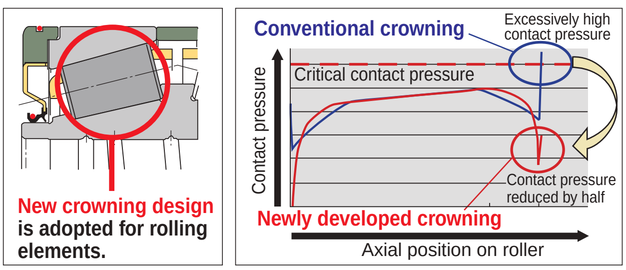
Patent pending

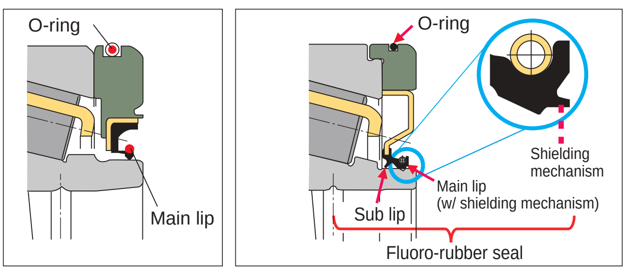
"High sealing" fluoro-rubber seals, boasting a minimized seal volume, are adopted as standard.
Through optimization of the tightening force of the main lip and the provision of a shielding arrangement against foreign substances, the water intrusion volume has been reduced by more than 50%: at the same time, the sub lip helps prevent the outflow of grease.

4. Long-life grease as standard

The bearing is prefilled with long-life grease.
A rinsing and/or grease prefilling procedure is not necessary when the bearing is installed on the side of the machine.







Conventional design   ULTAGE design

"ULTAGE®" (a name created from the combination of **"ultimate,"** signifying refinement,and **"stage,"** signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

Metric series Tolerances [JIS 0 Class]

(1) Inner rings Unit : μm

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter within plane Δ_{dmp}		Bore diameter variation V_{dp}	Mean bore diameter variation V_{dmp}	Inner ring radial runout K_{ia}	Combination width deviation of 4-row bearings Δ_{B2s}, Δ_{C2s}	
over	incl.	high	low	max	max	max	high	low
180	250	0	-30	30	23	50	+750	-750
250	315	0	-35	35	26	60	+900	-900
315	400	0	-40	40	30	70	+1 000	-1 000
400	500	0	-45	45	34	80	+1 200	-1 200
500	630	0	-50	50	38	90	+1 200	-1 200
630	800	0	-75	75	56	105	+1 500	-1 500
800	1 000	0	-100	100	75	120	+1 500	-1 500

(2) Outer rings Unit : μm

Nominal outside diameter D mm		Dimensional tolerance of mean outside diameter within plane Δ_{Dmp}		Outside diameter variation V_{Dp}	Mean outside diameter variation V_{Dmp}	Inner ring radial runout K_{ea}
over	incl.	high	low	max	max	max
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70
400	500	0	-45	45	34	80
500	630	0	-50	50	38	100
630	800	0	-75	75	56	120
800	1 000	0	-100	100	75	140

Inch series Tolerances [ABMA 0 Class]

(1) Inner rings Unit : μm

Nominal bore diameter d mm		Single bore diameter deviation Δ_{ds}	
over	incl.	high	low
76.2	266.7	+25	0
266.7	304.8	+25	0
304.8	609.6	+51	0
609.6	914.4	+76	0

(2) Outer rings Unit : μm

Nominal outside diameter D mm		Single outside diameter deviation Δ_{Ds}	
over	incl.	high	low
266.7	304.8	+25	0
304.8	609.6	+51	0
609.6	914.4	+76	0

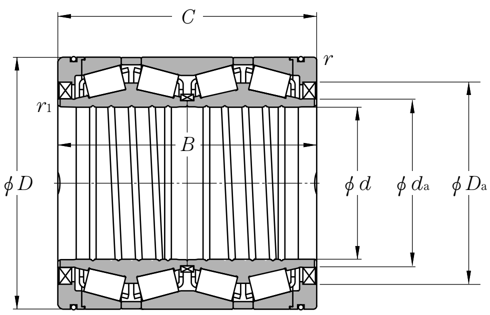
(3) Radial deflection of inner and outer rings Unit : μm

Nominal outside diameter D mm		Radial runout K_{ia}, K_{ea}
over	incl.	max
266.7	304.8	51
304.8	609.6	51
609.6	914.4	76

(4) Combination width deviation of 4-row bearings Unit : μm

Nominal bore diameter d mm		Nominal outside diameter D mm		Combination width deviation of 4-row bearings Δ_{B2s}, Δ_{C2s}	
over	incl.	over	incl.	high	low
101.6	304.8			+1 520	-1 520
304.8	609.6	—	508.0	+1 520	-1 520
304.8	609.6	508.0	—	+1 520	-1 520
609.6	—			+1 520	-1 520

Dimension Table (For information about bearing models not listed in the Dimension Table, contact NTN Engineering.)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{or} = F_r + Y_o F_a$

For values of e, Y_1, Y_2 and Y_o see the table below.

Series	Bearing numbers	Boundary dimensions mm						Standard ❷ radial clearance (approx.) mm	Standard ❷ axial clearance mm
		d	D	B	C	r_{1s} min ❶	r_s min ❶		
Metric series	CROU-4401LLA1X	220	295	315	315	1	2.5	0.093～0.106	0.420～0.480
	CROU-4501LLA1X	225	320	230	230	1	2.5	0.099～0.115	0.360～0.420
	CROU-4801LLA1X	240	338	248	248	1	2.5	0.104～0.118	0.450～0.510
	CROU-4802LLA1X	240	338	340	340	1	2.5	0.107～0.123	0.400～0.460
	CROU-5001LLA1X	250	365	270	270	1	2.5	0.113～0.129	0.420～0.480
	CROU-5201LLA1X	260	365	340	340	1	2.5	0.115～0.131	0.430～0.490
	CROU-6001LLA1X	300	420	310	310	1	2.5	0.131～0.147	0.490～0.550
	CROU-6201LLA1X	310	430	350	350	1	2.5	0.136～0.154	0.520～0.590
	CROU-8201LLA1X	410	546	400	400	1.5	2.5	0.173～0.188	0.780～0.850
	CROU-8801LLA1X	440	590	480	480	1.5	2.5	0.188～0.204	0.850～0.920
	CROU-8802LLA1X	440	620	454	454	3	2.5	0.195～0.211	0.880～0.950
	CROU-10601LLA1X※	530	780	570	570	3	2.5	0.244～0.259	1.100～1.170
Inch series	CROU-4402LLA1X	220.662	314.325	239.712	239.712	1	2.5	0.098～0.111	0.450～0.510
	CROU-5101LLA1X	254.000	358.775	269.875	269.875	1	2.5	0.111～0.127	0.430～0.490
	CROU-6101LLA1X	304.902	412.648	266.700	266.700	1	2.5	0.130～0.150	0.450～0.520
	CROU-6901LLA1X	343.052	457.098	254.000	254.000	1	2.5	0.136～0.158	0.430～0.500
	CROU-6902LLA1X	343.052	457.098	299.000	299.000	1	2.5	0.143～0.163	0.500～0.570
	CROU-10001LLA1X※	501.650	711.200	520.700	520.700	3	2.5	0.206～0.226	0.730～0.800
	CROU-11901LLA1X	595.312	844.550	615.950	615.950	3	2.5	0.266～0.282	1.200～1.270

❶ Minimum allowable value of chamfer dimension r. ❷ Depending on operating conditions, appropriate values may vary. Contact **NTN** Engineering for technical assistance.

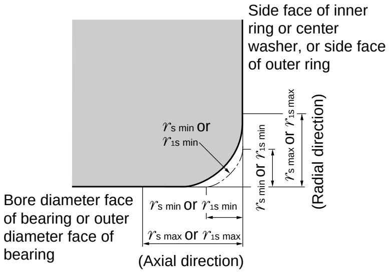
Bearing Number

(A-) CROU- 6001 LLA1X PX1

- PX1: Accuracy code
- LLA1X: Seal code
- 6001: Bearing bore number + added number
- CROU-: Bearing type (ULTAGE Series four row tapered roller bearing)
- (A-): Optional (special heat treatment [1])

NOTE 1) Carbonitriding

Chamfer Dimension



Unit : mm

$r_{s\,min}$ or $r_{1s\,min}$	Nominal bore diameter d over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
1	50	—	1.9	3
1.5	120	250	2.8	3.5
	250	—	3.5	4
2.5	120	250	4	5.5
	250	—	4.5	6
3	120	250	4.5	6.5
	250	400	5	7
	400	—	5.5	7.5

Operating Temperature Range

- -20 to +120˚C

Fit (recommended)

- Metric series: Shaft d6/ Housing G7
- Inch series: Contact **NTN** Engineering for technical assistance.

Standard Prelubricating Grease

- Brand: Kyodo Yushi Palmax RBG (L373)
- Fill amount: Space volume ratio 35%

Limiting Speed

- $dm \cdot N \leqq 30 \times 10^4$

dm : bearing center diameter (mm) $= (d+D)/2$
d : bearing bore diameter (mm)
D : bearing outside diameter (mm)
N : running speed (min^{-1})

The values above are shown as a guide, and may not be met under certain operating conditions.
For details, contact **NTN** Engineering.

Materials

- Inner and outer rings: Case hardening steel
- Rolling element: Bearing steel
  ※ mark only: Case hardening steel

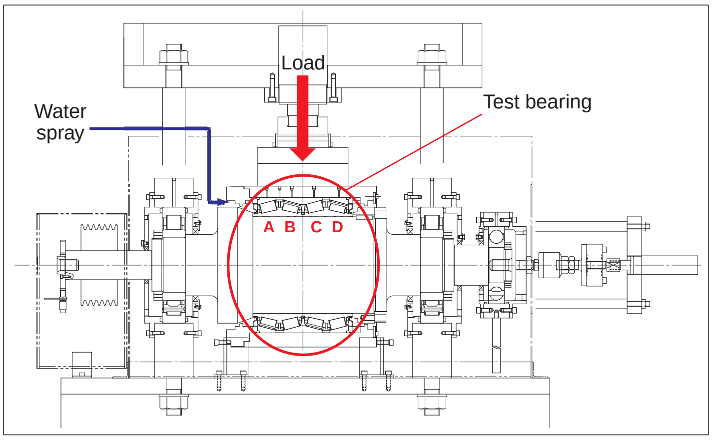
Basic load ratings dynamic (kN) C_r	static (kN) C_{0r}	dynamic (kgf) C_r	static (kgf) C_{0r}	Abutment and fillet dimensions (mm) d_a	D_a	Constant e	Axial load factor Y_1	Y_2	Y_0
1 880	4 650	192 000	475 000	235	267	0.33	2.03	3.02	1.98
1 870	3 700	190 000	375 000	241	294	0.41	1.64	2.44	1.6
2 320	4 600	236 000	470 000	259	309	0.35	1.95	2.90	1.91
2 960	6 850	302 000	700 000	257	299	0.40	1.68	2.50	1.64
2 760	5 300	280 000	540 000	272	333	0.40	1.68	2.50	1.64
3 340	7 450	340 000	760 000	275	327	0.40	1.68	2.50	1.64
3 600	7 650	366 000	780 000	318	382	0.40	1.68	2.50	1.64
4 020	8 900	410 000	910 000	329	388	0.39	1.72	2.56	1.68
5 520	13 300	562 000	1 350 000	434	504	0.33	2.03	3.02	1.98
6 600	16 200	670 000	1 650 000	462	540	0.33	2.03	3.02	1.98
7 600	16 700	780 000	1 700 000	473	570	0.33	2.03	3.02	1.98
13 400	29 400	1 370 000	3 000 000	581	710	0.33	2.03	3.02	1.98
2 240	4 350	228 000	440 000	240	290	0.33	2.07	3.09	2.03
2 760	5 700	282 000	580 000	274	328	0.39	1.74	2.59	1.70
2 800	5 850	286 000	600 000	323	379	0.43	1.56	2.32	1.52
2 820	5 950	288 000	605 000	360	423	0.47	1.43	2.12	1.40
3 500	8 150	356 000	830 000	364	423	0.43	1.57	2.34	1.53
10 000	23 900	1 020 000	2 440 000	542	642	0.42	1.60	2.38	1.56
13 900	33 000	1 420 000	3 350 000	638	770	0.33	2.03	3.02	1.98

Performance Test Data

●Water Resistance Durability Test

[Test conditions]

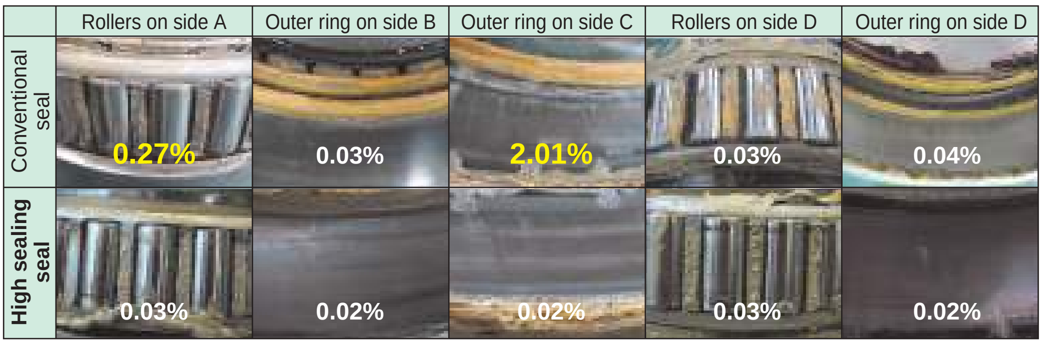
Bearing number: ULTAGE sealed four row tapered roller bearing CROU-6001LLAX1
(Dimensions: ϕ300×ϕ420×310, C_r: 3600 kN, C_{0r}: 7650 kN)
Prelubricating grease: Palmax RBG
Radial load: 390 kN (0.11 C_r)
Running speed: Cyclic operation where one cycle consists of ⇒300 min^{-1} (0.5 h) ⇒ 500 min^{-1} (1 h) ⇒ standstill (1 h)
Water spray: 0.15 L/min
Total running hours: 1000 h



Structure of test rig

[Status of bearing interior after test, and water content in grease (wt%)]

* Water content in factory-fresh grease is in the range of 0.001% to 0.04%.



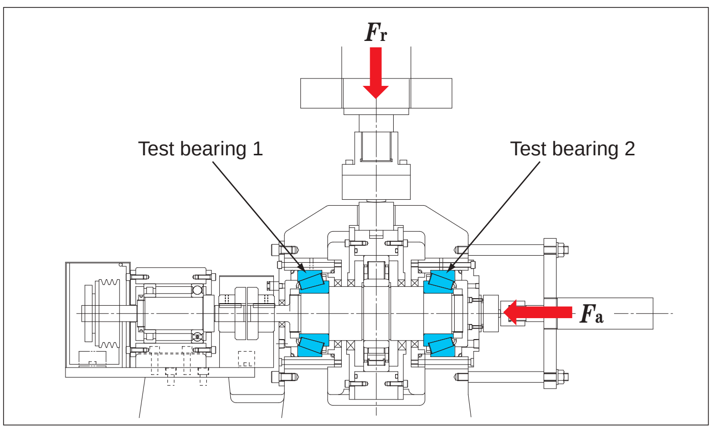

Appearance of test rig

Evidence of water intrusion is found on the conventional seal. In contrast, the NTN "high sealing" seal does not exhibit evidence of water intrusion.

●Life test result

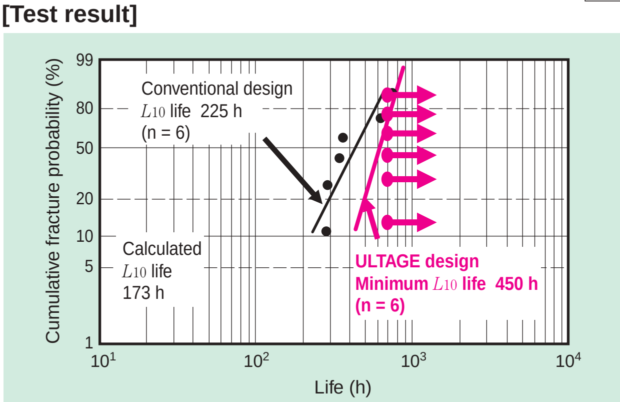
[Test conditions]

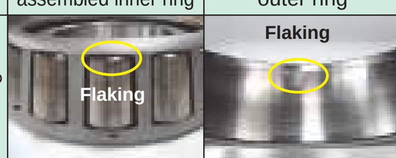
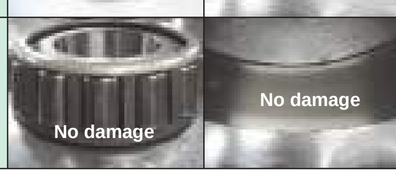
Bearing number: Comparison of conventional design and ULTAGE in terms of life 30316U (dimensions: ϕ80×ϕ170×42.5)
Lubrication: Turbine Oil VG68, circulating lubrication
Combined radial and axial loads: 117 kN/bearing (0.4 C_r equivalent, radial load: 75 kN/bearing, axial load: 50 kN/bearing)
Running speed: 2000 min^{-1}
Misalignment: 1/600 (0.1°)



Structure of test rig

[Test result]



	Appearance of assembled inner ring	Appearance of outer ring	Status
Conventional design			Flaking occurred near the chamfered end of rollers as well as at the corresponding contact point on the outer ring. (L_{10} = 225 h)
ULTAGE			After termination of the test at 690 hours, the test bearing was free from any failures including flaking.

ULTAGE bearings boast a life 2.6 times as long as their design life, and twice as long as the life of conventional bearings, when both bearing types are tested under test conditions of 0.4 C_r and 1/600 misalignment.

NTN®

Ball and Roller Bearings

CAT.No.2203/E

NTN "Ball and Roller Bearings Catalog"

Issue of CAT.No.2203/E

A rolling bearing is an important mechanical element that is used in various machines. Rolling bearings are required to have a long operating life, be small/lightweight, fast, and support special environments. Thus, the performance requirements are becoming more sophisticated and diversified. In particular, technology for enhancing the performance of bearing has been required in recent years. To meet these needs, **NTN** is performing research and development to enhance the performance of the entire machines.

The new general catalog has been entirely revised and edited so that the bearings of an optimum type and size can be provided based on the technical contents that are supported by the result of development and improvement.

The main revisions of the catalog are as follows.

- ○ The latest revision of ISO and JIS is reflected, and the pages of general commentaries such as bearing selection, bearing periphery design, and handling are largely increased.
- ○ Based on the results of in-house durability testing that has been accumulated over a long time, it has been confirmed that the bearing operating life is longer then previously published. Thanks to the continuous improvement of the material, product, and production techniques, the basic dynamic load ratings were revised based on the current bearing operating life data.
- ○ We are developing and expanding "ULTAGE," a new generation, all-world class rolling bearing series. This catalog introduces the ULTAGE series, which has been developed by **NTN** so far, and includes line-ups that are ready to be manufactured.

We would like you to use the "Ball and Roller Bearings Catalog" which has been revised, and we would like to work and develop with customers "to realize a smooth society". We hope to receive your continued patronage and support in the future.

Special bearings for each industry and application type are introduced in special sections at the end of the catalog. Please contact **NTN** Engineering for more information.

NTN

Ball and Roller Bearings

The CAD data of products is available on the **NTN** website. See our website for details.

TECHNICAL EXPLANATION CONTENTS

1. Classification and characteristics of rolling bearings

1.1 Structure

Most rolling bearings consist of **rings with a raceway** (inner ring and outer ring), **rolling elements** (either balls or rollers) and a **cage** as shown in **Fig. 1.1** (**Figs. A to H**). The cage separates the rolling elements at regular intervals, holds them in place within the inner and outer raceways, and allows them to rotate freely.

Raceway (inner ring and outer ring) or raceway washer[1] (shaft or housing)

The surface on which rolling elements roll is called the "**raceway surface**." The load placed on the bearing is supported by this contact surface.

Generally the inner ring fits on the axle or shaft and the outer ring in the housing.

Note 1: The raceway of thrust bearings is called the "raceway washer," the inner ring is called the "shaft raceway washer" and the outer ring is called the "housing raceway washer."

Rolling elements

Rolling elements are classified into two types: **balls** and **rollers**. Rollers come in four types: **cylindrical**, **needle**, **tapered**, and **spherical**. **Balls** geometrically contact with the raceway surfaces of the inner and outer rings at "**points**", while the contact surface of **rollers** is a "**line**" contact. Theoretically, rolling bearings are constructed to allow the rolling elements to rotate orbitally while also rotating on their own axes at the same time.

Cage

Cages function to maintain rolling elements at a uniform pitch so a load is never applied directly to the cage and to prevent the rolling elements from falling out when handling the bearing. Types of cages differ according to the way they are manufactured and include: **pressed**, **machined** and **formed cages**.

1.2 Classification

Rolling bearings are divided into two main classifications: **ball bearings** and **roller bearings**. Ball bearings are classified according to their bearing ring configurations: **deep groove type** and **angular contact type**. Roller bearings on the other hand are classified according to the shape of the rollers: **cylindrical**, **needle**, **tapered** and **spherical**. Rolling bearings can be further classified according to the direction in which the load is applied; **radial bearings** carry radial loads and **thrust bearings** carry axial loads. Other classification methods include: 1) number of rolling rows (**single**, **double**, or **4-row**), 2) **separable** and **non-separable**, in which either the inner ring or the outer ring can be detached.

There are also bearings designed for special applications, such as: precision rolling bearings for machine tools, bearings for special environments, as well as linear motion bearings (linear ball bearings, linear roller bearings and linear flat roller bearings). Types of rolling bearings are given in **Fig. 1.2**. For more detailed information, please refer to the page that introduces each bearing.

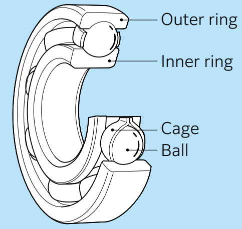


Fig. A Deep groove ball bearing

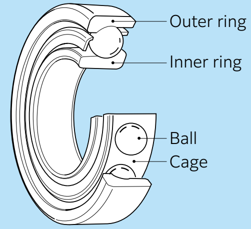


Fig. B Angular contact ball bearing

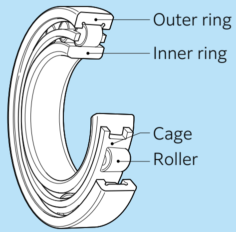


Fig. C Cylindrical roller bearing

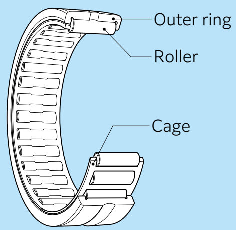


Fig. D Needle roller bearing

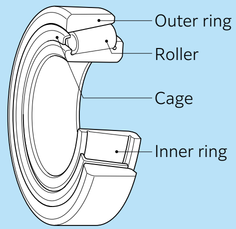


Fig. E Tapered roller bearing

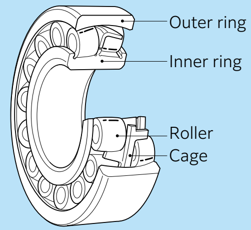


Fig. F Spherical roller bearing

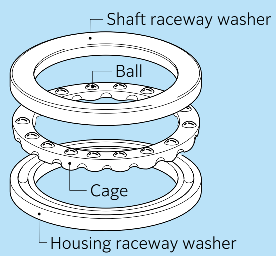


Fig. G Thrust ball bearing

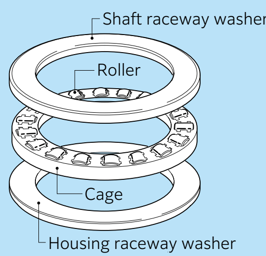


Fig. H Thrust roller bearing

Fig. 1.1 Rolling bearing

Classification and Characteristics of Rolling Bearings NTN

Commentary

- Rolling bearings
  - Ball bearings
    - Radial ball bearings
      - Deep groove ball bearings ……………… B- 17
      - Angular contact ball bearings 1) ……… B- 57
      - Duplex angular contact ball bearings 1) …………… B- 57
      - Four-point contact ball bearings …… B- 58
      - Double row angular contact ball bearings ……. B- 59
      - Self-aligning ball bearings ……………… B- 79
      - Ball bearings for rolling bearing unit 2)
    - Thrust ball bearings
      - Single direction thrust ball bearings … B-253
      - Double direction angular contact thrust ball bearings 1)
      - High speed duplex angular contact ball bearings 1) (for axial load)
  - Roller bearings
    - Radial roller bearings
      - Cylindrical roller bearings ……………… B- 93
      - Double row cylindrical roller bearings 1) ………… B- 94
      - Needle roller bearings 4) ………………… E- 2
      - Tapered roller bearings 1) ……………… B-127
      - Double row tapered roller bearings … B-128
      - Spherical roller bearings ……………… B-211
    - Thrust roller bearings
      - Thrust cylindrical roller bearings 4) … E- 2
      - Thrust needle roller bearings 4) ……… E- 2
      - Thrust tapered roller bearings 3)
      - Thrust spherical roller bearings ……. B-254

- Special application bearings
  - Four-row cylindrical roller bearings ……………………… C- 18
  - Four-row tapered roller bearings ……………………… C- 36
  - Ultra-thin section type ball bearings ………………… C- 58
  - SL type cylindrical roller bearings ……………………… C- 66
  - ULTAGE series Sealed four-row tapered roller bearings for rolling mill roll necks [CROU···LL type] 5) … C- 2
  - ULTAGE series Sealed spherical roller bearings [WA type] 5) …………… C- 6
  - ULTAGE series Spherical roller bearings with high-strength cage [EMA type] 5) … C- 10
  - ULTAGE series Deep groove ball bearings for high-speed servo motors [MA type] 5) … C- 14
  - ULTAGE series Precision rolling bearings for machine tools 5) ………… C- 76
  - Bearings for special environments 5) …………………… C- 76
  - Rubber molded bearings 5) ……………………………… C- 76
  - MEGAOHM™ series insulated bearings 5) ……………… C- 77
  - Clutches/torque limiters 5) ……………………………… C- 77

- Linear motion bearings
  - Linear ball bearings 4)
  - Linear roller bearings 4)
  - Linear flat roller bearings 4)

Fig. 1.2 Classification of rolling bearings

Note: 1) See **Precision Rolling Bearings (CAT. No. 2260/E)** for bearings of JIS 5 class or above.
2) See **Bearings Units (CAT. No. 2400/E)**.
3) See **Large Bearings (CAT. No. 2250/E)**.
4) See **Needle Roller Bearings (CAT. No. 2300/E)**.
5) See the section of "**Introduction of catalogs and technical reviews**" for the Cat. No of bearings marked with ∗5.

1.3 Characteristics

1.3.1 Characteristics of rolling bearings

Rolling bearings come in many shapes and varieties, each with its own distinctive features. However, when compared with sliding bearings, rolling bearings all have the following advantages:

(1) The **starting friction coefficient** is lower and there is little difference between this and the **dynamic friction coefficient**.

(2) They are internationally standardized, **interchangeable** and readily obtainable.

(3) They are easy to lubricate and consume less **lubricant**.

(4) As a general rule, **one bearing** can carry both radial and axial loads at the same time.

(5) May be used in either high or low temperature applications.

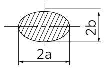
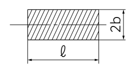
(6) **Bearing rigidity** can be improved by **preloading**.

Construction, classes, and special features of rolling bearings are fully described in the boundary dimensions and bearing numbering system section.

1.3.2 Ball bearings and roller bearings

Table 1.1 gives a comparison of ball bearings and roller bearings.

Table 1.1 Comparison of ball bearings and roller bearings

	Ball bearing	Roller bearing
Contact with raceway	 2a 2b **Point contact** Contact surface is oval when a load is applied.	 ℓ 2b **Linear contact** Contact surface is generally rectangular when a load is applied.
Characteristics	Because of point contact, where there is little rolling resistance, ball bearings are suitable for low torque and high-speed applications. They also have superior acoustic characteristics.	Because of linear contact, rotational torque is higher for roller bearings than for ball bearings, but rigidity is also higher.
Load capacity	Load capacity is lower for ball bearings, but radial bearings are capable of bearing loads in both the radial and axial direction.	Load capacity is higher for rolling bearings. Cylindrical roller bearings equipped with a lip can bear slight axial loads. Combining tapered roller bearings in pairs enables the bearings to bear an axial load in both directions.

Classification and Characteristics of Rolling Bearings NTN

Commentary

1.3.3 Contact angle and bearing type

A contact angle is an angle made by a line that connects the contact point of the inner ring, rolling element, and outer ring in the radial direction when a load is applied on the bearing (**Fig. 1.3**).

Bearings with a **contact angle of 45° or less** have a much greater radial load capacity and are classed as **radial bearings**; whereas bearings which have a contact angle over 45° have a greater axial load capacity and are classed as **thrust bearings**. There are also bearings classed as complex bearings which combine the loading characteristics of both radial and thrust bearings.

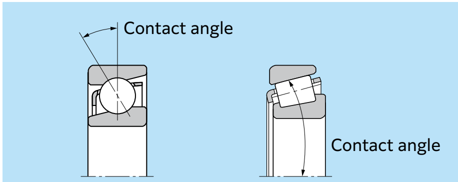


Fig. 1.3 Contact angle

1.3.4 Load acting on bearing

Types of loads applied on rolling bearings are given in **Fig. 1.4**. A moment load is caused by an unbalanced load and misalignment.

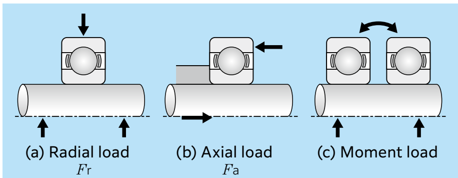


Fig. 1.4 Types of load

1.3.5 Standard bearings and special bearings

The boundary dimensions and shapes of bearings conforming to international standards are interchangeable and can be obtained easily and economically all over the world. It is therefore better to design mechanical equipment that can use standard bearings.

However, depending on the type of machine they are to be used in, and the expected application and function, a non-standard or specially designed bearing may be best. Bearings that are adapted to specific applications, and "unit bearings" which are integrated (built-in) into a machine's components, and other specially designed bearings are also available.

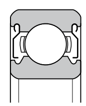
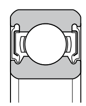
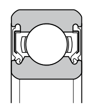
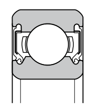
The features of typical standard bearings are as follows:

Deep groove ball bearing

The most common type of bearing, deep groove ball bearings are widely used in a variety of fields. Deep groove ball bearings can include shielded bearings or sealed bearings with grease to make them easier to use.

Deep groove ball bearings also include bearings with a locating snap-ring to facilitate positioning when mounting the outer ring, expansion compensating bearings which absorb dimension variation of the bearing fitting surface due to housing temperature, and TAB bearings that are able to withstand contamination in the lubricating oil.

Table 1.2 Configuration of sealed ball bearings

Type and code	Shielded type	Sealed type		
	Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Structure				

Angular contact ball bearing

The line that unites the point of contact of the inner ring, ball and outer ring runs at a certain angle (contact angle) in the radial direction.

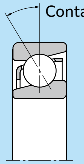
Angular contact ball bearings are generally designed with three contact angles. (Refer to **Table 1.3**)

Angular contact ball bearings can support an axial load, but cannot be used by themselves because of the contact angle. They must instead be used in pairs or in combination. (Refer to **Table 1.5**)

Angular contact ball bearings include double row angular contact ball bearings for which the inner and outer rings are combined as a single unit. (Refer to **Table 1.4**) The contact angle of double row angular contact ball bearings is 25°.

There are also four-point contact bearings that can support an axial load in both directions by themselves. These bearings however require caution because problems such as excessive temperature rise and wear could occur depending on the load conditions.

Table 1.3 Contact angle and symbol



Contact angle and contact angle symbol

Contact angle	15°	30°	40°
Contact angle symbol	C	A 1)	B

Note: 1. Contact angle symbol has been abbreviated as "A".

Table 1.4 Configuration of double row angular contact ball bearings

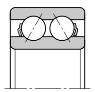
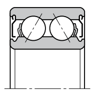
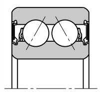
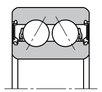
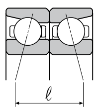
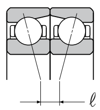
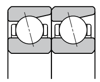
Type and code	Open type	Shielded type ZZ	Non-contact sealed type LLM	Contact sealed type LLD
Structure				

Table 1.5 Combinations of duplex angular contact ball bearings

Type and symbol	Back-to-back arrangement DB	Face-to-face duplex DF	Tandem arrangement DT
Structure			

ℓ : Distance between load centers

Classification and Characteristics of Rolling Bearings NTN

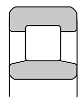
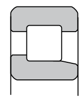
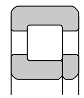
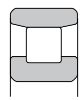
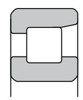
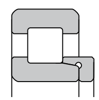
Cylindrical roller bearing

Cylindrical roller bearings use rollers for rolling elements, and therefore have a high load capacity. The rollers are guided by the ribs of the inner or outer ring. The inner and outer rings can be separated to facilitate assembly, and both can be fit with a shaft or housing tightly. If there are no ribs, either the inner or the outer ring can move freely in the axial direction. Cylindrical roller bearings are therefore ideal to be used as so-called "free side bearings" that absorb shaft expansion. In the case where there are ribs, the bearing can bear a slight axial load between the end of the rollers and the ribs. Cylindrical roller bearings include the HT type which modifies the shape of the roller end face and ribs for increasing axial load capacity, and the EA type and E type with a special internal design for enhancing radial load capacity. The EA type is standardized for small-diameter sizes.

Table 1.6 shows the basic shapes.

In addition to these, there are cylindrical roller bearings with multiple rows of rollers and the SL type of full complement roller bearings without a cage.

Table 1.6 Types of cylindrical roller bearings

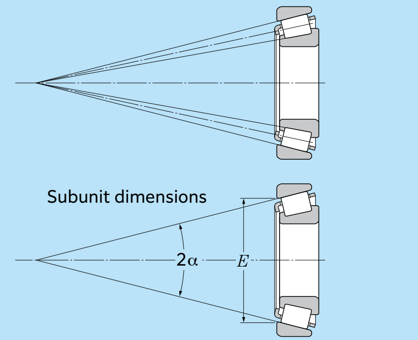
Type code	Type NU Type N	Type NJ Type NF	Type NUP Type NH (NJ HJ)
Design	 Type NU	 Type NJ	 Type NUP
	 Type N	 Type NF	 Type NH

Tapered roller bearing

Tapered roller bearings are designed so the inner/outer ring raceway and apex of the tapered rollers intersect at one point on the bearing centerline. By receiving a combined load from the inner and outer ring, the rollers are pushed against the inner ring rib and are guided by the rib.

Induced force is produced in the axial direction when a radial load is applied, so it must be handled with a pair of bearings. The inner ring with rollers and outer ring come apart, thus facilitating mounting with clearance or preload. Assembled clearance is however hard to manage and requires special attention. Tapered roller bearings are capable of supporting large loads in both the axial and radial directions.

NTN also has a line of case hardened steel bearings designed for longer life (ETA-, etc.). **NTN** tapered roller bearings also include bearings with two and four rows of tapered rollers for extra-heavy loads.



E : Outer ring (cup) nominal small-end diameter
α : Nominal contact angle

Fig. 1.5 Tapered roller bearings

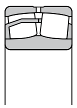
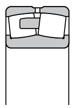
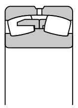
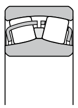
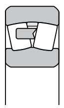
Spherical roller bearing

Equipped with an outer ring with a spherical raceway surface and an inner ring which holds two rows of barrel-shaped rolling elements, **NTN** spherical roller bearings are able to adjust center alignment to handle inclination of the axle or shaft.

There are a variety of spherical roller bearing types that differ according to their internal design.

In addition to cylindrical bore inner rings, spherical roller bearings can be produced with a tapered bore inner ring. The tapered bore bearing can easily be mounted on a shaft by means of an adapter or withdrawal sleeve. The bearing is capable of supporting heavy loads, and is therefore often used for industrial machinery. When a heavy axial load is applied to the bearing, the load on rollers of one row is not applied, and can cause problems. Attention must therefore be paid to operating conditions.

Table 1.7 Types of spherical roller bearings

Type	ULTAGE		B type	C type	213 type
	EA type	EM type			
Structure					

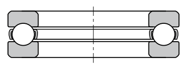
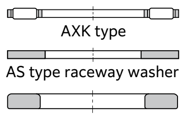
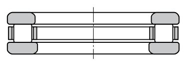
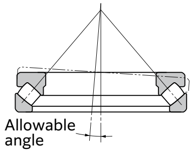
Thrust bearing

There are many types of thrust bearings that differ according to the shape of the rolling element and application.

Allowable rotational speed is generally low and special attention must be paid to lubrication.

In addition to the types shown in **Table 1.8** below, there are various other types of thrust bearings for special applications.

Table 1.8 Types of thrust bearings

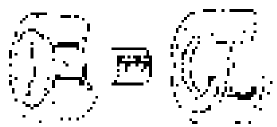
Type	Single direction thrust ball bearing	Needle roller thrust bearings
Structure		
	Thrust cylindrical roller bearing	Thrust self-aligning roller bearing
		

Needle roller bearing

Needle roller bearings use needle rollers as rolling elements. The needle rollers are a maximum of 6 mm in diameter and are 3 to 10 times as long as they are in diameter (JIS B1506 rolling bearings roller). Because the bearings use needle rollers as rolling elements, the cross-section is thin, but they have a high load capacity for their size. Due to the large number of rolling elements, bearings have high rigidity and are ideally suited to oscillating motion.

There are various types of needle roller bearings, and just a few of the most representative types are covered here. For details, see the catalog "**Needle roller bearings (CAT. No. 2300/E)**."

Table 1.9 Main types of needle roller bearings

Type	Needle roller bearing with cage
Structure	
	Solid type needle roller bearings
	
	Drawn cup needle roller bearings
	
	Cam follower Roller follower
	

Bearing unit

A unit comprised of a ball bearing inserted into various types of housings. The housing can be bolted onto machinery and the inner ring can be easily mounted on the shaft with a set screw.

This means the bearing unit can support rotating equipment without a special design to allow for mounting. A variety of standardized housing shapes are available, including pillow block and flange types. The outer diameter of the bearing is spherical just like the inner diameter of the housing, so it is capable of aligning itself on the shaft.

For lubrication, grease is filled inside the bearing, and foreign particles are prevented from entering with a shaft riding seal and slinger shield.

For details, see the catalog "**Bearing unit (CAT. No. 2400/E)**."

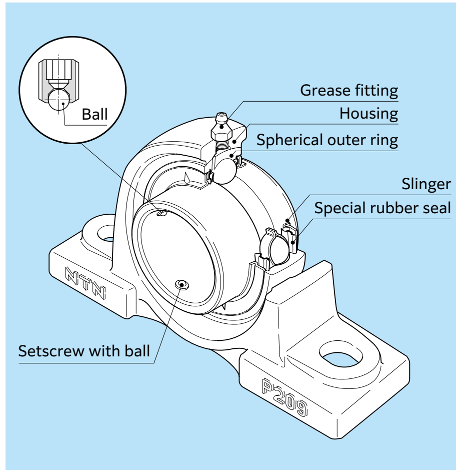


Fig. 1.6 Bearing unit with grease fitting

2. Bearing selection

NTN provides rolling bearings (hereinafter referred to as bearings) of various types and dimensions. When selecting the correct bearing for your application, it is important to consider several factors, and analyze using various means.

2.1 Bearing selection flow chart

An example of the procedure for selecting bearings is shown in the following flow chart. When special consideration is necessary, consult with **NTN** Engineering.

Procedure	Confirmation items
Confirm operating conditions and operating environment	●Function and construction of components to house bearings ●Bearing mounting location ●Bearing load (direction and magnitude) ●Rotational speed ●Vibration and shock load ●Bearing temperature (Ambient temperature/ temperature rise) ●Operating environment (potential for corrosion, degree of contamination, extent of lubrication)
Select bearing type and configuration	●Dimensional limitations (refer to page insert···A-46) ●Bearing load (magnitude,direction,vibration; presence of shock load) (refer to page insert···A-34) ●Rotational speed (refer to page insert···A-106) ●Bearing tolerances (refer to page insert···A-54) ●Rigidity (refer to page insert···A-101) ●Allowable misaligment of inner/outer rings (refer to page insert···A-149) ●Friction torque (refer to page insert···A-110) ●Bearing arrangement (fixed side, floating side) (refer to page insert···A-17) ●Installation and disassembly requirements (refer to page insert···A-150) ●Bearing availability and cost
Select bearing dimensions	●Design life of components to house bearings (refer to page insert···A-27) ●Dynamic/static equivalent load conditions (refer to page insert···A-41) ●Safety factor (refer to page insert···A-31) ●Allowable Speed (refer to page insert···A-106) ●Allowable axial load (refer to page insert···A-31) ●Allowable space (refer to page insert···A-46)
Select bearing tolerances	●Shaft runout tolerances (refer to page insert···A-54) ●Rotational speed (refer to page insert···A-106) ●Torque fluctuation
Select bearing's internal clearance	●Material and shape of shaft and housing (refer to page insert···A-146) ●Bearing Fits (refer to page insert···A-75) ●Temperature differential between inner/outer rings (refer to page insert···A-92) ●Allowable misalignment of inner/outer rings (refer to page insert···A-149) ●Load (magnitude, nature) (refer to page insert···A-34) ●Amount of preload (refer to page insert···A-100) ●Rotational speed (refer to page insert···A-106)
Select cage type and material	●Rotational speed (refer to page insert···A-106) ●Noise level ●Vibration and shock load ●Momentary load ●Lubrication type and method (refer to page insert···A-111)
Select lubricant, lubrication method, sealing method	●Operating temperature (refer to page insert···A-164) ●Rotational speed (refer to page insert···A-106) ●Lubrication type and method (refer to page insert···A-111) ●Sealing method (refer to page insert···A-124) ●Maintenance and inspection (refer to page insert···A-164)
Select any special bearing specifications	●Operating environment (high/low temperature, vacuum, pharmaceutical, etc.) ●Requirement for high reliability
Confirm handling procedures	●Installation-related dimensions (refer to page insert···A-148) ●Installation and disassembly procedures (refer to page insert···A-152)

Selection of bearing type and configuration

(1) Dimensional limitations
There is a wide range of standardized bearing types and dimensions. Typically, for bearing used in machines, it is necessary to select the optimal bearing type and dimension that fits the space allowed in the machine.

(2) Bearing load
There can be various directions, characteristics, and magnitudes of loading that act on bearings. However, in determining the appropriate bearing type, it is also necessary to consider whether the acting load is a radial load only or combined radial and axial load. In addition, it is necessary to determine what bearing type and size is appropriate based on the basic load rating, specified in the bearing dimension table, while considering the magnitude of the load being applied.

(3) Rotational speed
The allowable speed of a bearing will differ depending upon bearing type, size, tolerances, cage type, load, lubricating conditions, and cooling conditions.

The allowable speeds listed in the bearing tables for grease and oil lubrication are for normal tolerance **NTN** bearings. In general, deep groove ball bearings, angular contact ball bearings, and cylindrical roller bearings are most suitable for high speed applications.

(4) Bearing tolerances
The dimensional accuracy and operating tolerances of bearings are regulated by ISO and JIS standards.

For equipment requiring high tolerance shaft runout or high speed operation, bearings with Class 5 tolerance or higher are recommended.

Deep groove ball bearings, angular contact ball bearings, and cylindrical roller bearings are recommended for high rotational tolerances.

(5) Rigidity
Elastic deformation occurs along the contact surfaces of a bearing's rolling elements and raceway surfaces under loading. With certain types of equipment it is necessary to reduce this deformation as much as possible. In general, roller bearings exhibit less elastic deformation than ball bearings. Furthermore, in some cases, bearings are given a load in advance (preloaded) to increase their rigidity. This procedure is commonly applied to deep groove ball bearings, angular contact ball bearings, and tapered roller bearings.

(6) Misalignment of inner and outer rings
Shaft flexure, variations in shaft or housing accuracy, and fitting errors result in a certain degree of misalignment between the bearing's inner and outer rings. In situations where the degree of misalignment is liable to be relatively large, self-aligning ball bearings, spherical roller bearings, bearing units and other bearings with aligning properties are advisable.(Refer to **Fig. 2.1**)

(7) Noise and torque levels
Rolling bearings are manufactured and processed according to high precision standards, and therefore generally produce only slight amounts of noise and torque. For applications requiring particularly low-noise or low-torque operation, deep groove ball bearings and cylindrical roller bearings are most appropriate.

(8) Installation and disassembly
Some applications require frequent disassembly and reassembly to enable periodic inspections and repairs. For such applications, bearings with separable inner/outer rings, such as cylindrical roller bearings, needle roller bearings, and tapered roller bearings are most appropriate. Incorporation of adapter sleeves simplifies the installation and disassembly of self-aligning ball bearings and spherical roller bearings with tapered bores.

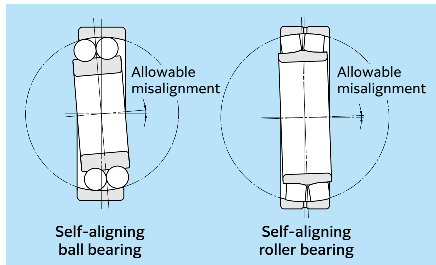


Fig. 2.1

Bearing Selection

2.2 Type and characteristics

Table 2.1 shows the main types and characteristics of rolling bearings.

Table 2.1 Main types of rolling bearings and performance comparison

Characteristics \ Bearing type	Deep groove ball bearings	Angular contact ball bearings	Double row angular contact ball bearings	Duplex angular contact ball bearings	Self-aligning ball bearings	Cylindrical roller bearings	Singleflange cylindrical roller bearings	Doubleflange cylindrical roller bearings	Double row cylindrical roller bearings	Needle roller bearings
Load capacity: Radial load	☆☆	☆☆	☆☆☆	☆☆☆	☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆☆	☆☆☆
Load capacity: Axial load	☆☆ Both directions	☆☆☆ One direction	☆☆☆ Both directions	☆☆☆ Both directions	☆ Both directions	×	☆ One direction	☆ Both directions	×	×
Load capacity: Combined load	☆☆	☆☆☆	☆☆☆	☆☆☆	☆	×	☆☆	☆☆	×	×
High speed rotation 1)	☆☆☆☆	☆☆☆☆	☆☆	☆☆☆	☆☆	☆☆☆☆	☆☆☆	☆☆☆	☆☆☆	☆☆☆
Accuracy under high speed 1)	☆☆☆	☆☆☆	☆☆	☆☆☆		☆☆☆	☆☆	☆	☆☆☆	
Low noise/vibration 1)	☆☆☆☆	☆☆☆		☆		☆	☆	☆	☆	☆
Low friction torque 1)	☆☆☆☆	☆☆☆		☆☆	☆	☆				
High rigidity 1)			☆☆	☆☆		☆☆	☆☆	☆☆	☆☆☆	☆☆
Vibration/shock resistance 1)			☆		×	☆☆	☆☆	☆☆	☆☆	☆☆
Allowable misalignment for inner/outer rings 1)	☆				☆☆☆	☆				
Stationary in axial direction 2)	◎	○	◎ For DB and DF arrangement	◎	◎		○	◎		
Movable in axial direction 3)	○		○ For DB arrangement	○	○	◎			◎	◎
Separable of inner and outer rings 4)					○	○	○	○	○	○
Tapered bore inner ring 5)						○			○	
Remarks		Duplex arrangement required				NU, N type	NJ, NF type	NUP, NP, NH type	NNU, NN type	NA type
Reference page	B-17	B-57	B-59	B-57	B-79	B-93	B-93	B-93	B-94	E-2

Tapered roller bearings	Double-row, 4-row tapered roller bearings	Spherical roller bearings	Thrust ball bearings	Thrust cylindrical roller bearings	Thrust spherical roller bearings	Reference page	Bearing type / Characteristics
☆☆☆	☆☆☆☆	☆☆☆☆	×	×	☆		Load capacity: Radial load
☆☆☆☆ One direction	☆☆☆☆ Both directions	☆☆ Both directions	☆☆☆ One direction	☆☆☆☆ One direction	☆☆☆☆ One direction		Load capacity: Axial load
☆☆☆	☆☆☆☆	☆☆☆	×	×	×		Load capacity: Combined load
☆☆☆	☆☆	☆☆	☆	☆	☆	A-106	High speed rotation 1)
☆☆☆	☆		☆			A-54	Accuracy under high speed 1)
			☆			—	Low noise/vibration 1)
						A-110	Low friction torque 1)
☆☆	☆☆☆☆	☆☆☆		☆☆☆	☆☆☆	—	High rigidity 1)
☆☆	☆☆☆	☆☆☆		☆☆☆	☆☆☆	A-34	Vibration/shock resistance 1)
☆		☆☆☆		×	☆☆☆	A-149	Allowable misalignment for inner/outer rings 1)
○	◎	◎	○	○	○	A-17	Stationary in axial direction 2)
	○	○	○			A-17	Movable in axial direction 3)
○	○		○	○	○	—	Separable of inner and outer rings 4)
		○				A-147	Tapered bore inner ring 5)
Duplex arrangement required				Including thrust needle roller bearings		—	Remarks
B-127	B-128 C-36	B-211	B-253	E-2	B-254		Reference page

1) ☆☆☆☆ : Particularly excellent
☆☆☆ : Excellent
☆☆ : Highly possible
☆ : Possible
× : Poor

2) ◎indicates dual direction. ○indicates single direction axial movement only.

3) ◎indicates movement in the axial direction is possible for the raceway surface; ○indicates movement in the axial direction is possible for the fitting surface of the outer ring or inner ring.

4) ○indicates both inner ring and outer ring are separable.

5) ○indicates inner ring with tapered bore is possible.

2.3 Selection of bearing arrangement

In general, a shaft is supported by two bearings. A bearing that positions and fixes the shaft in the axial direction is called the "**fixed side bearing**" and a bearing that allows the axial movement is called the "**floating side bearing**." This allows expansion and contraction of the shaft due to temperature variation and absorbs errors in the bearing mounting clearance. Fixing two bearings without providing a floating side bearing applies an excessive load on bearings because of the expansion and contraction or the error, damaging the bearings at an early stage.

The **fixed side bearing** is able to support radial and axial loads. A bearing that can fix axial movement in both directions should therefore be selected. A **floating side bearing** that allows movement in the axial direction while supporting a radial load is desirable. Movement in the axial direction **occurs on the raceway surface** for bearings with separable inner and outer rings such as **cylindrical roller bearings**, and **occurs on the fitting surface** for those which are not separable, such as **deep groove ball bearings**.

When shaft expansion and contraction due to temperature fluctuations is slight, the same type of bearing may be used for both the fixed-side and floating-side bearing.

Table 2.2 (1) shows typical bearing arrangements where the bearing type differs on the fixed side and floating side.**Table 2.2 (2)** shows some common bearing arrangements where no distinction is made between the fixed side and floating side. Vertical shaft bearing arrangements are shown in **Table 2.2 (3)**.

Table 2.2 (1) Bearing arrangement (distinction between fixed and floating-side)

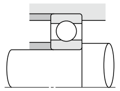
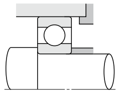
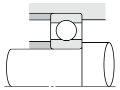
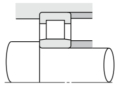
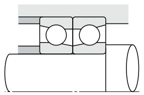
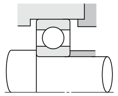
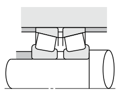
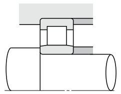
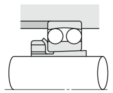
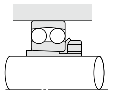
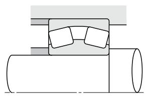
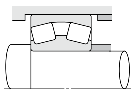
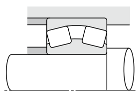
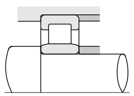
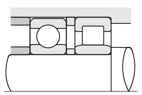
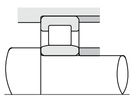
Arrangement		Remarks	Application (Reference)
Fixed side	Floating side		
		1. General arrangement for small machinery. 2. For radial loads, but will also accept axial loads in some degree.	Small pumps, auto-mobile transmissions, etc.
		1. Suitable when mounting error and shaft deflection are minimal or used for high rotational speed application. 2. Even with expansion and contraction of shaft, the floating side moves smoothly.	Medium-sized electric motors, ventilators, etc.
		1. Relatively heavy radial loading and dual direction of axial loading possible. 2. In place of duplex angular contact ball bearings, double-row angular contact ball bearings are also used.	Worm gears, reducers, compressors
		1. Heavy loading capable. 2. Shafting rigidity increased by preloading the two back-to-back fixed bearings. 3. Requires high precision shafts and housings, and minimal fitting errors.	Industrial machinery, large reducers
		1. Allows for shaft deflection and fitting errors. 2. By using an adapter on long shafts without screws or shoulders, bearing mounting and dismounting can be facilitated. 3. Self-aligning ball bearings are used for positioning in the axial direction, and not suitable for applications requiring support of axial load.	Conveyors
		1. Widely used in general industrial machinery with heavy and shock load demands. 2. Allows for shaft deflection and fitting errors in some degree. 3. Accepts radial loads as well as dual direction of axial loads in some degree.	Industrial machinery, large reducers
		1. Accepts radial loads as well as dual direction axial loads in some degree. 2. Suitable if an inner and outer ring tight fit is required.	Industrial machinery, large reducers
		1. Capable of handling large radial and axial loads at high rotational speeds. 2. Maintains clearance between the bearing's outer diameter and housing inner diameter to prevent deep groove ball bearings from receiving radial loads.	Diesel locomotives, carriage axles

Table 2.2 (2) Bearing arrangement (no distinction between fixed and floating-side)

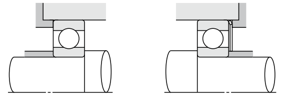
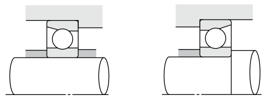
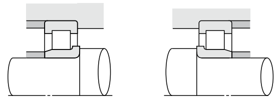
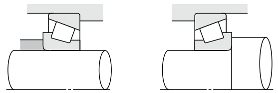
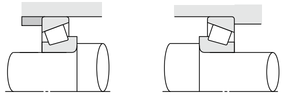
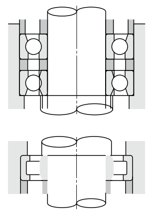
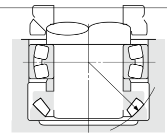
Arrangement	Remarks	Application (Reference)
	1. General arrangement for use in small machines. 2. Preload is sometimes applied by placing a spring on the outer ring side surface or inserting an adjusted shim. (can be floating-side bearings.)	Small electric motors, small reduction gears, etc.
	1. Back-to-back arrangement is preferable to face to face arrangement when moment load applied. 2. Able to support axial and radial loads; suitable for high-speed rotation. 3. Rigidity of shaft can be enhanced by providing preload.	Machine tool spindles, etc.
	1. Capable of supporting heavy loads and impact loads. 2. Suitable if an inner and outer ring tight fit is required. 3. Care must be taken so axial clearance does not become too small during operation.	Construction equipment, mining equipment sheaves, agitators, etc.
 Back-to-back arrangement  Face-to-face arrangement	1. Withstands heavy and shock loads. Wide range application. 2. Shaft rigidity can be enhanced by providing preload, but make sure preload is not excessive. 3. Back-to-back arrangement for moment loads, and face-to-face arrangement to alleviate fitting errors. 4. With face-to-face arrangement, inner ring tight fit is facilitated.	Reduction gears, front and rear axle of automobiles, etc.

Table 2.2 (3) Bearing arrangement (Vertical shaft)

Arrangement	Remarks	Application (Reference)
	1. When a fixing bearing is a duplex angular contact ball bearing, the floating bearing should be a cylindrical roller bearing.	Vertically mounted electric motors, etc.
	1. Most suitable arrangement for very heavy axial loads. 2. Shaft deflection and mounting error can be absorbed by matching the center of the spherical surface with the center of spherical roller thrust bearings.	Crane center shafts, etc.

3. Load rating and life

3.1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly being subjected to repeated compressive stresses which causes flaking of these surfaces to occur. This flaking is due to material fatigue and will eventually cause bearings to fail.

The effective life of a bearing is usually defined in terms of **the total number of revolutions** a bearing can undergo before **flaking** of either the raceway surface or the rolling element surfaces occurs.

Other causes of bearing failure are often attributed to problems such as seizing, abrasions, cracking, chipping, scuffing, rust, etc. However, these so called "causes" of bearing failure are usually themselves caused by improper installation, insufficient or improper lubrication, faulty sealing or improper bearing selection.

Since the above mentioned "causes" of bearing failure can be avoided by taking proper precautions, and are not simply caused by material fatigue, they are considered separately from the flaking aspect.

3.2 Basic rating life and basic dynamic load rating

A group of seemingly identical bearings when subjected to identical loads and operating conditions will exhibit a wide diversity in their durability. This "life" disparity can be accounted for by the difference in the fatigue of the bearing material itself.

This disparity is considered statistically when calculating bearing life, and **the basic rating life** is defined as follows.

The basic rating life is based on a 90% statistical model which is expressed as the total number of revolutions 90% of the bearings in an identical group of bearings subjected to identical operating conditions will attain or surpass before flaking due to material fatigue. For bearings operating at fixed constant speeds, the basic rating life (90% reliability) is expressed in the total number of hours of operation. Basic dynamic load rating expresses a rolling bearing's capacity to support a dynamic load.

The basic dynamic load rating is **the load which a bearing can theoretically endure for a basic rating life of one million revolutions**. This is expressed as pure radial load for radial bearings and pure axial load for thrust bearings. These are referred to as "**basic dynamic radial load rating (C_r)**" and "**basic dynamic axial load rating (C_a).**"

The basic dynamic load ratings given in the bearing tables of this catalog are for bearings constructed of **NTN** high quality bearing materials and of good manufacturing quality.

The relationship between the basic rating life, the basic dynamic load rating and the dynamic equivalent load is shown in formulas (3.1) and (3.2).

For ball bearings : $L_{10} = \left(\frac{C}{P}\right)^3$ ········· (3.1)

For roller bearings: $L_{10} = \left(\frac{C}{P}\right)^{10/3}$ ····· (3.2)

Where:

L_{10} : Basic rating life 10^6 revolutions
C : Basic dynamic load rating N
Radial bearing C_r
Thrust bearing C_a
P : Dynamic equivalent load N 1)
Radial bearing P_r
Thrust bearing P_a

1) For more details, please refer to the section "4. Bearing load calculation."

The relationship between rotational speed n and speed factor f_n as well as the relationship between life factor f_h and basic rating life L_{10h} are shown in **Table 3.1** and **Fig. 3.1**.

Table 3.1 Bearing basic rating life, life factor, and speed factor

Division	Ball bearing	Roller bearing
Basic rating life L_{10h} h	$\frac{10^6}{60n}\left(\frac{C}{P}\right)^3 = 500 f_h^3$	$\frac{10^6}{60n}\left(\frac{C}{P}\right)^{10/3} = 500 f_h^{10/3}$
Life factor f_h	$f_n \frac{C}{P}$	$f_n \frac{C}{P}$
Speed factor f_n	$\left(\frac{33.3}{n}\right)^{1/3}$	$\left(\frac{33.3}{n}\right)^{3/10}$

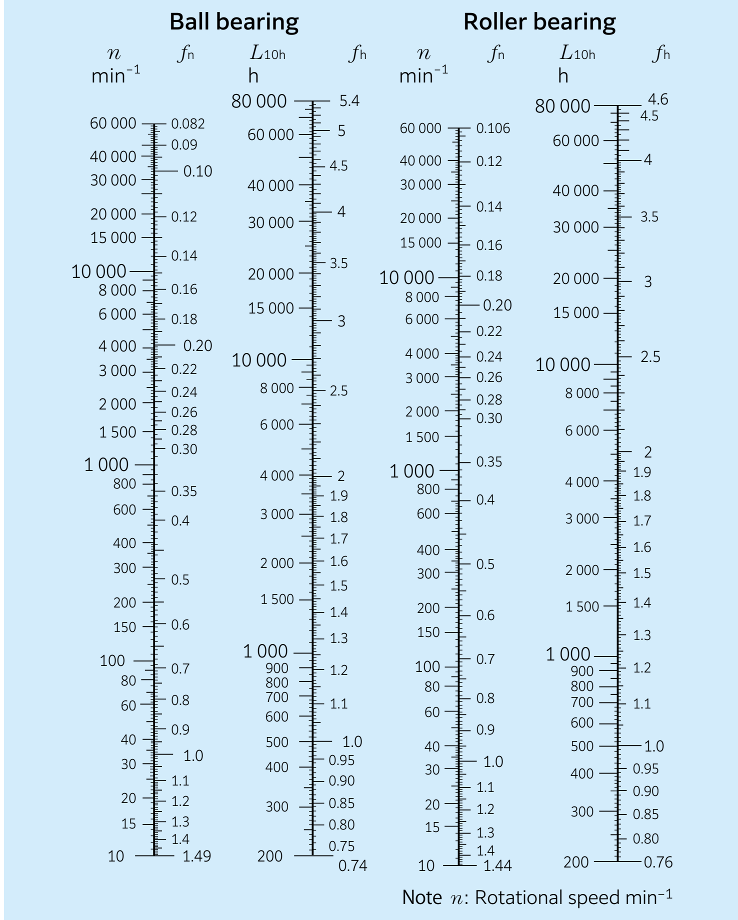


Fig. 3.1 Bearing life rating scale

When several bearings are incorporated in machines or equipment as complete units, all the bearings in the unit are considered as a whole when computing bearing system life (see formula 3.3).

$$L = \frac{1}{\left(\frac{1}{L_1{}^e} + \frac{1}{L_2{}^e} + \cdots \frac{1}{L_n{}^e}\right)^{1/e}} \quad \cdots\cdots\cdots \quad (3.3)$$

Where:

L : Total basic rating life of entire unit, h

$L_1, L_2 \cdots L_n$: Basic rating life of individual bearings 1, 2, ⋯n, h

e : e = 10/9 ⋯⋯⋯ For ball bearings

e = 9/8 ⋯⋯⋯⋯ For roller bearings

When the load conditions vary at regular intervals, the life can be given by formula (3.4).

$$L_m = \left(\frac{\phi_1}{L_1} + \frac{\phi_2}{L_2} + \cdots\cdots \frac{\phi_j}{L_j}\right)^{-1} \cdots\cdots\cdots \quad (3.4)$$

Where:

L_m : Total life of bearing, h

ϕ_j : Frequency of individual load conditions ($\Sigma\phi_j = 1$)

L_j : Life under individual conditions, h

If dynamic equivalent load P and rotational speed n are operating conditions of the bearing, basic rated dynamic load C that satisfies required life of the bearing is determined using **Table 3.1** and formula (3.5). Bearings that satisfy the required C can be selected from the bearing dimensions table provided in the catalog.

$$C = P\frac{f_h}{f_n} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (3.5)$$

3.3 Adjusted rating life

The basic bearing rating life can be calculated through the formulas mentioned earlier in Section 3.2. However, in some applications bearing reliability higher than 90% may be required. In addition, bearing life may be enhanced by the use of specialty bearing materials or manufacturing processes. Bearing life is also sometimes affected by operating conditions such as lubrication, temperature and rotational speed.

Basic rating life adjusted to compensate for reliability, special bearing materials and enhancements, and specific operation conditions is called "**adjusted rating life**," and is determined using formula (3.6).

$$L_{na} = a_1 \cdot a_2 \cdot a_3 \cdot L_{10} \cdots\cdots\cdots\cdots\cdots \quad (3.6)$$

Where:

L_{na} : Adjusted rating life in millions of revolutions (10^6)

a_1 : Life adjustment factor for reliability

a_2 : Life adjustment factor for special bearing properties

a_3 : Life adjustment factor for operating conditions

3.3.1 Life adjustment factor for reliability a_1

The value of **life adjustment factor for reliability a_1** is provided in **Table 3.2** for reliability of 90% or greater.

3.3.2 Life adjustment factor for special bearing properties a_2

Bearing characteristics concerning life vary according to bearing material, quality of material and if using a special manufacturing process. In this case, life is adjusted using **life adjustment factor for special bearing properties a_2**.

The basic dynamic load ratings listed in the catalog are based on **NTN**'s standard material and the adjustment factor used is a_2 = 1. However, an adjustment factor of a_2 other than 1 may be used for bearings with specially enhanced materials and manufacturing methods.

[NOTE: a_2 < 1 may occur for temperature stabilization]

a_2 > 1 may be used for bearings with specially improved materials and manufacturing methods.

Bearings made of high carbon chrome bearing steel, conventionally heat treated, may experience dimensional changes during operation if used at high temperatures for extended periods of time. Temperature stabilization treatment (**TS treatment**) can be used to provide increased dimensional stability of bearing materials at high operational temperatures. However, the dimensional stabilization treatment results in a lower overall hardness of heat treated bearing materials; therefore, the life is adjusted by multiplying by life adjustment factor for special bearing properties a_2 given in **Table 3.3**.

For further clarification please consult with **NTN** Engineering.

Table 3.2 Life adjustment factor for reliability a_1

Reliability %	L_n	Life adjustment factor for reliability a_1
90	L_{10}	1.00
95	L_5	0.64
96	L_4	0.55
97	L_3	0.47
98	L_2	0.37
99	L_1	0.25
99.2	$L_{0.8}$	0.22
99.4	$L_{0.6}$	0.19
99.6	$L_{0.4}$	0.16
99.8	$L_{0.2}$	0.12
99.9	$L_{0.1}$	0.093
99.92	$L_{0.08}$	0.087
99.94	$L_{0.06}$	0.080
99.95	$L_{0.05}$	0.077

Table 3.3 Treatment for dimensional stabilization

Code	Max. operating temperature °C	Life adjustment factor for special bearing properties a_2
TS2	160	1.00
TS3	200	0.73
TS4	250	0.48

Please consult **NTN** Engineering for life adjustment factor for special bearing properties (a_2) when using dimensional stabilization treatment combined with any specialty bearing material.

3.3.3 Life adjustment factor for operating conditions a_3

Life adjustment factor for operating conditions a_3 is used to compensate for when lubrication condition worsens due to a rise in temperature or rotational speed, lubricant deteriorates or it becomes contaminated with foreign matter.

Generally speaking, when lubricating conditions are satisfactory, the a_3 factor has a value of 1.0; and when lubricating conditions are exceptionally favorable, and all other operating conditions are normal, a_3 can have a value greater than 1.0. The factor a_3 may be less than 1.0 due to the following cases:

- Dynamic viscosity of lubrication is too low for bearing operating temperature (13 mm²/s or less for ball bearings, 20 mm²/s or less for roller bearings as a standard)
- Rotational speed is particularly low (when the product of pitch diameter D_{pw} mm and rotational speed n min^{-1} is $D_{pw} \cdot n$ < 10 000)
- Lubricant contaminated with foreign matter or moisture

If using a special operating condition, consult with **NTN** Engineering.

The operating life may be also shortened by misalignment and operating clearance but these operating conditions are not accounted for by the a_3 factor. (See sections "3.7 Misalignment angle (installation error) and life" and "3.8 Clearance and life.")

Even if a_2 > 1 is used for specialty bearings made of enhanced materials or produced by special manufacturing methods, a_2 x a_3 < 1 is used if lubricating conditions are not favorable.

When an excessively heavy load is applied, harmful plastic distortion may result at the contact surfaces between the rolling elements and raceways. The formulae for determining basic rating life (3.1, 3.2, and 3.6) do not apply if P_r exceeds either C_{0r} (basic static load rating) or 0.5 C_r for radial bearings, or if P_a exceeds 0.5 C_a for thrust bearings.

3.4 Modified rating life

3.4.1 Background

Adjusted rating life L_{na} of bearings is as shown in formula (3.6). System conditions corresponding to a_2 and a_3 are considered independently in that approach. However, it is desirable to consider the integrated system as a whole, resulting in adoption of ISO281:2007. This approach considers **life modification factor a_{ISO}**, which provides a more practical method to consider the influence of lubrication, contamination and fatigue load on bearing life. Based on these decisions in ISO 281, JIS B 1518 was similarly revised in 2013.

Modified rating life L_{nm} using life modification factor a_{ISO} can be obtained by formula (3.7).

$$L_{nm} = a_1 \cdot a_{ISO} \cdot L_{10} \quad \cdots\cdots\cdots\cdots (3.7)$$

3.4.2 Life modification factor a_{ISO}

The life modification factor, a_{ISO}, is a function of lubrication, contamination, material characteristics, and load as shown in formula 3.8.

$$a_{ISO} = f\left(\frac{e_c C_u}{P}, \kappa\right) \quad \cdots\cdots\cdots\cdots (3.8)$$

Where:

C_u : Fatigue load limit

The fatigue load limit is a load applied on bearings that results in the fatigue limit stress at the maximum loaded contact within the raceway. This depends on the bearing type, internal specifications, quality, and material strength. In ISO 281:2007, 1.5GPa is recommended as contact stress corresponding to C_u for the bearings made of commonly used high quality material and good manufacturing quality. The fatigue load limit values with respect to the **NTN** bearing numbers are specified in each specification table.

e_c : Contamination factor

The presence of hard particle contaminants in the lubricant (oil) have the potential to form indentations on the raceway surface, resulting in surface initiated damage and in reduction in bearing life. Contamination factor e_c considers this and depends on the level of contamination, bearing size, and lubricant viscosity (oil film thickness). As shown in **Table 3.4**, approximate values are determined by the bearing size (may be substituted by rolling element pitch diameter D_{pw}, average bearing diameter $(d + D)/2$), filtration and seal structures (including presence of pre-washing).

κ : Viscosity ratio

Bearings are used on the assumption that the rolling contact surface is separated by the lubricant. However, when the viscosity of the lubricant is low, separation becomes insufficient and metal to metal contact occurs, causing surface initiated damage. Viscosity ratio κ considers this effect and is represented by formula (3.9) by the ratio of dynamic viscosity ν in use with respect to reference dynamic viscosity ν_1 of the lubricant.

$$\kappa = \nu / \nu_1 \quad \cdots\cdots\cdots\cdots (3.9)$$

Reference dynamic viscosity ν_1 depends on rotation speed n and size (D_{pw}), and can be obtained by **Fig. 3.2** or formula (3.10) and formula (3.11).

Table 3.4 Value of contamination factor e_c

Level of contamination	e_c D_{pw}< 100mm	e_c D_{pw}≧ 100mm
Extreme cleanliness Particle size of the order of lubricant film thickness; laboratory conditions	1	1
High cleanliness Oil filtered through extremely fine filter; conditions typical of bearing greased for life and sealed	0.8~0.6	0.9~0.8
Normal cleanliness Oil filtered through fine filter; conditions typical of bearings greased for life and shielded	0.6~0.5	0.8~0.6
Slight contamination Slight contamination in lubricant	0.5~0.3	0.6~0.4
Typical contamination Conditions typical of bearings without integral seals; course filtering; wear particles and ingress from surroundings	0.3~0.1	0.4~0.2
Severe contamination Bearing environment heavily contaminated and bearing arrangement with inadequate sealing	0.1~0	0.1~0
Very severe contamination	0	0

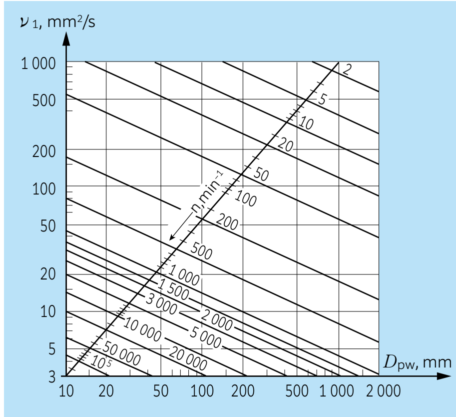


Fig. 3.2 Diagram for reference dynamic viscosity ν_1

In the case of $n < 1\,000\text{min}^{-1}$,

$$\nu_1 = 45\,000\, n^{-0.83} D_{pw}^{-0.5} \quad \cdots\cdots (3.10)$$

In the case of $n \geqq 1\,000\text{min}^{-1}$,

$$\nu_1 = 4\,500\, n^{-0.5} D_{pw}^{-0.5} \quad \cdots\cdots (3.11)$$

Fig. 3.3 shows the relationship among C_u/P, e_c, κ and, a_{ISO} of radial ball bearings. Using the figure has the following restrictions:

1) For practical use, the life modification factor shall be limited $a_{ISO} \leq 50$.
2) In the case of $\kappa > 4$, $\kappa = 4$ shall be assumed. The same approach does not apply in the case of $\kappa < 0.1$.

Diagrams for radial roller bearings, thrust ball bearings, and thrust roller bearing have also been presented (**Figs. 3.4 to 3.6**). The diagrams can be applied regardless of lubrication types; however, for grease lubrication, special additives, and special rotating behaviors, consult with **NTN** Engineering.

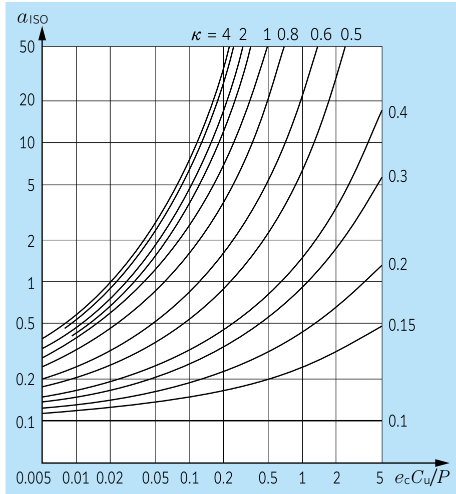


Fig. 3.3 Life modification factor a_{ISO} (radial ball bearing)

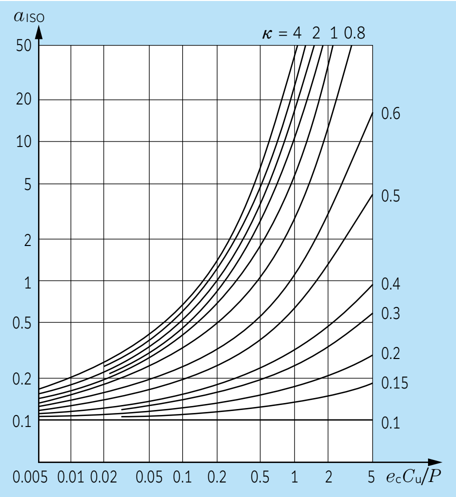


Fig. 3.4 Life modification factor a_{ISO} (radial roller bearing)

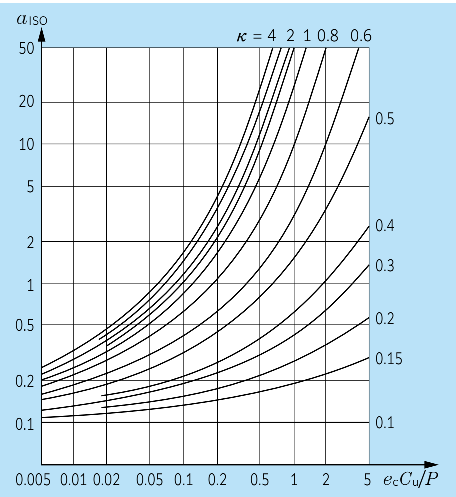


Fig. 3.5 Life modification factor a_{ISO} (thrust ball bearing)

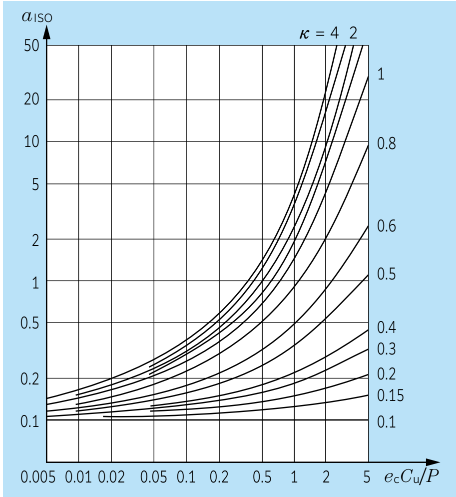


Fig. 3.6 Life modification factor a_{ISO} (thrust roller bearing)

3.4.3 Applicable bearings of modified rating life

Fatigue load limit C_u used for the calculation of life modification factor a_{ISO} depends on the bearing materials. **NTN** bearings that have undergone standard through hardening (immersion quenching) and is made of bearing steel, the fatigue load limit value with respect to each bearing number is specified in each dimension table, and a_{ISO} can be applied.

3.5 Machine applications and requisite life

When selecting a bearing, it is essential that the requisite life of the bearing be established in relation to the operating conditions. The requisite life of the bearing is usually determined by the type of machine in which the bearing will be used, and duration of service and operational reliability requirements. A general guide to these requisite life criteria is shown in **Table 3.5**.

When determining bearing size, the fatigue life of the bearing is an important factor; however, besides bearing life, the strength and rigidity of the shaft and housing must also be taken into consideration.

Table 3.5 Machine application and requisite life (reference)

Service classification	Machine application and requisite life L_{10h} ×10³ hours				
	Up to 4	4 to 12	12 to 30	30 to 60	60 or more
Machines used for short periods or used only occasionally	Household appliances Electric hand tools	Farm machinery Office equipment			
Short period or intermittent use, but with high reliability requirements	Medical appliances Measuring instruments	Home air-conditioning motor Construction equipment Elevators Cranes	Crane (sheaves)		
Machines not in constant use, but used for long periods	Automobiles Two-wheeled vehicles	Small motors Buses/trucks General gear drives Woodworking machines	Machine spindles Industrial motors Crushers Vibrating screens	Main gear drives Rubber/plastic Calender rolls Printing machines	
Machines in constant use over 8 hours a day		Roll neck of steel mill Escalators Conveyors Centrifuges	Railway vehicle axles Air conditioners Large motors Compressor pumps	Locomotive axles Traction motors Mine hoists Pressed flywheels	Papermaking machines Propulsion equipment for marine vessels
24 hour continuous operation, non-interruptible					Water supply equipment Mine drain pumps/ventilators Power generating equipment

3.6 Weibull distribution and life adjustment factor for reliability

As described in "3.2 Basic rating life and basic dynamic load rating," a group of seemingly identical bearings when subjected to an identical load and operating conditions may exhibit a wide variation in their durability. In general, this variation is known to follow the "Weibull distribution," and the basic theory is constructed on the premise that the bearing operating life follows the Weibull distribution also regarding the life calculation formulae (3.1) and (3.2) and the calculation formula of the basic dynamic load rating C.

As an index representing the variation of the Weibull distribution, there is a coefficient called a Weibull slope. A value 10/9 for ball bearings and 9/8 for roller bearings are given in the basic life calculation theory of ISO and JIS. According to this, for example, for a deep groove ball bearing, a difference of 5 times or more is generated between the L_{10} life of 90% reliability and the L_{50} life of 50% reliability.

In some applications where a bearing is used, a life study with reliability exceeding 90% may be required, and in such a case, a life adjustment factor for reliability a_1 is used. In the latest ISO (ISO 281:2007) and JIS (JIS B 1518:2013), a_1 values were updated based on measured test data (see **Fig. 7**). **Table 3.2** shows the latest a_1 values after review.

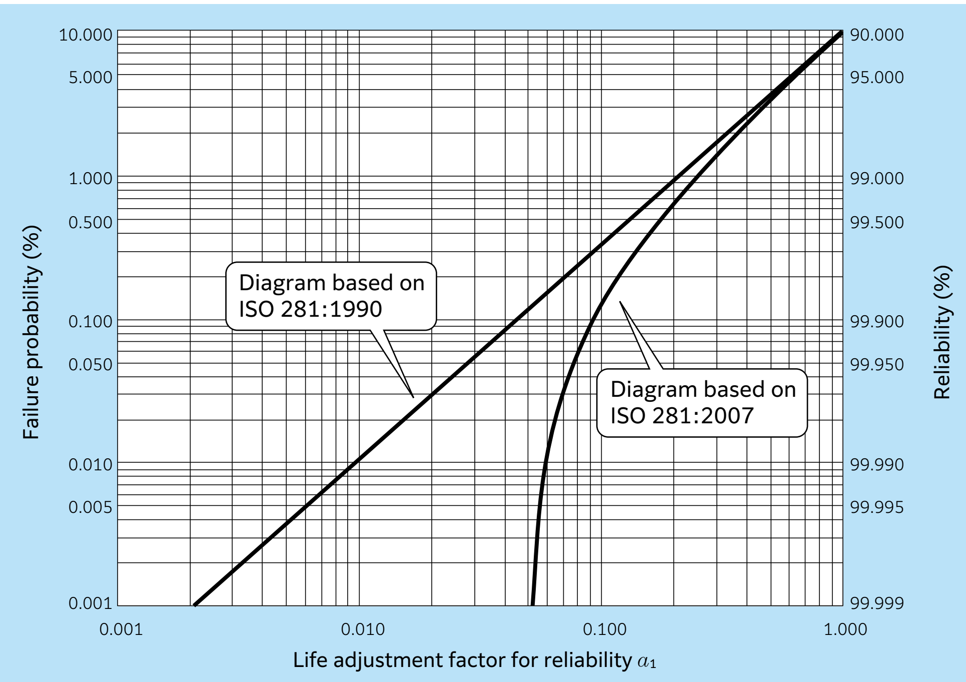


Fig. 7 Life adjustment factor for reliability a_1

3.7 Misalignment angle (installation error) and life

A lack of accuracy and/or rigidity of the shaft or housing can cause misalignment between the bearing inner and outer rings similar to an externally applied moment load.

The bearing operating life calculation in the case of receiving a moment load cannot be obtained by the commonly used $L = (C_r / P_r)^{P}$, which is generally used, and it is necessary to obtain it considering the internal design, clearance, etc. of each bearing.

Since the life decrease rate differs depending on the internal clearance, the load condition, and the internal design, it is necessary to calculate the ratio under individual conditions, and the rate cannot be given as a factor in general.

Fig. 3.8 and **Fig. 3.9** show the results of detailed calculation of the relationship between the misalignment angle (installation error) and the life of a deep groove ball bearing and a cylindrical roller bearing.

See **Table 14.6** in section "14. Shaft and housing design" for the rough standard of allowable misalignment and allowable misalignment of each bearing type.

For further clarification please consult with **NTN** Engineering.

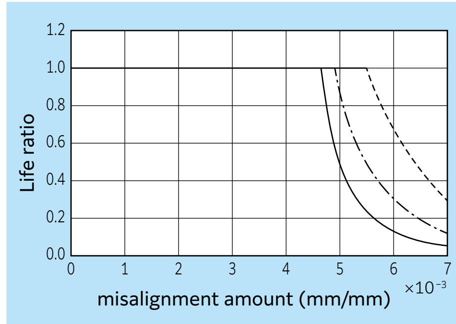


Fig. 3.8 Misalignment angle and life ratio of deep groove ball bearing

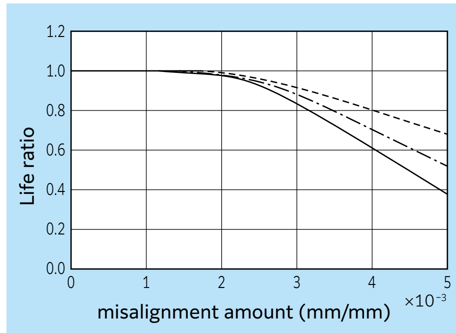
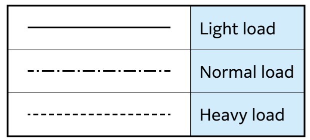


Fig. 3.9 Misalignment angle and life ratio of cylindrical roller bearing



3.8 Clearance and life

It is very difficult to accurately determine what the clearance of a rolling bearing should be in a normal operating state.

When a bearing is subjected to a simple load and full rotation slight clearance is preferable. However, too large of a clearance can cause life deterioration and vibration. In contrast, a negative clearance (preload) can extend the operating life and prevent shaft runout. However, too large of a preload increases friction, temperature rise, lubrication degradation and can cause seizures in extreme cases.

As a general guideline a target of zero operating clearance should be acceptable.

1) Clearance and rolling element load W

(1) In the case of bearing clearance larger than 0 [**Fig. 3.11**], load distribution $\varepsilon < 0.5$ holds. The maximum rolling element load becomes larger than when the bearing clearance is zero [**Fig. 3.10**].

[Load factor ε and conceptual diagram]

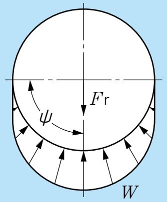


Fig.3.10
$\varepsilon = 0.5$ $\psi = \pm 90°$
Radial clearance 0

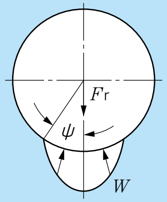


Fig.3.11
$0 < \varepsilon < 0.5$ $0 < \psi < 90°$
There is radial clearance

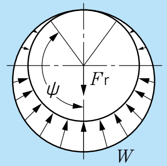


Fig.3.12
$0.5 < \varepsilon < 1$
$90° < \psi < 180°$
Radial preload state,
or large axial load

(2) **Fig. 3.13** shows an ideal graph in which operating in a slightly preloaded condition results in maximum bearing life.

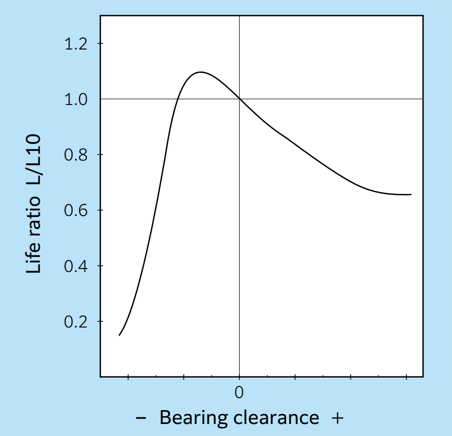


Fig. 3.13 Bearing clearance and life ratio

3.9 Basic static load rating

It has been found through experience that a permanent deformation of 0.0001 times the diameter of the rolling element, occurring at the most heavily stressed contact point between the raceway and the rolling elements, can be tolerated without any subsequent impariment of bearing operation.

Testing indicates the above level of permanent deformation corresponds to a calculated contact stress as shown below. The basic static load rating is defined as the static applied load which results in such a contact stress at the center of the contact patch between the raceway and the rolling element receiving the maximum load.

Roller bearings: 4 000 MPa
Ball bearings
(excluding self-aligning ball bearings): 4 200 MPa
Self-aligning ball bearings: 4 600 MPa

Referred to as "**basic static radial load rating**" for radial bearings and "**basic static axial load rating**" for thrust bearings, the basic static load rating is expressed as C_{0r} or C_{0a} respectively and is provided in the bearing dimensions table.

3.10 Allowable static equivalent load

Generally the static equivalent load which can be permitted (See page A-41) is limited by the basic static load rating as stated in Section 3.9. However, depending on application requirements regarding friction and smooth operation, these limits may be greater or lesser than the basic static load rating.

This is generally determined by taking the safety factor S_0 given in formula (3.12) and guidelines of **Table 3.6** into account.

$$S_0 = C_0 / P_0 \quad \cdots\cdots\cdots (3.12)$$

Where:
S_0: Safety factor
C_0: Basic static load rating, N
Radial bearing: C_{0r}
Thrust bearing: C_{0a}
P_0: Static equivalent load, N
Radial bearing: P_{0r}
Thrust bearing: P_{0a}

Table 3.6 Minimum safety factor values S_0

Operating conditions	Ball bearing	Roller bearing
Applications that require quiet rotation	2	3
Applications subjected to impact loads	1.5	3
Normal rotation applications	1	1.5

Note: 1. For spherical thrust roller bearings, min. S_0 value = 4.
2. For shell needle roller bearings, min. S_0 value = 3. However, for premium shells (see **the catalog: CAT. No. 3029/JE**), min. S_0 value = 2.
3. When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_0 max value.
4. If a large axial load is applied to deep groove ball bearings or angular ball bearings, the contact ellipse may exceed the raceway surface. For more information, please contact **NTN** Engineering.
5. When an AS type raceway washer is used in a thrust bearing, min. S_0 value = 3.

3.11 Allowable axial load

Radial bearings can also receive axial loads, but load is limited depending on the bearing type.

(1) Ball bearing

When an axial load acts on ball bearings, such as deep groove ball bearings and angular contact ball bearings, the contact angle changes with the load. The contact ellipse formed between the ball and the raceway surface may protrude from the groove when the load exceeds the allowable range.

This contact surface has an elliptical shape in which 1/2 the major diameter becomes a as shown in **Fig. 3.14**. The maximum allowable axial load is the maximum applied load in which the contact ellipse does not exceed the shoulder of the raceway groove. It is important to note that the axial load must result in P_{max} < 4200 MPa even if the contact ellipse does not exceed the shoulder of the groove. The allowable axial load differs depending on the bearing internal clearance, groove curvature, and groove shoulder dimension.

When a combination radial and axial load is applied, verify truncation does not occur at the maximum loaded rolling element.

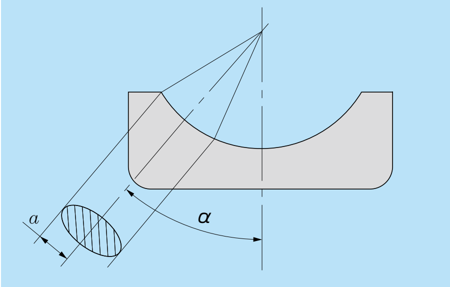


Fig. 3.14 Contact ellipse

(2) Tapered roller bearing (Fig. 3.15)

A tapered roller bearing supports axial load at the raceway surface and at the interface between the roller end face and large end rib. Therefore, the bearing can receive a larger axial force by increasing the contact angle α. However, there are different limits depending on the rotational speed and lubrication conditions because sliding contact occurs between the roller large end face and the large end rib inside face. Generally, the PV value, which is obtained by multiplying the sliding speed to the sliding surface pressure, is checked and calculated by a computer.

For further clarification please consult with **NTN** Engineering.

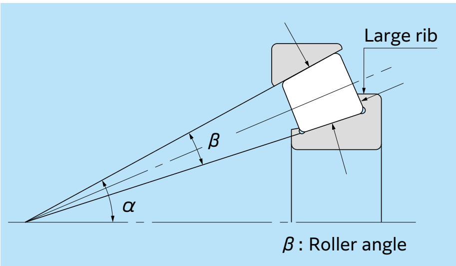


Fig. 3.15 Tapered roller bearings

(3) Cylindrical roller bearings

Cylindrical roller bearings with ribs on the inner and outer rings are capable of simultaneously supporting a certain degree of radial and axial loads. Unlike basic dynamic load ratings which are based on rolling fatigue, allowable axial load is determined by heat generated at the sliding surface between the ends of the rollers and rib which may cause wear and/or seizure. Based on testing and experience, allowable axial load can be estimated using formula (3.13).

$$P_t = k \cdot d^2 \cdot P_z \quad \cdots\cdots (3.13)$$

Where:

P_t : Allowable axial load when rotating N

k : Factor determined by internal design of bearing (see **Table 3.7**)

d : Bearing bore mm

P_z : Allowable surface pressure of rib MPa (see **Fig. 3.16**)

If the axial load is greater than the radial load, the rollers will not rotate properly. The allowable axial load therefore must not exceed the value for $F_{a\,max}$ given in **Table 3.7**.

The following are also important to operate the bearing smoothly under an axial load:

1) Do not make the internal radial clearance any larger than necessary because it may affect life and abrasion between the raceway surface and the roller.
2) Use lubricant with an extreme pressure additive to suppress heat generation, seizure, and abrasion between the roller end surface and the rib.
3) Make the shoulder of the housing and shaft high enough for the rib of the bearing to prevent it from being damaged.
4) If the bearing is to support an extreme axial load, mounting precision should be improved and the bearing should be rotated slowly before actual use.

If large cylindrical roller bearings (bore of 300 mm or more) are to support an axial load or moment load simultaneously, please contact **NTN** Engineering.

NTN Engineering also offers cylindrical roller bearings for high axial loads (HT type). For details, please contact **NTN** Engineering.

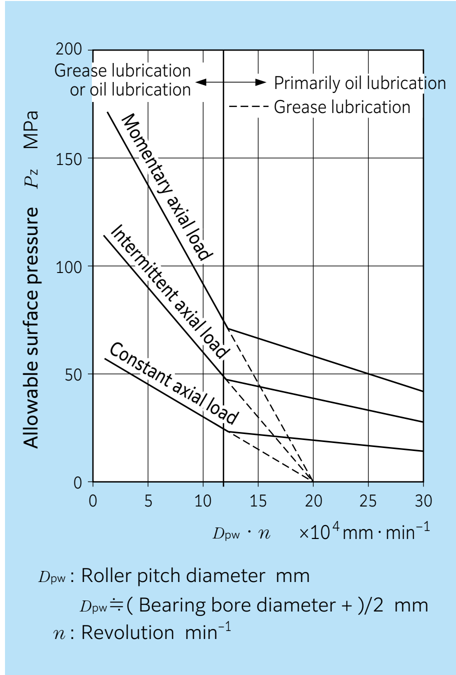


Fig. 3.16 Allowable surface pressure of rib

Table 3.7 Factor k values and allowable axial load ($F_{a\,max}$)

Bearing series	k	$F_{a\,max}$
NJ, NUP10 NJ, NUP, NF, NH2, NJ, NUP, NH22	0.040	$0.4F_r$
NJ, NUP, NF, NH3, NJ, NUP, NH23	0.065	$0.4F_r$
NJ, NUP, NH2EA (E) NJ, NUP, NH22EA (E)	0.050	$0.4F_r$
NJ, NUP, NH3EA (E) NJ, NUP, NH23EA (E)	0.080	$0.4F_r$
NJ, NUP, NH4,	0.100	$0.4F_r$
SL01-48	0.022	$0.2F_r$
SL01-49	0.034	$0.2F_r$
SL04-50	0.044	$0.2F_r$

Note: Type EA and type E have the same value.

3.12 Review of basic dynamic load ratings

As a result of continuous improvement related to material cleanliness, and production techniques, years of in-house durability testing has confirmed **NTN** bearings produced today have a longer operating life compared with past products. Based on this bearing life test data, the basic dynamic load ratings of ball and roller bearings were reviewed and updated to more accurately reflect true bearing performance.

The basic dynamic load ratings for many **NTN** products have been formally increased and can be found in the dimensional tables for each bearing type within this catalog.

* Some bearings use the same basic dynamic load rating as conventional products.

3.13 Bearing life calculation tool

The basic rating life of bearings can be calculated using the bearing technical calculation tool on the **NTN** website (https://www.ntnglobal.com/tool/calc/).

4. Bearing load calculation

To compute bearing loads, the forces which act on the shaft being supported by the bearing must be determined. Loads which act on the shaft and its related parts include weight of the rotating components, load produced when the machine performs work, and load produced by transmission of dynamic force. These can be mathematically calculated, but calculation is difficult in many cases.

A method of calculating loads that act upon shafts that convey dynamic force, which is the primary application of bearings, is provided herein.

4.1 Load acting on shafts

4.1.1 Load factor

There are many instances where the actual operational shaft load is much greater than the theoretically calculated load, due to shock. This actual shaft load can be estimated by using formula (4.1).

$$K = f_w \cdot K_c \cdots\cdots (4.1)$$

Where:

K : Actual shaft load N
f_w : Load factor (**Table 4.1**)
K_c : Theoretically calculated value N

Table 4.1 Load factor f_w

Amount of shock	f_w	Machine application examples
Very little or no shock	1.0 to 1.2	Electric machines, machine tools, measuring instruments.
Light shock	1.2 to 1.5	Railway vehicles, automobiles, rolling mills, metal working machines, paper making machines, printing machines, aircraft, textile machines, electrical units, office machines.
Heavy shock	1.5 to 3.0	Crushers, agricultural equipment, construction equipment, cranes.

4.1.2 Gear load

The loads operating on gears can be divided into three main types according to the direction in which the load is applied; i.e. tangential (K_t), radial (K_s), and axial (K_a). The magnitude and direction of these loads differ according to the types of gears involved. The following refers to the calculation methods of loads acting on four types of gears.

(1) Loads acting on parallel shaft gears

The forces acting on spur gears and helical gears are depicted in **Fig. 4.1** to **Fig. 4.3**.

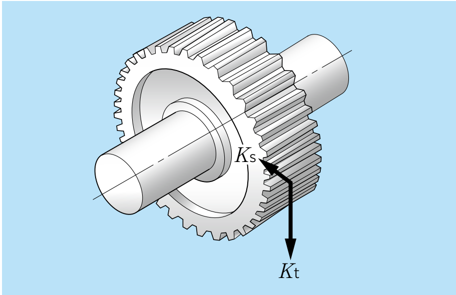


Fig. 4.1 Spur gear loads

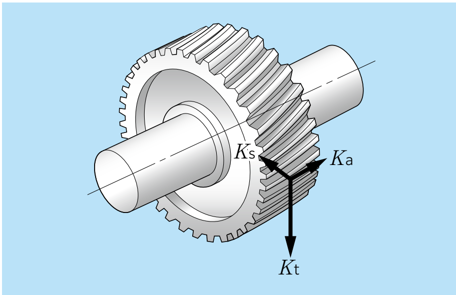


Fig. 4.2 Helical gear loads

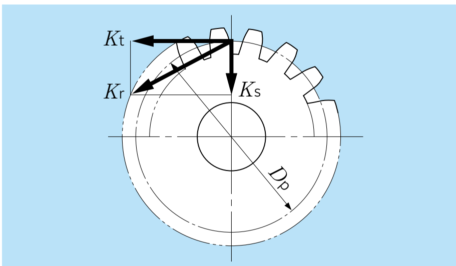


Fig. 4.3 Radial resultant forces

Loads acting on gears are obtained from formulas (4.2) to (4.6).

Equation 4.2 describes the gear load in the tangential direction when the shaft input torque is known

$$K_t = \frac{2T}{D_p} \cdots\cdots (4.2)$$

Equation 4.3 describes the gear load in the tangential direction when the transmitted power is known

$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \cdots\cdots (4.3)$$

$$K_s = K_t \cdot \tan\alpha \text{ (Spur gear)} \cdots\cdots (4.4a)$$

$$= K_t \cdot \frac{\tan\alpha}{\cos\beta} \text{ (Helical gear)} \cdots\cdots (4.4b)$$

$$K_r = \sqrt{K_t^2 + K_s^2} \cdots\cdots (4.5)$$

$$K_a = K_t \cdot \tan\beta \text{ (Helical gear)} \cdots\cdots (4.6)$$

Where:

K_t : Tangential gear load (tangential force), N
K_s : Radial gear load (separating force), N
K_r : Right angle shaft load (resultant force of tangential force and separating force), N
K_a : Parallel load on shaft, N
T : Input torque, N · mm
H : Transmitted force, kW
n : Rotational speed min^{-1}
D_p : Gear pitch circle diameter, mm
α : Gear pressure angle, deg
β : Helix angle, deg

Because the actual gear load also contains vibrations and shock loads as well, the theoretical load obtained by the above formula can also be adjusted by the gear factor f_z as shown in **Table 4.2**.

Table 4.2 Gear factor f_z

Gear type	f_z
Precision ground gears (Pitch and tooth profile errors of less than 0.02mm)	1.05 to 1.1
Ordinary machined gears (Pitch and tooth profile errors of less than 0.1mm)	1.1 to 1.3

(2) Loads acting on cross shafts

Gear loads acting on straight tooth bevel gears and spiral bevel gears on cross shafts are shown in **Figs. 4.4** and **4.5**. The calculation methods for these gear loads are shown in **Table 4.3**.

Herein, to calculate gear loads for straight bevel gears, the helix angle β = 0.

The symbols and units used in **Table 4.3** are as follows:

K_t : Tangential gear load (tangential force), N
K_s : Radial gear load (separating force), N
K_a : Parallel shaft load (axial load), N
H : Transmitted power, kW
n : Rotational speed min^{-1}
D_{pm} : Mean pitch circle diameter, mm
α : Gear pressure angle, deg
β : Helix angle, deg
δ : Pitch cone angle, deg

Because the two shafts intersect, pinions and gears have the relationship of formula (4.7) and formula (4.8).

$$K_{sp} = K_{ag} \cdots\cdots (4.7)$$

$$K_{ap} = K_{sg} \cdots\cdots (4.8)$$

Where:

K_{sp} , K_{sg} : Pinion and Gear separating force, N
K_{ap} , K_{ag} : Pinion and Gear axial load, N

For spiral bevel gears, the direction of the load varies depending on the direction of the helix angle, the direction of rotation, and which side is the driving side or the driven side. The directions for the separating force (K_s) and axial load (K_a) shown in **Fig. 4.5** are positive directions. The direction of rotation and the helix angle direction are defined as viewed from the large end of the gear. The gear rotation direction in **Fig. 4.5** is assumed to be clockwise (right).

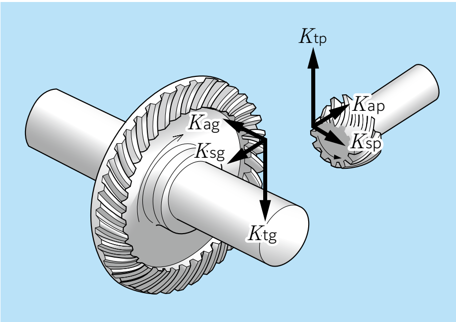


Fig. 4.4 Loads on bevel gears

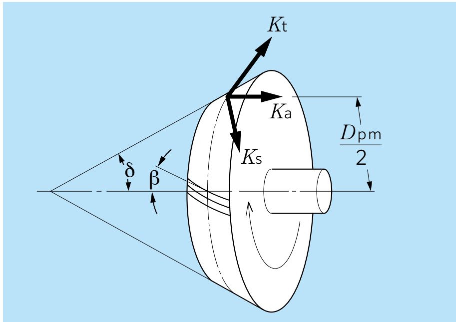


Fig. 4.5 Bevel gear diagram

Table 4.3 Loads acting on bevel gears

Types of load	Rotation direction	Clockwise	Counter clockwise	Clockwise	Counter clockwise
	Helix direction	Right	Left	Left	Right
Tangential load (tangential force) K_t		$K_t=\frac{19.1\times10^6\cdot H}{D_{pm}\cdot n}$			
Radial load (separation force) K_s	Driving side	$K_s=K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta}+\tan\beta\sin\delta\right]$		$K_s=K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta}-\tan\beta\sin\delta\right]$	
	Driven side	$K_s=K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta}-\tan\beta\sin\delta\right]$		$K_s=K_t\left[\tan\alpha\frac{\cos\delta}{\cos\beta}+\tan\beta\sin\delta\right]$	
Parallel load on gear shaft (axial load) K_a	Driving side	$K_a=K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta}-\tan\beta\cos\delta\right]$		$K_a=K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta}+\tan\beta\cos\delta\right]$	
	Driven side	$K_a=K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta}+\tan\beta\cos\delta\right]$		$K_a=K_t\left[\tan\alpha\frac{\sin\delta}{\cos\beta}-\tan\beta\cos\delta\right]$	

(3) Load acting on hypoid gears

A hypoid gear is a spiral bevel gear that transmits power by offset shafts. **Fig. 4.6** shows the load acting on a hypoid gear, and **Table 4.4** shows the calculation method.

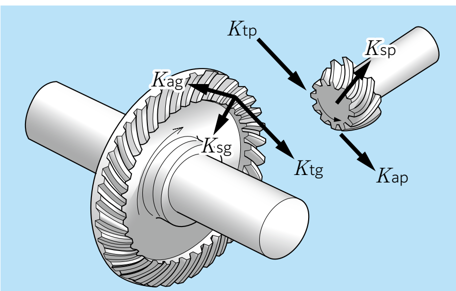


Fig. 4.6

Where:

K_t : Tangential gear load (tangential force), N
K_s : Radial gear load (separating force), N
K_a : Parallel shaft load (axial load), N
H : Transmitted force, kW
n : Rotational speed min^{-1}
D_p : Gear mean pitch circle diameter, mm
α : Gear pressure angle, deg
β : Helix angle, deg
δ_1 : Tooth tip cone angle, deg
δ_2 : Tooth bottom cone angle, deg
*The driving shaft has a subscript p, and the driven shaft has a subscript g.

Table 4.4 Formula of load acting on hypoid gears

Types of load	Rotation direction	Clockwise	Counter clockwise	Clockwise	Counter clockwise
	Helix direction	Right	Left	Left	Right
Tangential load (tangential force) K_t	Driving shaft	Formula (4.9)		Formula (4.10)	
	Driven shaft				
Radial load (separation force) K_s	Driving shaft	Formula (4.11)		Formula (4.12)	
	Driven shaft	Formula (4.13)		Formula (4.14)	
Parallel load on gear shaft (axial load) K_a	Driving shaft	Formula (4.15)		Formula (4.16)	
	Driven shaft	Formula (4.17)		Formula (4.18)	

$$K_{tp}=\frac{19.1\times10^6H}{D_{pmp}\ n_p}\ \cdots\cdots\cdots\cdots (4.9)$$

$$K_{tg}=\frac{19.1\times10^6H}{D_{pmg}\ n_g}=\frac{\cos\beta_g}{\cos\beta_p}K_{tp}\cdots (4.10)$$

$$K_{sp}=\frac{K_{tp}}{\cos\beta_p}(\tan\alpha_p\cos\delta_{p1}+\sin\beta_p\sin\delta_{p1})\cdots (4.11)$$

$$K_{sp}=\frac{K_{tp}}{\cos\beta_p}(\tan\alpha_p\cos\delta_{p1}-\sin\beta_p\sin\delta_{p1})\cdots (4.12)$$

$$K_{sg}=\frac{K_{tg}}{\cos\beta_g}(\tan\alpha_g\cos\delta_{g2}-\sin\beta_g\sin\delta_{g2})\cdots (4.13)$$

$$K_{sg}=\frac{K_{tg}}{\cos\beta_g}(\tan\alpha_g\cos\delta_{g2}+\sin\beta_g\sin\delta_{g2})\cdots (4.14)$$

$$K_{ap}=\frac{K_{tp}}{\cos\beta_p}(\tan\alpha_p\sin\delta_{p1}-\sin\beta_p\cos\delta_{p1})\cdots (4.15)$$

$$K_{ap}=\frac{K_{tp}}{\cos\beta_p}(\tan\alpha_p\sin\delta_{p1}+\sin\beta_p\cos\delta_{p1})\cdots (4.16)$$

$$K_{ag}=\frac{K_{tg}}{\cos\beta_g}(\tan\alpha_g\sin\delta_{g2}+\sin\beta_g\cos\delta_{g2})\cdots (4.17)$$

$$K_{ag}=\frac{K_{tg}}{\cos\beta_g}(\tan\alpha_g\sin\delta_{g2}-\sin\beta_g\cos\delta_{g2})\cdots (4.18)$$

(4) Load acting on worm gears

A worm gear is a gear made by combining a worm (screw gear) and a worm wheel (helical gear). The gear direction differs depending on the rotation direction and the screw direction (right screw, left screw) of the worm shaft. **Fig. 4.8** shows the direction of loads acting on the gear, and **Table 4.5** shows the calculation method of the loads.

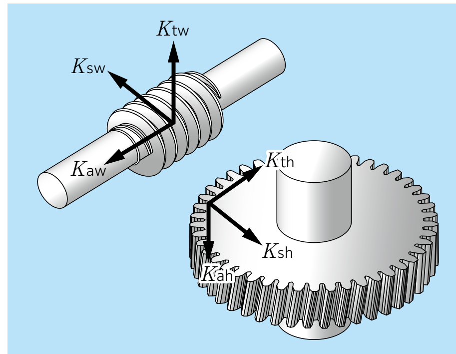


Fig. 4.7 Worm gears

K_t : Tangential gear load (tangential force), N
K_s : Radial gear load (separating force), N
K_a : Parallel shaft load (axial load), N
H : Transmitted force, kW
n : Rotational speed min^{-1}
D_p : Gear mean pitch circle diameter, mm
α : Gear pressure angle, deg
γ : Worm lead angle, deg
*The worm shaft has a subscript w, and the worm gear has a subscript h.

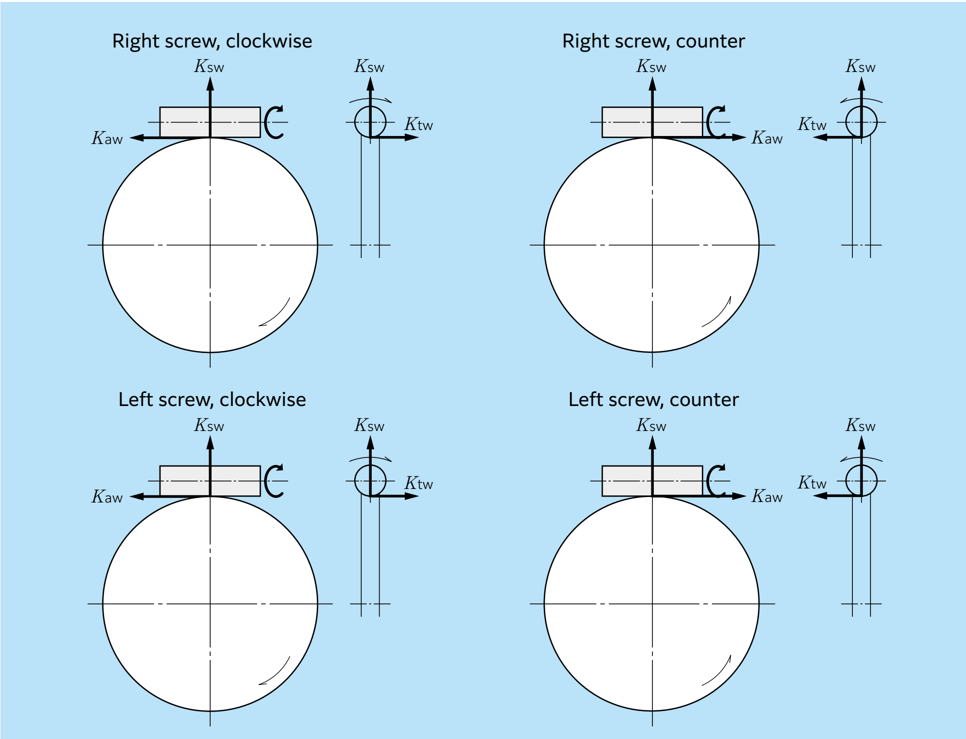


Fig. 4.8 Load acting on worm gears

Table 4.5 Calculation method of load acting on worm gears

Gear type	Worm shaft	Worm gear
Tangential load (tangential force) K_t	$K_{tw}=\dfrac{19.1\times10^{6} H}{n D_{pw}}$	$K_{th}=\dfrac{K_{tw}}{\tan\gamma}=K_{aw}$
Radial load (separating force) K_s	$K_{sw}=\dfrac{K_{tw}\tan\alpha}{\tan\gamma}$	$K_{sh}=\dfrac{K_{tw}\tan\alpha}{\tan\gamma}=K_{sw}$
Parallel load on gear shaft (axial load) K_a	$K_{aw}=\dfrac{K_{tw}}{\tan\gamma}$	$K_{ah}=K_{tw}$

4.1.3 Chain / belt shaft load

The tangential loads on sprockets or pulleys when power (load) is transmitted by means of chains or belts can be calculated by formula (4.19) as shown in **Fig. 4.9**.

$$K_t=\frac{19.1\times10^{6}\cdot H}{D_p\cdot n}\quad\cdots\cdots\cdots\cdots\quad(4.19)$$

Where:

K_t : Sprocket/pulley tangential load, N
H : Transmitted power, kW
D_p : Sprocket/pulley pitch diameter, mm

For belt drives, an initial tension is applied to give sufficient constant operating tension on the belt and pulley.

Taking this tension into account, the radial loads acting on the pulley are expressed by formula (4.20). For chain drives, the same formula can also be used if vibrations and shock loads are taken into consideration.

$$K_r=f_b\cdot K_t\quad\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots(4.20)$$

Where:

K_r : Sprocket or pulley radial load, N
f_b : Chain or belt factor (**Table 4.6**)

Table 4.6 chain or belt factor f_b

Chain or belt type	f_b
Chain (single)	1.2 to 1.5
V-belt	1.5 to 2.0
Timing belt	1.1 to 1.3
Flat belt (w / tension pulley)	2.5 to 3.0
Flat belt	3.0 to 4.0

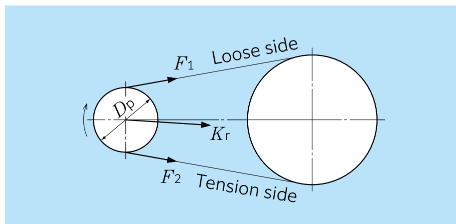


Fig. 4.9 Chain / belt loads

4.2 Bearing load distribution

For shafting, the static tension is considered to be supported by the bearings, and any loads acting on the shafts are distributed to the bearings. For example, in the gear shaft assembly depicted in **Fig. 4.10**, the applied bearing loads can be found by using formulas (4.21) and (4.22).

This example is a simple case, but in reality, many of the calculations are quite complicated.

$$F_{rA}=\frac{a+b}{b}F_{\mathrm{I}}+\frac{d}{c+d}F_{\mathrm{II}}\quad\cdots\cdots\cdots\cdots(4.21)$$

$$F_{rB}=-\frac{a}{b}F_{\mathrm{I}}+\frac{c}{c+d}F_{\mathrm{II}}\quad\cdots\cdots\cdots\cdots(4.22)$$

Where:

F_{rA} : Radial load on bearing A, N
F_{rB} : Radial load on bearing B, N
$F_{\mathrm{I}}, F_{\mathrm{II}}$: Radial load on shaft, N

If directions of radial load differ, the vector sum of each respective load must be determined.

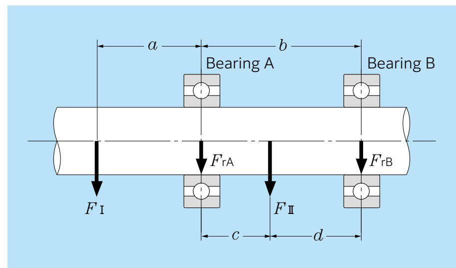


Fig. 4.10

4.3 Mean load

The load on bearings used in machines under normal circumstances will, in many cases, fluctuate according to a fixed time period or planned operation schedule. The load on bearings operating under such conditions can be converted to a mean load (F_m). This is a load which gives bearings the same life they would have under constant operating conditions.

(1) Fluctuating stepped load (Fig. 4.11)

The mean bearing load, F_m, for stepped loads is calculated from formula (4.23). $F_1, F_2 \cdots\cdots F_n$ are the loads acting on the bearing; $n_1, n_2 \cdots\cdots n_n$ and $t_1, t_2 \cdots\cdots t_n$ are the bearing speeds and operating times respectively.

$$F_m = \left[\frac{\Sigma (F_i{}^p n_i t_i)}{\Sigma (n_i t_i)}\right]^{1/p} \cdots\cdots\cdots\cdots\cdots (4.23)$$

Where:

$p = 3$ For ball bearings

$p = 10/3$ For roller bearings

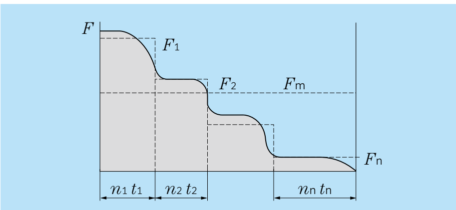


Fig. 4.11 Stepped load

(2) Continuously fluctuating load (Fig. 4.12)

Where it is possible to express the function $F(t)$ in terms of load cycle t_o and time t, the mean load is found by using formula (4.24).

$$F_m = \left[\frac{1}{t_o}\int_o^{t_o} F(t)^p dt\right]^{1/p} \cdots\cdots\cdots\cdots\cdots (4.24)$$

Where:

$p = 3$ For ball bearings

$p = 10/3$ For roller bearings

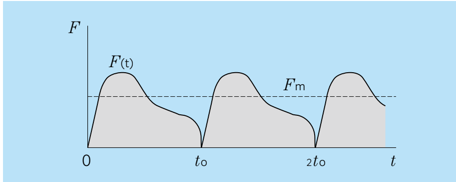


Fig. 4.12 Load that fluctuated as function of time

(3) Linear fluctuating load (Fig. 4.13)

The mean load, F_m, can be approximated by formula (4.25).

$$F_m = \frac{F_{min} + 2F_{max}}{3} \cdots\cdots\cdots\cdots\cdots\cdots (4.25)$$

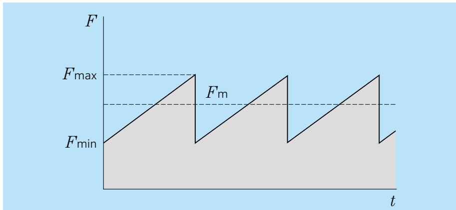


Fig. 4.13 Linear fluctuating load

(4) Sinusoidal fluctuating load (Fig. 4.14)

The mean load, F_m, can be approximated by formulas (4.26) and (4.27).

Case (a) $F_m = 0.75\, F_{max} \cdots\cdots\cdots\cdots\cdots\cdots (4.26)$

Case (b) $F_m = 0.65\, F_{max} \cdots\cdots\cdots\cdots\cdots\cdots (4.27)$

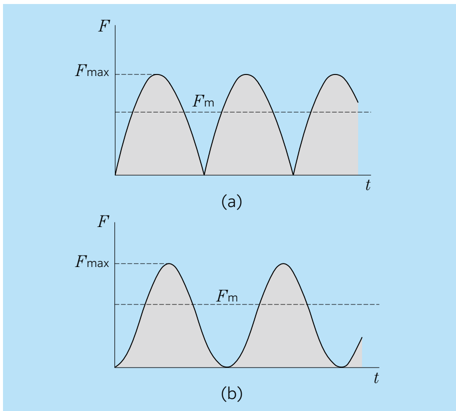


Fig. 4.14 Sinusoidal variable load

4.4 Equivalent load

4.4.1 Dynamic equivalent load

When both dynamic radial loads and dynamic axial loads act on a bearing at the same time, **the hypothetical load acting on the center of the bearing which gives the bearings the same life** as if they had only a radial load or only an axial load **is called the dynamic equivalent load**.

For radial bearings, this load is expressed as pure radial load and is called the dynamic equivalent radial load. For thrust bearings, it is expressed as pure axial load, and is called the dynamic equivalent axial load.

(1) Dynamic equivalent radial load

The dynamic equivalent radial load is expressed by formula (4.28).

$$P_r = XF_r + YF_a \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.28)$$

Where:

P_r : Dynamic equivalent radial load, N

F_r : Actual radial load, N

F_a : Actual axial load, N

X : Radial load factor

Y : Axial load factor

The values for X and Y are listed in the bearing tables.

(2) Dynamic equivalent axial load

As a rule, standard thrust bearings with α contact angle of 90° cannot carry radial loads. However, self-aligning thrust roller bearings can accept some radial load. The dynamic equivalent axial load for these bearings is given in formula (4.29).

$$P_a = F_a + 1.2F_r \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.29)$$

Where:

P_a : Dynamic equivalent axial load, N

F_a : Actual axial load, N

F_r : Actual radial load, N

Provided that $F_r / F_a \leqq 0.55$ only.

4.4.2 Static equivalent load

The static equivalent load is **a hypothetical load which would cause the same total permanent deformation at the most heavily stressed contact point between the rolling elements and the raceway** as under actual load conditions; that is when both static radial loads and static axial loads are simultaneously applied to the bearing.

For radial bearings this hypothetical load refers to pure radial loads, and for thrust bearings it refers to pure centric axial loads. These loads are designated static equivalent radial loads and static equivalent axial loads respectively.

(1) Static equivalent radial load

For radial bearings the static equivalent radial load can be found by using formula (4.30) or (4.31). The greater of the two resultant values is always taken for P_{0r}.

$$P_{0r} = X_0 F_r + Y_0 F_a \cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.30)$$

$$P_{0r} = F_r \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.31)$$

Where:

P_{0r} : Static equivalent radial load, N

F_r : Actual radial load, N

F_a : Actual axial load, N

X_0 : Static radial load factor

Y_0 : Static axial load factor

The values for X_0 and Y_0 are given in the respective bearing tables.

(2) Static equivalent axial load

For spherical thrust roller bearings the static equivalent axial load is expressed by formula (4.32).

$$P_{0a} = F_a + 2.7F_r \cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.32)$$

Where:

P_{0a} : Static equivalent axial load, N

F_a : Actual axial load, N

F_r : Actual radial load, N

Provided that $F_r / F_a \leqq 0.55$ only.

4.4.3 Load calculation for angular contact ball bearings and tapered roller bearings

For angular contact ball bearings and tapered roller bearings the pressure cone apex (load center) is located as shown in **Fig. 4.15**, and their values are listed in the bearing tables.

When radial loads act on these types of bearings a component force is induced in the axial direction. For this reason, these bearings are used in pairs. For load calculation this component force must be taken into consideration and is expressed by formula (4.33).

$$F_a=\frac{0.5F_r}{Y} \quad \cdots\cdots\cdots\cdots\cdots\cdots (4.33)$$

Where:

F_a : Axial component force, N
F_r : Actual radial load, N
Y : Axial load factor

The axial loads for these bearing pairs are given in **Table 4.7.**

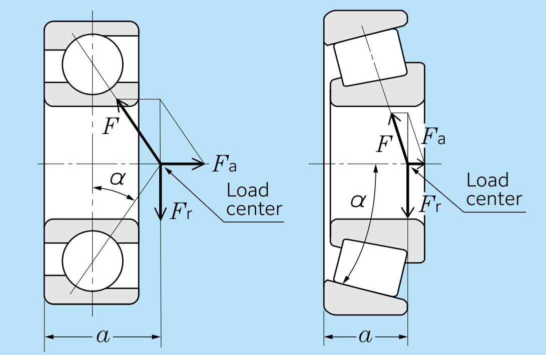
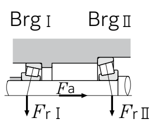
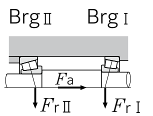
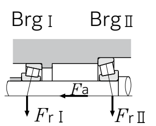
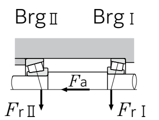


Fig. 4.15 Pressure cone apex and axial component force

Table 4.7 Bearing arrangement and equivalent load

Load center	Load conditions	Axial load
Rear 	$\frac{0.5F_{r\,I}}{Y_{I}} \leqq \frac{0.5F_{r\,II}}{Y_{II}}+F_a$	$F_{a\,I}=\frac{0.5F_{r\,II}}{Y_{II}}+F_a$ ——
Front 	$\frac{0.5F_{r\,I}}{Y_{I}} > \frac{0.5F_{r\,II}}{Y_{II}}+F_a$	—— $F_{a\,II}=\frac{0.5F_{r\,I}}{Y_{I}}-F_a$
Rear 	$\frac{0.5F_{r\,II}}{Y_{II}} \leqq \frac{0.5F_{r\,I}}{Y_{I}}+F_a$	—— $F_{a\,II}=\frac{0.5F_{r\,I}}{Y_{I}}+F_a$
Front 	$\frac{0.5F_{r\,II}}{Y_{II}} > \frac{0.5F_{r\,I}}{Y_{I}}+F_a$	$F_{a\,I}=\frac{0.5F_{r\,II}}{Y_{II}}-F_a$ ——

Note: 1. Applies when preload is zero.
2. Radial forces in the opposite direction to the arrow in the above illustration are also regarded as positive.
3. Dynamic equivalent radial load is calculated by using the table on the right of the size table of the bearing after axial load is obtained for X and Y factor.

4.5 Bearing rating life and load calculation examples

In the examples given in this section, for the purpose of calculation, all hypothetical load factors as well as all calculated load factors may be presumed to be included in the resultant load values.

Bearing loads and the basic rating life of bearings can be calculated using the bearing technical calculation tool on the **NTN** website (https://www.ntnglobal.com).

(Example 1)
What is the rating life in hours of operation L_{10h} for deep groove ball bearing **6208** operating at rotational speed n = 650 min^{-1}, with a radial load F_r of 3.2 kN?

From formula (4.28) the dynamic equivalent radial load P_r:

$P_r=F_r=3.2$kN

Basic dynamic load rating C_r for bearing **6208** given on page B-26 is 32.5 kN, ball bearing speed factor f_n relative to rotational speed n = 650 min^{-1} from **Fig. 3.1** is f_n = 0.37. Thus life factor f_h from formula (3.5) is:

$$f_h=f_n\frac{C_r}{P_r}=0.37\times\frac{32.5}{3.2}=3.76$$

Therefore, with f_h = 3.76 from **Fig. 3.1** the rated life, L_{10h}, is approximately 27 000 hours.

(Example 2)
What is the life rating L_{10h} for the same bearing and conditions as in **Example 1**, but with an additional axial load F_a of 1.8 kN?

To find the dynamic equivalent radial load value for P_r, the radial load factor X, axial load factor Y, and Constant e are used.

Basic static load rating C_{0r} for bearing **6208** given on page B-26 is 17.8 kN and f_0 is 14.0. Therefore:

$$\frac{f_0\cdot F_a}{C_{0r}}=\frac{14\times1.8}{17.8}=1.42$$

Calculated by the proportional interpolation method given on B-27, e = 0.30.

For the operating radial load and axial load:

$$\frac{F_a}{F_r}=\frac{1.8}{3.2}=0.56>e=0.30$$

From B-27, X = 0.56 and Y = 1.44, and from formula (4.28) the dynamic equivalent radial load, P_r, is:

$P_r=XF_r+YF_a$
$=0.56\times3.2+1.43\times1.8$
$=4.38$ kN

From **Fig. 3.1** and **Table 3.1** the life factor, f_h, is:

$$f_h=f_n\frac{C_r}{P_r}=0.37\times\frac{32.5}{4.38}=2.75$$

Therefore, with life factor f_h = 2.75, from **Fig. 3.1** the rated life, L_{10h}, is approximately 10,500 hours.

(Example 3)
Determine the optimum model number for a cylindrical roller bearing operating at the rotational speed n = 450 min^{-1}, with a radial load F_r of 200 kN, and which must have a life (L_{10h}) of over 20 000 hours.

From **Fig. 3.1** the life factor f_h = 3.02 (L_{10h} at 20 000), and the speed factor f_n = 0.46 (n = 450 min^{-1}). To find the required basic dynamic load rating, C_r, formula (3.5) is used.

$$C_r=\frac{f_h}{f_n}P_r=\frac{3.02}{0.46}\times200=1\ 313\text{kN}$$

From page B-108, the smallest bearing that fulfills all the requirements is **NU2332E** (C_r = 1 460 kN).

(Example 4)
The spur gear shown in **Fig. 4.16** (pitch diameter D_p = 150 mm, pressure angle α = 20°) is supported by a pair of tapered roller bearings, **32907XU** (C_r = 30.5 kN) and **32908XU** (C_r = 36.0 kN). Find rating life for each bearing when gear transfer power H = 150 kW and rotational speed n = 2 000 min^{-1}.

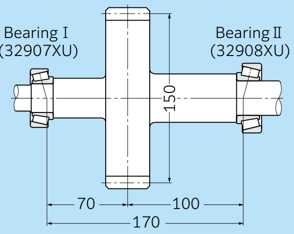


Fig. 4.16 Spur gear diagram

The gear load from formulas (4.3), (4.4a) and (4.5) is:

$$K_t = \frac{19.1\times10^6\cdot H}{D_p\cdot n} = \frac{19\,100\,000\times150}{150\times2\,000}$$
$$= 9.55\text{kN}$$
$$K_s = K_t\cdot\tan\alpha = 9.55\times\tan20°$$
$$= 3.48\text{kN}$$
$$K_r = \sqrt{K_t^2+K_s^2} = \sqrt{9.55^2+3.48^2}$$
$$= 10.16\text{kN}$$

The radial loads for bearings Ⅰ and Ⅱ are:

$$F_{r\,\mathrm{I}} = \frac{100}{170}K_r = \frac{100}{170}\times10.16 = 5.98\text{kN}$$
$$F_{r\,\mathrm{II}} = \frac{70}{170}K_r = \frac{70}{170}\times10.16 = 4.18\text{N}$$
$$\frac{0.5F_{r\,\mathrm{I}}}{Y_{\mathrm{I}}} = 1.45 > \frac{0.5F_{r\,\mathrm{II}}}{Y_{\mathrm{II}}} = 1.01 \text{ Therefore,}$$

The axial loads for bearing Ⅰ and Ⅱ are:

$$F_{a\,\mathrm{I}} = 0\text{kN}$$
$$F_{a\,\mathrm{II}} = \frac{0.5F_{r\,\mathrm{I}}}{Y_{\mathrm{I}}} = \frac{0.5\times5.98}{2.06} = 1.45\text{kN}$$

From page B-137, the dynamic equivalent radial load for bearing Ⅰ is:

$$\frac{F_{a\,\mathrm{I}}}{F_{r\,\mathrm{I}}} = \frac{0}{5.98} = 0 < e = 0.29$$
$$P_{r\,\mathrm{I}} = F_{r\,\mathrm{I}} = 5.98\text{kN}$$

Equally, the dynamic equivalent radial load for bearing Ⅱ is:

$$\frac{F_{a\,\mathrm{II}}}{F_{r\,\mathrm{II}}} = \frac{1.45}{4.18} = 0.35 > e = 0.29$$
$$P_{r\,\mathrm{II}} = XF_{r\,\mathrm{II}} + Y_{\mathrm{II}}F_{a\,\mathrm{II}}$$
$$= 0.4\times4.18 + 2.07\times1.45$$
$$= 4.67\text{kN}$$

From formula (3.5) and **Fig. 3.1** the life factor, f_h, for each bearing is

$$f_{h\,\mathrm{I}} = f_n\frac{C_{r\,\mathrm{I}}}{P_{r\,\mathrm{I}}} = 0.293\times30.5/5.98 = 1.49$$
$$f_{h\,\mathrm{II}} = f_n\frac{C_{r\,\mathrm{II}}}{P_{r\,\mathrm{II}}} = 0.293\times36.0/4.67 = 2.26$$

Therefore, from **Table 3.1**
$L_{h\,\mathrm{I}}$ = 500$f_{h\,\mathrm{I}}$ = 1 900 hours
$L_{h\,\mathrm{II}}$ = 500$f_{h\,\mathrm{II}}$ = 7 550 hours

The combined system bearing life, L_h, from formula (3.3) is:

$$L_h = \frac{1}{\left[\dfrac{1}{L_{h1}^{\,e}} + \dfrac{1}{L_{h2}^{\,e}}\right]^{1/e}}$$
$$= \frac{1}{\left[\dfrac{1}{1\,900^{9/8}} + \dfrac{1}{7\,550^{9/8}}\right]^{8/9}}$$
$$= 1\,600 \text{ hours}$$

(Example 5)
Find the mean load for spherical roller bearing **23932EMD1** (C_r = 455 kN) when operated under the fluctuating conditions shown in **Table 4.8.**

Table 4.8

Condition No. i	Operating time ϕ_i %	Radial load F_{ri} kN	Axial load F_{ai} kN	Rotational speed n_i min^{-1}
1	5	10	2	1 200
2	10	12	4	1 000
3	60	20	6	800
4	15	25	7	600
5	10	30	10	400

The dynamic equivalent radial load, P_r, for each operating condition is found by using formula (4.28) and shown in **Table 4.9** . Because all the values for F_{ri} and F_{ai} from the bearing tables are greater than $F_a / F_r > e$ = 0.17, X = 0.67, Y_2 = 5.81

$$P_{ri} = XF_{ri} + Y_2\,F_{ai} = 0.67F_{ri} + 5.81F_{ai}$$

From formula (4.23) the mean load, F_m, is:

$$F_m = \left[\frac{\Sigma\,(P_{ri}^{\,10/3}\cdot n_i\cdot\phi_i)}{\Sigma\,(n_i\cdot\phi_i)}\right]^{3/10} = 50.0\text{kN}$$

Table 4.9

Condition No. i	Dynamic equivalent radial load. P_{ri} (kN)
1	18.3
2	31.3
3	48.3
4	57.4
5	78.2

(Example 6)
Find the threshold values for rating life time and allowable axial load when cylindrical roller bearing **NUP312** is used under the following conditions:
Provided that intermittent axial load and oil lubricant.
Radial load F_r = 10kN
Rotational speed n = 2 000min^{-1}

Radial load F_r is 10 kN, and
$P_r = F_r$ = 10kN
The speed factor of cylindrical roller bearing, f_n , at n = 2 000 min^{-1} , from **Table 3.1**

$$f_n = \left(\frac{33.3}{2\,000}\right)^{3/10} = 0.293$$

The life factor, f_h , from **Table 3.1**

$$f_h = 0.293\times\frac{137}{10} = 4.01$$

Therefore the basic rated life, L_{10h} , from **Table 3.1**
L_{10h} = 500 × 4.01$^{10/3}$ ≒ 51 000 hours
Next, the allowable axial load of the cylindrical roller bearing is shown on page A-32.
In formula (3.13) on page A-32, based on **NUP312** from **Table 3.7** on page A-33, k = 0.065. In addition, D_{pw} = (60 + 130) / 2 = 95 mm, n = 2 000 min^{-1}.
Thus, the formula below holds when the case of the intermittent axial load is taken into consideration.
$D_{pw}\cdot n$ × 10^4 = 19 × 10^4
In **Fig. 3.16** on page A-33, $D_{pw}\cdot n$ = 19 × 10^4. In the case of the intermittent axial load, allowable surface pressure at the lip P_t = 40 MPa.
Therefore the allowable axial load, P_t , becomes the following.
P_t = 0.065 × 60^2 × 40 = 9 360N
Based on **Table 3.7** on page A-33, it is within the limits of $F_{a\,max}$ < 0.4 × 10 000 = 4 000 N.
Therefore P_t < 4 000 N.

5. Boundary dimensions and bearing number codes

5.1 Boundary dimensions

A rolling bearing's major dimensions, known as "boundary dimensions," are shown in **Figs. 5.1 - 5.3**. To facilitate international bearing interchangeability and economical bearing production, bearing boundary dimensions have been standardized by the International Organization for Standardization (ISO). In Japan, rolling bearing boundary dimensions are regulated by Japanese Industrial Standards (JIS B 1512 series).

Boundary dimensions which have been standardized include: bearing bore diameter, outside diameter, width/height, and chamfer dimensions - all important dimensions when considering the compatibility of shafts, bearings, and housings. However, as a general rule, bearing internal construction dimensions are not covered by these standards.

For metric series rolling bearings there are 90 standardized bore diameters (d) ranging in size from 0.6 mm - 2,500 mm.

Outer diameter dimensions (D) for radial bearings with standardized bore diameter dimensions are covered in the "diameter series;" their corresponding width dimensions (B) are covered in the "width series." For thrust bearings there is no width series; instead, these dimensions are covered in the "height series." The combination of all these series is known as the "dimension series." All series numbers are shown in **Table 5.1**.

Although many rolling bearing dimensions are standardized and have been listed here for purposes of future standardization, there are many standard bearing dimensions which are not presently manufactured.

Boundary dimensions for radial bearings and thrust bearings are shown in the attached tables (I-2 to I-19).

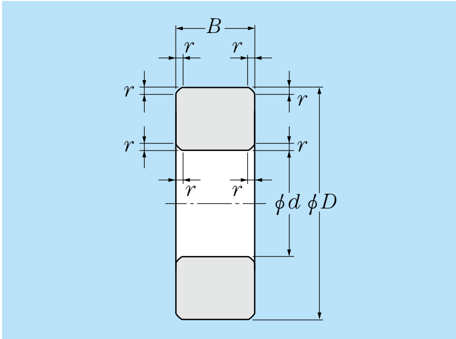


Fig. 5.1 Radial bearings (excluding tapered roller bearings)

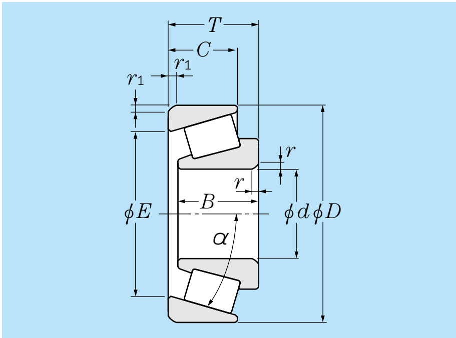


Fig. 5.2 Tapered roller bearings

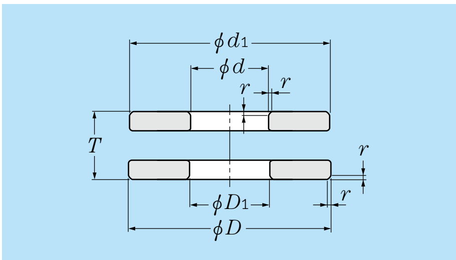


Fig. 5.3 Single direction thrust bearings

Table 5.1 Dimension series numbers

		Dimension series			Reference diagram
		Diameter series (outer diameter dimensions)	Width series (width dimensions)	Height series (height dimensions)	
Radial bearings (excluding tapered roller bearings)	Code	7.8.9.0.1.2.3.4	8.0.1.2.3.4.5.6	—	Fig. 5.4
	Dimension	Small ◄——► Large	Small ◄——► Large		
Tapered roller bearings	Code	9. 0. 1. 2. 3	0. 1. 2. 3	—	Fig. 5.5
	Dimension	Small ◄——► Large	Small ◄——► Large		
Thrust bearings	Code	0. 1. 2. 3. 4	—	7.9.1.2	Fig. 5.6
	Dimension	Small ◄——► Large		Small ◄——► Large	

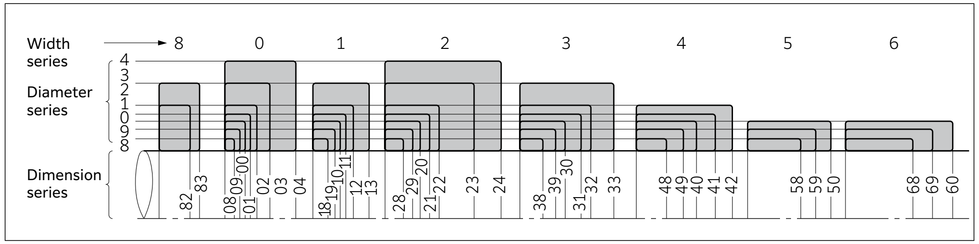


Fig. 5.4 Dimension series for radial bearings (excluding tapered roller bearings; diameter series 7 has been omitted)

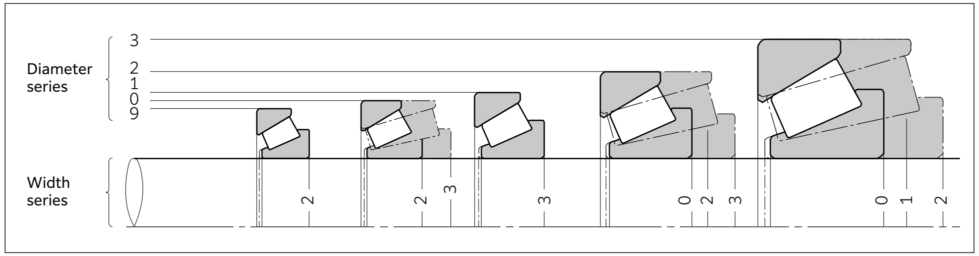


Fig. 5.5 Dimension series for tapered roller bearings (based on JIS B 1534)

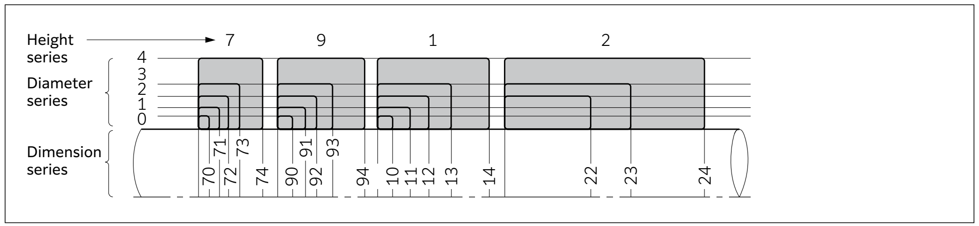


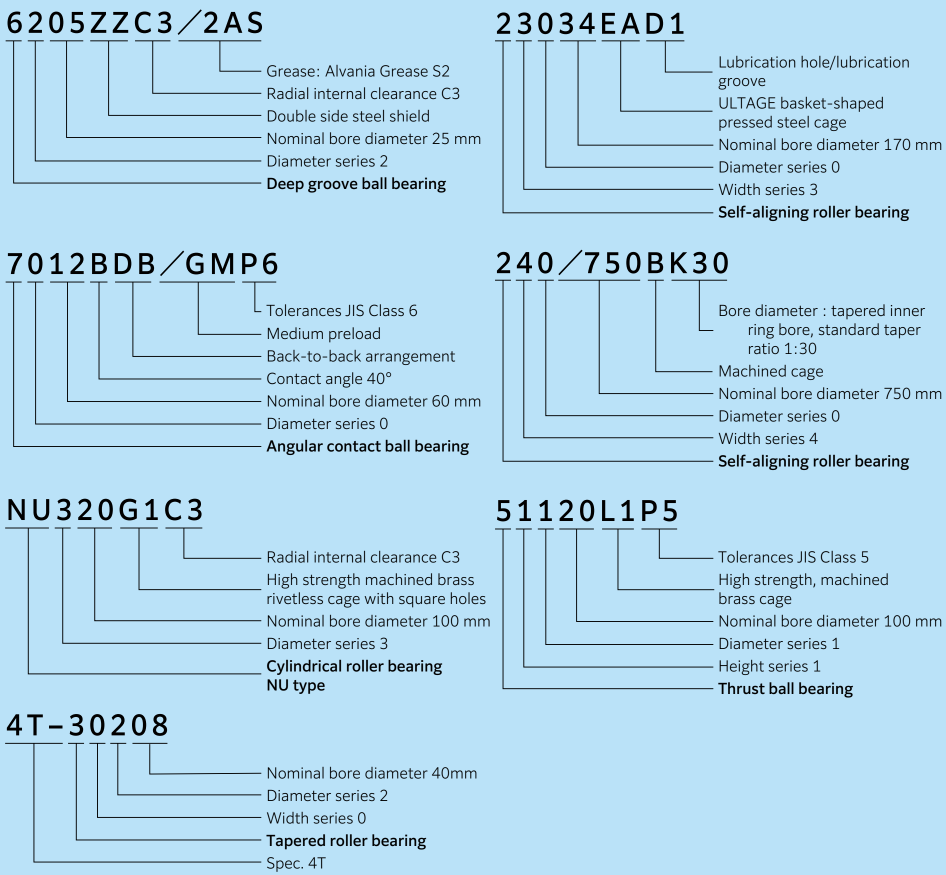
Fig. 5.6 Dimension series for thrust bearings (excluding diameter series 5)

5.2 Bearing numbers

Rolling bearing part numbers indicate **bearing type**, **dimensions**, **tolerances**, **internal construction**, and other related specifications. Bearing numbers are comprised of a "**basic number**" followed by "**supplementary codes**." The makeup and order of bearing numbers is shown in **Table 5.2**.

The **basic number** indicates general information about a bearing, such as its fundamental type, boundary dimensions, series number, bore diameter code and contact angle. The **supplementary codes** derive from prefixes and suffixes which indicate a bearing's tolerances, internal clearances, and related specifications.

(Bearing number examples)



"ULTAGE" (a name created from the combination of "ultimate," signifying refinement, and "stage," signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of bearings that are noted for their industry-leading performance.

Boundary Dimensions and Bearing Number Codes

Table 5.2 Bearing number composition and arrangement

Supplementary prefix code

Special application/ material/ heat treatment code	
4T-	4T tapered roller bearings
E-	Bearings using case hardened steel
F-	Stainless steel bearings
TS2-	Dimension stabilized bearing for high temperature use (to 160°C)
TS3-	Dimension stabilized bearing for high temperature use (to 200°C)
TS4-	Dimension stabilized bearing for high temperature use (to 250°C)

Basic number — Bearing series

Bearing series code	Dimension series code: Width/height series [1]	Dimension series code: Diameter series
Deep groove ball bearings (type code 6)		
67	(1)	7
68	(1)	8
69	(1)	9
160	(0)	0
60	(1)	0
62	(0)	2
63	(0)	3
Angular contact ball bearings (type code 7)		
78	(1)	8
79	(1)	9
70	(1)	0
72	(0)	2
73	(0)	3
Self aligning ball bearings (type code 1, 2)		
12	(0)	2
13	(0)	3
22	(2)	2
23	(2)	3
Cylindrical roller bearings (type code NU, N, NF,NNU, NN, etc.)		
NU10	1	0
NU2	(0)	2
NU22	2	2
NU3	(0)	3
NU23	2	3
NU4	(0)	4
NNU49	4	9
NN30	3	0
Tapered roller bearings (type code 3)		
329X	2	9
320X	2	0
302	0	2
322	2	2
303	0	3
303D	0	3
313X	1	3
323	2	3
Spherical roller bearings (type code 2)		
239	3	9
230	3	0
240	4	0
231	3	1
241	4	1
222	2	2
232	3	2
213	1	3
223	2	3
Single direction thrust ball bearings (type code 5)		
511	1	1
512	1	2
513	1	3
514	1	4
Cylindrical roller thrust bearings (type code 8)		
811	1	1
812	1	2
893	9	3
Spherical thrust roller bearings (type code 2)		
292	9	2
293	9	3
294	9	4

Basic number — Bore diameter code

Code	Bore diameter mm
/0.6	0.6
/1.5	1.5
/2.5	2.5
1	1
⋮	⋮
9	9
00	10
01	12
02	15
03	17
/22	22
/28	28
/32	32
04	20
05	25
06	30
⋮	⋮
88	440
92	460
96	480
/500	500
/530	530
/560	560
	⋮
/2 360	2 360
/2 500	2 500

Basic number — Contact angle code

Code [1]	Contact angle
Angular contact ball bearing	
(A)	Standard contact angle 30°
B	Standard contact angle 40°
C	Standard contact angle 15°
Tapered roller bearing	
(B)	Contact angle over 10° to/including 17°
C	Contact angle over 17° to/including 24°
D	Contact angle over 24° to/including 32°

1) Codes in ( ) are not shown in nominal numbers.
Note: Please consult **NTN** Engineering concerning bearing series codes, and supplementary prefix/suffix codes not listed in the above table.

Boundary Dimensions and Bearing Number Codes

Supplementary suffix codes

Internal modifications code

Code	Description
U	Internationally interchangeable tapered roller bearings
R	Non-internationally interchangeable tapered roller bearings
ST	Low torque tapered roller bearings
HT	Angular ball bearings and cylindrical roller bearings for high axial loads
E	High load capacity cylindrical roller bearing
EA	ULTAGE series cylindrical roller bearings
E	ULTAGE series self aligning roller bearings
UTG	ULTAGE series Large tapered roller bearing

Cage code

Code	Description
L1	High strength, machined brass cage
F1	Machined carbon steel cage
G1	High strength machined brass rivetless cage with square holes
G2	Pin type cage
J	Pressed steel cage
T2	Molded resin cage
A	Pressed steel cage (ULTAGE series self aligning roller bearings)
M	High strength, machined brass cage (ULTAGE series self aligning roller bearings)

Seal / Shield code

Code	Description
LB	One-side synthetic rubber seal (non-contact type)
LLB	Double-side synthetic rubber seal (non-contact type)
LU	One-side synthetic rubber seal (contact type)
LLU	Double-side synthetic rubber seal (contact type)
LH	One-side synthetic rubber seal (low-torque type)
LLH	Double-side synthetic rubber seal (low-torque type)
Z	One-side steel Shield
ZZ	Double-side steel Shield

Raceway external configuration code

Code	Description
K	Tapered inner ring bore, standard taper ratio 1:12
K30	Tapered inner ring bore, standard taper ratio 1:30
N	With snap ring groove
NR	Snap ring
D	With oil hole
D1	Lubrication hole/lubrication groove

Duplex arrangement code

Code	Description
DB	Back-to-back arrangement
DF	Face-to-face arrangement
DT	Tandem arrangement
D2	Two matched, paired bearings
+α	Spacer (α = spacer's standard width dimensions)

Internal clearance [1] Preload code

Code	Description
C2	Internal clearance less than normal
(CN)	Normal clearance
C3	Internal clearance greater than normal
C4	Internal clearance greater than C3
C5	Internal clearance greater than C4
CM	Radial internal clearance for electric motor use
/GL	Light preload
/GN	Normal preload
/GM	Medium preload
/GH	Heavy preload

Tolerance code [1]

Code	Description
(P0)	JIS Class 0
P6	JIS Class 6
P5	JIS Class 5
P4	JIS Class 4
P2	JIS Class 2
−4	ABMA Class 4
−2	ABMA Class 2
−3	ABMA Class 3
−0	ABMA Class 0
−00	ABMA Class 00

Lubrication

Code	Description
/2AS	Alvania Grease S2
/3AS	Alvania Grease S3
/8A	Alvania Grease EP2
/5K	Multemp SRL
/LX11	Barrierta JFE552
/LP03	Solid grease

1) Codes in ( ) are not shown in nominal numbers.
Note: Please consult **NTN** Engineering concerning bearing series codes, and supplementary prefix/suffix codes not listed in the above table.

5.2.1 Numbers of inch series tapered roller bearings

The composition of numbers of inch series tapered roller bearings is specified by the American Bearing Manufacturers Association (ABMA). The inner ring component (CONE) and the outer ring (CUP) each have a corresponding number. **Table 5.3** shows the composition of these numbers. Each corresponding code is also described in more detail below.

Table 5.3 Bearing number composition

Prefix code	Contact angle code	Series number	Serial number	Suffix code
XX	○	○○○	○○	XX

Note: X in the table is represented by letters, and ○ is represented by numbers.

XX ○ ○○○ ○○ XX

Load limit code
This code has 9 types from light loads to heavy loads:
EL, LL, L, LM, M, HM, H, HH, and EH.
"J" at the beginning of the code indicates metric bearings.

Contact angle code
This code indicates the contact angle of the series. The classification of each code is shown in **Table 5.3 (1)**.

Series number
A number that is determined by internal specifications.

Serial number
The serial number of the outer ring is 10 to 19.
The serial number of the inner ring is 30 to 49.
Serial numbers exceeding the above are 20 to 29. The outer ring starts from 20, and the inner ring starts from 29 in the opposite direction.

Suffix code
This code consists of either one or two letters. It is used when the appearance and the inside of the standard type are changed.

Table 5.3 (1) Contact angle symbol

Code	Outer ring angle (contact angle × 2) Inc.	Below
1	0°	24°
2	24°	25°30′
3	25°30′	27°
4	27°	28°30′
5	28°30′	30°30′
6	30°30′	32°30′
7	32°30′	36°
8	36°	45°
9	45°(Excluding thrust bearings)	

5.2.2 Numbers of metric tapered roller bearings based on ISO355

Dimension series previously not covered by 3XX are regulated under JIS B 1512. These dimension series are specified in ISO355 and consist of series codes of the angle, diameter, and width. In addition, the inner ring subunit and the outer ring are internationally interchangeable. The composition of bearing numbers are shown in **Table 5.4**. The series codes of the dimension series are shown in **Table 5.4 (1) to (3)**.

Table 5.4 Bearing number composition

Tapered roller bearing code	Dimension series: Angle series	Dimension series: Diameter series	Dimension series: Width series	Bore diameter code
T	○	X	X	○○○

Note: X in the table is represented by letters, and ○ is represented by numbers.

T ○ X X ○○○

Tapered roller bearing code

Angle series code
This code represents the contact angle.
The classification is shown in **Table 5.4 (1)**.

Diameter series code
This code represents the ratio of the bearing outside diameter to the bearing inner diameter. The classification is shown in **Table 5.4 (2)**.

Width series code
This code represents the ratio of the assembly width to the difference between the outer diameter and inner diameter of the single row bearing.
The classification is shown in **Table 5.4 (3)**.

Bore diameter code
The bearing bore diameter is represented in mm.
Example) 040: bore diameter dimension 40 mm

Table 5.4 (1) Angle series code

Code	Contact angle α Over	Incl.
2	10°	13°52′
3	13°52′	15°59′
4	15°59′	18°55′
5	18°55′	23°
6	23°	27°
7	27°	30°

Table 5.4 (2) Diameter series code

Code	$\frac{D}{d^{0.77}}$ Over	Incl.
B	3.4	3.8
C	3.8	4.4
D	4.4	4.7
E	4.7	5
F	5	5.6
G	5.6	7

Note: Quantifiers
d: Nominal inner diameter
D: Nominal outside diameter

Table 5.4 (3) Width series code

Code	$\frac{T}{(D-d)^{0.95}}$ Over	Incl.
B	0.50	0.68
C	0.68	0.80
D	0.80	0.88
E	0.88	1

Note: Quantifiers
d: Nominal inner diameter
D: Nominal outside diameter
T: Assembly width of single row bearing

6. Bearing tolerances

6.1 Dimensional and rotational accuracy

Bearing "tolerances" or dimensional accuracy and running accuracy, are regulated by ISO and JIS standards, JIS B 1514 (rolling bearing tolerances) series. For **dimensional accuracy**, these standards prescribe the tolerances necessary when installing bearings on shafts or in housings. **Running accuracy** is defined as the allowable limits for bearing runout during operation.

Dimensional accuracy

Dimensional accuracy constitutes the acceptable values for bore diameter, outer diameter, assembled bearing width, and bore diameter uniformity as seen in chamfer dimensions, allowable inner ring tapered bore deviation and shape error. Also included are variation of mean bore diameter within a plane, outer diameter within a plane, mean outer diameter within a plane, as well as raceway thickness (for thrust bearings).

Running accuracy

Running accuracy constitutes the acceptable values for inner and outer ring radial runout and axial runout, inner ring side surface squareness, and outer ring outer diameter squareness.

Allowable rolling bearing tolerances have been established according to precision classes. Bearing precision is stipulated as JIS class 6, class 5, class 4, or class 2, with precision rising from ordinary precision indicated by class 0.

Table 6.1 indicates which standards and precision classes are applicable to the major bearing types. **Table 6.2** shows a relative comparison between JIS B 1514 precision class standards and other standards.

For details of allowable limitations and values, refer to **Tables 6.4 - 6.10**, which are described in the application table column of **Table 6.1**. Allowable values for chamfer dimensions are shown in **Table 6.11**. Allowable limitations and values for radial bearing inner ring tapered bores are shown in **Table 6.12**.

Table 6.1 Bearing types and applicable tolerance

Bearing type		Applicable standard	Accuracy class					Tolerance table
Deep groove ball bearings		JIS B 1514-1 (ISO492)	Class 0	Class 6	Class 5	Class 4	Class 2	Table 6.4
Angular contact ball bearings			Class 0	Class 6	Class 5	Class 4	Class 2	
Self-aligning ball bearings			Class 0	—	—	—	—	
Cylindrical roller bearings			Class 0	Class 6	Class 5	Class 4	Class 2	
Needle roller bearings			Class 0	Class 6	Class 5	Class 4	—	
Self-aligning roller bearings			Class 0	—	—	—	—	
Tapered roller bearings	Metric series (single-row)	JIS B 1514	Class 0, 6X	Class 6[1]	Class 5	Class 4	—	Table 6.5
	Metric series (double-row/four-row)	BAS1002	Class 0	—	—	—	—	Table 6.6
	Inch series	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Table 6.7
	J series	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A	Table 6.8
Thrust ball bearings		JIS B 1514-2 (ISO199)	Class 0	Class 6	Class 5	Class 4	—	Table 6.9
Spherical roller thrust bearings			Class 0	—	—	—	—	Table 6.10

1) The class is the **NTN** standard class.

Table 6.2 Comparison of tolerance classifications of national standards

Standard	Applicable standard	Accuracy class					Bearing type
Japanese industrial standard (JIS)	JIS B 1514-1	Class 0, 6	Class 6	Class 5	Class 4	Class 2	Radial bearings
	JIS B 1514-2	Class 0	Class 6	Class 5	Class 4	—	Thrust bearings
International Organization for Standardization (ISO)	ISO 492	Normal class Class 6X	Class 6	Class 5	Class 4	Class 2	Radial bearings
	ISO 199	Normal Class	Class 6	Class 5	Class 4	—	Thrust bearings
	ISO 578	Class 4	—	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)
	ISO 1224	—	—	Class 5A	Class 4A	—	Precision instrument bearings
Deutsches Institut fur Normung (DIN)	DIN 620	P0	P6	P5	P4	P2	All types
American National Standards Institute (ANSI) American Bearing Manufacturer's Association (ABMA)	ANSI/ABMA Std.20 [1]	ABEC-1 RBEC-1	ABEC-3 RBEC-3	ABEC-5 RBEC-5	ABEC-7	ABEC-9	Radial bearings (excluding tapered roller bearings)
	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A	Tapered roller bearings (Metric series)
	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)

1) "ABEC" is applied to ball bearings and "RBEC" to roller bearings.
Note: 1. JIS B 1514 series, ISO492, 199, and DIN620 have the same specification level.
2. The tolerance and allowance of JIS B 1514 series are slightly different from those of ABMA standards.

Application of accuracy class

Ordinary precision JIS Class 0 is applied to general roller bearings. However, depending on the conditions and applications, bearings with JIS Class 5 or higher may be necessary.

Table 6.3 shows application examples of accuracy class according to the required performance of bearings to be used.

Table 6.3 Application example of accuracy class

Required performance	Application example	Applied accuracy class
Accuracy under high speed	Machine tool main spindles Printing machine body bearings Magnetic tape guides	JIS Class 5, JIS Class 4 or higher JIS Class 5 JIS Class 5
High rotational speed	Jet engine main spindles Turbochargers Machine tool main spindles Touchdown bearings of magnetic bearing spindles for turbo-molecular pumps	JIS Class 4 or higher Equivalent to JIS Class 4 JIS Class 5, JIS Class 4 or higher JIS Class 5
Low torque low noise	Machine tool main spindles Hubs of road bikes Cleaner motors Hand spinners Fan motors	JIS Class 5, JIS Class 4 or higher JIS Class 5 JIS Class 0 JIS Class 0 JIS Class 0

6.2 JIS terms

The following is a description of JIS accuracy terms used in **Table 6.4**.

(However, the outer diameter surface is omitted because the meaning is similar.)

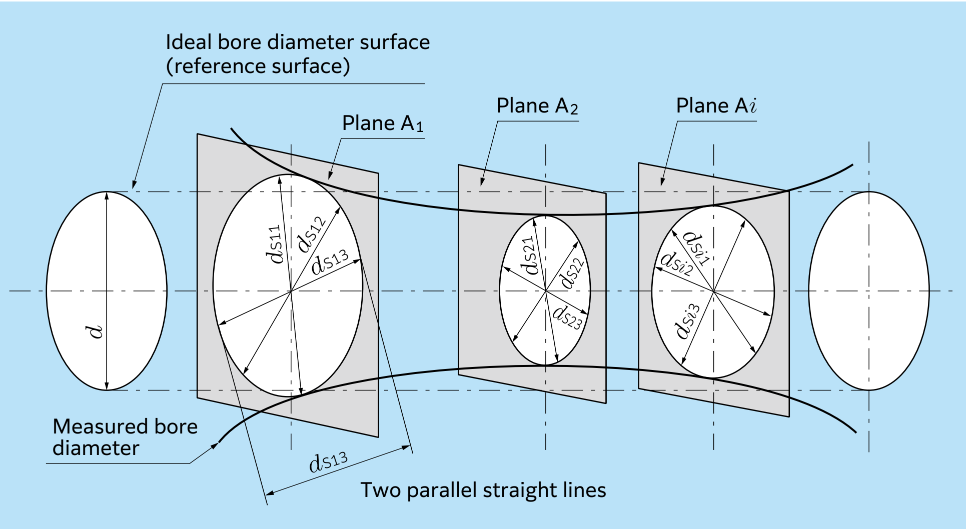


Fig. 6.1 Shape model figure

Terms	Quantifiers	Description
Nominal bore diameter	d	Reference dimension representing the bore diameter size, and reference value with respect to the dimensional difference of the actual bore diameter surface.
Single bore diameter	d_s	Distance between two parallel straight lines that are in contact with the intersection line of the actual bearing bore diameter surface and the radial plane.
Deviation of a single bore diameter	Δ_{ds}	Difference between d_s and d (difference of nominal diameter serving as the measured bore and standard).
Mean bore diameter in a single plane	d_{mp}	Arithmetic mean of the maximum and minimum measured bore diameters within one radial plane. In the model figure, in arbitrary radial plane A_i, when the maximum bore diameter is d_{si1} and the minimum bore diameter is d_{si3}, the value is obtained by $(d_{si1} + d_{si3})/2$. There is one value for each plane.
Mean bore diameter	d_m	Arithmetic mean of the maximum and minimum measured bore diameters obtained from all the cylindrical surfaces. In the model figure, when the maximum measured bore diameter is d_{s11} and the minimum measured bore diameter is d_{s23}, which are obtained from the all the planes A_1, A_2,…A_i, the mean bore diameter is obtained by $(d_{s11} + d_{s23})/2$. There is one value for one cylindrical surface.
Deviation of mean bore diameter	Δ_{dm}	Difference between the mean bore diameter and the nominal bore diameter.
Deviation of mean bore diameter in a single plane	Δ_{dmp}	Difference between the arithmetic mean and the nominal bore diameter of the maximum and minimum measured bore diameters within one radial plane. The value is specified in JIS.
Variation of bore diameter in a single plane	V_{dsp}	Difference between the maximum and minimum measured bore diameters within one radial plane. In the model figure, in radial plane A_1, when the maximum measured bore diameter is d_{s11} and the minimum measured bore diameter is d_{s13}, the difference is V_{dsp} and one value can be obtained for one plane. This characteristic is an index that indicates the roundness. The value is specified in JIS.
Variation of mean bore diameter	V_{dmp}	Difference between the maximum and minimum values of the mean bore diameter within a plane that are obtained from all the planes. A unique value is obtained for each product, and it is near to cylindricity (that is different from geometric cylindricity). The value is specified in JIS.
Nominal inner ring width	B	Distance between both theoretical side surfaces of a raceway. This value is a reference dimension that represents the raceway surface (distance between both side surfaces).
Single inner ring width	B_s	Distance between two intersections. The straight is perpendicular to the plane that is in contact with the inner ring reference side and both actual side surfaces. This value represents the actual width dimension of an inner ring.
Deviation of a single inner ring width	Δ_{Bs}	Difference between the measured inner ring width and the nominal inner ring width. This value is also the difference between the measured inner ring width dimension and the reference dimension that represents the inner ring width. The value is specified in JIS.
Variation of inner ring width	V_{Bs}	Difference between the maximum and minimum measured inner ring widths, which are specified in JIS.
Radial runout of inner ring of assembled bearing	K_{ia}	Difference between the maximum and minimum values of the radial distance between the inner ring bore diameter at each angle position and one fixed point of the outer ring outer diameter surface with respect to radial runout.
Axial runout of inner ring of assembled bearing	S_{ia}	Difference between the maximum and minimum values of the axial distance between the inner ring reference side surface at each angle position and one fixed point of the outer ring outer diameter surface with respect to half the radial distance of the raceway contact diameter from the inner ring central axis and the inner ring of a deep groove ball bearing.

Bearing Tolerances

NTN

Commentary

Table 6.4 Tolerance of radial bearings (except tapered roller bearings)

Table 6.4 (1) Inner rings

Unit: μm

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}									
		Class 0		Class 6		Class 5		Class 4[1)]		Class 2[1)]	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
0.6[4)]	2.5	0	−8	0	−7	0	−5	0	−4	0	−2.5
2.5	10	0	−8	0	−7	0	−5	0	−4	0	−2.5
10	18	0	−8	0	−7	0	−5	0	−4	0	−2.5
18	30	0	−10	0	−8	0	−6	0	−5	0	−2.5
30	50	0	−12	0	−10	0	−8	0	−6	0	−2.5
50	80	0	−15	0	−12	0	−9	0	−7	0	−4
80	120	0	−20	0	−15	0	−10	0	−8	0	−5
120	150	0	−25	0	−18	0	−13	0	−10	0	−7
150	180	0	−25	0	−18	0	−13	0	−10	0	−7
180	250	0	−30	0	−22	0	−15	0	−12	0	−8
250	315	0	−35	0	−25	0	−18	—	—	—	—
315	400	0	−40	0	−30	0	−23	—	—	—	—
400	500	0	−45	0	−35	—	—	—	—	—	—
500	630	0	−50	0	−40	—	—	—	—	—	—
630	800	0	−75	—	—	—	—	—	—	—	—
800	1 000	0	−100	—	—	—	—	—	—	—	—
1 000	1 250	0	−125	—	—	—	—	—	—	—	—
1 250	1 600	0	−160	—	—	—	—	—	—	—	—
1 600	2 000	0	−200	—	—	—	—	—	—	—	—

Nominal bore diameter d mm		Variation of bore diameter in a single plane V_{dsp}														
		Diameter series 9					Diameter series 0, 1					Diameter series 2, 3, 4				
		Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2
Over	Incl.	Max.					Max.					Max.				
0.6[4)]	2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
2.5	10	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
10	18	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	13	10	6	5	2.5	10	8	5	4	2.5	8	6	5	4	2.5
30	50	15	13	8	6	2.5	12	10	6	5	2.5	9	8	6	5	2.5
50	80	19	15	9	7	4	19	15	7	5	4	11	9	7	5	4
80	120	25	19	10	8	5	25	19	8	6	5	15	11	8	6	5
120	150	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
150	180	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	38	28	15	12	8	38	28	12	9	8	23	17	12	9	8
250	315	44	31	18	—	—	44	31	14	—	—	26	19	14	—	—
315	400	50	38	23	—	—	50	38	18	—	—	30	23	18	—	—
400	500	56	44	—	—	—	56	44	—	—	—	34	26	—	—	—
500	630	63	50	—	—	—	63	50	—	—	—	38	30	—	—	—
630	800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
800	1 000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 000	1 250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 250	1 600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 600	2 000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Nominal bore diameter d mm		Variation of mean bore diameter V_{dmp}					Radial runout of inner ring of assembled bearing K_{ia}					Perpendicularity of inner ring face with respect to the bore S_d			Axial runout of inner ring of assembled bearing S_{ia}[2)]		
		Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2
Over	Incl.	Max.					Max.					Max.			Max.		
0.6[4)]	2.5	6	5	3	2	1.5	10	5	4	2.5	1.5	7	3	1.5	7	3	1.5
2.5	10	6	5	3	2	1.5	10	6	4	2.5	1.5	7	3	1.5	7	3	1.5
10	18	6	5	3	2	1.5	10	7	4	2.5	1.5	7	3	1.5	7	3	1.5
18	30	8	6	3	2.5	1.5	13	8	4	3	2.5	8	4	1.5	8	4	2.5
30	50	9	8	4	3	1.5	15	10	5	4	2.5	8	4	1.5	8	4	2.5
50	80	11	9	5	3.5	2	20	10	5	4	2.5	8	5	1.5	8	5	2.5
80	120	15	11	5	4	2.5	25	13	6	5	2.5	9	5	2.5	9	5	2.5
120	150	19	14	7	5	3.5	30	18	8	6	2.5	10	6	2.5	10	7	2.5
150	180	19	14	7	5	3.5	30	18	8	6	5	10	6	4	10	7	5
180	250	23	17	8	6	4	40	20	10	8	5	11	7	5	13	8	5
250	315	26	19	9	—	—	50	25	13	—	—	13	—	—	15	—	—
315	400	30	23	12	—	—	60	30	15	—	—	15	—	—	20	—	—
400	500	34	26	—	—	—	65	35	—	—	—	—	—	—	—	—	—
500	630	38	30	—	—	—	70	40	—	—	—	—	—	—	—	—	—
630	800	55	—	—	—	—	80	—	—	—	—	—	—	—	—	—	—
800	1 000	75	—	—	—	—	90	—	—	—	—	—	—	—	—	—	—
1 000	1 250	94	—	—	—	—	100	—	—	—	—	—	—	—	—	—	—
1 250	1 600	120	—	—	—	—	120	—	—	—	—	—	—	—	—	—	—
1 600	2 000	150	—	—	—	—	140	—	—	—	—	—	—	—	—	—	—

Nominal bore diameter d mm		Deviation of a single inner ring width Δ_{Bs}										Variation of inner ring width V_{Bs}				
		Normal bearings						Duplex bearings[3)]								
		Class 0	Class 6	Class 5	Class 4	Class 2		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4	Class 2
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Max.				
0.6[4)]	2.5	0	−40	0	−40	0	−40	—	—	0	−250	12	12	5	2.5	1.5
2.5	10	0	−120	0	−40	0	−40	0	−250	0	−250	15	15	5	2.5	1.5
10	18	0	−120	0	−80	0	−80	0	−250	0	−250	20	20	5	2.5	1.5
18	30	0	−120	0	−120	0	−120	0	−250	0	−250	20	20	5	2.5	1.5
30	50	0	−120	0	−120	0	−120	0	−250	0	−250	20	20	5	3	1.5
50	80	0	−150	0	−150	0	−150	0	−380	0	−250	25	25	6	4	1.5
80	120	0	−200	0	−200	0	−200	0	−380	0	−380	25	25	7	4	2.5
120	150	0	−250	0	−250	0	−250	0	−500	0	−380	30	30	8	5	2.5
150	180	0	−250	0	−250	0	−250	0	−500	0	−380	30	30	8	5	4
180	250	0	−300	0	−300	0	−300	0	−500	0	−500	30	30	10	6	5
250	315	0	−350	0	—	—	—	0	−500	0	—	35	35	13	—	—
315	400	0	−400	0	—	—	—	0	−630	0	—	40	40	15	—	—
400	500	0	−450	—	—	—	—	—	—	—	—	50	45	—	—	—
500	630	0	−500	—	—	—	—	—	—	—	—	60	50	—	—	—
630	800	0	—	—	—	—	—	—	—	—	—	70	—	—	—	—
800	1 000	0	—	—	—	—	—	—	—	—	—	80	—	—	—	—
1 000	1 250	0	—	—	—	—	—	—	—	—	—	100	—	—	—	—
1 250	1 600	0	—	—	—	—	—	—	—	—	—	120	—	—	—	—
1 600	2 000	0	—	—	—	—	—	—	—	—	—	140	—	—	—	—

1) The dimensional difference Δ_{ds} of the measured bore diameter applied to Classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{dmp} of the mean bore diameter within a plane. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 for Class 4, and also to all the diameter series for Class 2.

2) Applies to ball bearings such as deep groove ball bearings and angular ball bearings.

3) Applies to individual raceway rings manufactured for combined bearing use.

4) The nominal bore diameter of bearings of 0.6 mm is included in this dimensional division.

Table 6.4 (2) Outer rings

Unit: μm

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}									
		Class 0		Class 6		Class 5		Class 4[5)]		Class 2[5)]	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
2.5[8)]	6	0	−8	0	−7	0	−5	0	−4	0	−2.5
6	18	0	−8	0	−7	0	−5	0	−4	0	−2.5
18	30	0	−9	0	−8	0	−6	0	−5	0	−4
30	50	0	−11	0	−9	0	−7	0	−6	0	−4
50	80	0	−13	0	−11	0	−9	0	−7	0	−4
80	120	0	−15	0	−13	0	−10	0	−8	0	−5
120	150	0	−18	0	−15	0	−11	0	−9	0	−5
150	180	0	−25	0	−18	0	−13	0	−10	0	−7
180	250	0	−30	0	−20	0	−15	0	−11	0	−8
250	315	0	−35	0	−25	0	−18	0	−13	0	−8
315	400	0	−40	0	−28	0	−20	0	−15	0	−10
400	500	0	−45	0	−33	0	−23	—	—	—	—
500	630	0	−50	0	−38	0	−28	—	—	—	—
630	800	0	−75	0	−45	0	−35	—	—	—	—
800	1 000	0	−100	0	−60	—	—	—	—	—	—
1 000	1 250	0	−125	—	—	—	—	—	—	—	—
1 250	1 600	0	−160	—	—	—	—	—	—	—	—
1 600	2 000	0	−200	—	—	—	—	—	—	—	—
2 000	2 500	0	−250	—	—	—	—	—	—	—	—

Nominal outside diameter D mm		Variation of outside diameter in a single plane[6)] V_{Dsp} Open bearing														
		Diameter series 9					Diameter series 0, 1					Diameter series 2, 3, 4				
		Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2
Over	Incl.	Max.					Max.					Max.				
2.5[8)]	6	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
6	18	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	12	10	6	5	4	9	8	5	4	4	7	6	5	4	4
30	50	14	11	7	6	4	11	9	5	5	4	8	7	5	5	4
50	80	16	14	9	7	4	13	11	7	5	4	10	8	7	5	4
80	120	19	16	10	8	5	19	16	8	6	5	11	10	8	6	5
120	150	23	19	11	9	5	23	19	8	7	5	14	11	8	7	5
150	180	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	38	25	15	11	8	38	25	11	8	8	23	15	11	8	8
250	315	44	31	18	13	8	44	31	14	10	8	26	19	14	10	8
315	400	50	35	20	15	10	50	35	15	11	10	30	21	15	11	10
400	500	56	41	23	—	—	56	41	17	—	—	34	25	17	—	—
500	630	63	48	28	—	—	63	48	21	—	—	38	29	21	—	—
630	800	94	56	35	—	—	94	56	26	—	—	55	34	26	—	—
800	1 000	125	75	—	—	—	125	75	—	—	—	75	45	—	—	—
1 000	1 250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 250	1 600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 600	2 000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 000	2 500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Nominal outside diameter D mm		Variation of outside diameter in a single plane V_{Dsp}[6)] Sealed/shield bearings diameter		Variation of mean outside diameter V_{Dmp}					Radial runout of outer ring of assembled bearing K_{ea}				
		Diameter series 2,3,4	Diameter series 0,1,2,3,4										
		Class 0	Class 6	Class 0	Class 6	Class 5	Class 4	Class 2	Class 0	Class 6	Class 5	Class 4	Class 2
Over	Incl.	Max.		Max.					Max.				
2.5[8)]	6	10	9	6	5	3	2	1.5	15	8	5	3	1.5
6	18	10	9	6	5	3	2	1.5	15	8	5	3	1.5
18	30	12	10	7	6	3	2.5	2	15	9	6	4	2.5
30	50	16	13	8	7	4	3	2	20	10	7	5	2.5
50	80	20	16	10	8	5	3.5	2	25	13	8	5	4
80	120	26	20	11	10	5	4	2.5	35	18	10	6	5
120	150	30	25	14	11	6	5	2.5	40	20	11	7	5
150	180	38	30	19	14	7	5	3.5	45	23	13	8	5
180	250	—	—	23	15	8	6	4	50	25	15	10	7
250	315	—	—	26	19	9	7	4	60	30	18	11	7
315	400	—	—	30	21	10	8	5	70	35	20	13	8
400	500	—	—	34	25	12	—	—	80	40	23	—	—
500	630	—	—	38	29	14	—	—	100	50	25	—	—
630	800	—	—	55	34	18	—	—	120	60	30	—	—
800	1 000	—	—	75	45	—	—	—	140	75	—	—	—
1 000	1 250	—	—	—	—	—	—	—	160	—	—	—	—
1 250	1 600	—	—	—	—	—	—	—	190	—	—	—	—
1 600	2 000	—	—	—	—	—	—	—	220	—	—	—	—
2 000	2 500	—	—	—	—	—	—	—	250	—	—	—	—

Nominal outside diameter D mm		Perpendicularity of outer ring outside surface with respect to the face S_D			Axial runout of outer ring of assembled bearing S_{ea}[7)]			Deviation of a single outer ring width Δ_{Cs}	Variation of outer ring width V_{Cs}			
		Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	All classes	Class 0,6	Class 5	Class 4	Class 2
Over	Incl.	Max.			Max.				Max.			
2.5[8)]	6	8	4	1.5	8	5	1.5	Depends on tolerance of Δ_{Bs} in relation to d of the same bearing	Depends on tolerance of V_{Bs} in relation to d of the same bearing	5	2.5	1.5
6	18	8	4	1.5	8	5	1.5			5	2.5	1.5
18	30	8	4	1.5	8	5	2.5			5	2.5	1.5
30	50	8	4	1.5	8	5	2.5			5	2.5	1.5
50	80	8	4	1.5	10	5	4			6	3	1.5
80	120	9	5	2.5	11	6	5			8	4	2.5
120	150	10	5	2.5	13	7	5			8	5	2.5
150	180	10	5	2.5	14	8	5			8	5	2.5
180	250	11	7	4	15	10	7			10	7	4
250	315	13	8	5	18	10	7			11	7	5
315	400	13	10	7	20	13	8			13	8	7
400	500	15	—	—	23	—	—			15	—	—
500	630	18	—	—	25	—	—			18	—	—
630	800	20	—	—	30	—	—			20	—	—
800	1 000	—	—	—	—	—	—			—	—	—
1 000	1 250	—	—	—	—	—	—			—	—	—
1 250	1 600	—	—	—	—	—	—			—	—	—
1 600	2 000	—	—	—	—	—	—			—	—	—
2 000	2 500	—	—	—	—	—	—			—	—	—

5) The dimensional difference Δ_{Ds} of the measured outer diameter applied to Classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{Dmp} of the mean outer diameter within a plane. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 for Class 4, and also to all the diameter series for Class 2.

6) Applies to cases where snap rings are not installed on the bearings.

7) Applies to ball bearings such as deep groove ball bearings and angular ball bearings.

8) The nominal bore diameter of bearings of 2.5 mm is included in this dimensional division.

Table 6.5 Tolerance of tapered roller bearings (metric series)

Table 6.5 (1) Inner rings

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}						Variation of bore diameter in a single plane V_{dsp}				Variation of mean bore diameter V_{dmp}				Radial runout of inner ring of assembled bearing K_{ia}				Perpendicularity of inner ring face with respect to the bore S_d	
		Class 0, Class 6×		Class 6 1), Class 5		Class 4 2)		Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 5	Class 4
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Max.				Max.				Max.				Max.	
10	18	0	−12	0	−7	0	−5	12	7	5	4	9	5	5	4	15	7	5	3	7	3
18	30	0	−12	0	−8	0	−6	12	8	6	5	9	6	5	4	18	8	5	3	8	4
30	50	0	−12	0	−10	0	−8	12	10	8	6	9	8	5	5	20	10	6	4	8	4
50	80	0	−15	0	−12	0	−9	15	12	9	7	11	9	6	5	25	10	7	4	8	5
80	120	0	−20	0	−15	0	−10	20	15	11	8	15	11	8	5	30	13	8	5	9	5
120	180	0	−25	0	−18	0	−13	25	18	14	10	19	14	9	7	35	18	11	6	10	6
180	250	0	−30	0	−22	0	−15	30	22	17	11	23	16	11	8	50	20	13	8	11	7
250	315	0	−35	—	—	—	—	35	—	—	—	26	—	—	—	60	—	—	—	—	—
315	400	0	−40	—	—	—	—	40	—	—	—	30	—	—	—	70	—	—	—	—	—

Unit: μm

Nominal bore diameter d mm		Axial runout of inner ring of assembled bearing S_{ia}	Deviation of a single inner ring width Δ_{Bs}						Deviation of the actual assembled bearing width Δ_{Ts}					
		Class 4	Class 0, Class 6		Class 6×		Class 5, Class 4		Class 0, Class 6		Class 6×		Class 5, Class 4	
Over	Incl.	Max.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
10	18	3	0	−120	0	−50	0	−200	+200	0	+100	0	+200	−200
18	30	4	0	−120	0	−50	0	−200	+200	0	+100	0	+200	−200
30	50	4	0	−120	0	−50	0	−240	+200	0	+100	0	+200	−200
50	80	4	0	−150	0	−50	0	−300	+200	0	+100	0	+200	−200
80	120	5	0	−200	0	−50	0	−400	+200	−200	+100	0	+200	−200
120	180	7	0	−250	0	−50	0	−500	+350	−250	+150	0	+350	−250
180	250	8	0	−300	0	−50	0	−600	+350	−250	+150	0	+350	−250
250	315	—	0	−350	0	−50	—	—	+350	−250	+200	0	—	—
315	400	—	0	−400	0	−50	—	—	+400	−400	+200	0	—	—

1) Class 6 is the **NTN** standard class.
2) The dimensional difference Δ_{ds} of the measured bore diameter applied to Class 4 is the same as the tolerance of dimensional difference Δ_{dmp} of the mean bore diameter within a plane.

Table 6.5 (2) Outer rings

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}						Variation of outside diameter in a single plane V_{Dsp}				Variation of mean outside diameter V_{Dmp}				Radial runout of outer ring of assembled bearing K_{ea}				Perpendicularity of outer ring outside surface with respect to the face S_D 3)	
		Class 0, Class 6×		Class 6 1), Class 5		Class 4 4)		Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 0, Class 6×	Class 6 1)	Class 5	Class 4	Class 5	Class 4
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Max.				Max.				Max.				Max.	
18	30	0	−12	0	−8	0	−6	12	8	6	5	9	6	5	4	18	9	6	4	8	4
30	50	0	−14	0	−9	0	−7	14	9	7	5	11	7	5	5	20	10	7	5	8	4
50	80	0	−16	0	−11	0	−9	16	11	8	7	12	8	6	5	25	13	8	5	8	4
80	120	0	−18	0	−13	0	−10	18	13	10	8	14	10	7	5	35	18	10	6	9	5
120	150	0	−20	0	−15	0	−11	20	15	11	8	15	11	8	6	40	20	11	7	10	5
150	180	0	−25	0	−18	0	−13	25	18	14	10	19	14	9	7	45	23	13	8	10	5
180	250	0	−30	0	−20	0	−15	30	20	15	11	23	15	10	8	50	25	15	10	11	7
250	315	0	−35	0	−25	0	−18	35	25	19	14	26	19	13	9	60	30	18	11	13	8
315	400	0	−40	0	−28	0	−20	40	28	22	15	30	21	14	10	70	35	20	13	13	10
400	500	0	−45	—	—	—	—	45	—	—	—	34	—	—	—	80	—	—	—	—	—
500	630	0	−50	—	—	—	—	60	—	—	—	38	—	—	—	100	—	—	—	—	—

Unit: μm

Nominal outside diameter D mm		Axial runout of outer ring of assembled bearing S_{ea}	Deviation of a single outer ring width Δ_{Cs}			
		Class 4	Class 0, Class 6 1), Class 5, Class 4		Class 6× 5)	
Over	Incl.	Max.	Upper	Lower	Upper	Lower
18	30	5	Depends on tolerance of Δ_{Bs} in relation to d of the same bearing		0	−100
30	50	5			0	−100
50	80	5			0	−100
80	120	6			0	−100
120	150	7			0	−100
150	180	8			0	−100
180	250	10			0	−100
250	315	10			0	−100
315	400	13			0	−100
400	500	—			0	−100
500	630	—			0	−100

3) Does not apply to bearings with flange.
4) The dimensional difference Δ_{Ds} of the measured outer diameter applied to Class 4 is the same as the tolerance of dimensional difference Δ_{Dmp} of the mean outer diameter within a plane.

5) Applies to bearings with a nominal bore diameter d over 10 mm and 400 mm or less.

Table 6.5 (3) Effective width of inner subunits and outer rings

Unit: μm

Nominal bore diameter d mm		Deviation of the actual effective width of inner subunit assembled with a master outer ring Δ_{T1s}				Deviation of the actual effective width of outer ring assembled with a master inner subunit Δ_{T2s}			
		Class 0		Class 6×		Class 0		Class 6×	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
10	18	+100	0	+50	0	+100	0	+50	0
18	30	+100	0	+50	0	+100	0	+50	0
30	50	+100	0	+50	0	+100	0	+50	0
50	80	+100	0	+50	0	+100	0	+50	0
80	120	+100	−100	+50	0	+100	−100	+50	0
120	180	+150	−150	+50	0	+200	−100	+100	0
180	250	+150	−150	+50	0	+200	−100	+100	0
250	315	+150	−150	+100	0	+200	−100	+100	0
315	400	+200	−200	+100	0	+200	−200	+100	0

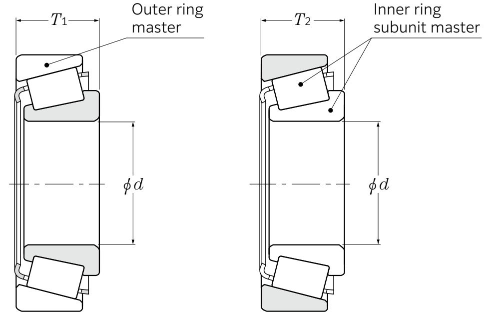


Table 6.6 Tolerance of tapered roller bearings (inch series)

Table 6.6 (1) Inner rings

Unit: μm

Nominal bore diameter d mm (inch) Over	Incl.	Deviation of a single bore diameter Δ_{ds} Class 4 Upper	Class 4 Lower	Class 2 Upper	Class 2 Lower	Class 3 Upper	Class 3 Lower	Class 0 Upper	Class 0 Lower	Class 00 Upper	Class 00 Lower
— —	76.2 (3)	+13	0	+13	0	+13	0	+13	0	+8	0
76.2 (3)	266.7 (10.5)	+25	0	+25	0	+13	0	+13	0	+8	0
266.7 (10.5)	304.8 (12)	+25	0	+25	0	+13	0	+13	0	—	—
304.8 (12)	609.6 (24)	+51	0	+51	0	+25	0	—	—	—	—
609.6 (24)	914.4 (36)	+76	0	—	—	+38	0	—	—	—	—
914.4 (36)	1 219.2 (48)	+102	0	—	—	+51	0	—	—	—	—
1 219.2 (48)	— —	+127	0	—	—	+76	0	—	—	—	—

Table 6.6 (2) Outer rings

Unit: μm

Nominal outside diameter D mm (inch) Over	Incl.	Deviation of a single outside diameter Δ_{Ds} Class 4 Upper	Class 4 Lower	Class 2 Upper	Class 2 Lower	Class 3 Upper	Class 3 Lower	Class 0 Upper	Class 0 Lower	Class 00 Upper	Class 00 Lower
— —	266.7 (10.5)	+25	0	+25	0	+13	0	+13	0	+8	0
266.7 (10.5)	304.8 (12)	+25	0	+25	0	+13	0	+13	0	—	—
304.8 (12)	609.6 (24)	+51	0	+51	0	+25	0	—	—	—	—
609.6 (24)	914.4 (36)	+76	0	+76	0	+38	0	—	—	—	—
914.4 (36)	1 219.2 (48)	+102	0	—	—	+51	0	—	—	—	—
1 219.2 (48)	— —	+127	0	—	—	+76	0	—	—	—	—

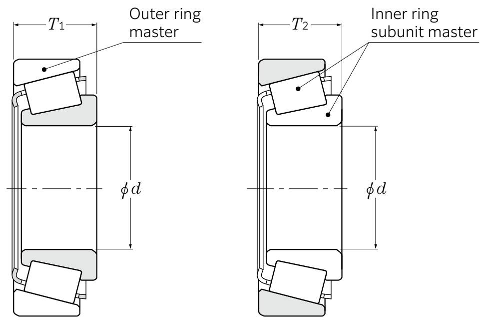
Table 6.6 (3) Assembly width of single-row bearings, combination width of 4-row bearings, effective width of inner ring subunits, effective width of outer rings

Nominal bore diameter d mm (inch) Over	Incl.	Nominal outside diameter D mm (inch) Over	Incl.	Deviation of the actual assembled single row bearing width Δ_{Ts} Class 4 Upper	Class 4 Lower	Class 2 Upper	Class 2 Lower	Class 3 Upper	Class 3 Lower	Class 0,00 Upper	Class 0,00 Lower	Deviation of four-row bearing overall width Δ_{B2s}, Δ_{C2s} Class 4,2,3,0 Upper	Lower
—	101.6 (4)			+203	0	+203	0	+203	−203	+203	−203	+1 524	−1 524
101.6 (4)	304.8 (12)			+356	−254	+203	0	+203	−203	+203	−203	+1 524	−1 524
304.8 (12)	609.6 (24)	—	508.0 (20)	+381	−381	+381	−381	+203	−203	—	—	+1 524	−1 524
304.8 (12)	609.6 (24)	508.0 (20)	—	+381	−381	+381	−381	+381	−381	—	—	+1 524	−1 524
609.6 (24)	—			+381	−381	—	—	+381	−381	—	—	+1 524	−1 524

Table 6.6 (4) Radial runout of inner and outer rings

Unit: μm

Nominal outside diameter D mm (inch) Over	Incl.	Radial runout of inner ring of assembled bearing K_{ia} / Radial runout of outer ring of assembled bearing K_{ea} Class 4 Max.	Class 2 Max.	Class 3 Max.	Class 0 Max.	Class 00 Max.
—	304.8 (14)	51	38	8	4	2
304.8 (14)	609.6 (24)	51	38	18	—	—
609.6 (24)	914.4 (36)	76	51	51	—	—
914.4 (36)	—	76	—	76	—	—



Unit: μm

Deviation of the actual effective width of inner subunit assembled with a master outer ring Δ_{T1s} Class 4 Upper	Class 4 Lower	Class 2 Upper	Class 2 Lower	Class 3 Upper	Class 3 Lower	Deviation of the actual effective width of outer ring assembled with a master inner subunit Δ_{T2s} Class 4 Upper	Class 4 Lower	Class 2 Upper	Class 2 Lower	Class 3 Upper	Class 3 Lower
+102	0	+102	0	+102	−102	+102	0	+102	0	+102	−102
+152	−152	+102	0	+102	−102	+203	−102	+102	0	+102	−102
—	—	+178	−178 1)	+102	−102 1)	—	—	+203	−203 1)	+102	−102 1)
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

1) Applies to nominal bore diameters d of 406.400 mm (16 inch) or less.

Table 6.7 Tolerance of double-row and 4-row tapered roller bearings (metric series)

Table 6.7 (1) Inner rings

Unit: μm

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}		Variation of bore diameter in a single plane V_{dsp}	Variation of mean bore diameter V_{dmp}	Radial runout of inner ring of assembled bearing K_{ia}	Deviation of a single inner ring width Δ_{Bs}		Deviation of bearing overall width: Double row bearing Δ_{B1s}		Deviation of bearing overall width: Four-row bearing Δ_{B2s}	
Over	Incl.	Upper	Lower	Max.	Max.	Max.	Upper	Lower	Upper	Lower	Upper	Lower
30	50	0	−12	12	9	20	0	−120	+240	−240	—	—
50	80	0	−15	15	11	25	0	−150	+300	−300	—	—
80	120	0	−20	20	15	30	0	−200	+400	−400	+500	−500
120	180	0	−25	25	19	35	0	−250	+500	−500	+600	−600
180	250	0	−30	30	23	50	0	−300	+600	−600	+750	−750
250	315	0	−35	35	26	60	0	−350	+700	−700	+900	−900
315	400	0	−40	40	30	70	0	−400	+800	−800	+1 000	−1 000
400	500	0	−45	45	34	80	0	−450	+900	−900	+1 200	−1 200
500	630	0	−60	60	40	90	0	−500	+1 000	−1 000	+1 200	−1 200
630	800	0	−75	75	45	100	0	−750	+1 500	−1 500	+1 500	−1 500
800	1 000	0	−100	100	55	115	0	−1 000	+1 500	−1 500	+1 500	−1 500

1) Values in dot-line frame are the **NTN** stadard.

Table 6.7 (2) Outer rings

Unit: μm

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}		Variation of outside diameter in a single plane V_{Dsp}	Variation of mean outside diameter V_{Dmp}	Radial runout of outer ring of assembled bearing K_{ea}	Deviation of a single outer ring width Δ_{Cs}		Deviation of bearing overall width: Double row bearing Δ_{C1s}		Deviation of bearing overall width: Four-row bearing Δ_{C2s}	
Over	Incl.	Upper	Lower	Max.	Max.	Max.	Upper	Lower	Upper	Lower	Upper	Lower
50	80	0	−16	16	12	25	Depends on tolerance of Δ_{Bs} in relation to d of the same bearing		Depends on tolerance of Δ_{B1s} in relation to d of the same bearing		Depends on tolerance of Δ_{B2s} in relation to d of the same bearing	
80	120	0	−18	18	14	35						
120	150	0	−20	20	15	40						
150	180	0	−25	25	19	45						
180	250	0	−30	30	23	50						
250	315	0	−35	35	26	60						
315	400	0	−40	40	30	70						
400	500	0	−45	45	34	80						
500	630	0	−50	60	38	100						
630	800	0	−75	80	55	120						
800	1 000	0	−100	100	75	140						
1 000	1 250	0	−125	130	90	160						
1 250	1 600	0	−160	170	100	180						

Table 6.8 Tolerance of tapered roller bearings of J series (metric series)

Table 6.8 (1) Inner rings

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}								Variation of bore diameter in a single plane V_{dsp}				Variation of mean bore diameter V_{dmp}				Axial runout of inner ring of assembled bearing S_{ia}
		Class K		Class N		Class C		Class B		Class K	Class N	Class C	Class B	Class K	Class N	Class C	Class B	Class B
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Max.				Max.				Max.
10	18	0	−12	0	−12	0	−7	0	−5	12	12	4	3	9	9	5	4	3
18	30	0	−12	0	−12	0	−8	0	−6	12	12	4	3	9	9	5	4	4
30	50	0	−12	0	−12	0	−10	0	−8	12	12	4	3	9	9	5	5	4
50	80	0	−15	0	−15	0	−12	0	−9	15	15	5	3	11	11	5	5	4
80	120	0	−20	0	−20	0	−15	0	−10	20	20	5	3	15	15	5	5	5
120	180	0	−25	0	−25	0	−18	0	−13	25	25	5	3	19	19	5	7	7
180	250	0	−30	0	−30	0	−22	0	−15	30	30	6	4	23	23	5	8	8

Note: Please consult **NTN** Engineering for Class A bearings.

Table 6.8 (2) Outer rings

Unit: μm

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}								Variation of outside diameter in a single plane V_{Dsp}				Variation of mean outside diameter V_{Dmp}				Axial runout of outer ring of assembled bearing S_{ea}
		Class K		Class N		Class C		Class B		Class K	Class N	Class C	Class B	Class K	Class N	Class C	Class B	Class B
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Max.				Max.				Max.
18	30	0	−12	0	−12	0	−8	0	−6	12	12	4	3	9	9	5	4	3
30	50	0	−14	0	−14	0	−9	0	−7	14	14	4	3	11	11	5	5	3
50	80	0	−16	0	−16	0	−11	0	−9	16	16	4	3	12	12	6	5	4
80	120	0	−18	0	−18	0	−13	0	−10	18	18	5	3	14	14	7	5	4
120	150	0	−20	0	−20	0	−15	0	−11	20	20	5	3	15	15	8	6	4
150	180	0	−25	0	−25	0	−18	0	−13	25	25	5	3	19	19	9	7	5
180	250	0	−30	0	−30	0	−20	0	−15	30	30	6	4	23	23	10	8	6
250	315	0	−35	0	−35	0	−25	0	−18	35	35	8	5	26	26	13	9	6
315	400	0	−40	0	−40	0	−28	0	−20	40	40	10	5	30	30	14	10	6

Note: Please consult **NTN** Engineering for Class A bearings.

Table 6.8 (3) Effective width of inner subunits and outer rings

Unit: μm

Nominal bore diameter d mm		Deviation of the actual effective width of inner subunit assembled with a master outer ring Δ_{T1s}								Deviation of the actual effective width of outer ring assembled with a master inner subunit Δ_{T2s}							
		Class K		Class N		Class C		Class B		Class K		Class N		Class C		Class B	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
10	80	+100	0	+50	0	+100	−100	∗	∗	+100	0	+50	0	+100	−100	∗	∗
80	120	+100	−100	+50	0	+100	−100	∗	∗	+100	−100	+50	0	+100	−100	∗	∗
120	180	+150	−150	+50	0	+100	−100	∗	∗	+200	−100	+100	0	+100	−150	∗	∗
180	250	+150	−150	+50	0	+100	−150	∗	∗	+200	−100	+100	0	+100	−150	∗	∗

Note: 1. " ∗ " mark bearings are manufactured only for combined bearings.
2. Please consult **NTN** Engineering for Class A bearings.

Unit: μm

Deviation of the actual assembled bearing width Δ_{Ts}							
Class K		Class N		Class C		Class B	
Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
+200	0	+100	0	+200	−200	+200	−200
+200	0	+100	0	+200	−200	+200	−200
+200	0	+100	0	+200	−200	+200	−200
+200	0	+100	0	+200	−200	+200	−200
+200	−200	+100	0	+200	−200	+200	−200
+350	−250	+150	0	+350	−250	+200	−250
+350	−250	+150	0	+350	−300	+200	−300

Table 6.8 (4) Radial runout of inner and outer rings

Unit: μm

Nominal outside diameter D mm		Radial runout of inner ring of assembled bearing K_{ia} Radial runout of outer ring of assembled bearing K_{ea}			
		Class K	Class N	Class C	Class B
Over	Incl.	Max.			
18	30	18	18	5	3
30	50	20	20	6	3
50	80	25	25	6	4
80	120	35	35	6	4
120	150	40	40	7	4
150	180	45	45	8	4
180	250	50	50	10	5
250	315	60	60	11	5
315	400	70	70	13	5

Note: Please consult **NTN** Engineering for Class A bearings.

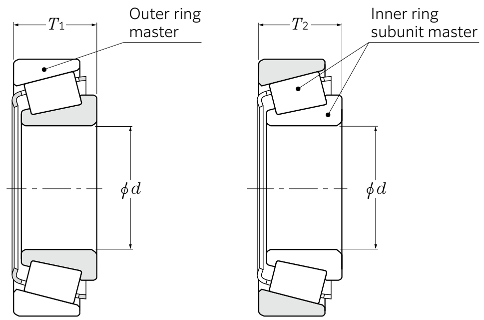


Table 6.9 Tolerance of thrust ball bearings

Table 6.9 (1) Shaft washer

Unit: μm

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}				Variation of bore diameter in a single plane V_{dsp}		Variation in thickness between shaft washer raceway and back face S_i			
		Class 0, 6, 5		Class 4		Class 0, 6, 5	Class 4	Class 0	Class 6	Class 5	Class 4
Over	Incl.	Upper	Lower	Upper	Lower	Max.		Max.			
—	18	0	−8	0	−7	6	5	10	5	3	2
18	30	0	−10	0	−8	8	6	10	5	3	2
30	50	0	−12	0	−10	9	8	10	6	3	2
50	80	0	−15	0	−12	11	9	10	7	4	3
80	120	0	−20	0	−15	15	11	15	8	4	3
120	180	0	−25	0	−18	19	14	15	9	5	4
180	250	0	−30	0	−22	23	17	20	10	5	4
250	315	0	−35	0	−25	26	19	25	13	7	5
315	400	0	−40	0	−30	30	23	30	15	7	5
400	500	0	−45	0	−35	34	26	30	18	9	6
500	630	0	−50	0	−40	38	30	35	21	11	7

Table 6.9 (2) Housing washer

Unit: μm

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}				Variation of outside diameter in a single plane V_{Dsp}		Variation in thickness between housing washer raceway and back face S_e
		Class 0, 6, 5		Class 4		Class 0, 6, 5	Class 4	Class 0, 6, 5, 4
Over	Incl.	Upper	Lower	Upper	Lower	Max.		Max.
10	18	0	−11	0	−7	8	5	Depends on tolerance of S_i against d of the same bearings
18	30	0	−13	0	−8	10	6	
30	50	0	−16	0	−9	12	7	
50	80	0	−19	0	−11	14	8	
80	120	0	−22	0	−13	17	10	
120	180	0	−25	0	−15	19	11	
180	250	0	−30	0	−20	23	15	
250	315	0	−35	0	−25	26	19	
315	400	0	−40	0	−28	30	21	
400	500	0	−45	0	−33	34	25	
500	630	0	−50	0	−38	38	29	
630	800	0	−75	0	−45	55	34	

Table 6.9 (3) Bearing height

Unit: μm

Nominal bore diameter d mm		Deviation of the actual bearing height, single-direction bearing 1) Δ_{Ts}	
Over	Incl.	Upper	Lower
—	30	0	−75
30	50	0	−100
50	80	0	−125
80	120	0	−150
120	180	0	−175
180	250	0	−200
250	315	0	−225
315	400	0	−300
400	500	0	−350
500	630	0	−400

1) Applies to flat back face bearing of Class 0.
The values are the **NTN** standard.

Table 6.10 Tolerance of spherical thrust roller bearings

Table 6.10 (1) Shaft washer

Unit: μm

Nominal bore diameter d mm		Deviation of mean bore diameter in a single plane Δ_{dmp}		Variation of bore diameter in a single plane V_{dsp}	Perpendicularity of shaft washer back face with respect to the bore 1) S_d	Deviation of the actual bearing height 1) Δ_{Ts}	
Over	Incl.	Upper	Lower	Max.	Max.	Upper	Lower
50	80	0	−15	11	25	+150	−150
80	120	0	−20	15	25	+200	−200
120	180	0	−25	19	30	+250	−250
180	250	0	−30	23	30	+300	−300
250	315	0	−35	26	35	+350	−350
315	400	0	−40	30	40	+400	−400
400	500	0	−45	34	45	+450	−450

1) The standard conforms to JIS B 1539.

Table 6.10 (2) Housing washer

Unit: μm

Nominal outside diameter D mm		Deviation of mean outside diameter in a single plane Δ_{Dmp}	
Over	Incl.	Upper	Lower
120	180	0	−25
180	250	0	−30
250	315	0	−35
315	400	0	−40
400	500	0	−45
500	630	0	−50
630	800	0	−75
800	1 000	0	−100

6.3 Chamfer measurements and tolerance or allowable values of tapered bore

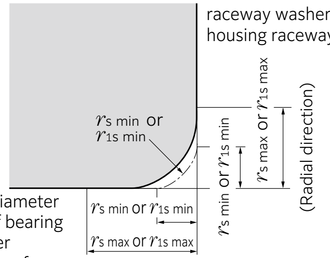


Table 6.11 Allowable critical-value of bearing chamfer

Table 6.11 (1) Radial bearings (except tapered roller bearing)

Unit: μm

$r_{s\,min}$ [1] or $r_{1s\,min}$	Nominal bore diameter d Over	Incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
0.05	–	–	0.1	0.2
0.08	–	–	0.16	0.3
0.1	–	–	0.2	0.4
0.15	–	–	0.3	0.6
0.2	–	–	0.5	0.8
0.3	–	40	0.6	1
	40	–	0.8	1
0.6	–	40	1	2
	40	–	1.3	2
1	–	50	1.5	3
	50	–	1.9	3
1.1	–	120	2	3.5
	120	–	2.5	4
1.5	–	120	2.3	4
	120	–	3	5
2	–	80	3	4.5
	80	220	3.5	5
	220	–	3.8	6
2.1	–	280	4	6.5
	280	–	4.5	7
2.5	–	100	3.8	6
	100	280	4.5	6
	280	–	5	7
3	–	280	5	8
	280	–	5.5	8
4	–	–	6.5	9
5	–	–	8	10
6	–	–	10	13
7.5	–	–	12.5	17
9.5	–	–	15	19
12	–	–	18	24
15	–	–	21	30
19	–	–	25	38

1) These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Table 6.11 (2) Tapered roller bearings of metric series

Unit: μm

$r_{s\,min}$ [2] or $r_{1s\,min}$	Nominal bore diameter d [3] or nominal outside diameter D Over	Incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
0.3	–	40	0.7	1.4
	40	–	0.9	1.6
0.6	–	40	1.1	1.7
	40	–	1.3	2
1	–	50	1.6	2.5
	50	–	1.9	3
1.5	–	120	2.3	3
	120	250	2.8	3.5
	250	–	3.5	4
2	–	120	2.8	4
	120	250	3.5	4.5
	250	–	4	5
2.5	–	120	3.5	5
	120	250	4	5.5
	250	–	4.5	6
3	–	120	4	5.5
	120	250	4.5	6.5
	250	400	5	7
	400	–	5.5	7.5
4	–	120	5	7
	120	250	5.5	7.5
	250	400	6	8
	400	–	6.5	8.5
5	–	180	6.5	8
	180	–	7.5	9
6	–	180	7.5	10
	180	–	9	11

2) These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.
3) Inner rings shall be in accordance with the division of "d" and outer rings with that of "D".
Note: The standard applies to the bearings whose dimensional series (refer to the dimensional table) are specified in the standard ISO 355 or JIS B 1512. For further information concerning bearings outside of these standards or tapered roller bearings using a US customary unit, please contact **NTN** Engineering.

Commentary

Bearing Tolerances

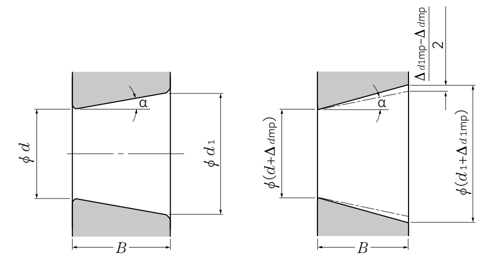
NTN

Table 6.11 (3) Thrust bearings

Unit: μm

$r_{s\,min}$ or $r_{1\,min}$ [4]	$r_{s\,max}$ or $r_{1s\,max}$ Radial and axial directions
0.05	0.1
0.08	0.16
0.1	0.2
0.15	0.3
0.2	0.5
0.3	0.8
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5
4	6.5
5	8
6	10
7.5	12.5
9.5	15
12	18
15	21
19	25

4) These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the



Theoretical tapered bore   Tapered bore having dimensional differen of mean bore diameter within plane

Table 6.12 (1) Tolerance of tapered bores of radial bearings and tapered bores with allowable standard taper ratio 1:12 (Class 0)

Unit: μm

d mm Over	Incl.	Δ_{dmp} Upper	Lower	$\Delta_{d1mp}-\Delta_{dmp}$ Upper	Lower	V_{dsp} [1) 2)] Max.
	10	+ 22	0	+ 15	0	9
10	18	+ 27	0	+ 18	0	11
18	30	+ 33	0	+ 21	0	13
30	50	+ 39	0	+ 25	0	16
50	80	+ 46	0	+ 30	0	19
80	120	+ 54	0	+ 35	0	22
120	180	+ 63	0	+ 40	0	40
180	250	+ 72	0	+ 46	0	46
250	315	+ 81	0	+ 52	0	52
315	400	+ 89	0	+ 57	0	57
400	500	+ 97	0	+ 63	0	63
500	630	+110	0	+ 70	0	70
630	800	+125	0	+ 80	0	—
800	1 000	+140	0	+ 90	0	—
1 000	1 250	+165	0	+105	0	—
1 250	1 600	+195	0	+125	0	—

Table 6.12 (2) Tolerance of tapered bores of radial bearings and tapered bores with allowable standard taper ratio 1:30 (Class 0)

Unit: μm

d mm Over	Incl.	Δ_{dmp} Upper	Lower	$\Delta_{d1mp}-\Delta_{dmp}$ Upper	Lower	V_{dsp} [1) 2)] Max.
50	80	+15	0	+30	0	19
80	120	+20	0	+35	0	22
120	180	+25	0	+40	0	40
180	250	+30	0	+46	0	46
250	315	+35	0	+52	0	52
315	400	+40	0	+57	0	57
400	500	+45	0	+63	0	63
500	630	+50	0	+70	0	70

1) Applies to all radial flat planes of tapered bores.
2) Does not apply to diameter series 7 and 8.
Note: Quantifiers
For a standard taper ratio of $\frac{1}{12}$, $d_1 = d + \frac{1}{12}B$
For a standard taper ratio of $\frac{1}{30}$, $d_1 = d + \frac{1}{30}B$
Δ_{dmp} : Dimensional difference of the mean bore diameter within the flat surface at the theoretical small end of the tapered bore
Δ_{d1mp} : Dimensional difference of the mean bore diameter within the flat surface at the theoretical large end of the tapered bore
V_{dsp} : Unevenness of the bore diameter with the flat surface
B : Nominal width of inner ring
α : $\frac{1}{2}$ of the tapered bore's standard taper angle

For a standard taper ratio of $\frac{1}{12}$
α = 2°23′9.4″
= 2.38594°
= 0.041643 rad

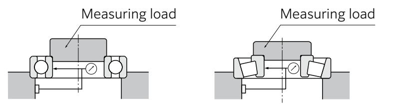
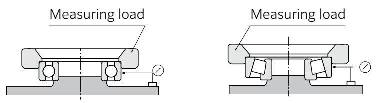
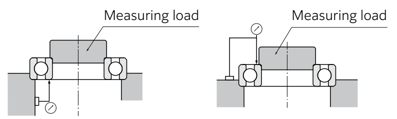
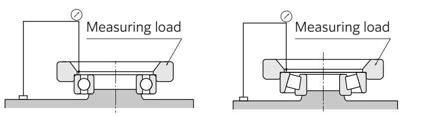
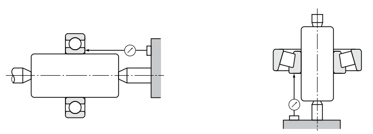
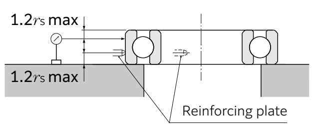
For standard taper ratio of $\frac{1}{30}$
α = 0°57′17.4″
= 0.95484°
= 0.016665 rad

6.4 Bearing tolerance measurement methods

For reference, measurement methods for rolling bearing tolerances are specified in JIS B 1515-2.

Table 6.13 shows some of the major methods of measuring rotation tolerances.

Table 6.13 Rotation tolerance measurement methods

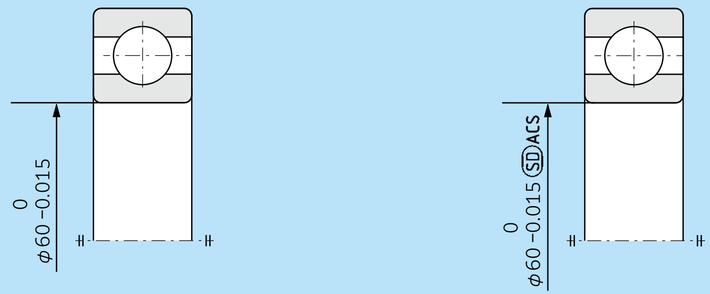
Accuracy characteristics	Measurement methods	
Radial runout of inner ring of assembled bearing (K_{ia})		Radial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Radial runout of outer ring of assembled bearing (K_{ea})		Radial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Axial runout of inner ring of assembled bearing (S_{ia})		Axial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Axial runout of outer ring of assembled bearing (S_{ea})		Axial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Perpendicularity of inner ring face with respect to the bore (S_d)		The squareness of the inner ring side surface is the difference between the maximum and minimum readings of the measuring device when the inner ring is turned one revolution together with the tapered mandrel.
Perpendicularity of outer ring outside surface with respect to the face (S_D)		The squareness of the outer ring outer diameter surface is the difference between the maximum and minimum readings of the measuring device when the outside ring is turned one revolution along the reinforcing plate.

6.5 Geometrical product specifications (GPS)

GPS is an abbreviation of geometrical product specifications. GPS is the new drawing notation for accurately describing the geometrical specifications of product shapes, dimensions, and surface characteristics. The standard that specifies rules for making drawings with GPS is called "GPS standard."

<Purpose of GPS>

While conventional drawing notation typically describes product dimensions and characteristics accurately, there are several "unclear" aspects of the conventional notation that can lead to varying interpretations (see **Fig. 6.2**). The main purpose of the GPS is to eliminate the ambiguity of drawing notation, thereby preventing troubles.



The dimensional tolerance of bearing bore diameters is specified in ISO/JIS as "Dimensional tolerance of mean bore diameter within plane" (see **Table 6.4 (1)**). However, expressions such as "within plane" and "mean" are omitted in the conventional drawing notation as shown above. This can lead to several interpretations of the dimensional tolerance.

Conventional notation

GPS code "SD" represents "middle" and "ACS" represents "arbitrary cross section." By adding these two codes after the inner bore tolerance, it is possible to clearly express "middle of the measured diameter within an arbitrary cross section", which is the dimensional tolerance of the mean bore diameter within a plane.

GPS notation

Fig. 6.2 Notation example of bearing bore diameter tolerance

<Applying GPS to rolling bearings>
In regards to standards related to roller bearings, ISO 492 specifying the tolerance of radial bearings and ISO 199 specifying the tolerance of thrust bearings were revised with GPS in 2014. In response to this, JIS B 1514–1 and JIS B 1514–2 were also revised in 2017.

<Example of bearing drawing applying GPS>
Fig. 6.3 shows an example of a bearing drawing that uses GPS.

Drawings that use GPS include notations and codes that are different from the ones used in conventional drawings.

For details, please contact **NTN** Engineering.

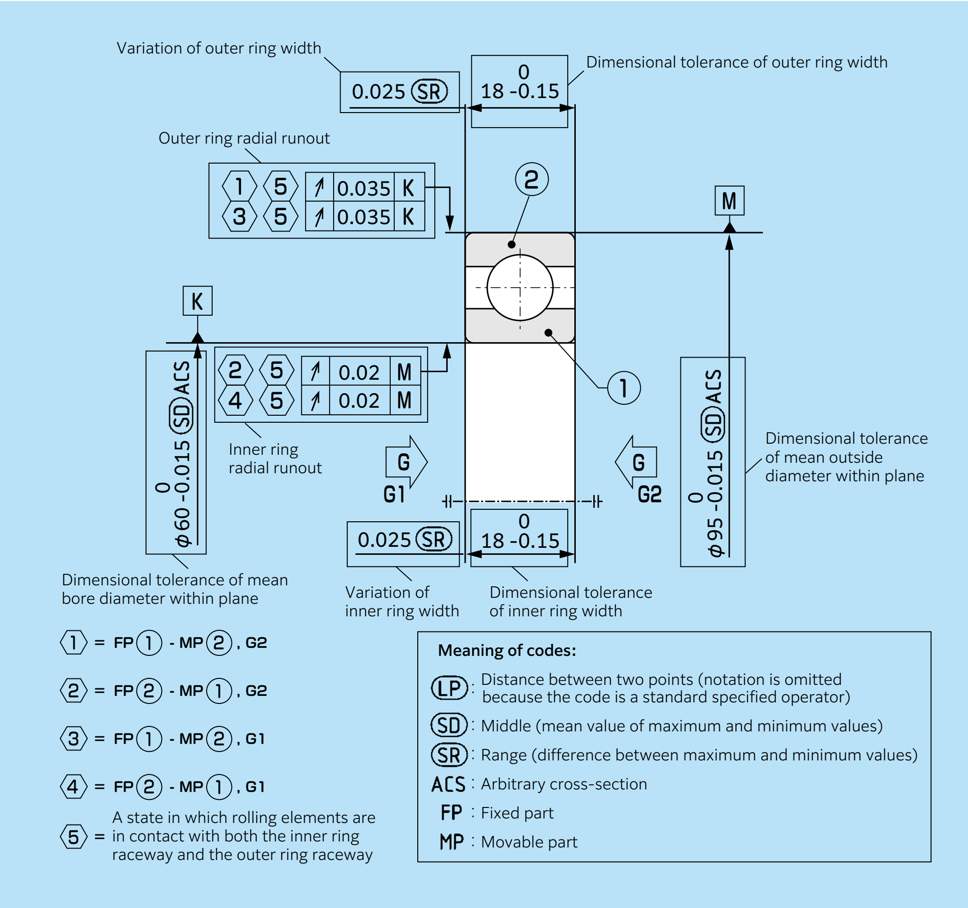


Fig. 6.3 Example of bearing drawing applying GPS

7. Bearing fits

7.1 Resultant fits

For rolling bearings, it is necessary to fix inner and outer rings on the shaft or in the housing so that relative movement does not occur between fitting surfaces during operation or under load. This relative movement between the mating surfaces of the bearing and the shaft or housing can occur in a radial direction, an axial direction, or in the direction of rotation. Types of resultant fit include **tight**, **transition** and **loose fits**, which describe whether or not there is interference between the bearing and the shaft or housing.

The most effective way to fix the mating surfaces between a bearing and shaft or housing is to apply a “tight fit.” The advantage of a tight fit for thin walled bearings is that it provides uniform load support over the entire ring circumference without any loss of load carrying capacity. However, with a tight fit, ease of installation and disassembly is lost; and when using a non-separable bearing as the floating-side bearing, axial displacement is not possible. For this reason, a tight fit cannot be recommended in all cases.

7.2 The necessity of a proper fit

In some cases, an improper fit may lead to damage and shorten bearing life. Therefore it is necessary to carefully select the proper fit. Some possible bearing failures caused by an improper fit are listed below.

- Raceway cracking, early flaking and displacement of raceway
- Raceway and shaft or housing abrasion caused by creeping and fretting corrosion
- Seizing caused by negative internal clearances
- Increased noise and deteriorated rotational accuracy due to raceway groove deformation

Please refer to “16. Bearing Damage and Corrective Measures” for information concerning diagnosis of these conditions.

7.3 Fit selection

Selection of a proper fit is dependent upon thorough analysis of bearing operating conditions, including consideration of:

- Shaft and housing material, wall thickness, surface finish accuracy, etc.
- Machinery operating conditions (nature and magnitude of load, rotational speed, temperature, etc.)

7.3.1 "Tight fit" or "Loose fit"

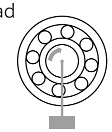
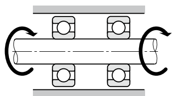
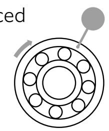
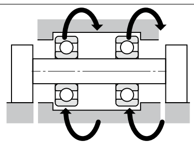
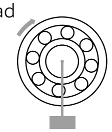
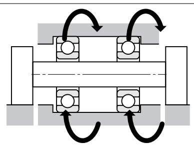
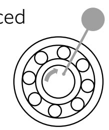
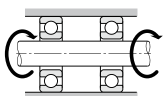
(1) For bearing rings under rotating loads, a **tight fit** is necessary. (Refer to **Table 7.1**) "Raceways under rotating loads" refers to raceways receiving loads rotating relative to their radial direction.

For bearing rings under static loads, on the other hand, a **loose fit** is sufficient.

(Example) Rotating inner ring load = the direction of the radial load on the inner ring is rotating relatively

(2) For non-separable bearings, such as deep groove ball bearings, it is generally recommended that either the inner ring or outer ring be given a **loose fit**.

Table 7.1 Radial load and bearing fit

Design		Bearing rotation		Ring load	Fit
Static load			Inner ring: Rotating Outer ring: Stationary	Rotating inner ring load Static outer ring load	Inner ring: Tight fit Outer ring: Loose fit
Unbalanced load			Inner ring: Stationary Outer ring: Rotating		
Static load			Inner ring: Stationary Outer ring: Rotating	Static inner ring load Rotating outer ring load	Inner ring: Loose fit Outer ring: Tight fit
Unbalanced load			Inner ring: Rotating Outer ring: Stationary		

7.3.2 Recommended fits

Bearing fit is governed by the tolerances selected for bearing shaft diameters and housing bore diameters.

Widely used fits for Class 0 tolerance bearings and various shaft and housing bore diameter tolerances are shown in **Fig. 7.1**.

Generally-used, standard fits for most types of bearings and operating conditions are shown in **Tables 7.2** to **7.7**.

Table 7.2: Fits for radial bearings
Table 7.3: Fits for thrust bearings
Table 7.4: Fits for electric motor bearings
Table 7.6: Inch series tapered roller bearings Fits of (ANSI/ABMA CLASS 4)
Table 7.7: Inch series tapered roller bearings Fits of (ANSI/ABMA CLASS 3, CLASS 0)

Table 7.5 shows fits and their numerical values.

For special fits or applications, please consult **NTN** Engineering.

7.3.3 Interference minimum and maximum values

The following points should be considered when it is necessary to calculate the interference for an application:

- Regarding minimum values,
  1) interference is reduced by radial loads
  2) interference is reduced by differences between bearing temperature and ambient temperature
  3) interference is reduced by variation in mating surface
  4) interference is reduced by deformation
- The upper limit value should not exceed 1/ 1 000 of the shaft diameter.

Required interference calculations are shown below.

(1) Mating surface variation and interference

Interference decreases because the mating surface is smoothed by the resultant fit (surface roughness is reduced). The amount the interference decreases depends on the roughness of the mating surfaces. It is generally necessary to anticipate the following decrease in interference.

For ground shafts: 1.0 to 2.5 μm
For machined shafts: 5.0 to 7.0 μm

The interference including this decrease amount is called effective interference.

(2) Radial loads and required interference

Interference of the inner ring and shaft decreases when a radial load is applied to the bearing. The interference required for installation to solid shafts is expressed by formulae (7.1) and (7.2) for each load condition.

General applications ($F_r \leqq 0.3C_{0r}$)

$$\Delta d_F = 0.08(d \cdot F_r / B)^{1/2} \text{ N} \quad \cdots\cdots(7.1)$$

Under heavy load conditions ($F_r > 0.3\,C_{0r}$)

$$\Delta d_F = 0.02(F_r / B) \text{ N} \quad \cdots\cdots(7.2)$$

Where:

Δd_F : Required effective interference according to radial load μm
d : Bearing bore mm
B : Inner ring width mm
F_r : Actual radial load, N
C_{0r} : Basic static load rating N

For solid shafts, please contact **NTN** Engineering.

(3) Temperature difference and required interference

Interference between inner rings and steel shafts is reduced as a result of temperature increases (difference between bearing temperature and ambient temperature, ΔT) caused by bearing rotation. Calculation of the minimum required amount of interference in such cases is shown in formula (7.3).

$$\Delta d_T = 0.0015 \cdot d \cdot \Delta T \quad \cdots\cdots(7.3)$$

Δd_T : Required effective interference for temperature difference μm
ΔT : Difference between inner ring temperature and ambient temperature °C
d : Bearing bore mm

(4) Maximum interference

When bearing rings are installed with an interference fit, tensile or compressive stress may occur along their raceways. If interference is too great, this may cause damage to the rings and reduce bearing life. The maximum stress due to the resultant fit must not exceed approximately 127 MPa for safety. If the value is to be exceeded, consult **NTN** Engineering.

See section "17.4 Resultant fit surface pressure" for the calculation method of maximum stress due to the resultant fit.

(5) Interference change amount when materials other than steel are used for shafts and housings

When materials other than steel are used for shafts and housings, the fits between the inner ring and the shaft and the outer ring and the housing change because of difference in the expansion coefficient of each material as the temperature rises during the rotation of the bearing. Therefore, it is necessary to set the resultant fit with expansion coefficients in consideration. The calculation formula of the change in interference is shown below.

$$\Delta d_{TE} = (\alpha_1 - \alpha_2) \times d \times \Delta T$$

Δd_{TE} : Change in interference caused by difference in the expansion coefficients mm

α_1 : Bearing expansion coefficient 1/°C

α_2 : Shaft and housing expansion coefficient 1/°C

d : Reference dimension of resultant fit mm

ΔT : Temperature increase by bearing rotation °C

(Expansion coefficient: See **Table 13.19** in "13. Bearing Materials.")

7.3.4 Other details

(1) Large interference fits are recommended for,
- Operating conditions with large vibrations or shock loads
- Applications using hollow shafts or housings with thin walls
- Applications using housings made of light alloys or plastic

(2) Small interference fits are preferable for,
- Applications requiring high running accuracy
- Applications using small sized bearings or thin walled bearings

(3) Consideration must also be given to the fact that fit selection will effect internal bearing clearance selection. (refer to page A-88.)

(4) A particular type of fit is recommended for SL type cylindrical roller bearings. (refer to page C-67.)

(5) Bearing dimensions are measured and managed at a temperature of 20°C.

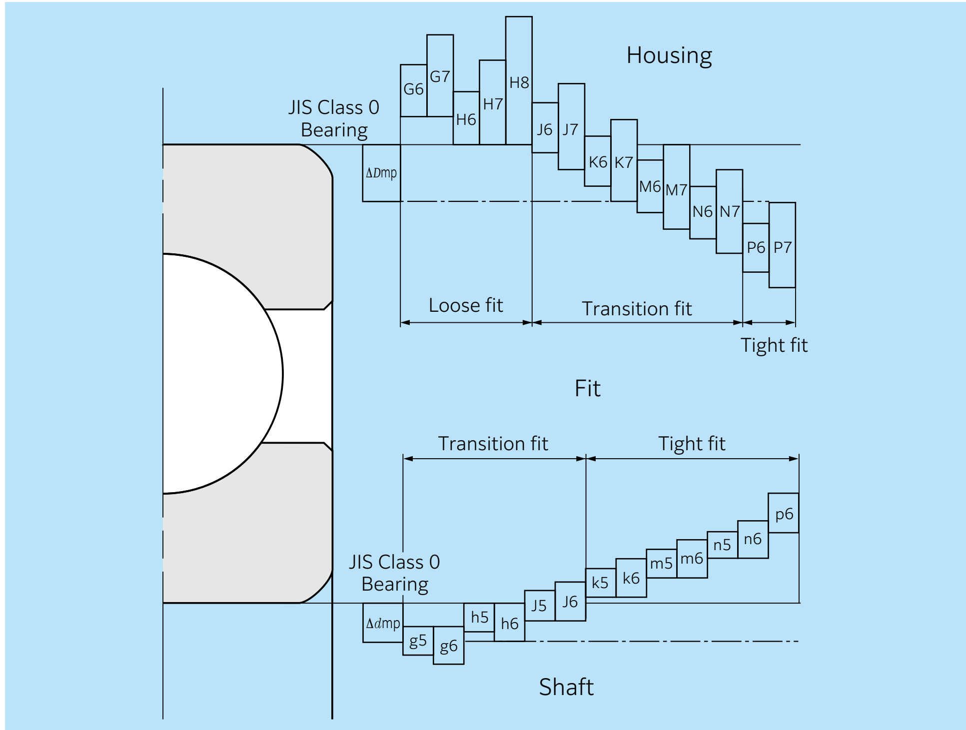


Fig 7.1 State of resultant fit

Bearing Fits

Table 7.2 General standards for radial bearing fits (JIS Class 0, 6X, 6)

Table 7.2 (1) Tolerance class of shafts commonly used for radial bearings (classes 0, 6X and 6)

Condition No.		Ball bearing Over	Ball bearing Incl.	Cylindrical roller bearing / Tapered roller bearing Over	Cylindrical roller bearing / Tapered roller bearing Incl.	Self-aligning roller bearing Over	Self-aligning roller bearing Incl.	Shaft tolerance class	Remarks
		Shaft diameter (mm)							
Cylindrical bore bearing (Classes 0, 6X and 6)									
Inner ring rotational load or load of undetermined direction	Light load [1] or Fluctuating load	—	18	—	—	—	—	h5	When greater accuracy is required js5, k5, and m5 may be substituted for js6, k6, and m6.
		18	100	—	40	—	—	js6	
		100	200	40	140	—	—	k6	
		—	—	140	200	—	—	m6	
	Normal load [1]	—	18	—	—	—	—	js5	Alteration of inner clearances to accommodate fit is not a consideration with single-row angular contact bearings and tapered roller bearings. Therefore, k5 and m5 may be substituted for k6 and m6.
		18	100	—	40	—	40	k5	
		100	140	40	100	40	65	m5	
		140	200	100	140	65	100	m6	
		200	280	140	200	100	140	n6	
		—	—	200	400	140	280	p6	
		—	—	—	—	280	500	r6	
	Heavy load [1] or Impact load	—	—	50	140	50	100	n6	Use bearings with larger internal clearances than CN clearance bearings.
		—	—	140	200	100	140	p6	
		—	—	200	—	140	200	r6	
Static inner ring load	Inner ring must move easily over shaft	Overall shaft diameter						g6	When greater accuracy is required use g5. For large bearings, f6 will suffice to facilitate movement.
	Inner ring does not have to move easily over shaft	Overall shaft diameter						h6	When greater accuracy is required use h5.
Center axial load		Overall shaft diameter						js6	Generally, shaft and inner rings are not fixed using resultant fits.
Tapered bore bearing (class 0) (with adapter or withdrawal sleeve)									
Full load		Overall shaft diameter						h9/IT5 [2]	h10/IT7 [2] will suffice for power transmitting shafts.

Table 7.2 (2) Fit with shaft (fits for tapered bore bearings (Class 0) with adapter assembly/ withdrawal sleeve)

Full load	All bearing types	Tolerance class	h9 / IT5 [2]	General applications
			H10 / IT7 [2]	Transmission shafts, etc.

1) Standards for light loads, normal loads, and heavy loads
- Light loads: dynamic equivalent radial load ≦ 0.05 Cr
- Normal loads: 0.05 Cr ≦ dynamic equivalent radial load ≦ 0.10 Cr
- Heavy loads: 0.10 Cr < dynamic equivalent radial load

2) IT5 and IT7 show shaft roundness tolerances, cylindricity tolerances, and related values.

Note: All values and fits listed in the above tables are for solid steel shafts.

Bearing Fits

Table 7.2 (3) Tolerance class of housing bores commonly used for radial bearings (classes 0, 6X and 6)

Conditions: Housing	Conditions: Load type, etc.		Conditions: Outer ring axial direction movement [3]	Housing bore tolerance class	Remarks
Single housing or Divided housing	Static outer ring load	All types of loads	Yes	H7	G7 can be used for large bearings or bearings with large temperature differential between the outer ring and housing.
		Light [1] or ordinary load [1]	Yes	H8	—
		Shaft and inner ring become hot	Easily	G7	F7 be used for large bearings or bearings with large temperature differential between the outer ring and housing.
Single housing		Requires precise rotation under light or ordinary loads	As a rule, it cannot move.	K6	Primarily applies to roller bearings.
			Yes	Js6	Primarily applies to ball bearings.
		Requires low noise operation	Yes	H6	—
	Indeterminate load	Light or ordinary load	Yes	Js7	If high accuracy is required, Js6 and K6 are used in place of Js7 and K7.
		Ordinary or heavy load [1]	As a rule, it cannot move.	K7	
		High impact load	No	M7	—
	Rotating outer ring load	Light or fluctuating load	No	M7	—
		Ordinary or heavy load	No	N7	Primarily applies to ball bearings.
		Heavy load or large impact load with thin wall housing [2]	No	P7	Primarily applies to roller bearings.

1) Standards for light loads, normal loads, and heavy loads
- Light loads: dynamic equivalent radial load ≦ 0.05 Cr
- Normal loads: 0.05 Cr ≦ dynamic equivalent radial load ≦ 0.10 Cr
- Heavy loads: 0.10 Cr < dynamic equivalent radial load

2) The axial direction needs to be secured because the outer ring may move in the shaft direction, causing problems, depending on the use. (Example: planetary gear, etc.)

3) Indicates whether or not outer ring axial movement is possible with non-separable type bearings.

Note: 1. All values and fits listed in the above tables are for cast iron or steel housings.
2. If only a center axial load is applied to the bearing, select a tolerance class that provides clearance for the outer ring in the radial direction.

Table 7.3 Standard fits for thrust bearings (JIS Class 0 and 6)

Table 7.3 (1) Shaft fits

Bearing type	Load conditions		Fit	Shaft diameter mm Over Incl.	Tolerance class
All thrust bearings	Centered axial load only		Transition fit	Overall shaft diameter	js6 or h6
Self-aligning roller thrust bearing	Combined load	Static inner ring load	Transition fit	Overall shaft diameter	js6
		Rotating inner ring load or Indeterminate load	Transition fit Tight fit	Up to 200 400 to 200 400 or more	k6 or js6 m6 or k6 n6 or m6

Table 7.3 (2) Housing fits

Bearing type	Load conditions		Fit	Tolerance class	Remarks
All thrust bearings	Centered axial load only		Loose fit	Select a tolerance class that will provide clearance between outer ring and housing.	
Self-aligning roller thrust bearing	Combined load	Static outer ring load	Loose fit	H8	Greater accuracy required with thrust ball bearings
				H7	——
		Indeterminate load or Rotating outer ring load	Transition fit	K7	Normal operating conditions
				M7	For relatively large radial loads

Note: All values and fits listed in the above tables are for cast iron or steel housings.

Table 7.4 Fits for electric motor bearings

Bearing type	Shaft fits		Housing fits	
	Shaft diameter mm Over Incl.	Tolerance class	Housing bore diameter	Tolerance class
Deep groove ball bearing	～ 18 18 ～ 100 100 ～ 160	j5 k5 m5	All sizes	H6 or J6
Cylindrical roller bearing	～ 40 40 ～ 160 160 ～ 200	k5 m5 n6	All sizes	H6 or J6

Table 7.5 Numeric values associated with fits for radial bearing of class 0

Table 7.5 (1) Shaft fits

Nominal bearing bore diameter d mm Over	Incl.	Mean bore[1] diameter deviation Δ_{dmp} Upper	Lower	g5 Bearing Shaft	g6 Bearing Shaft	h5 Bearing Shaft	h6 Bearing Shaft	j5 Bearing Shaft	js5 Bearing Shaft	j6 Bearing Shaft
3	6	0	−8	4T~ 9L	4T~ 12L	8T~ 5L	8T~ 8L	11T~ 2L	10.5T~ 2.5L	14T~ 2L
6	10	0	−8	3T~11L	3T~ 14L	8T~ 6L	8T~ 9L	12T~ 2L	11T ~ 3L	15T~ 2L
10	18	0	−8	2T~14L	2T~ 17L	8T~ 8L	8T~11L	13T~ 3L	12T ~ 4L	16T~ 3L
18	30	0	−10	3T~16L	3T~ 20L	10T~ 9L	10T~13L	15T~ 4L	14.5T~ 4.5L	19T~ 4L
30	50	0	−12	3T~20L	3T~ 25L	12T~11L	12T~16L	18T~ 5L	17.5T~ 5.5L	23T~ 5L
50	80	0	−15	5T~23L	5T~ 29L	15T~13L	15T~19L	21T~ 7L	21.5T~ 6.5L	27T~ 7L
80	120	0	−20	8T~27L	8T~ 34L	20T~15L	20T~22L	26T~ 9L	27.5T~ 7.5L	33T~ 9L
120 140 160	140 160 180	0	−25	11T~32L	11T~ 39L	25T~18L	25T~25L	32T~11L	34T ~ 9L	39T~11L
180 200 225	200 225 250	0	−30	15T~35L	15T~ 44L	30T~20L	30T~29L	37T~13L	40T ~10L	46T~13L
250 280	280 315	0	−35	18T~40L	18T~ 49L	35T~23L	35T~32L	42T~16L	46.5T~11.5L	51T~16L
315 355	355 400	0	−40	22T~43L	22T~ 54L	40T~25L	40T~36L	47T~18L	52.5T~12.5L	58T~18L
400 450	450 500	0	−45	25T~47L	25T~ 60L	45T~27L	45T~40L	52T~20L	58.5T~13.5L	65T~20L

1) The above table is not applicable to tapered roller bearings whose bore diameter d is 30 mm or less.

Table 7.5 (2) Housing fits

Nominal bearing bore diameter D mm Over	Incl.	Mean bore[2] diameter deviation Δ_{Dmp} Upper	Lower	G7 Housing Bearing	H6 Housing Bearing	H7 Housing Bearing	J6 Housing Bearing	J7 Housing Bearing	Js7 Housing Bearing	K6 Housing Bearing
6	10	0	−8	5L~ 28L	0~17L	0~ 23L	4T~13L	7T~16L	7.5T~15.5L	7T~10L
10	18	0	−8	6L~ 32L	0~19L	0~ 26L	5T~14L	8T~18L	9T ~17L	9T~10L
18	30	0	−9	7L~ 37L	0~22L	0~ 30L	5T~17L	9T~21L	10.5T~19.5L	11T~11L
30	50	0	−11	9L~ 45L	0~27L	0~ 36L	6T~21L	11T~25L	12.5T~23.5L	13T~14L
50	80	0	−13	10L~ 53L	0~32L	0~ 43L	6T~26L	12T~31L	15T ~28L	15T~17L
80	120	0	−15	12L~ 62L	0~37L	0~ 50L	6T~31L	13T~37L	17.5T~32.5L	18T~19L
120	150	0	−18	14L~ 72L	0~43L	0~ 58L	7T~36L	14T~44L	20T ~38L	21T~22L
150	180	0	−25	14L~ 79L	0~50L	0~ 65L	7T~43L	14T~51L	20T ~45L	21T~29L
180	250	0	−30	15L~ 91L	0~59L	0~ 76L	7T~52L	16T~60L	23T ~53L	24T~35L
250	315	0	−35	17L~104L	0~67L	0~ 87L	7T~60L	16T~71L	26T ~61L	27T~40L
315	400	0	−40	18L~115L	0~76L	0~ 97L	7T~69L	18T~79L	28.5T~68.5L	29T~47L
400	500	0	−45	20L~128L	0~85L	0~108L	7T~78L	20T~88L	31.5T~76.5L	32T~53L

2) The above table is not applicable to tapered roller bearings whose outside diameter D is 150 mm or less.
Note: Fit symbol "**L**" indicates clearance and "**T**" indicates interference.

Unit: μm

js6 Bearing Shaft	k5 Bearing Shaft	k6 Bearing Shaft	m5 Bearing Shaft	m6 Bearing Shaft	n6 Bearing Shaft	p6 Bearing Shaft	r6 Bearing Shaft	Nominal bearing bore diameter d mm Over	Incl.
12T ~ 4L	14T~1T	17T~1T	17T~ 4T	20T~ 4T	24T~ 8T	28T~ 12T	– –	3	6
12.5T~ 4.5L	15T~1T	18T~1T	20T~ 6T	23T~ 6T	27T~10T	32T~ 15T	– –	6	10
13.5T~ 5.5L	17T~1T	20T~1T	23T~ 7T	26T~ 7T	31T~12T	37T~ 18T	– –	10	18
16.5T~ 6.5L	21T~2T	25T~2T	27T~ 8T	31T~ 8T	38T~15T	45T~ 22T	– –	18	30
20T ~ 8L	25T~2T	30T~2T	32T~ 9T	37T~ 9T	45T~17T	54T~ 26T	– –	30	50
24.5T~ 9.5L	30T~2T	36T~2T	39T~11T	45T~ 11T	54T~20T	66T~ 32T	– –	50	80
31T ~11L	38T~3T	45T~2T	48T~13T	55T~ 13T	65T~23T	79T~ 37T	– –	80	120
37.5T~12.5L	46T~3T	53T~3T	58T~15T	65T~ 15T	77T~27T	93T~ 43T	113T~ 63T 115T~ 65T 118T~ 68T	120 140 160	140 160 180
44.5T~14.5L	54T~4T	63T~4T	67T~17T	76T~ 17T	90T~31T	109T~ 50T	136T~ 77T 139T~ 80T 143T~ 84T	180 200 225	200 225 250
51T ~16L	62T~4T	71T~4T	78T~20T	87T~ 20T	101T~34T	123T~ 56T	161T~ 94T 165T~ 98T	250 280	280 315
58T ~18L	69T~4T	80T~4T	86T~21T	97T~ 21T	113T~37T	138T~ 62T	184T~108T 190T~114T	315 355	355 400
65T ~20L	77T~5T	90T~4T	95T~23T	108T~ 23T	125T~40T	153T~ 68T	211T~126T 217T~132T	400 450	450 500

Unit: μm

K7 Housing Bearing	M7 Housing Bearing	N7 Housing Bearing	P7 Housing Bearing	Nominal bearing bore diameter D mm Over	Incl.
10T~13L	15T~ 8L	19T~ 4L	24T~ 1T	6	10
12T~14L	18T~ 8L	23T~ 3L	29T~ 3T	10	18
15T~15L	21T~ 9L	28T~ 2L	35T~ 5T	18	30
18T~18L	25T~ 11L	33T~ 3L	42T~ 6T	30	50
21T~22L	30T~ 13L	39T~ 4L	51T~ 8T	50	80
25T~25L	35T~ 15L	45T~ 5L	59T~ 9T	80	120
28T~30L	40T~ 18L	52T~ 6L	68T~10T	120	150
28T~37L	40T~ 25L	52T~ 13L	68T~ 3T	150	180
33T~43L	46T~ 30L	60T~ 16L	79T~ 3T	180	250
36T~51L	52T~ 35L	66T~ 21L	88T~ 1T	250	315
40T~57L	57T~ 40L	73T~ 24L	98T~ 1T	315	400
45T~63L	63T~ 45L	80T~ 28L	108T~ 0	400	500

Table 7.6 General fit standards for tapered roller bearings using US customary unit (ANSI class 4)

Table 7.6 (1) Fit with shaft

Unit: μm

Operating conditions		Nominal bearing bore diameter d mm Over	Incl.	Bore diameter tolerance Δ_{ds} Upper	Lower	Shaft diameter tolerance Upper	Lower	Fit [1]	Remarks
Rotating inner ring load	Normal load		76.2	+13	0	+38	+25	38T ~ 13T	Applicable when a slight impact load is applied as well.
		76.2	304.8	+25	0	+64	+38	64T ~ 13T	
		304.8	609.6	+51	0	+127	+76	127T ~ 25T	
		609.6	914.4	+76	0	+191	+114	191T ~ 38T	
	Heavy load Impact load		76.2	+13	0	+64	+38	64T ~ 25T	
		76.2	304.8	+25	0	0.5 μm mean interference per 1 mm of inner ring bore diameter. Minimum in terference is 25 μm. Tolerance for the shaft is adjusted to match tolerance of bearing bore diameter.			
		304.8	609.6	+51	0				
		609.6	914.4	+76	0	+457	+381	457T ~ 305T	
Rotating outer ring load	Inner ring does not have to move easily over shaft with an ordinary load.		76.2	+13	0	+13	0	13T ~ 13L	Not applicable when impact load is applied.
		76.2	304.8	+25	0	+25	0	25T ~ 25L	
		304.8	609.6	+51	0	+51	0	51T ~ 51L	
		609.6	914.4	+76	0	+76	0	76T ~ 76L	
	Inner ring must move easily over shaft with an ordinary load.		76.2	+13	0	0	−13	0 ~ 13L	
		76.2	304.8	+25	0	0	−25	0 ~ 51L	
		304.8	609.6	+51	0	0	−51	0 ~ 102L	
		609.6	914.4	+76	0	0	−76	0 ~ 152L	

Table 7.6 (2) Fit with housing

Unit: μm

Operating conditions		Nominal bearing outside diameter D mm Over	Incl.	Outer diameter dimensional tolerance Δ_{Ds} Upper	Lower	Housing bore diameter tolerance Upper	Lower	Fit [1]	Types of fits
Rotating inner ring load	When used on floating or fixed side		76.2	+25	0	+76	+51	25L ~ 76L	Loose fit
		76.2	127.0	+25	0	+76	+51	25L ~ 76L	
		127.0	304.8	+25	0	+76	+51	25L ~ 76L	
		304.8	609.6	+51	0	+152	+102	51L ~ 152L	
		609.6	914.4	+76	0	+229	+152	76L ~ 229L	
	When outer ring is adjusted in the axial direction		76.2	+25	0	+25	0	25T ~ 25L	Transition fit
		76.2	127.0	+25	0	+25	0	25T ~ 25L	
		127.0	304.8	+25	0	+51	0	25T ~ 51L	
		304.8	609.6	+51	0	+76	+25	25T ~ 76L	
		609.6	914.4	+76	0	+127	+51	25T ~ 127L	
	When outer ring is not adjusted in the axial direction		76.2	+25	0	−13	−38	64T ~ 13T	Tight fit
		76.2	127.0	+25	0	−25	−51	76T ~ 25T	
		127.0	304.8	+25	0	−25	−51	76T ~ 25T	
		304.8	609.6	+51	0	−25	−76	127T ~ 25T	
		609.6	914.4	+76	0	−25	−102	178T ~ 25T	
Rotating outer ring load	When outer ring is not adjusted in the axial direction		76.2	+25	0	−13	−38	64T ~ 13T	
		76.2	127.0	+25	0	−25	−51	76T ~ 25T	
		127.0	304.8	+25	0	−25	−51	76T ~ 25T	
		304.8	609.6	+51	0	−25	−76	127T ~ 25T	
		609.6	914.4	+76	0	−25	−102	178T ~ 25T	

1) Fit symbol "**L**" indicates clearance and "**T**" indicates interference.

Table 7.7 General fit standards for tapered roller bearings using US customary unit (ANSI classes 3 and 0)

Table 7.7 (1) Fit with shaft

Unit: μm

Operating conditions		Nominal bearing bore diameter d mm Over	Incl.	Bore diameter tolerance Δ_{ds} Upper	Lower	Shaft diameter tolerance Upper	Lower	Fit [1]
Rotating inner ring load	Precision machine tool spindles		304.8	+13	0	+30	+18	30T ~ 5T
		304.8	609.6	+25	0	+64	+38	64T ~ 13T
		609.6	914.4	+38	0	+102	+64	102T ~ 25T
	Heavy load Shock load High-speed rotation		304.8	+13	0	Minimum interference is 0.25 μm per 1 mm of inner ring bore diameter		
		304.8	609.6	+25	0			
		609.6	914.4	+38	0			
Rotating outer ring load	Precision machine tool spindles		304.8	+13	0	+30	+18	30T ~ 5T
		304.8	609.6	+25	0	+64	+38	64T ~ 13T
		609.6	914.4	+38	0	+102	+64	102T ~ 25T

Note: For class 0, bearing bore diameter d applies to 304.8 mm or less.

Table 7.7 (2) Fit with housing

Unit: μm

Operating conditions		Nominal bearing bore diameter D mm Over	Incl.	Outer diameter dimensional tolerance Δ_{Ds} Upper	Lower	Housing bore diameter tolerance Upper	Lower	Fit [1]	Types of fits
Rotating inner ring load	When used for floating-side		152.4	+13	0	+38	+25	13L ~ 38L	Loose fit
		152.4	304.8	+13	0	+38	+25	13L ~ 38L	
		304.8	609.6	+25	0	+64	+38	13L ~ 64L	
		609.6	914.4	+38	0	+89	+51	13L ~ 89L	
	When used for fixed side		152.4	+13	0	+25	+13	0 ~ 25L	
		152.4	304.8	+13	0	+25	+13	0 ~ 25L	
		304.8	609.6	+25	0	+51	+25	0 ~ 51L	
		609.6	914.4	+38	0	+76	+38	0 ~ 76L	
	When outer ring is adjusted in axial direction		152.4	+13	0	+13	0	13T ~ 13L	Transition fit
		152.4	304.8	+13	0	+25	0	13T ~ 25L	
		304.8	609.6	+13	0	+25	0	25T ~ 25L	
		609.6	914.4	+38	0	+38	0	38T ~ 38L	
	When outer ring is not adjusted in axial direction		152.4	+13	0	0	−13	25T ~ 0	Tight fit
		152.4	304.8	+13	0	0	−25	38T ~ 0	
		304.8	609.6	+25	0	0	−25	51T ~ 0	
		609.6	914.4	+38	0	0	−38	76T ~ 0	
Rotating outer ring load	Normal load When outer ring is not adjusted in the axial direction		152.4	+13	0	−13	−25	38T ~ 13T	
		152.4	304.8	+13	0	−13	−38	51T ~ 13T	
		304.8	609.6	+25	0	−13	−38	64T ~ 13T	
		609.6	914.4	+38	0	−13	−51	89T ~ 13T	

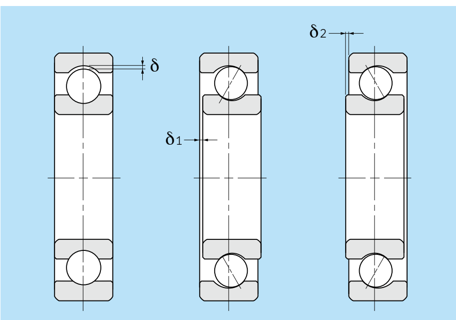
1) Fit symbol "**L**" indicates clearance and "**T**" indicates interference.
Note: For class 0, bearing outer diameter D applies to 304.8 mm or less.

8. Bearing internal clearance and preload

8.1 Bearing internal clearance

Bearing internal clearance is the amount of internal free movement before mounting. As shown in **Fig. 8.1**, when either the inner ring or the outer ring is fixed and the other ring is free to move, displacement can take place in either an axial or radial direction. This amount of displacement (radially or axially) is termed the internal clearance and, depending on the direction, is called **the radial internal clearance or the axial internal clearance**.

When the internal clearance of a bearing is measured, a slight measurement load is applied to the raceway so the internal clearance may be measured accurately. However, at this time, a slight amount of elastic deformation of the bearing occurs under the measurement load, and the clearance measurement value (measured clearance) is slightly larger than the true clearance. This difference between the true bearing clearance and the increased amount due to the elastic deformation must be compensated for. These compensation values are given in **Table 8.1**. For roller bearings the amount of elastic deformation is small enough to be ignored. The internal clearance values for each bearing class are shown in **Tables 8.8 through 8.16**.



Radial internal clearance = δ
axial internal clearance ≒ $\delta_1 + \delta_2$

Fig. 8.1 Internal clearance

8.2 Selection of internal clearance

The **internal clearance** of a bearing **under operating conditions** (effective clearance) is **usually smaller** than the initial clearance before being installed and operated. This is due to several factors including bearing fit, the difference in temperature between the inner and outer rings, etc. As a bearing's operating clearance has an effect on bearing life, heat generation, vibration, noise, etc.; care must be taken in selecting the most suitable operating clearance.

8.2.1 Criteria for selecting bearing internal clearance

A bearing's life is theoretically at its maximum when operating clearance is slightly negative in steady operation. However, in reality it is difficult to constantly maintain this optimal condition. If the negative clearance becomes larger by fluctuating operating conditions, heat will be produced and the life will decrease severely. Under normal circumstances, a **study should be performed to select an operating clearance slightly larger than zero**. For ordinary operating conditions, use fitting for ordinary loads. If rotational speed and operating temperature are ordinary, selecting normal clearance enables you to obtain the proper operating clearance.

Table 8.2 gives examples applying internal clearances other than CN (normal) clearance.

For the relationship between clearance and life, see the section of "3.8 Clearance and life."

Table 8.1 Adjustment of radial internal clearance based on measured load (deep groove ball bearing)

Unit: μm

Nominal bearing bore diameter mm		Measuring Load N	Adjustment of internal clearance				
Over	Incl.		C2	CN	C3	C4	C5
10(included)	18	24.5	3~4	4	4	4	4
18	50	49	4~5	5	6	6	6
50	200	147	6~8	8	9	9	9

Commentary

Bearing Internal Clearance and Preload NTN

Table 8.2 Examples of applications where bearing clearances other than CN (normal) clearance are used

Operating conditions	Applications	Selected clearance
With a heavy or shock load, high fit.	Railway vehicle axles	C3
	Vibration screens	C3, C4
With an indeterminate load, both inner and outer rings are tight fit.	Railway vehicle traction motors	C4
	Tractors and final reduction gear	C4
Shaft or inner ring is heated.	Paper making machines and driers	C3, C4
	Table rollers for rolling mill	C3
Required low noise and vibration when rotating.	Small electric motors	C2, CM
Adjustment of clearance to minimize shaft runout.	Main spindles of lathes (Double-row cylindrical roller bearings)	C9NA, C0NA
Loose fit for both inner and outer rings.	Roll neck of steel mill	C2

8.2.2 Calculation of operating clearance

Operating clearance of a bearing can be calculated from initial bearing internal clearance and considering the decrease in clearance due to fitting and the difference in temperature of the inner and outer rings.

$$\Delta_e = \Delta_0 - (\delta_f + \delta_t) = \Delta_f - \delta_t \cdots\cdots\cdots (8.1)$$

Where:
- Δ_e : Effective internal clearance, mm
- Δ_0 : Bearing internal clearance (initial), mm
- Δ_f : Residual clearance (clearance after preloading), mm
- δ_f : Reduced amount of clearance due to fitting, mm
- δ_t : Reduced amount of clearance due to temperature differential of inner and outer rings, mm

(1) Reduced clearance due to fitting

When bearings are installed with interference fits on shafts and in housings, the inner ring will expand and the outer ring will contract; **thus reducing the bearings' internal clearance**.

The amount of expansion or contraction varies depending on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. The differential can range from **approximately 70% to 90% of the effective interference**.

$$\delta_f = (0.70 \sim 0.90)\,\Delta d_{eff} \cdots\cdots\cdots\cdots\cdots (8.2)$$

- δ_f : Reduced amount of clearance due to interference, mm
- Δd_{eff} : Effective interference, mm

(2) Residual clearance

When the reduced clearance due to interference is calculated using the expansion rate and the contraction rate of each bearing, the residual clearance is calculated by the formula below.

1) Calculation considering distribution

Assume that the initial clearance, bearing inner ring bore diameter, bearing outer diameter outer diameter, bearing outer diameter, and housing bore diameter follow the normal distribution. The residual clearance is generally calculated as the range of percent defective.

When each dimension and clearance follow the normal distribution and the percent defective is 0.26% (standard range = ±3σ), residual clearance Δ_f can be represented by the formula below.

$$\Delta_f = \Delta_{fm} \pm 3\sigma_{\Delta f} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (8.3)$$

Where:
- Δ_{fm} : Average value of standard clearance, mm
- $\sigma_{\Delta f}$: Standard deviation of residual clearance

For the average values and standard deviation of residual clearance, see **Table 8.3** and **Table 8.4**.

2) Calculation by direct sum

When the use condition is severe and calculation is to be done under the worst condition, the maximum and minimum values of each dimension are used for direct sum.

$$\left.\begin{aligned}\Delta_{f\max} &= \Delta_{o\max} - \lambda_i \Delta_{d\min} - \lambda_o \Delta_{D\min}\\ \Delta_{f\min} &= \Delta_{o\min} - \lambda_i \Delta_{d\max} - \lambda_o \Delta_{D\max}\end{aligned}\right\} \quad (8.4)$$

$\Delta_{f\max}$ $\Delta_{f\min}$: Maximum and minimum values of residual clearance, mm

$\Delta_{o\max}$ $\Delta_{o\min}$: Maximum and minimum values of initial clearance, mm

$\Delta_{d\max}$ $\Delta_{d\min}$: Maximum and minimum values of inner ring interference, mm

$\Delta_{D\max}$ $\Delta_{D\min}$: Maximum and minimum values of outer ring interference, mm

λ_i λ_o : Inner ring expansion rate, outer ring contraction rate (See **Table 8.5**)

Table 8.3 Average value and standard deviation of residual clearance

Inner ring fit condition	Outer ring fit condition	Δ_{fm} (Average value of residual clearance)	$\sigma_{\Delta f}$ (Standard deviation of residual clearance)
Tight fit	Loose fit	$\Delta_{0m} - \lambda_I \cdot \Delta_{dm}$	$\sqrt{\sigma_{\Delta 0}^2 + \lambda_I^2 \cdot \sigma_{\Delta d}^2}$
	Tight fit	$\Delta_{0m} - \lambda_I \cdot \Delta_{dm} - \lambda_o \cdot \Delta_{Dm}$	$\sqrt{\sigma_{\Delta 0}^2 + \lambda_I^2 \cdot \sigma_{\Delta d}^2 + \lambda_o^2 \cdot \sigma_{\Delta D}^2}$
Loose fit	Loose fit	Δ_{0m}	$\sigma_{\Delta 0}$
	Tight fit	$\Delta_{0m} - \lambda_o \cdot \Delta_{Dm}$	$\sqrt{\sigma_{\Delta 0}^2 + \lambda_o^2 \cdot \sigma_{\Delta D}^2}$

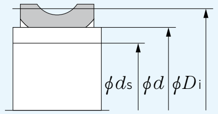
Table 8.4 Symbols and formulas used for calculation

		Average value	Standard deviation	Standard range
Shaft diameter	D_s	D_{sm}	$\sigma_{Ds} = \dfrac{R_{Ds}}{6}$	R_{Ds}
Inner ring bore diameter	d	d_m	$\sigma_d = \dfrac{R_d}{6}$	R_d
Inner ring interference	Δ_d	$\Delta_{dm} = D_{sm} - d_m$	$\sigma_{\Delta d} = \sqrt{\sigma_{Ds}^2 + \sigma_d^2}$	
Housing bore diameter	d_h	d_{hm}	$\sigma_{dh} = \dfrac{R_{dh}}{6}$	R_{dh}
Outer ring outer diameter	D	D_m	$\sigma_D = \dfrac{R_D}{6}$	R_D
Outer ring interference	Δ_D	$\Delta_{Dm} = D_m - d_{hm}$	$\sigma_{\Delta D} = \sqrt{\sigma_D^2 + \sigma_{dh}^2}$	
Initial clearance	Δ_0	Δ_{0m}	$\sigma_{\Delta 0} = \dfrac{R_{\Delta 0}}{6}$	$R_{\Delta 0}$
Residual clearance	Δ_f	Δ_{fm}	$\sigma_{\Delta f}$	
Inner ring expansion rate	λ_I	See **Table 8.5**		
Outer ring contraction rate	λ_o			

Note: When the linear expansion coefficient difference or the temperature difference of the outer ring and the housing or the inner ring and the shaft are to be considered, it is necessary to first calculate using the bearing inner ring bore diameter, bearing outer ring outer diameter, shaft outer diameter, and housing bore diameter before and after the expansion/contraction and then calculate the expansion rate of the raceway and the effective interference.

Table 8.5 Expansion rate and contraction rate of raceway diameter

Fit condition	Calculation item	Calculation formula	Symbol (Unit: N, mm)
Fit of inner ring and shaft (when the inner ring and the shaft are solid steel)	Inner ring expansion rate	$\lambda_I = \dfrac{d}{D_i}$	d : Inner ring bore diameter or shaft diameter d_s : Hollow shaft inner diameter D_i : Inner ring average raceway diameter (refer to **Table 8.7**)
Fit of inner ring and hollow shaft (when the inner ring and the shaft are solid steel)		$\lambda_I = \dfrac{d}{D_i} \cdot \dfrac{\left\{1 - \left(\dfrac{d_s}{d}\right)^2\right\}}{1 - \left\{\left(\dfrac{d}{D_i}\right)^2 \cdot \left(\dfrac{d_s}{d}\right)^2\right\}}$	
Fit of outer ring and housing (when the outer ring and the housing are solid steel)	Outer ring contraction rate	$\lambda_o = \dfrac{D_e}{D} \cdot \dfrac{\left\{1 - \left(\dfrac{D}{D_h}\right)^2\right\}}{1 - \left\{\left(\dfrac{D_e}{D}\right)^2 \cdot \left(\dfrac{D}{D_h}\right)^2\right\}}$	D : Outer ring outer diameter, housing bore diameter D_h : Housing outer diameter D_e : Outer ring average raceway diameter (refer to **Table 8.7**)
	Outer ring contraction rate $D_h = \infty$	$\lambda_o = \dfrac{D_e}{D}$	



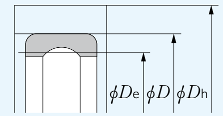
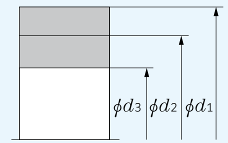


Table 8.6 Fit of two cylinders (general expression)

Calculation item	Calculation formula	Symbol (Unit: N, mm)
Expansion rate of outer cylinder outer diameter	$\lambda_1 = \dfrac{E_2\left(\dfrac{(d_1^2+d_2^2)}{(d_1^2-d_2^2)}+1\right)}{E_2\left\{\dfrac{(d_1^2+d_2^2)}{(d_1^2-d_2^2)}+\nu_1\right\}+E_1\left\{\dfrac{(d_2^2+d_3^2)}{(d_2^2-d_3^2)}-\nu_2\right\}} \cdot \dfrac{d_2}{d_1}$	E_1, E_2 : Longitudinal elastic modulus of outer and inner cylinders ν_1, ν_2 : Poisson's ratio of outer and inner cylinders
Contraction rate of inner cylinder bore diameter	$\lambda_2 = \dfrac{E_1\left(\dfrac{(d_2^2+d_3^2)}{(d_2^2-d_3^2)}+1\right)}{E_2\left\{\dfrac{(d_1^2+d_2^2)}{(d_1^2-d_2^2)}+\nu_1\right\}+E_1\left\{\dfrac{(d_2^2+d_3^2)}{(d_2^2-d_3^2)}-\nu_2\right\}} \cdot \dfrac{d_3}{d_2}$	



Note: **Table 13.6** (A-143) in the section of "13. Bearing materials" shows the physical property values of the main materials.

Table 8.7 Average raceway diameter (approximate expression)

Bearing type		Average raceway diameter	
		Inner ring	Outer ring
Ball bearing	All types	$1.05\dfrac{4d+D}{5}$	$0.95\dfrac{d+4D}{5}$
Self-aligning ball bearing	12	$1.03\dfrac{3d+D}{4}$	$0.97\dfrac{d+2D}{3}$
	13, 22	$1.03\dfrac{3d+D}{4}$	$0.97\dfrac{d+3D}{4}$
	23	$1.03\dfrac{4d+D}{5}$	$0.97\dfrac{d+4D}{5}$
Cylindrical roller bearing 1)	All types	$1.05\dfrac{3d+D}{5}$	$0.98\dfrac{d+3D}{4}$
Self-aligning roller bearing	Type B, type C, type 213	$\dfrac{2d+D}{3}$	$0.97\dfrac{d+4D}{5}$
	ULTAGE series	$\dfrac{3d+D}{4}$	$0.98\dfrac{d+5D}{6}$
Tapered roller bearing	All types	$\dfrac{3d+D}{4}$	$\dfrac{d+3D}{4}$

1) Average raceway diameter values shown for double-flange type.

(3) Reduced internal clearance due to inner/ outer ring temperature difference.

During operation, normally the outer ring will range from 5 to 10°C cooler than the inner ring or rotating parts. However, if the cooling effect of the housing is large, the shaft is connected to a heat source, or a heated substance is conducted through the hollow shaft; the temperature difference between the two rings can be even greater. **The amount of internal clearance is thus further reduced** by the differential expansion of the two rings.

$$\delta_t = \alpha \cdot \Delta T \cdot D_o \cdots\cdots\cdots\cdots (8.5)$$

δ_t : Reduced amount of clearance due to temperature differential of inner and outer rings, mm

α : Bearing material expansion coefficient 12.5×10^{-6}/°C

ΔT : Inner/outer ring temperature differential, °C

D_o : Outer ring raceway diameter, mm

Outer ring raceway diameter, D_o, values can be approximated by using formula (8.6) or (8.7).

For ball bearings and spherical roller bearings,

$$D_o = 0.20(d + 4.0D) \cdots\cdots\cdots\cdots (8.6)$$

For roller bearings (except spherical roller bearings),

$$D_o = 0.25(d + 3.0D) \cdots\cdots\cdots\cdots (8.7)$$

d : Bearing bore diameter, mm

D : Bearing outside diameter, mm

For the ULTAGE series bearings, consult **NTN** Engineering.

Note that the formula in item 8.2.2 only applies to steel bearings, shafts and housings.

"Operating clearance calculation (based on 3σ)" can be done by using the bearing technique calculation tool on the **NTN** website (https://www.ntnglobal.com).

Table 8.8 Radial internal clearance of deep groove ball bearings

Unit: μm

Nominal bearing bore diameter d mm		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	2.5	0	6	4	11	10	20	—	—	—	—
2.5	6	0	7	2	13	8	23	—	—	—	—
6	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690

Table 8.9 Radial internal clearance of self-aligning ball bearings

Unit: μm

Cylindrical bore bearing

Nominal bearing bore diameter *d* mm		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2.5	6	1	8	5	15	10	20	15	25	21	33
6	10	2	9	6	17	12	25	19	33	27	42
10	14	2	10	6	19	13	26	21	35	30	48
14	18	3	12	8	21	15	28	23	37	32	50
18	24	4	14	10	23	17	30	25	39	34	52
24	30	5	16	11	24	19	35	29	46	40	58
30	40	6	18	13	29	23	40	34	53	46	66
40	50	6	19	14	31	25	44	37	57	50	71
50	65	7	21	16	36	30	50	45	69	62	88
65	80	8	24	18	40	35	60	54	83	76	108
80	100	9	27	22	48	42	70	64	96	89	124
100	120	10	31	25	56	50	83	75	114	105	145
120	140	10	38	30	68	60	100	90	135	125	175
140	160	15	44	35	80	70	120	110	161	150	210

Tapered bore bearing

C2		CN		C3		C4		C5		Nominal bearing bore diameter *d* mm	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Over	Incl.
—	—	—	—	—	—	—	—	—	—	2.5	6
—	—	—	—	—	—	—	—	—	—	6	10
—	—	—	—	—	—	—	—	—	—	10	14
—	—	—	—	—	—	—	—	—	—	14	18
7	17	13	26	20	33	28	42	37	55	18	24
9	20	15	28	23	39	33	50	44	62	24	30
12	24	19	35	29	46	40	59	52	72	30	40
14	27	22	39	33	52	45	65	58	79	40	50
18	32	27	47	41	61	56	80	73	99	50	65
23	39	35	57	50	75	69	98	91	123	65	80
29	47	42	68	62	90	84	116	109	144	80	100
35	56	50	81	75	108	100	139	130	170	100	120
40	68	60	98	90	130	120	165	155	205	120	140
45	74	65	110	100	150	140	191	180	240	140	160

Table 8.10 (1) Radial internal clearance for duplex angular contact ball bearings

Unit: μm

Nominal bearing bore diameter *d* mm		C1		C2		CN		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	10	3	8	6	12	8	15	15	22	22	30
10	18	3	8	6	12	8	15	15	24	30	40
18	30	3	10	6	12	10	20	20	32	40	55
30	50	3	10	8	14	14	25	25	40	55	75
50	80	3	11	11	17	17	32	32	50	75	95
80	100	3	13	13	22	22	40	40	60	95	120
100	120	3	15	15	30	30	50	50	75	110	140
120	150	3	16	16	33	35	55	55	80	130	170
150	180	3	18	18	35	35	60	60	90	150	200
180	200	3	20	20	40	40	65	65	100	180	240

Note: The clearance group in the table is applied only to contact angles in the table below.

Contact angle symbol	Nominal contact angle	Applicable clearance [2)]
C	15°	C1, C2
A [1)]	30°	C2, CN, C3
B	40°	CN, C3, C4

1) Not indicated for bearing number.
2) For information concerning clearance other than applicable clearance, please contact **NTN** Engineering.

Table 8.10 (2) Radial internal clearance of double row angular contact ball bearings

Unit: μm

Nominal bearing bore diameter *d* mm		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
10only		0	10	5	15	10	21	16	28	24	36
10	18	1	11	6	16	12	23	19	31	28	40
18	24	1	11	6	16	13	24	21	33	31	43
24	30	1	13	6	19	13	26	21	35	31	45
30	40	2	15	7	22	15	30	24	39	35	50
40	50	2	15	9	24	17	32	28	45	40	57
50	65	0	15	7	24	16	33	28	48	41	61
65	80	1	17	11	31	21	42	34	56	50	74
80	100	3	20	13	36	25	49	40	65	58	67

Table 8.11 Radial internal clearance of bearings for electric motor

Unit: μm

Nominal bearing bore diameter *d* mm		Radial internal clearance CM			
		Deep groove ball bearing		Cylindrical roller bearing	
Over	Incl.	Min.	Max.	Min.	Max.
10	18	4	11	—	—
18	24	5	12	—	—
24	30	5	12	15	30
30	40	9	17	15	30
40	50	9	17	20	35
50	65	12	22	25	40
65	80	12	22	30	45
80	100	18	30	35	55
100	120	18	30	35	60
120	140	24	38	40	65
140	160	24	38	50	80
160	180	—	—	60	90
180	200	—	—	65	100

Note: 1. Suffix CM is added to bearing numbers.
Example: 6205 ZZ CM
2. Clearance not interchangeable for cylindrical roller bearings.

Table 8.12 Interchangeable radial internal clearance for cylindrical roller bearing (cylindrical bore)

Unit: μm

Nominal bearing bore diameter *d* mm		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	10	0	25	20	45	35	60	50	75	—	—
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735

Table 8.13 Non-interchangeable radial internal clearance for cylindrical roller bearing

Unit: μm

Nominal bearing bore diameter *d* mm		Cylindrical bore bearing											
		C1NA		C2NA		NA 1)		C3NA		C4NA		C5NA	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	10	5	10	10	20	20	30	35	45	45	55	—	—
10	18	5	10	10	20	20	30	35	45	45	55	65	75
18	24	5	10	10	20	20	30	35	45	45	55	65	75
24	30	5	10	10	25	25	35	40	50	50	60	70	80
30	40	5	12	12	25	25	40	45	55	55	70	80	95
40	50	5	15	15	30	30	45	50	65	65	80	95	110
50	65	5	15	15	35	35	50	55	75	75	90	110	130
65	80	10	20	20	40	40	60	70	90	90	110	130	150
80	100	10	25	25	45	45	70	80	105	105	125	155	180
100	120	10	25	25	50	50	80	95	120	120	145	180	205
120	140	15	30	30	60	60	90	105	135	135	160	200	230
140	160	15	35	35	65	65	100	115	150	150	180	225	260
160	180	15	35	35	75	75	110	125	165	165	200	250	285
180	200	20	40	40	80	80	120	140	180	180	220	275	315
200	225	20	45	45	90	90	135	155	200	200	240	305	350
225	250	25	50	50	100	100	150	170	215	215	265	330	380
250	280	25	55	55	110	110	165	185	240	240	295	370	420
280	315	30	60	60	120	120	180	205	265	265	325	410	470
315	355	30	65	65	135	135	200	225	295	295	360	455	520
355	400	35	75	75	150	150	225	255	330	330	405	510	585
400	450	45	85	85	170	170	255	285	370	370	455	565	650
450	500	50	95	95	190	190	285	315	410	410	505	625	720

Tapered bore bearing												Nominal bearing bore diameter *d* mm	
C9NA 2)		C0NA 2)		C1NA		C2NA		NA 1)		C3NA			
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Over	Incl.
5	5	7	17	10	20	20	30	35	45	45	55	—	10
5	10	7	17	10	20	20	30	35	45	45	55	10	18
5	10	7	17	10	20	20	30	35	45	45	55	18	24
5	10	10	20	10	25	25	35	40	50	50	60	24	30
5	12	10	20	12	25	25	40	45	55	55	70	30	40
5	15	10	20	15	30	30	45	50	65	65	80	40	50
5	15	10	20	15	35	35	50	55	75	75	90	50	65
10	20	15	30	20	40	40	60	70	90	90	110	65	80
10	25	20	35	25	45	45	70	80	105	105	125	80	100
10	25	20	35	25	50	50	80	95	120	120	145	100	120
15	30	25	40	30	60	60	90	105	135	135	160	120	140
15	35	30	45	35	65	65	100	115	150	150	180	140	160
15	35	30	45	35	75	75	110	125	165	165	200	160	180
20	40	30	50	40	80	80	120	140	180	180	220	180	200
20	45	35	55	45	90	90	135	155	200	200	240	200	225
25	50	40	65	50	100	100	150	170	215	215	265	225	250
25	55	40	65	55	110	110	165	185	240	240	295	250	280
30	60	45	75	60	120	120	180	205	265	265	325	280	315
30	65	45	75	65	135	135	200	225	295	295	360	315	355
35	75	50	90	75	150	150	225	255	330	330	405	355	400
45	85	60	100	85	170	170	255	285	370	370	455	400	450
50	95	70	115	95	190	190	285	315	410	410	505	450	500

1) For bearings with normal clearance, only NA is added to bearing numbers. Example: NU310NA

2) C9NA, C0NA and C1NA clearances are applied only to precision bearings of JIS Class 5 and higher.

Table 8.14 Axial internal clearance for double row and duplex tapered roller bearings (metric series)

Unit: μm

Nominal bearing bore diameter *d* mm		Contact $\alpha \leqq 27°$ ($e \leqq 0.76$)							
		C2		CN		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18	24	25	75	75	125	125	170	170	220
24	30	25	75	75	125	145	195	195	245
30	40	25	95	95	165	165	235	210	280
40	50	20	85	85	150	175	240	240	305
50	65	20	85	110	175	195	260	280	350
65	80	20	110	130	220	240	325	325	410
80	100	45	150	150	260	280	390	390	500
100	120	45	175	175	305	350	480	455	585
120	140	45	175	175	305	390	520	500	630
140	160	60	200	200	340	400	540	520	660
160	180	80	220	240	380	440	580	600	740
180	200	100	260	260	420	500	660	660	820
200	225	120	300	300	480	560	740	720	900
225	250	160	360	360	560	620	820	820	1 020
250	280	180	400	400	620	700	920	920	1 140
280	315	200	440	440	680	780	1 020	1 020	1 260
315	355	220	480	500	760	860	1 120	1 120	1 380
355	400	260	560	560	860	980	1 280	1 280	1 580
400	500	300	600	620	920	1 100	1 400	1 440	1 740
500	560	350	650	750	1 050	1 250	1 550	1 650	1 950
560	630	400	700	850	1 150	1 400	1 700	1 850	2 150

Contact $\alpha > 27°$ ($e > 0.76$)								Nominal bearing bore diameter *d* mm	
C2		CN		C3		C4			
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Over	Incl.
10	30	30	50	50	70	70	90	18	24
10	30	30	50	60	80	80	100	24	30
10	40	40	70	70	100	90	120	30	40
10	40	40	70	80	110	110	140	40	50
10	40	50	80	90	120	130	160	50	65
10	50	60	100	110	150	150	190	65	80
20	70	70	120	130	180	180	230	80	100
20	70	70	120	150	200	210	260	100	120
20	70	70	120	160	210	210	260	120	140
30	100	100	160	180	240	240	300	140	160
—	—	—	—	—	—	—	—	160	180
—	—	—	—	—	—	—	—	180	200
—	—	—	—	—	—	—	—	200	225
—	—	—	—	—	—	—	—	225	250
—	—	—	—	—	—	—	—	250	280
—	—	—	—	—	—	—	—	280	315
—	—	—	—	—	—	—	—	315	355
—	—	—	—	—	—	—	—	355	400
—	—	—	—	—	—	—	—	400	500
—	—	—	—	—	—	—	—	500	560
—	—	—	—	—	—	—	—	560	630

Note: 1. This table applies to bearings contained in the catalog. For information concerning other bearings or bearings using US customary units, please contact **NTN** Engineering.
2. The correlation of axial internal clearance (Δa) and radial internal clearance (Δr) is expressed as $\Delta r = 0.667 \times e \times \Delta a$.
e: Constant (see dimensions table)
3. The table does not apply to the bearing series 329X, 330, 322C, and 323C, 303C, and T4CB.

Table 8.15 Radial internal clearance of spherical roller bearings

Unit: μm

Nominal bearing bore diameter *d* mm		Cylindrical bore bearing									
		C2		CN		C3		C4		C5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
14	18	10	20	20	35	35	45	45	60	60	75
18	24	10	20	20	35	35	45	45	60	60	75
24	30	15	25	25	40	40	55	55	75	75	95
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	35	55	55	75	75	100	100	125
50	65	20	40	40	65	65	90	90	120	120	150
65	80	30	50	50	80	80	110	110	145	145	180
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	500	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1 000
560	630	170	310	310	480	480	650	650	850	850	1 100
630	710	190	350	350	530	530	700	700	920	920	1 190
710	800	210	390	390	580	580	770	770	1 010	1 010	1 300
800	900	230	430	430	650	650	860	860	1 120	1 120	1 440
900	1 000	260	480	480	710	710	930	930	1 220	1 220	1 570
1 000	1 120	290	530	530	780	780	1 020	1 020	1 330	1 330	1 720
1 120	1 250	320	580	580	860	860	1 120	1 120	1 460	1 460	1 870
1 250	1 400	350	640	640	950	950	1 240	1 240	1 620	1 620	2 080

Tapered bore bearing										Nominal bearing bore diameter *d* mm	
C2		CN		C3		C4		C5			
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Over	Incl.
—	—	—	—	—	—	—	—	—	—	14	18
15	25	25	35	35	45	45	60	60	75	18	24
20	30	30	40	40	55	55	75	75	95	24	30
25	35	35	50	50	65	65	85	85	105	30	40
30	45	45	60	60	80	80	100	100	130	40	50
40	55	55	75	75	95	95	120	120	160	50	65
50	70	70	95	95	120	120	150	150	200	65	80
55	80	80	110	110	140	140	180	180	230	80	100
65	100	100	135	135	170	170	220	220	280	100	120
80	120	120	160	160	200	200	260	260	330	120	140
90	130	130	180	180	230	230	300	300	380	140	160
100	140	140	200	200	260	260	340	340	430	160	180
110	160	160	220	220	290	290	370	370	470	180	200
120	180	180	250	250	320	320	410	410	520	200	225
140	200	200	270	270	350	350	450	450	570	225	250
150	220	220	300	300	390	390	490	490	620	250	280
170	240	240	330	330	430	430	540	540	680	280	315
190	270	270	360	360	470	470	590	590	740	315	355
210	300	300	400	400	520	520	650	650	820	355	400
230	330	330	440	440	570	570	720	720	910	400	450
260	370	370	490	490	630	630	790	790	1 000	450	500
290	410	410	540	540	680	680	870	870	1 100	500	560
320	460	460	600	600	760	760	980	980	1 230	560	630
350	510	510	670	670	850	850	1 090	1 090	1 360	630	710
390	570	570	750	750	960	960	1 220	1 220	1 500	710	800
440	640	640	840	840	1 070	1 070	1 370	1 370	1 690	800	900
490	710	710	930	930	1 190	1 190	1 520	1 520	1 860	900	1 000
530	770	770	1 030	1 030	1 300	1 300	1 670	1 670	2 050	1 000	1 120
570	830	830	1 120	1 120	1 420	1 420	1 830	1 830	2 250	1 120	1 250
620	910	910	1 230	1 230	1 560	1 560	2 000	2 000	2 470	1 250	1 400

Table 8.16 Axial internal clearance of four points contact ball bearings

Unit: μm

Nominal bearing bore diameter *d* mm		C2		CN		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
17	40	26	66	56	106	96	146	136	186
40	60	36	86	76	126	116	166	156	206
60	80	46	96	86	136	126	176	166	226
80	100	56	106	96	156	136	196	186	246
100	140	66	126	116	176	156	216	206	266
140	180	76	156	136	196	176	236	226	296
180	220	96	176	156	216	196	256	246	316

8.3 Preload

Normally, bearings are used with a slight internal clearance under operating conditions. However, in some applications, bearings are given an initial load; this means that the bearings' internal clearance is negative before operation. This is called "preload" and is commonly applied to angular ball bearings and tapered roller bearings.

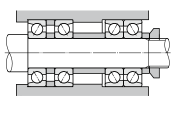
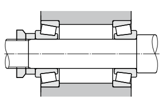
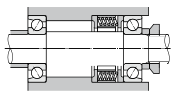
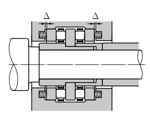
8.3.1 Purpose of preload

The following results are obtained by constant elastic compressive force applied to the contact points of rolling elements and raceway by providing preload.

(1) Bearing's rigidity increases, internal clearance tends not to be produced even when heavy load is applied.
(2) The particular frequency of the bearing increases and is **suitable for high-speed rotation**.
(3) Shaft runout is suppressed; **rotation and position precision are enhanced**.
(4) **Vibration** and **noise** are **controlled**.
(5) Sliding of rolling elements by turning, spinning, or pivoting, is controlled and **smearing is reduced**.
(6) **Fretting** produced by external vibration is prevented.

Applying excessive preload could result in reduction of life, abnormal heating, or increase in turning torque. You should therefore consider the objectives before determining the amount of preload.

Table 8.17 Preloading methods and characteristics

Method	Basic pattern	Applicable bearings	Object	Methods and characteristics	Applications
Fixed position preload		**Angular contact ball bearing**	Maintaining accuracy of rotating shaft, preventing vibration, increasing rigidity	Preloading is accomplished by a predetermined offset of the rings or by using spacers. For the standard preload see **Table 8.18**.	Grinding machines Lathes Milling machines Measuring instruments
		**Tapered roller bearing** **Thrust ball bearing** **Angular contact ball bearing**	Increasing bearing rigidity	Preload is accomplished by adjusting a threaded screw. The amount of preload is set by measuring the starting torque or axial displacement.	Lathes Milling machines Differential gears of automotives Printing machines Wheels
Constant pressure preload		**Angular contact ball bearing** **Deep groove ball bearing** **Tapered roller bearing (high speed)**	Maintaining accuracy and preventing vibration and noise with a constant amount of preload without being affected by loads or temperature	Preloading is accomplished by using coil or belleville springs. For deep groove ball bearings: 4 to 10 d N d: shaft diameter (mm) For angular contact ball bearings: see **Table 8.18**.	Internal grinding machines Electric motors High speed shafts in small machines Tension reels
		**Self-aligning roller thrust bearing** **Cylindrical roller thrust bearing** **Thrust ball bearing**	Preload is primarily used to prevent smearing of opposite axial load side when bearing an axial load.	Preload is accomplished by using coil or belleville springs. Recommended preloads for thrust ball bearings:(larger value of the formulas below is adopted) $T_1 = 0.42\,(nC_{0a})^{1.9} \times 10^{-13}$ N $T_2 = 0.00083\,C_{0a}$ N Self-aligning roller thrust bearing, Cylindrical roller thrust bearing $T = 0.025\,C^{0.8}$ N	Rolling mills Extruding machines

Remarks T : preload, N
n : Rotational speed min^{-1}
C_{0a}: Basic static axial load rating, N

8.3.2 Preloading methods and amounts

The most common method of applying preload on a bearing is to change the relative position of the inner and outer rings of the bearing in the axial direction while applying an axial load between bearings on opposing sides. There are two types of preload: fixed position preload and constant pressure preload.

The basic pattern, purpose and characteristics of bearing preloads are shown in **Table 8.17**.

Fixed position preload

1) Fixed position preload is effective for positioning the two bearings and also for increasing the rigidity.
2) The amount of preload will change due to axial displacement caused by temperature differences between the shaft and housing and the inner and outer rings. Preload will also change as a result of displacement due to loads.

Constant pressure preload

1) Due to the use of a spring for the constant pressure preload, the preloading amount can be kept constant, even when the distance between the two bearings fluctuates under the influence of operating heat and load.
2) Axial loads cannot be applied in the direction in which springs are contracted.

Also, the standard preloading amount for the paired angular contact ball bearings is shown in **Table 8.18**. Light and normal preload is applied to prevent general vibration, and medium and heavy preload is applied especially when rigidity is required.

8.3.3 Preload and rigidity

The increased rigidity effect preloading has on bearings is shown in **Fig. 8.2** to **Fig. 8.4**. When the offset inner rings of the two paired angular contact ball bearings are pressed together, each inner ring is displaced axially by the amount δ_o and is thus given a preload, F_o, in the direction. Under this condition, when external axial load F_a is applied, bearing Ⅰ will have an increased displacement by the amount δ_a and bearing Ⅱ will have a decreased displacement. At this time the loads applied to bearing Ⅰ and Ⅱ are F_{I} and F_{II}, respectively. Under the condition of no preload, bearing Ⅰ will be displaced by the amount δ_b when axial load F_a is applied. Since the amount of displacement, δ_a, is less than δ_b, it indicates a higher rigidity for δ_a.

If a large axial load is to be applied, care must be taken because the preload may be released, causing problems such as heat generation, vibration, and rigidity decrease.

Three-row combinations and two-row combinations are different and have unique right and left displacement diagrams. **Figure 8.3** uses a two-row diagram for bearing Ⅰ, and **Figure 8.4** uses a two-row diagram for bearing Ⅱ. When preload F_o is applied, bearing Ⅰ is displaced by δ_{01} and bearing Ⅱ is displaced by δ_{02}. Under this condition, when axial load F_a is additionally applied, bearing Ⅰ will have an increased displacement by the amount δ_a and bearing Ⅱ will have a decreased displacement.

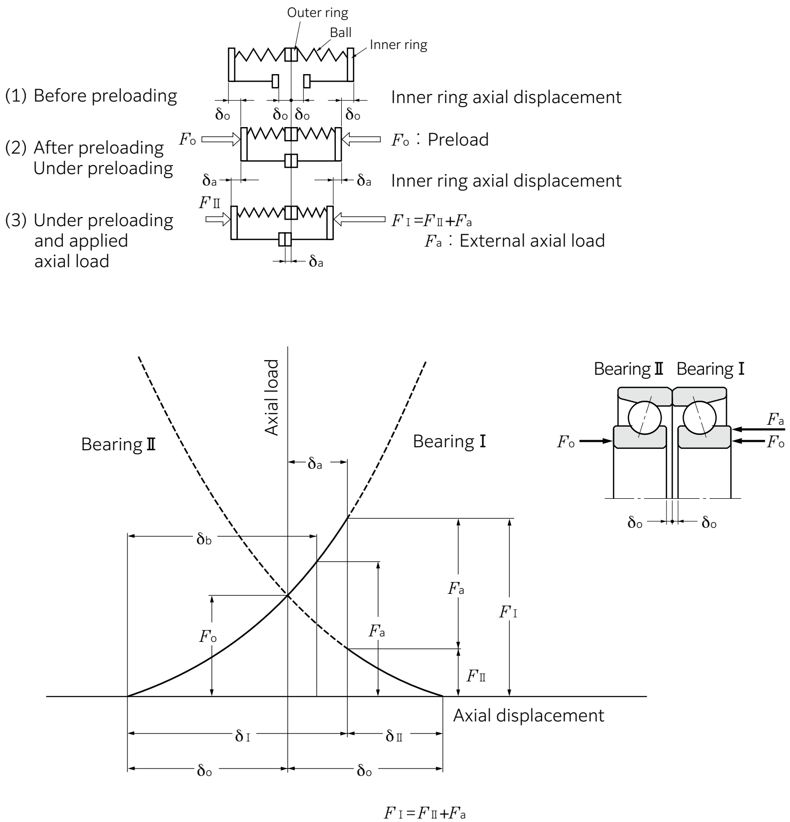


Fig. 8.2 Fixed position preload model diagram and preload diagram

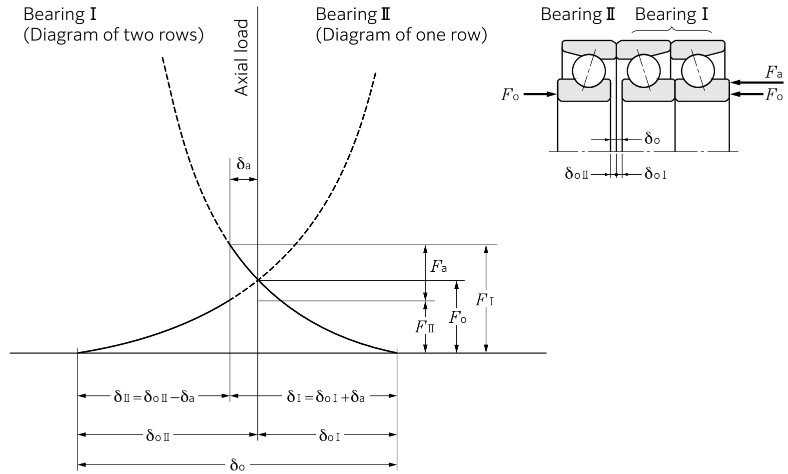


Fig. 8.3 Preload diagram of DBT combination (DT side load)

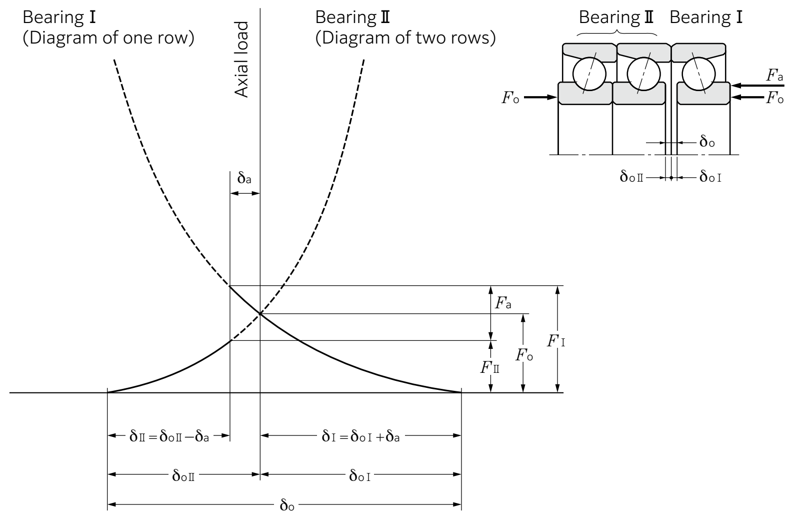


Fig. 8.4 Preload diagram of DBT combination (DB side load)

Table 8.18 The normal preload of duplex angular contact ball bearings

Unit: N

Nominal bearing bore diameter d mm		bearing Series 79				70			
Over	Incl.	Light preload GL	Normal preload GN	Medium preload GM	Heavy preload GH	Light preload GL	Normal preload GN	Medium preload GM	Heavy preload GH
—	12	—	39	78	147	29	78	147	196
12	18	—	49	147	196	29	78	147	294
18	32	29	98	196	294	49	147	294	490
32	40	49	147	294	590	78	294	590	885
40	50	49	196	390	685	78	294	590	980
50	65	78	245	490	785	147	490	880	1 470
65	80	98	390	785	1 180	147	590	1 470	1 960
80	90	147	490	980	1 470	196	885	1 960	2 940
90	95	147	490	980	1 470	196	885	1 960	2 940
95	100	196	685	1 270	1 960	196	885	1 960	2 940
100	105	196	685	1 270	1 960	294	980	2 450	3 900
105	110	196	685	1 270	1 960	294	980	2 450	3 900
110	120	245	885	1 780	2 940	294	980	2 450	3 900
120	140	294	980	1 960	3 450	490	1 470	3 450	5 900
140	150	390	1 270	2 450	4 400	490	1 470	3 450	5 900
150	160	390	1 270	2 450	4 400	685	2 450	4 900	8 850
160	170	390	1 270	2 450	4 400	685	2 450	4 900	8 850
170	180	490	1 770	3 450	5 900	685	2 450	4 900	8 850
180	190	490	1 770	3 450	5 900	885	3 450	6 850	9 800
190	200	685	2 450	4 900	7 850	885	3 450	6 850	9 800

Nominal bearing bore diameter d mm		Series 72, 72B				73, 73B			
Over	Incl.	Light preload GL	Normal preload GN	Medium preload GM	Heavy preload GH	Light preload GL	Normal preload GN	Medium preload GM	Heavy preload GH
—	12	29	98	196	294	49	147	294	390
12	18	29	98	294	390	49	147	390	490
18	32	78	196	490	785	98	294	590	980
32	40	98	390	885	1 470	147	490	980	1 960
40	50	147	590	980	1 960	196	785	1 470	2 450
50	65	196	785	1 470	2 940	294	980	2 450	3 900
65	80	294	980	2 450	3 900	390	1 470	3 450	4 900
80	90	490	1 470	2 940	4 900	590	1 960	3 900	5 900
90	95	490	1 960	3 900	5 900	590	2 450	4 900	6 850
95	100	490	1 960	3 900	5 900	590	2 450	4 900	6 850
100	105	590	2 450	4 900	7 850	685	2 940	5 900	8 850
105	110	590	2 450	4 900	7 850	685	2 940	5 900	8 850
110	120	590	2 450	4 900	7 850	685	2 940	5 900	8 850
120	140	785	2 940	5 900	9 800	885	3 900	7 850	11 800
140	150	785	2 940	5 900	9 800	885	3 900	7 850	11 800
150	160	885	3 900	7 850	11 800	980	4 400	8 800	13 700
160	170	885	3 900	7 850	11 800	980	4 400	8 800	13 700
170	180	885	3 900	7 850	11 800	980	4 400	8 800	13 700
180	190	980	4 400	8 850	13 700	1 470	5 900	11 800	15 700
190	200	980	4 400	8 850	13 700	1 470	5 900	11 800	15 700

8.4 Necessary minimum load

In general, when a bearing is operated under no load or a very light load, slippage may occur between the rolling element and the raceway (see "8.3.1 Purpose of preload"). In the case of high-speed rotation, a gyro slip or a cage slip may cause early damage such as smearing. In this case it is necessary to apply a minimum load to prevent slippage during bearing operation.

A rough standard for the necessary minimum radial loads for radial bearings is shown below.

Ball bearings (except self-aligning ball bearings): $0.023\ C_{0r}$
Self-aligning ball bearings: $0.018\ C_{0r}$
Roller bearings: $0.040\ C_{0r}$
Where, C_{0r}: Basic static rating load (N)

∗Consult with **NTN** for the necessary minimum axial loads for thrust bearings.

9. Allowable speed

9.1 Constant speed rotation

As the rotational speed of the bearing increases, the temperature of the bearing also rises due to heat generation inside the bearing due to friction. This may result in damage to the bearing, such as seizure, and the bearing will be unable to continue stable operation. Therefore, the maximum speed at which it is possible for the bearing to continuously operate without the generation of excessive heat beyond specified limits is called the **allowable speed** (min^{-1}). The allowable speed of a bearing depends on the type of bearing, bearing dimensions, type of cage, load, lubrication conditions, and cooling conditions.

The bearing dimensional table gives approximate allowable rotational speeds for grease and oil lubrication.

- The bearing must have the proper internal clearance prescribed in the **NTN** Engineering standard design specifications and must be properly installed.
- A quality lubricant must be used. The lubricant must be replenished and changed when necessary.
- The bearing must be operated at normal operating temperature under ordinary load conditions ($P \leqq 0.08\, C_r$, $F_a / F_r \leqq 0.3$).

If the load is below the minimum necessary load (see section "8. Bearing Internal Clearance and Preload 8.4"), rolling elements may not turn smoothly. If so, please contact **NTN** Engineering for more information. **Allowable rotation for deep groove ball bearings with contact seal (LLU type) or low-torque seal (LLH type) is determined according to the circumferential speed of the seal**. For bearings to be used under heavier than normal load conditions, the allowable speed values listed in the bearing tables must be multiplied by an adjustment factor. The adjustment factors f_L and f_C are given in **Figs. 9.1** and **9.2**.

Also, **when radial bearings are mounted on vertical shafts**, retention of lubricant and cage guidance are less favorable when compared to horizontal shaft mounting. Therefore, the allowable speed should be reduced to **approximately 80% of the listed speed**. For speeds other than those mentioned above, and for which data is incomplete, please consult **NTN** Engineering.

If rotational speed is to exceed allowable rotational speed given in the dimensions table, it will require special considerations, such as using a bearing for which cage specifications, internal clearance and precision have been thoroughly checked. It may require adopting forced circulation, jet oil or mist oil lubrication as the lubrication method.

Under such high speed operating conditions, when special care is taken, the standard allowable speeds given in the bearing tables can be adjusted upward. The maximum speed adjustment values, f_B, by which the bearing table speeds can be multiplied, are shown in **Table 9.1**. However, for any application requiring speeds in excess of the standard allowable speed, please consult **NTN** Engineering.

Polylube bearings (see section 11.4) have their original allowable rotational speed provision. For details, see the special catalogs "**Polylube bearing (CAT. No. 3022/E)**" and "**Polylube needle bearing (CAT. No. 3605/J)**."

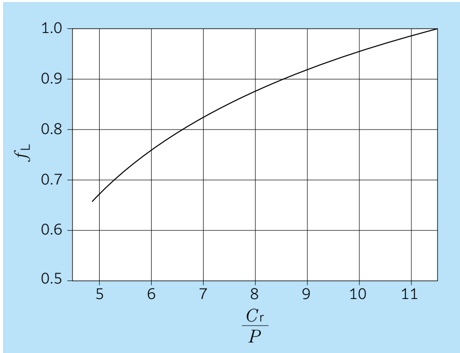


Fig. 9.1 Value of adjustment factor f_L depends on bearing load

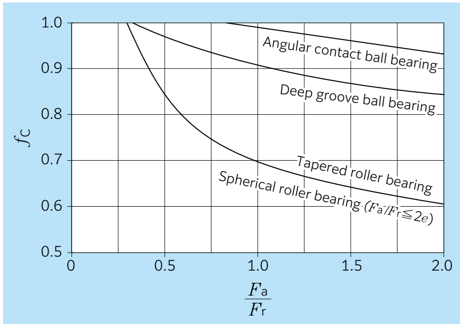


Fig. 9.2 Value of adjustment factor f_C depends on combined load

Table 9.1 Adjustment factor, f_B, for allowable number of revolutions

Bearing type	Adjustment factor f_B
Deep groove ball bearing	3.0
Angular contact ball bearing	2.0
Cylindrical roller bearing	2.5
Tapered roller bearing	2.0

9.2 Low-speed rotation and rapid acceleration/deceleration

When the bearing rotational speed is particularly low (the product of the rotational speed n (min^{-1}) and the rolling element pitch diameter D_{pw} (mm) is $D_{pw}\, n$ < 10 000), an elastohydrodynamic lubrication oil film may not be formed at the contact surface between the rolling element and the raceway surface.

Under such conditions, lubricant containing an extreme-pressure additive (EP additive) should be used.

When rapid acceleration/deceleration is included in the operating conditions, the cage may break.

Please contact **NTN** Engineering because the allowable rotational speed needs to be examined individually.

9.3 Oscillating applications

In small oscillating movement, the rotation direction changes before the bearing makes one rotation.

The moment when the rotation method forwards and reverses, the rotational speed becomes zero. At this time, a lubrication oil film in the fluid mechanics may not be formed or maintained.

Under such conditions, lubricant containing an extreme-pressure additive (EP additive) should be used.

Suitable preload may be applied to reduce the sliding of rolling elements.

When the oscillation angle is extremely small, an oil film is unlikely to be formed on the contact surface between the raceway surface and the rolling element, and fretting (slight abrasion) may occur.

Please contact **NTN** Engineering because the allowable rotational speed needs to be examined individually.

9.4 Heat rating rotational speed

The heat rating rotational speed is an index standardized in JIS B 1550:2010 (ISO 15312:2003) that uses bearing operating temperature as reference.

This standard refers to the rotational speed of the inner ring of the bearing when the heat generation amount due to the bearing internal friction becomes equivalent to the heat radiation amount of the shaft and housing for mounting the bearing in the case where the bearing is operated at the reference condition below.

Reference conditions are shown below.

(1) Reference temperature

Reference temperature of static outer ring (housing raceway washer): 70°C

Reference ambient temperature around bearing: 20°C

(2) Reference load

Radial bearing ($0° \leqq \alpha \leqq 45°$):

Pure radial load of $0.05 \times C_{0r}$

Thrust roller bearing ($45° \leqq \alpha \leqq 90°$):

Pure axial load of $0.02 \times C_{0a}$

(3) Lubricant

The lubricant must be mineral oil that is free of an extreme-pressure additive and have viscosity ν below the following values at 70°C.

Radial bearing:

ν = 12 mm^2/s (equivalent to ISO VG32)

Thrust roller bearing:

ν = 24 mm^2/s (equivalent to ISO VG68)

(4) Lubrication method

In oil bath lubrication, the oil level is the center of the rolling element that is at the lowermost position.

Refer to JIS B 1550:2010 (ISO 15312:2003) for further details.

10. Friction and temperature rise

10.1 Friction

One of the main functions required of a bearing is that it must have low friction. Under normal operating conditions rolling bearings have a much **smaller friction coefficient** than sliding bearings, especially when comparing **starting friction**.

The friction coefficient for rolling bearings is expressed by formula (10.1).

$$\mu = \frac{2M}{Pd} \quad \cdots\cdots\cdots\cdots (10.1)$$

Where:

μ : Friction coefficient

M : Friction moment, N · mm

P : Load, N

d : Bearing bore, mm

The dynamic friction coefficient for rolling bearings varies with the type of bearing, load, lubrication, speed, and other factors. For normal operating conditions, the approximate friction coefficients for various bearing types are listed in **Table 10.1**.

Table 10.1 Friction coefficient for bearings (reference)

Bearing type	Friction coefficient $\mu \times 10^{-3}$
Deep groove ball bearings	1.0～1.5
Angular contact ball bearings	1.2～1.8
Self-aligning ball bearings	0.8～1.2
Cylindrical roller bearings	1.0～1.5
Needle roller bearings	2.0～3.0
Tapered roller bearings	1.7～2.5
Self-aligning roller bearings	2.0～2.5
Thrust ball bearings	1.0～1.5
Thrust roller bearings	2.0～3.0

10.2 Temperature rise

Almost all friction loss in a bearing is transformed into heat within the bearing itself and causes the temperature of the bearing to rise. The amount of thermal generation caused by the friction moment can be calculated using formula (10.2).

$$Q = 0.105 \times 10^{-6} M \times n \quad \cdots\cdots\cdots (10.2)$$

Where:

Q : Thermal value, kW

M : Friction moment, N · mm

n : Rotational speed, min^{-1}

Bearing operating temperature is determined by the equilibrium or balance between the amount of heat generated by the bearing and the amount of heat conducted away from the bearing. In most cases the temperature rises sharply during initial operation, then increases slowly until it reaches a stable condition and then remains constant. The time it takes to reach this steady state depends on the amount of heat produced, heat capacity/diffusion of the shaft and housing, amount of lubricant and method of lubrication. If the temperature continues to rise and does not become constant, it must be assumed that there is some improper function.

When any **abnormal temperature rise** is observed, examine the equipment. Remove the bearing for inspection if necessary. Some possible causes of abnormal temperature rises would be as follows.

- **Bearing misalignment** (due to moment load or incorrect installation)
- **Insufficient internal clearance**
- **Excessive preload**
- **Amount of lubricant too small** or **large**
- **Unsuitable lubricant**
- **Heat generated from sealing mechanism**
- **Excessive load**
- **Rapid acceleration and deceleration**
- **Heat conducted from external sources**

10.3 Starting torque calculation

The starting torque refers to the torque generated at the time of initial bearing rotation, and the torque generation factor differs between ball bearings and roller bearings. For ball bearings, this calculation is shown below with an angular contact ball bearing. For roller bearings, a tapered roller bearing is used as an example.

Even if the actual starting torque value is the same number, the torque calculation value is a reference value because there is measurement variation for each bearing.

1) Preload and staring torque of angular contact ball bearings

Bearings having a contact angle such as angular contact ball bearings and tapered roller bearings cannot be used by themselves. Two bearings must face each other or be used in combination. In this case, the bearings are often used by applying a preload, and the larger the preload is, the larger the friction torque of the bearing becomes. The starting torque of the angular contact ball bearing when a preload is applied generates the majority of the spin slip and the rolling friction torque.

The relationship between the preload and the starting torque of angular contact ball bearings is not a simple proportional relationship, and the calculation is complicated; therefore, please contact **NTN** Engineering.

2) Preload and starting torque of tapered roller bearings

The starting torque of tapered roller bearings are influenced by the following factors.

(1) Sliding friction between roller large end surface and inner ring large rib surface
(2) Rolling friction of rolling surface
(3) Sliding friction of roller and cage
(4) Stirring resistance of lubricant

However, (2) to (4) are extremely small compared with (1); therefore, the starting torque of tapered roller bearings is calculated by (1).

Starting torque M of tapered roller bearings is represented by formula (10.3).

$$M = \mu \cdot \mathrm{e} \cdot \cos(\beta/2) \cdot F_a \quad \mathrm{N \cdot mm} \quad \cdots(10.3)$$

M : Starting torque, N · mm
μ : Friction coefficient
e : Contact position between roller and inner ring rib, mm (**see Figure 10.1**)
β : Roller angle, ° (**see Figure 10.1**)
F_a : Preload, N

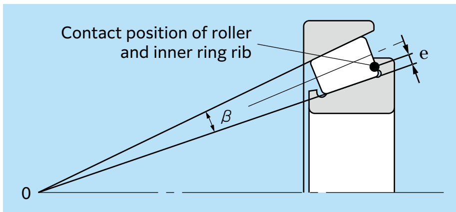


Figure 10.1 β and e

Figure 10.2 shows calculation examples. For details, please contact **NTN** Engineering.

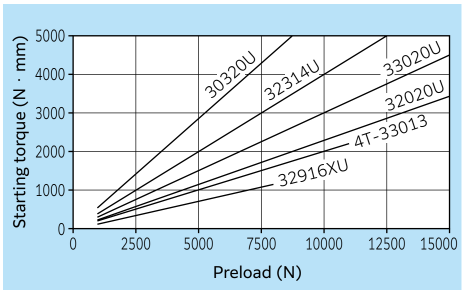


Figure 10.2 Preload and starting torque of tapered roller bearings

11. Lubrication

11.1 Purpose of lubrication

The purpose of rolling bearing lubrication is to prevent direct metallic contact between the various rolling and sliding elements. This is accomplished through the formation of a thin oil (or grease) film on the contact surfaces. Lubricant is necessary for operating rolling bearings. For rolling bearings, lubrication has the following advantages:

(1) **Reduction** of **friction** and **wear**
It prevents direct metallic contact between the rolling and sliding elements of bearing components and reduces friction and wear.
(2) **Prolonged** bearing **life**
The rolling fatigue life is prolonged by forming an oil film on the rolling contact surface part.
(3) **Friction heat dissipation** and cooling
circulating lubrication can dissipate heat generated from friction or conducted from the outside.
(4) Others
It **prevents foreign materials from entering** inside the bearing and suppresses corrosion (rust) by covering the bearing surface with oil.

In order to exhibit these effects, a lubrication method that matches service conditions is required. In addition to this, a quality lubricant must be selected, the proper amount of lubricant must be used and the bearing must be designed to prevent foreign matter from getting in or lubricant from leaking out. If lubrication is insufficient, friction is not reduced, causing excessive rise in bearing temperature or abnormal wear. Therefore, an appropriate lubrication and lubrication method should be selected.

Fig. 11.1 shows the relationship between oil volume, friction loss, and temperature rise. **Table 11.1** details the characteristics of this relationship.

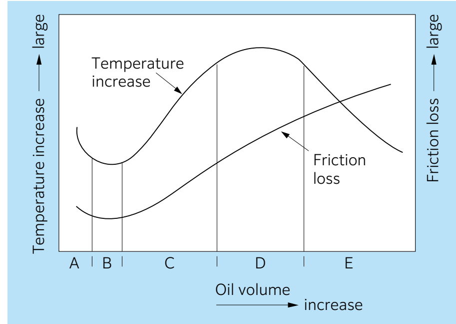


Fig. 11.1

Table 11.1 Oil volume, friction loss, and temperature increase (See Fig. 11.1)

Range	Characteristics	Lubrication method
A	When oil volume is extremely low, direct metallic contact occurs in places between the rolling elements and raceway surfaces. Bearing abrasion and seizing may occur.	—
B	A thin oil film develops over all surfaces, friction is minimal and bearing temperature is low.	Grease lubrication Oil mist Air-oil lubrication
C	As oil volume increases, heat buildup is balanced by cooling.	Circulating lubrication
D	Regardless of oil volume, temperature increases at a fixed rate.	Circulating lubrication
E	As oil volume increases, cooling dominates and bearing temperature decreases.	Forced circulation lubrication Oil jet lubrication

11.2 Lubrication methods and characteristics

Lubrication methods for bearings can be roughly divided into **grease** and **oil lubrication**. Each of these has its own features, so the lubrication method that best offers the required function must be selected.

Characteristics of each method are shown in **Table 11.2**.

Table 11.2 Comparison of grease lubrication and oil lubrication characteristics

Concern \ Method	Grease lubrication	Oil lubrication
Handling	◎	△
Reliability	○	◎
Cooling effect	×	○ (Circulation necessary)
Seal structure	○	△
Power loss	○	○
Environment contamination	○	△
High speed rotation	×	○

◎ : Very good ○ : Good △ : Fair × : Poor

11.3 Grease lubrication

Grease lubricants are relatively easy to handle and require only the simplest sealing devices. For these reasons, grease is the most widely used lubricant for rolling bearings. It is used in a bearing that is pre-sealed with grease (sealed/shielded bearing), or if using an unsealed bearing, fill the bearing and housing with the proper amount of grease, and replenish or change the grease regularly.

With sealed bearings, the proper grease amount does not cause leakage; however, under use conditions including a lot of vibrations, which cause grease to flow easily, or under high-speed outer ring rotation, in which large centrifugal force is applied on the grease, the grease may purge (in rare cases). Please consult **NTN** Engineering.

11.3.1 Types and characteristics of grease

Lubricating grease is composed of either a mineral base oil or a synthetic base oil. **To this base a thickener and other additives are added**. The properties of all greases are mainly determined by the kind of base oil used and by the combination of thickening agent and various additives. **Table 11.5** shows general grease varieties and characteristics, and **Table 11.6** shows grease brand names and their characteristics. (See pages A-116 and A-117.) As performance characteristics of even the same type of grease will vary widely from brand to brand, **it is necessary to check the manufacturers' data when selecting grease**.

(1) Base oil

Mineral oil or synthetics such as **ester oil**, **synthetic hydrocarbon oil**, or **ether oil** are used as the base of greases.

Generally, greases with low viscosity base oils are best suited for low temperatures and high speeds; grease using high-viscosity base oil has superior high-temperature and high-load characteristics.

(2) Thickening agents

Thickening agents are compounded with base oils to maintain the semi-solid state of the grease. Thickening agents consist of two types of bases: metallic soaps and non-soaps. Metallic soap thickeners include: **lithium**, **sodium**, **calcium**, etc. Non-soap base thickeners are divided into two groups: inorganic (**silica gel**, **bentonite**, etc.) and organic (**polyurea**, **fluorocarbon**, etc.). The various special characteristics of a grease, such as **limiting temperature range**, **mechanical stability**, water resistance, etc. depend largely on the type of **thickening agent** used. For example, a sodium based grease is generally poor in water resistance properties, while greases with bentone, poly-urea and other non-metallic soaps as the thickening agent are generally superior in high temperature properties.

(3) Additives

Various additives are added to grease depending on the purpose. Typical additives include **anti-oxidants**, **high-pressure additives** (EP additives), **rust preventives**, and **anti-corrosives**. For bearings subject to heavy loads and/or shock loads, grease containing high-pressure additives should be used. Anti-oxidants are added to grease used in most types of rolling bearings.

(4) Consistency

Consistency is an index that indicates hardness and fluidity of grease. **The higher the NLGI number, the HARDER the grease is**. For the lubrication of rolling bearings, greases with the NLGI consistency numbers of 1, 2, and 3 are used. General relationships between consistency and application of grease are shown in **Table 11.3**.

Table 11.3 Consistency of grease

NLGI consistency No.	JIS(ASTM) 60 times blend consistency	Application
0	355 to 385	For centralized greasing use
1	310 to 340	For centralized greasing use
2	265 to 295	For general use and sealed bearing use
3	220 to 250	For general use, high temperature use, and sealed bearing use
4	175 to 205	For special use

(5) Mixing different types of greases

When greases of different kinds are mixed together, the consistency of the greases will change (usually softer), the operating temperature range will be lowered, and other changes in characteristics will occur. As a rule, grease should not be mixed with grease of any other brand. However, if different greases must be mixed, at least greases with the same base oil and thickening agent should be selected.

11.3.2 Amount of grease

The amount of grease used in any given situation will depend on many factors relating to the size and shape of the housing, space limitations, bearing's rotating speed and type of grease used. As a rule of thumb, **bearings should be filled to 30 to 40% of their space and housing should be filled 30 to 60%**. Where speeds are high and temperature rises need to be kept to a minimum, a reduced amount of grease should be used. **Excessive amounts of grease cause temperature rises which in turn cause the grease to soften and may allow leakage. Oxidation and deterioration of excessive grease fills may cause the lubricating efficiency to be lowered.** Moreover, the standard bearing space can be found by formula (11.1)

$$V = K \cdot W \quad \cdots\cdots (11.1)$$

where,

V : Quantity of bearing space open type (approx.), cm^3

K : Bearing space factor (see value of K in **Table 11.4**)

W : Mass of bearing, kg

A predetermine amount of grease is filled in the bearing with a grease gun or a syringe. After sealing it is not possible to spread the grease by hand - only by rotating the bearing by hand.

Table 11.4 Bearing space factor K

Bearing type[1)]			Cage type	K
Deep groove ball bearing[2)]			Pressed cage	61
Angular contact ball bearing			Pressed cage	54
			Machined cage	33
			Molded resin cage	33
Cylindrical roller bearing	NU type[3)]		Pressed cage	50
			Machined cage	36
	N type[5)]		Pressed cage	55
			Machined cage	37
	ULTAGE series(EA type) E type	NU type[4)]	Machined cage	33
			Molded resin cage	33
		N type[4)]	Machined cage	34
			Molded resin cage	35
Tapered roller bearing			Pressed cage	46
Spherical roller bearing	Type C		Pressed cage	35
	Type B Type 213		Machined cage	28
	ULTAGE series	Type EA	Pressed cage	33
		Type EM	Machined cage	31

1) Does not apply to model numbers that are not specified in the catalog.
2) Does not apply top 160 series bearings. 3) Does not apply to NU4 series.
4) Applies to G1 machined cages only. 5) Does not apply to N4 series.

Table 11.5 Grease varieties and characteristics [1]

	Soap-based							Non-soap-based			
	Lithium (Li) grease				Calcium (Ca) grease	Calcium (Ca) grease	Sodium (Na) grease	Organic			Inorganic
Thickening agent [2]	Li soap			Li complexed soap	Ca soap (cup grease)	Ca complexed soap	Na soap	Urea	Urea	PTFE	Silica gel
Base oil [3]	Mineral oil	Ester oil	Silicone oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Synthetic oil	Fluorinated	Ester oil
Dropping point °C	170 to 190	170 to 190	200 to 210	>250	80 to 100	200 to 280	170 to 200	>260	>260	None	>260
Operating temperature range °C	−30 to 120	−50 to 130	−50 to 160	−30 to 130	−20 to 70	−20 to 130	−20 to 130	−30 to 140	−40 to 180	−40 to 250	−70 to 150
Mechanical stability	Good	Good	Good	Good	OK	Good	Good	Good to Excellent	Good to Excellent	OK to Good	Good
Pressure resistance	Good	Good	Poor	Good	OK	Good to Excellent	Good	Good to Excellent	Good to Excellent	Good	Good
Water resistance	Good	Good	Good	Good	Good	Good	Poor	Good to Excellent	Good to Excellent	Good	Good
Characteristics/ application	Balanced performance with less disadvantages All purpose grease	Excellent low temperature and wear characteristics Suitable for small sized and miniature bearings	Excellent characteristics at low and high temperatures Poor load resistance	Balanced performance with less disadvantages Usable for relatively high temperature	Used for low speed and light loads Unusable for high temperature	Excellent pressure resistance	Some emulsification when water is introduced Usable for relatively high temperature	Excellent water resistance and oxidation stability	Excellent water resistance and oxidation stability Used for high temperature and high speed applications	Excellent chemical resistance Used for high temperature applications	Excellent characteristics at low temperature

1) Use the grease performance as rough standards because it differs depending on the manufacturer's additive formation.
2) Na soap-based grease may be emulsified by water and high humidity conditions.
Urea-based grease may deteriorate polyfluorocarbons and rubber.
3) Ester oil-based grease may swell acrylic materials, and silicone-based grease may swell silicone materials.
Some silicone-based greases and fluorine-based greases have poor noise performance and rustproofing performance.

Table 11.6 Grease brands and their nature

Brand	Code	Thickener	Base oil	Base oil viscosity mm²/s		60 times blend consistency		Dropping point °C	Operating temperature range °C	Characteristics
				40°C	100°C	Representative value	NLGI No			
Alvania Grease S2	2AS	Li soap	Mineral oil	131	12.2	283	2	181	−25 to 120	All-purpose (standard grease for deep grease ball bearings)
Alvania Grease S3	3AS	Li soap	Mineral oil	131	12.2	242	3	182	−20 to 135	All-purpose (standard grease for ball bearings of bearing units)
Alvania EP Grease 2	8A	Li soap	Mineral oil	220	15.9	284	2	184	−20 to 110	All-purpose for high loads
Multemp PS No. 2	1K	Li soap	Ester + PAO	15.9	—	270	2	190	−50 to 130	For low temperature and low torque
Multemp SRL	5K	Li soap	Ester	24.1	—	250	2 to 3	192	−40 to 150	For low temperature to high temperature, all-purpose (standard grease for miniature/small diameter ball bearings)
SH33L	3L	Li soap	Silicone	70	27	320	1 to 2	220	−70 to 140	For low temperature
SH44M	4M	Li soap	Silicone	80	19	260	2 to 3	204	−40 to 160	For high temperature
ISOFLEX NBU15	15K	Ba complexed soap	Diester + mineral oil	23	5	280	2	220 or above	−40 to 130	For high speed
SHC POLYREX 462	L791	Urea	PAO	460	40	280	2	270	−20 to 170	For food machinery
SE-1	L749	Urea	PAO + ester	22	5	265	2	220 or above	−50 to 120	For high speed
ME-1	L700	Urea	Ester + PAO	61.3	9.3	231	3	250 or above	−30 to 160	For high temperature and high speed
EP-1	L542	Urea	PAO	46.8	—	220	2	260 or above	−40 to 160	For high temperature and high speed
NA103A	L756	Urea	PAO + ether	53.5	—	270	2	260 or above	−40 to 180	Brittle separation
MP-1	L448	Urea	Synthetic oil	40.6	7.1	243	3	250 or above	−40 to 150	For high temperature and high speed
Grease J	L353	Urea	Ester	75	10	305	1 to 2	280 or above	−20 to 180	For high temperature
Cosmo Wide Grease WR3	2M	Na terephthalate	Diester + mineral oil	31.6	6	238	3	230 or above	−40 to 150	For low temperature to high temperature, all-purpose
Mobilgrease 28	9B	Bentonite	PAO	30	5.7	293	1 to 2	307	−54 to 177	MIL-PRF-81322 For low temperature to high temperature
Aeroshell Grease 7	5S	Microgel	Diester	10.3	3.1	296	1 to 2	260 or above	−73 to 149	MIL-PRF-23827C

Note: 1. Representative values are shown for the base oil viscosity, consistency, and dropping point.
2. The upper and lower limits of the operating temperature range differ depending on the usage environment and requirement specifications. Please consult with **NTN** Engineering.

11.3.3 Grease replenishment

As the lubricating performance of grease declines with the time, grease must be filled in proper intervals.

The replenishment interval depends on the type of bearing, dimensions, bearing's rotating speed, bearing temperature, and type of grease. An easy reference chart for calculating grease replenishment interval is shown in **Fig. 11.2**. This chart indicates the replenishment interval for standard rolling bearing grease when used under normal operating conditions. As operating temperatures increase, the grease interval should be shortened accordingly. Generally, for every 10°C increase in bearing temperature above 80°C, the grease interval period is shortened to "2/3".

For grease replenishment interval of the ULTAGE series, please contact **NTN** Engineering.

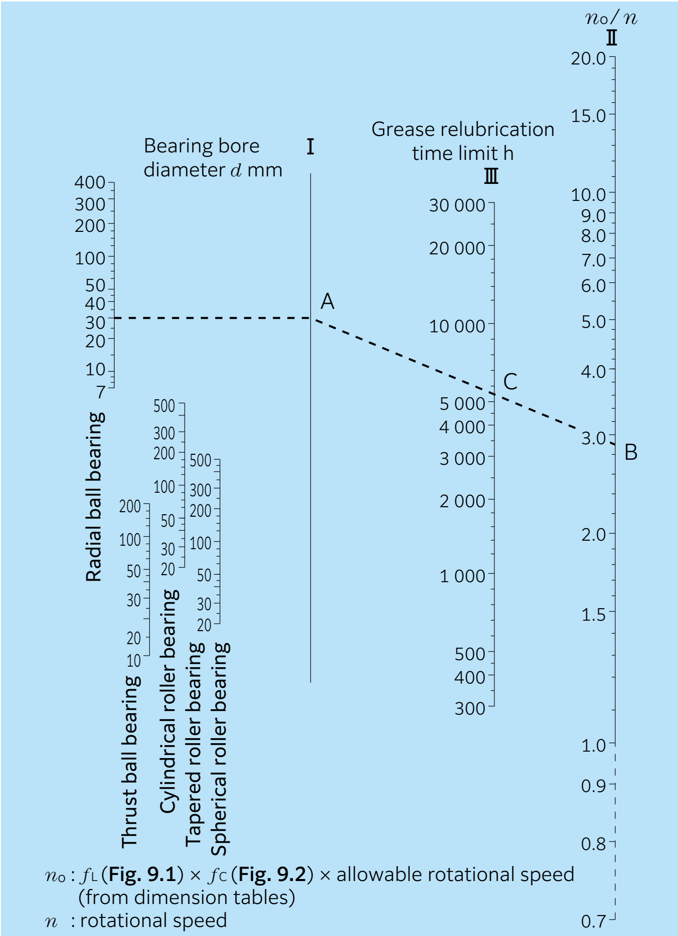


Fig. 11.2 Diagram for grease interval

(Example) Find the grease relubrication time limit for deep groove ball bearing 6206, with a radial load of 2.0 kN operating at 3 600 min^{-1}

From **Fig. 9.1** C_r / P_r = 21.6 / 2.0 kN = 10.8, f_L = 0.96. Allowable rotational speed from the dimensions tables for bearing 6206 is 11 000 min^{-1}. Allowable rotational speed n_o for 2.0 kN radial load is:

$$n_o = 0.96 \times 11\,000 = 10\,560 \text{min}^{-1}$$

Therefore, $\frac{n_o}{n} = \frac{10\,560}{3\,600} = 2.93$

The point where vertical line Ⅰ intersects a horizontal line drawn from the point equivalent of d = 30 for the radial ball bearing shown in **Fig. 11.2** shall be point A. Find intersection point C where vertical line Ⅲ intersects the straight line formed by joining point B (n_o / n = 2.93) with A by a straight line Ⅱ. It shows that grease life in this case is approximately 5,500 hours.

11.3.4 Grease life estimation of sealed ball bearings

There is a method of estimating the grease life of single row sealed and greased ball bearings.

The estimated grease life changes depending on the grease type, temperature, shaft rotational speed, and load; therefore, please contact **NTN** Engineering for details.

11.4 Solid grease

"Solid grease" is a lubricant composed mainly of lubricating grease and ultra-high polymer polyethylene. Solid grease begins as grease that has the same viscosity as a more traditional grease. After being heated and cooled, a process known a "calcination", the grease hardens while maintaining a large quantity of lubricant within the polymer structure. The result of this solidification is that the grease does not easily leak from the bearing, even when the bearing is subjected to strong vibrations or centrifugal force.

Bearings with solid grease are available in two types: the spot-pack type in which solid grease is injected into the cage, and the full-pack type in which all free space around the rolling elements is completely filled with solid grease.

Spot-pack solid grease is available for deep groove ball bearings, small diameter ball bearings, and bearing units. Full-pack solid grease is available for self-aligning ball bearings, spherical roller bearings, and needle roller bearings.

Primary advantages:

(1) Minimal grease leakage

(2) Low bearing torque with spot-pack type solid grease

For more details, please refer to the special catalog "**Bearings with solid grease (CAT. No. 3022/E).**"

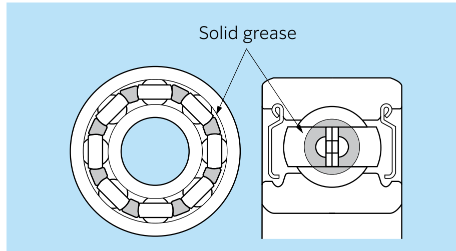


Fig. 11.3 Deep groove ball bearing with spot-pack solid grease (Z shield) (Available for deep groove ball bearings)

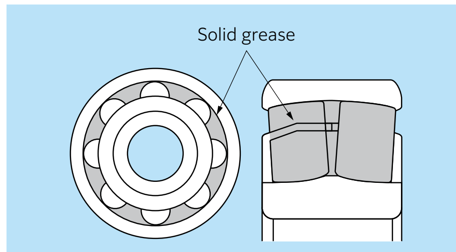


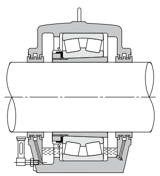
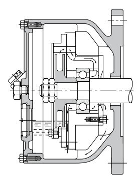
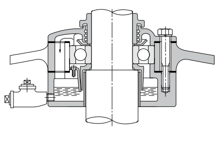
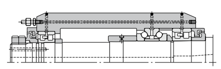
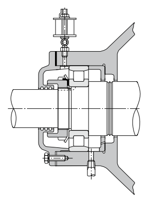
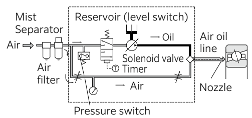
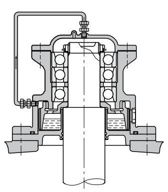
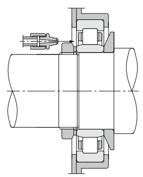
Fig. 11.4 Spherical roller bearing with full-pack solid grease (Available for spherical roller bearings)

11.5. Oil lubrication

Oil lubrication is suitable for applications requiring that bearing-generated heat or heat applied to the bearing from other sources be carried away from the bearing and dissipated to the outside.

Table 11.7 shows the main methods of oil lubrication.

Table 11.7 Oil lubrication methods

Lubrication method	Example	Lubrication method	Example
(Oil bath lubrication) ● Oil bath lubrication is the most generally used method of lubrication, and is widely used for low to moderate rotational speed applications. ● For horizontal shaft applications, oil level should be maintained at approximately the center of the lowest rolling element, according to the oil gauge, when the bearing is at rest. For vertical shafts at low speeds, oil level should be maintained at 50 - 80% submergence of the rolling elements.		**(Disc lubrication)** ● In this method, a partially submerged disc rotates and pulls oil up into a reservoir from which it then drains down through the bearing, lubricating it.	
(Oil spray lubrication) ● In this method, an impeller or similar device mounted on the shaft draws up oil and sprays it onto the bearing. This method can be used at considerably high speeds.		**(Oil mist lubrication)** ● Using pressurized air, lubricating oil is atomized before passing through the bearing. ● Due to the low lubricant resistance, this method is well suited to high speed applications.	
(Drip lubrication) ● In this method, oil is collected above the bearing and allowed to drip down into the housing where it becomes a lubricating mist as it strikes the rolling elements. Another version allows only slight amounts of oil to pass through the bearing. ● Used at relatively high speeds for light to moderate load applications. ● In most cases, oil volume is a few drops per minute.		**(Air-oil lubrication)** ● In this method, the required minimum amount of lubricating oil is measured and fed to each bearing at ideal intervals using compressed air. ● Fresh lubricating oil is constantly fed. ● Because the required oil quantity is very small, the working environment can be kept clean.	
(Circulating lubrication) ● Used for bearing cooling or for automatic oil supply systems in which the oil supply is centrally located. ● One of the advantages of this method is that oil cooling devices and filters to maintain oil purity can be installed within the system. ● In order for oil to thoroughly lubricate the bearing, oil inlets and outlets must be provided on opposite sides of the bearing.		**(Oil jet lubrication)** ● This method lubricates by injecting oil under high pressure directly into the side of the bearing. This is a reliable system for high speed, high temperature or otherwise severe conditions. ● Used for lubricating the bearings in jet engines, gas turbines, and other high speed equipment. ● Under-race lubrication is one example of this type of lubrication.	

11.5.1 Selection of lubricating oil

Under normal operating conditions, **machine oil**, **turbine oil**, and other mineral oils are widely used for the lubrication of rolling bearings. However, for temperatures **below -30°C** or **above 150°C**, synthetic oils such as **ester oil**, **silicone oil**, and **fluorinated oil** are used.

For lubricating oils, viscosity is one of the most important properties and determines an oil's lubricating efficiency. If viscosity is too low, formation of the oil film will be insufficient, and damage to the rolling surface will occur. If viscosity is too high, viscous resistance will also be great, resulting in temperature increase and friction loss. In general, **for higher speed applications, a lower viscosity oil** should be used; **for heavier load applications, a higher viscosity oil** should be used.

Lubrication of rolling bearings requires viscosity shown in **Table 11.8**, which is dependent on the use conditions. **Fig 11.5** shows the relation between lubricating oil viscosity and temperature. This is used to select a lubrication oil with viscosity characteristics appropriate for the operating temperature.

For reference, **Table 11.9** lists the selection standards for lubricating oil viscosity based on bearing operating conditions.

Table 11.8 Required lubricating oil viscosity for bearings

Bearing type	Dynamic viscosity mm^2/s
Ball bearings, Cylindrical roller bearings, Needle roller bearings	13 or above
Spherical roller bearings, Tapered roller bearings, Needle roller thrust bearings	20 or above
Self-aligning roller thrust bearing	30 or above

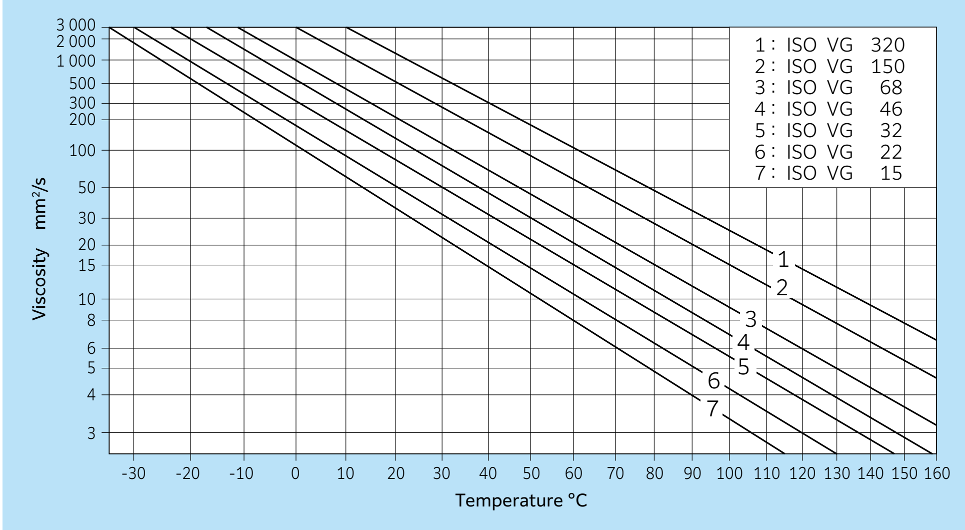


Fig 11.5 Relation between lubricating oil viscosity and temperature

Table 11.9 Standards for lubricating oil viscosity

Bearing operating temperature °C	dn value[1]	Lubricating oil ISO viscosity grade (VG)		Suitable bearing
		Normal load	Heavy load or shock load	
−30 to 0	Up to allowable rotational speed	22, 32	46	All types
0 to 60	Up to 15 000	46, 68	100	All types
	15 000 to 80 000	32, 46	68	All types
	80 000 to 150 000	22, 32	32	All types but thrust ball bearings
	150 000 to 500 000	10	22, 32	Single row radial ball bearings, cylindrical roller bearings
60 to 100	Up to 15 000	150	220	All types
	15 000 to 80 000	100	150	All types
	80 000 to 150 000	68	100, 150	All types but thrust ball bearings
	150 000 to 500 000	32	68	Single row radial ball bearings, cylindrical roller bearings
100 to 150	Up to allowable rotational speed	320		All types
0 to 60	Up to allowable rotational speed	46, 68		Self-aligning roller bearing
60 to 100	Up to allowable rotational speed	150		

1) dn value: [dn = bearing bore diameter d (mm) × rotational speed n (min^{-1})]
Note: 1. Applied when lubrication method is either oil bath or circulating lubrication.
2. Please consult **NTN** Engineering in cases where operating conditions fall outside the range covered by this table.

11.5.2 Oiling amount

When a bearing is to be supplied with oil forcibly, the amount of heat generated from the bearing is equal to the sum of the amount of heat dissipated from the housing and the amount of heat carried away by the oil.

The oiling amount that serves as a rough indication when a standard housing is used can be obtained by formula (11.2).

$$Q = K \cdot q \quad \cdots\cdots (11.2)$$

where,

Q: oiling amount per bearing (cm^3/min)
K: coefficient determined by allowable temperature rise of oil (**Table 11.10**)
q: oiling amount obtained by diagram (cm^3/min) (**Fig. 11.6**)

The heat dissipation amount differs depending on the housing type. Therefore, in the actual operation, it is desirable to obtain the oiling amount suitable for the actual machine by adjusting the amount obtained by formula (11.2) to 1.5 to 2 times.

In addition, when calculating the oiling amount assuming that no heat is dissipated from the housing and the generated heat amount is completely carried away by the oil, use the shaft diameter in the diagram as d = 0.

Table 11.10 Value of K

Expelled oil temp minus supplied oil temp °C	K
10	1.5
15	1
20	0.75
25	0.6

(Example) For tapered roller bearing **30220U** mounted on a flywheel shaft with a radial load of 9.5 kN, operating at 1 800 min^{-1}, what is the amount of lubricating oil Q required to keep the bearing temperature rise below 15°C?

d = 100mm,
$dn = 100 \times 1\,800 = 18 \times 10^4$
From **Fig. 11.6** q = 180cm^3/min
Assume the bearing temperature is approximately equal to the expelled oil temperature,
from **Table 11.10**, since K = 1
$Q = K \times q = 1 \times 180 = 180$cm^3/min

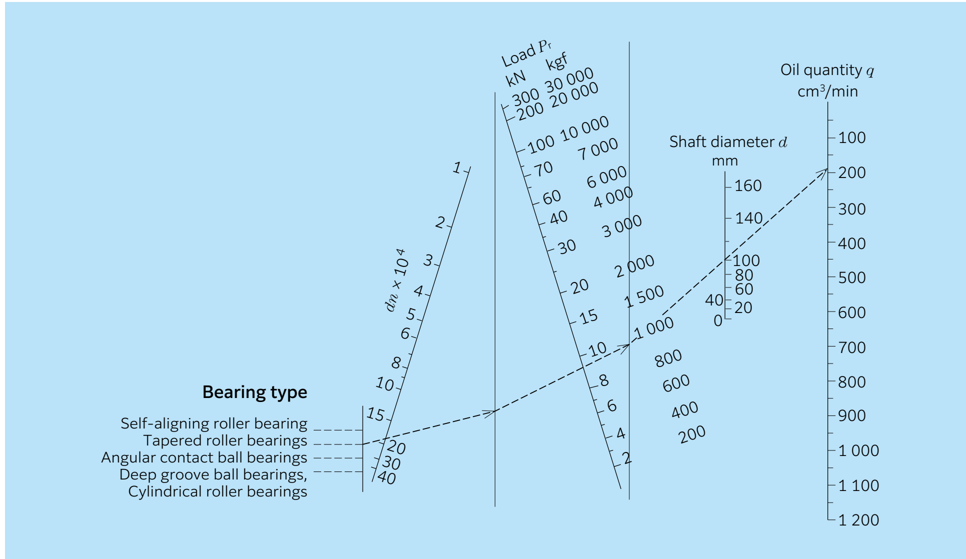


Fig. 11.6 Oil quantity guidelines

11.5.3 Relubrication intervals

The intervals at which lubricating oil should be changed varies depending upon operating conditions, oil quantity, and type of oil used. In general, for oil bath lubrication where the operating temperature is 50°C or less, oil should be replaced once a year. When the operating temperature is between 80°C - 100°C, oil should be replaced at least once every three months. For important equipment, it is advisable that lubricating efficiency and oil purity deterioration be checked regularly to determine when oil replacement is necessary.

12. External bearing sealing devices

External seals have two main functions: to prevent lubricating oil from leaking out of the bearing, and to prevent dust, water, and other contaminants from entering inside the bearing. When selecting a seal, the following factors should be considered, in addition to the application's operating conditions: Type of lubricant (oil or grease), seal lip speed, shaft misalignment, space limitations, seal friction and heat generation, and cost.

Sealing devices for rolling bearings fall into two main classifications: non-contact seals and contact seals.

- **Non-contact seals**: Non-contact seals utilize a small clearance between the shaft and the housing, or between the shaft and sealing apparatus. Therefore friction is negligible, making them suitable for high speed applications.

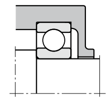
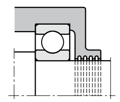
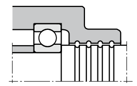
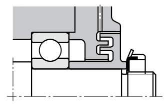
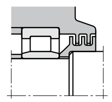
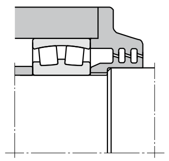
  In order to improve sealing capability, the gaps between the shaft and sealing apparatus are often filled with lubricant.

- **Contact seals**: A contact seal is a seal in which a molded synthetic rubber lip on a steel plate is pressed against the shaft. Contact seals are generally far superior to non-contact seals in sealing effectiveness, although their friction torque and temperature rise coefficients are higher. Furthermore, because the lip portion of a contact seal slides while in contact with the shaft, the allowable lip speed may vary based on the seal design.

  The surface at which the seal lip contacts the shaft must be lubricated. Ordinary bearing lubricant can also be used for this purpose.

  Table 12.1 lists the special characteristics of seals and other points to be considered when choosing an appropriate seal.

Table 12.1 Seal characteristics and selection considerations

Type	Seal construction	Designation	Seal characteristics and selection considerations
Non-contact seals		**Clearance seal**	This is an simple seal design with a small radial clearance between the shaft and housing.
		**Oil groove seal** (oil grooves on housing side)	Several concentric oil grooves are provided on the housing inner diameter to improve the sealing effectiveness. When the grooves are filled with lubricant, the ingress of external contaminants is prevented.
		**Oil groove seal** (oil grooves on shaft side and housing side)	Oil grooves are provided on both the shaft outer diameter and housing inner diameter for a seal with even greater sealing effectiveness.
		**Axial labyrinth seal**	This seal has a labyrinth passageway on the axial side of the housing.
		**Radial labyrinth seal**	A labyrinth passageway is located on the radial side of the housing. For use with split housings. This offers better sealing effectiveness than axial labyrinth seals.
		**Aligning type labyrinth seal**	The seal's labyrinth passageway is slanted and has sufficient clearance to prevent contact between the housing projections and the shaft, even as the shaft realigns.

Cautionary points regarding selection (clearance seal and oil groove seals)

- In order to improve sealing effectiveness, clearances between the shaft and housing should be minimized. However, care should be taken to confirm shaft/bearing rigidity and other factors to avoid direct contact between the shaft and housing during operation.

Oil groove clearance (approx.)

Shaft diameter mm	Clearance mm
Up to 50	0.2～0.4
50 or larger	0.5～1.0

- Oil groove width, depth (reference)
  Width: 2 to 5 mm
  Depth: 4 to 5 mm
- Three or more oil grooves should be provided.
- Sealing effectiveness can be further improved by filling the oil groove portion with grease of which ASTM worked penetration is 150 to 200.
- Grease is generally used as the lubricant for labyrinth seals, and, except in low speed applications, is commonly used together with other sealing devices.

Cautionary points regarding selection (labyrinth seals)

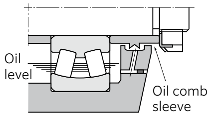
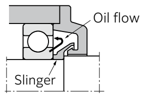
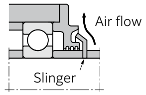
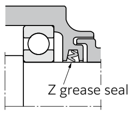
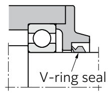
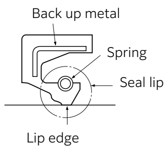
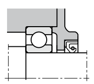
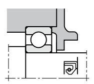
- In order to improve sealing effectiveness, labyrinth passageway clearances should be minimized. However, care should be taken to confirm shaft/bearing rigidity, fit, internal clearances and other factors to avoid direct contact between labyrinth projections during operation.

Labyrinth clearance (approx.)

Shaft diameter mm	Clearance mm	
	Radial direction	Axial direction
—～ 50	0.2～0.4	1.0～2.0
50～200	0.5～1.0	3.0～5.0

- Sealing effectiveness can be further improved by filling the labyrinth passageway with grease of which ASTM worked penetration is 150 to 200.
- Labyrinth seals are suitable for high speed applications.

External Bearing Sealing Devices

Type	Seal construction	Designation	Seal characteristics and selection considerations
Non-contact seals		**Oil comb sleeve**	In this design, lubricating oil that makes its way out of the housing along the shaft is thrown off by projections on the oil comb sleeve and recirculated.
		**Slinger provided in the housing**	Seal type whereby a slinger is provided in the housing that prevents lubricant from leaking by centrifugal force produced via rotation.
		**Slinger provided outside the housing**	By mounting a slinger on the outside of the housing, centrifugal force helps to prevent dust and other solid contaminants from entering.
Contact seals		**Z grease seal**	In cross section resembling the letter "Z"; this seal's empty spaces are filled with grease. The seal is commonly used with a plummer block (housing).
		**V-ring seal**	This design enhances sealing efficiency with a lip that seals from the axial direction. With the aid of centrifugal force, this seal also offers effective protection against dust, water, and other contaminants entering the bearing. Can be used for both oil and grease lubrication. At seal peripheral speeds in excess of 12 m/s, seal ring fit is lost due to centrifugal force, and a clamping band is necessary to hold it in place.
	  For dust proof  For preventing lubricant leakage	**Oil seal**	Oil seals are widely used, and their shapes and dimensions are standardized under JIS B 2402. In this design, a ring-shaped spring is installed in the lip section. As a result, contact pressure is exerted between the lip edge and shaft surface, and sealing effectiveness is good. When the bearing and oil seal are in close proximity, the internal clearance of the bearing may be reduced by heat produced by the oil seal. In addition to considering the heat generated by contact seals at various peripheral speeds, internal bearing clearances must also be selected with caution. Depending on its orientation, the seal may function to prevent lubricant from leaking out or foreign matter from getting in.

Cautionary points regarding selection (non-contact seals)

- Seal type that utilizes centrifugal force of the slinger mounted on rotating shaft.
- If mounted on the inside of the housing, the slinger should function to seal in lubricant by the centrifugal force produced by rotation.
- If mounted on the outside of the housing, the slinger should function to seal out foreign matter by the fan effect produced by rotation.
- These seal types are commonly employed together with other sealing devices.

Cautionary points regarding selection (oil seal)

Shaft surface roughness (reference)

Peripheral speed m/s	Surface roughness *Ra*	Surface roughness *Rz*
～ 5	0.8	3.2
5～10	0.4	1.6
10～	0.2	0.8

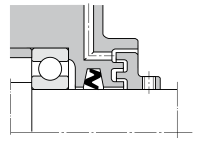
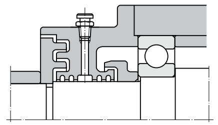
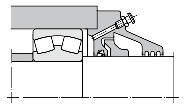
Shaft material (reference)

Material	Machine structural carbon steel Low carbon alloy steel Stainless steel
Surface hardness	HRC 40 or higher necessary HRC 55 or higher advisable
Processing method	Final grinding without repeat (moving), or buffed after hard chrome plating

Allowable speed/temperature according to seal type/material (reference)

Seal type/material		Allowable peripheral speed m/s $\left(v(\text{m/s})=\frac{\pi \times d(\text{mm}) \times n(\text{min}^{-1})}{60\,000}\right)$	Allowable temp °C
Oil seal	Nitrile rubber	16 or below	−25 ～120
	Acrylic rubber	26 or below	−15 ～150
	Fluorinated rubber	32 or below	−30 ～200
Z grease seal	Nitrile rubber	6 or below	−25 ～120
V-ring	Nitrile rubber	40 or below	−25 ～120

External Bearing Sealing Devices

Type	Seal construction	Designation	Seal characteristics and selection considerations
Combination seals		**Z-seal + Labyrinth seal**	This is an example of an axial labyrinth seal which has been combined with a Z seal to increase its sealing effectiveness. The axial labyrinth seal is affixed to the shaft with a setting bolt or other method. In the diagram on the left, both the direction of the Z-seal and the labyrinth seal are oriented to keep dust and other contaminants out of the bearing. Because a Z-seal has been incorporated, the allowable peripheral speed should not exceed 6 m/s.
		**Labyrinth seal + Oil groove seal + Slinger**	This is an example of a combination of three different non-contact seals. It has the advantage of preventing both lubricant leakage from inside the bearing and infiltration of dust and other contaminants from the outside. It is widely used on mining equipment and as a sealing system with plummer blocks in extremely dusty application conditions.
		**Oil groove seal + Slinger + Z-seal**	This is an example where an oil groove seal and slinger have been combined with a Z-seal to increase its sealing efficiency. In the diagram on the left, all three seals have been oriented to keep dust and other contaminants out of the bearing. It is widely used on mining equipment and as a sealing system with plummer blocks in extremely dusty application conditions.

13. Bearing materials

13.1 Raceway and rolling element

While the contact surfaces of a bearing's raceways and rolling elements are subjected to repeated heavy stress, they must also maintain high precision and rotational accuracy.

To accomplish this, the raceways and rolling elements must be made of a material that has high hardness, is resistant to rolling fatigue, is wear resistant, and has good dimensional stability. The most common cause of fatigue in bearings is the inclusion of non-metallic inclusions in the steel. Nonmetallic inclusions contain hard oxides that can cause fatigue cracks. Clean steel with minimal non-metallic inclusions must therefore be used.

All **NTN** bearings use steel that is low in oxygen content and nonmetallic impurities, refined by a vacuum degassing process and outside hearth smelting. For bearings requiring especially high reliability and long life, steels of even higher in purity, such as vacuum melted steel (VIM / VAR) and electro-slag melted steel (ESR), are used.

13.1.1 Raceway and rolling element materials

1) High/mid carbon alloy steel

In general, steel types capable of being **"through hardened"** below the material surface are employed for raceways and rolling elements. Foremost among these is **high carbon chromium bearing steel**, which is widely used. For large type bearings and bearings with large cross sectional dimensions, induction hardened bearing steel is used, which incorporates manganese(Mn) or molybdenum(Mo). Midcarbon chromium steel incorporating silicon(Si) and manganese may also be used, which gives it hardening properties comparable to high carbon chromium steel.

Table 13.1 (A-140) gives the chemical composition of representative high carbon chrome bearing steels that meet JIS G 4805. SUJ2 is frequently used. SUJ3, with enhanced hardening characteristics containing a large quantity of Mn, is used for large bearings. SUJ5 is SUJ3 to which Mo has been added to further enhance hardening characteristics, and is used for oversized bearings or bearings with thick walls.

Table 13.1 (A-140) lists the chemical composition of the primary materials that are equivalent or similar to these JIS high carbon chrome bearing steels. The chemical composition of JIS SUJ2 is nearly equivalent to that of AISI, SAE standard 52100, German DIN standard 100Cr6, and Chinese GB standard GCr15.

2) Carburizing (case hardened) steel

Carburizing hardens the steel from the surface to the proper depth, leaving a relatively soft core. This provides **hardness and toughness**, making the material **suitable for impact loads**. **NTN** uses carburizing (case hardened) steel for most of its tapered roller bearings. In terms of case hardened steel for **NTN**'s other bearings, chromium steel and chrome molybdenum steel are used for small to medium sized bearings, and nickel chrome molybdenum steel is used for large sized bearings. **Table 13.2** (A-141) shows the chemical composition of representative carburizing steels of JIS.

The table lists the chemical composition of similar materials. The chemical composition of JIS SCM420 is nearly equivalent to that of AISI, SAE standard 4118, German DIN standard 20CrMo4 or 25CrMo4. Chinese GB standard has a slightly different amount of Cr and Mo compared with G20CrMo.

3) High temperature capable bearing steel

When bearings made of ordinary high carbon chromium steel which have undergone standard heat treatment are used for long durations at high temperatures, unacceptably large dimensional changes can occur as described in section 13.1.2. For this reason, **a dimension stabilizing treatment** (TS treatment) has been devised for very high temperature applications. This treatment however reduces the hardness of the material, thereby reducing rolling fatigue life. (See section "3.3.2 Bearing characteristics factor a_2" on page A-22.) Note that dimensional changes can occur in normal use too.

Standard high temperature bearings for use at temperatures from **150°C - 200°C**, add silicon to the steel to improve heat resistance. This results in a bearing with excellent rolling fatigue life with minimal dimensional change or softening at high temperatures.

A variety of heat resistant steels are also incorporated in bearings to minimize softening and dimensional changes when used at high temperatures. Two of these are high-speed molybdenum steel and high-speed tungsten steel. For bearings requiring heat resistance in high speed applications, there is also heat resistant case hardened molybdenum steel (see **Table 13.3** on A-142).

4) Corrosion resistant bearing steel

For applications requiring high corrosion resistance, **stainless steel** is used. To achieve this corrosion resistance, a large proportion of the alloying element chrome is added to martensitic stainless steel (**Table 13.4** on A-142).

5) Induction hardened steel

Besides the use of surface hardening steel, induction hardening is also utilized for bearing raceway surfaces, and for this purpose **mid-carbon steel** is mainly used for its lower carbon content instead of through hardening steel.

Table 13.5 (A-142) shows the chemical composition of the primary materials that are similar to the representative medium carbon steels (machine structural carbon steels) of JIS used for small products. For deep hardened layers required for **larger bearings** and **bearings with large surface dimensions, mid-carbon steel is fortified with chromium and molybdenum**.

6) Other bearing materials

For ultra high speed applications and applications requiring very high level corrosion resistance, ceramic bearing materials such as Si_3N_4 are also available.

13.1.2 Properties and characteristics of bearing Materials

1) Physical and mechanical properties of bearing materials (besides resin)

Table 13.6 and **Table 13.7** (A-143) show physical and mechanical properties of the representative materials used for raceways, rolling elements, and cages.

2) Dimensional change of bearings

Dimensions of bearings used for a long time may change depending on the use condition. This phenomenon is called dimensional change.

<Mechanism of dimensional change>

A standard bearing steel structure contains a small amount of austenite in the matrix of hard martensite. This austenite is partially retained austenite without being transformed into martensite in the cooling process of the bearing steel quenching process, and is called residual austenite.

Since the residual austenite is an unstable structure, it is transformed into a stable structure (martensite) when the bearing is being used. This structure transformation is the cause of the dimensional change of bearings.

Fig. 13.1 shows measured values of dimensional change of a standard bearing held at 120°C over an extended period of time.

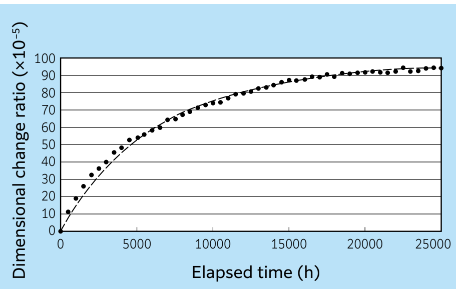


Fig. 13.1 Example of dimensional change rate of standard bearings that are held at 120°C for a long time (measured values)

The dimensional change rate becomes larger as the elapsed time or the temperature of exposure increases.

Depending on the use condition, dimensional change may occur with bearings made of general bearing steel that did not reach 100°C, which is the normal limit.

Bearings that underwent dimension stabilization treatment (TS treatment) have a significantly lower dimensional change. For details, please contact **NTN** Engineering.

<Dimensional change problems and countermeasures>

Among dimensional change, particular attention should be paid to inner ring expansion.
When the inner ring expands by dimensional change, the interference between the inner ring and the shaft decreases, and the bearing may be heavily damaged by creeping or axial movement. Therefore, when a bearing is to be used for a long time, the bearing specifications and fixing method must be determined with the interference decrease due to dimensional change taken into consideration. **For example, the interference can be increased (see section "7. Bearing fits") or fixing in the axial direction can be reinforced (see section "14. Shaft and housing design")**.

<Situations to monitor dimensional change>

The dimensional change of bearings is expressed by the bearing dimension × dimensional change rate. Therefore, under a given temperature and elapsed time, larger bearings show greater dimensional change. Pay particular attention to the amount of dimensional change when large bearings are to be used with fits with small interference.

In addition, dimensional change does not occur during the rotation inspection immediately following bearing installation. It is observed after a long-period operation. Therefore, for machines and parts used for a long time, periodic inspection is effective for preventing problems. For detailed consideration, please consult **NTN** beforehand.

13.2 Cage

Bearing cage materials must have the strength to withstand rotational vibrations and shock loads. These materials must also have a low friction coefficient, be lightweight, and be able to withstand bearing operating temperatures.

13.2.1 Metal materials

For **small** and **medium sized bearings**, pressed steel cages of **cold** or **hot rolled material** with a low carbon content of approx. 0.1% are used. However, depending on the application, **austenitic stainless steel** is also used. Machined cages are generally used for **large bearings**. **Carbon steel for machine structures** or **high-strength cast brass** is frequently used for the cages, but other materials such as **aluminum alloy** are also used. **Table 13.8** and **Table 13.9** (A-143) show the chemical composition of the representative cage materials.

Besides **high-strength brass**, medium carbon **nickel**, **chrome** and **molybdenum steel** that has been hardened and tempered at high temperatures are also used for bearings used in aircraft. The materials are often **plated with silver** to enhance lubrication characteristics.

13.2.2 Resin materials

Recently resin cages are used in place of metals because the material is lightweight and easy to mold into complicated shapes. On the other hand, resins have disadvantages such as lower strength and heat resistance. Therefore, it is important to select resin materials that take advantage of their characteristics. **Table 13.10** (A-144) shows the characteristics of the representative cage resin materials. These materials are rarely used without being filled, and are usually reinforced with glass fiber (GF) or carbon fiber (CF).

[Characteristics of resin materials]

(Advantages)

- Lightweight
- High corrosion resistance
- High self-lubricating performance with less abrasion powder
- Low noise
- Can easily be molded into complicated shapes and various designs
- High productivity

(Disadvantages)

- Lower strength compared with metal
- Lower heat resistance compared with metal
- The strength and elastic modulus largely vary widely with temperature.
- The physical properties (strength) may change when resins are exposed to high temperatures for a long period.
- The strength may deteriorate when resins are exposed to certain types of chemical or oils.
- The thermal expansion coefficient is high, and the dimensional change is larger compared with metal.

<<Polyamide (PA): 66, 46>>

Polyamide is suitable for general cage materials because it is low cost and has high strength, heat resistance, wear resistance, and formability. This material has disadvantages such as high water absorbency, physical property deterioration and dimensional change due to water absorption. On the other hand, water absorption increases flexibility and toughness, enhancing the ease of assembly and shock resistance of cages. However, the physical property (strength) may deteriorate rapidly at high temperatures when polyamide is exposed to lubricating oil containing an S (suflur) type or P (phosphorus) type extreme pressure additive.

Polyamide 66 reinforced with glass fibers is the most used material because it has excellent performance as a cage material.

<<Polyphenylene sulfide (PPS)>>

Polyphenylene sulfide has high heat resistance (continuous operating temperature: 220 to 240°C), chemical resistance, melt fluidity, and formability.

<<Polyetheretherketone (PEEK)>>

Polyetheretherketone has the highest heat resistance among thermoplastic resins (continuous operating temperature: 240 to 260°C). It has excellent self-lubricating performance, shock resistance, and chemical resistance, but it is very expensive. It is mainly used for cages of high-speed bearings for machine tools.

<<Fabric reinforced phenolic resin>>
Phenolic resin is a thermosetting resin. It overcomes the disadvantages of hard and brittle phenolic resin having low shock resistance using fabric reinforcement. It is lightweight and has high lubricity and good mechanical properties. Injection molding cannot be performed because of the thermosetting property, so cages are made by machining. It is mainly used for cages of high-speed angular contact ball bearings for machine tools.

13.3 Rubber seal materials

Synthetic rubbers with high heat resistance and oil resistance are used as materials for seals. Different rubber is used depending on the degree of heat resistance.

Table 13.11 (A-144) shows the representative characteristics of the rubber materials.

<<Nitrile rubber (NBR)>>
Nitrile rubber has high oil resistance, heat resistance, and wear resistance, and is widely used as a general material for seals. The operating temperature range is -20 to 120°C.

<<Acrylic rubber (ACM)>>
Acrylic rubber has high heat resistance and can be used above the application temperature of NBR. It has excellent oil resistance but swells in ester oil. An ester oil resistant grade is also available. The operating temperature range is -15 to 150°C.

<<Fluorinated rubber (FKM)>>
Fluorinated rubber is a rubber material having excellent heat resistance, oil resistance, and chemical resistance. It is deteriorated by amine, so attention needs to be paid when combining fluorinated rubber with urea grease that precipitates amine at high temperatures. The operating temperature range is -30 to 230°C.

13.4 Periphery of bearing (shaft, housing)

Table 13.12 (A-145) and **Table 13.13** (A-145) show physical and mechanical properties of representative materials used for shafts and housings. Heat treatment is applied to bearing materials that are used under large loads. Steel with enhanced bending strength and wear resistance (fretting strength) is used. For such applications, bearing materials (**Table 13.6** and **Table 13.7** on A-143) may also be used as shaft materials.

For housing materials that are used under large loads, heat treatment is applied, and materials with enhanced wear resistance (fretting strength) are used. For lightweight applications, aluminum alloy is widely used.

13.5 NTN bearings with prolonged life

NTN is promoting approaches and research and development from various perspectives with respect to long operating life of bearings. Two examples of approaches for bearing materials and heat treatment, (1) TAB/ETA/EA bearings and (2) FA tapered roller bearings will be introduced in the following sections.

13.5.1 TAB/ETA/EA bearing series

1) Characteristics

(1) Effective for lubrication conditions with foreign matter having high hardness
The main cause of the damage of transmission bearings of automobiles is foreign matter in the lubricating oil. TAB/ETA/EA bearings can be used to prolong the operating life of machines under such contaminated lubricating oil conditions.

(2) High peeling strength
Peeling damage is often caused by deterioration of lubrication conditions during use. The limit life can be prolonged by enhancing the bearing's peeling resistance.

2) Mechanism of prolonged bearing life
Bearing damage is often seen on the raceway surface. By applying heat treatment and selecting appropriate materials, the surface structure has enhanced toughness and improved resilience without impairing the surface hardness. In addition, for tapered roller bearings, crowning is also optimized. These suppress suppresses the occurrence of small cracks that might become the starting point of peeling and damage, prolonging the operating life.

(1) Crack resistance and stress releasing effect
The residual austenite, which is softer than the martensitic parent phase, has an effect of relieving stress concentrations acting on the periphery of the dent formed by foreign matter on the rolling contact surface under lubrication conditions with foreign matter mixed into the oil, thereby suppressing the occurrence of cracks.

As shown in **Fig. 13.2**, all the residual stress on the top surface of the dent part is shifted to the tensile side. The standard heat-treated product of through hardened steel has residual tensile stress. When a specially heat-treated product and a standard heat-treated product are compared, the special heat treated material has less shifting of stresses to the tensile side, which can be harmful, and a stress release action is observed.

(2) Reason for long operating life
ETA and EA bearings have a structure with an appropriate amount of residual austenite and carbide dispersed on the surface region, and the structure is thermally stabilized by the special heat-treatment mentioned above.

The qualities of the material (residual stress, hardness, micro-structure) of a raceway surface generally change due to heat generation and shearing stress action during rolling contact, leading to fatigue cracks. Therefore, improving resistance to temper softening is effective to prevent surface-initiated damage. The residual austenite obtained by ordinary carburizing can suppress generation and progress of cracks and is work-hardened during use (the strength increases). Therefore, by using an appropriate amount of it, the material becomes tough. However, it is unstable against heat. On the other hand, when nitrogen is introduced and diffused under an appropriate condition, a matrix of residual austenite and matensite parent phase that is stable against heat is formed, and the material becomes resilient against quality changes.

3) Supported bearing sizes

Table 13.15

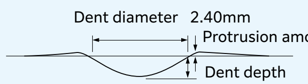
●Deep groove ball series	●Tapered roller series
TAB000 to TAB020	All types that have bearing diameter to be equal to or lower than ϕ600
TAB200 to TAB217	
TAB300 to TAB311	

For other types besides the above, please contact **NTN** Engineering.

Table 13.14 Comparison of dent shapes of each material

Material		Surface hardness [HRC]	Residual austenite amount [%]	Dent diameter [mm]	Dent depth [μm]	Protrusion amount [μm]
Through hardened steel	Standard bearing	62.0	10	2.40	80	5
	TAB bearing	62.0	28	2.45	83	4
Carburizing steel	Standard bearing	61.0	25	2.80	102.5	1
	ETA bearing	62.5	29	2.63	97.5	1

Example of dent shape



(Example of through hardened steel bearing)

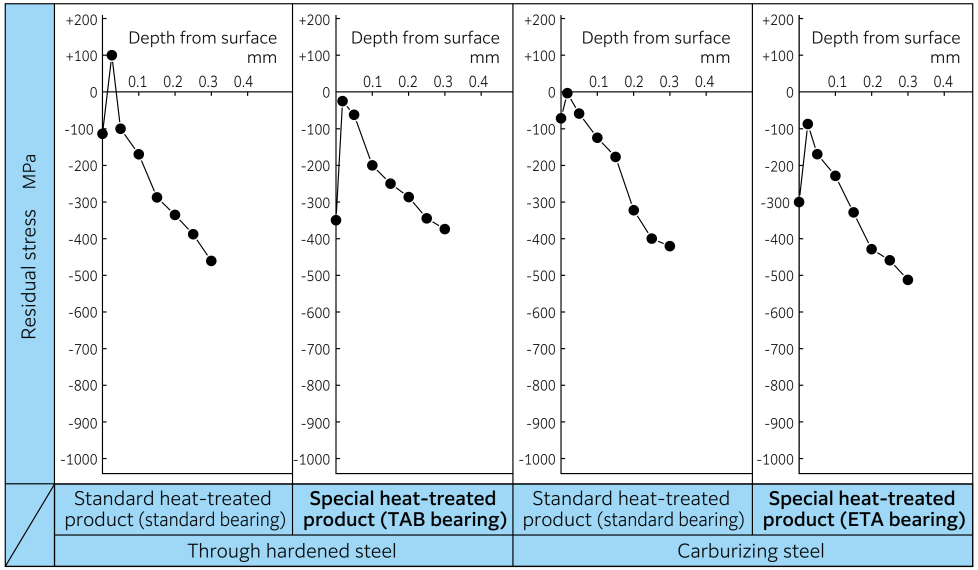


Fig. 13.2 Residual stress within a dent

4) Operating life test

The life test results of a standard bearing, a TAB bearing, and an ETA bearing are shown, but the data is for reference because it varies depending on the type of foreign matter under the contaminated lubricant condition.

(1) Tested bearings and test conditions

Table 13.16 shows tested bearings, and **Table 13.17** and **Table 13.18** shows the test conditions.

(2) Operating life data

Condition of lubricating oil containing foreign matter (reference)

Fig. 13.3 and **Fig. 13.4** show the results of tests conducted under lubrication conditions mixed with **NTN** standard foreign matter.

Table 13.16 Tested bearings

Bearing name	Boundary dimensions (mm)
Standard 6206	$\phi30 \times \phi62 \times 16$
TAB bearing TAB206	↑
Standard 30206	$\phi30 \times \phi62 \times 17.25$
ETA bearing ETA-30206	↑

Table 13.17 Test condition (6206, TAB206)

Radial load (kN)	6.9
Rotational speed (mm^{-1})	2 000
Lubricating oil	Turbine 56 + **NTN** standard foreign matter
Lubrication method	Oil bath

Table 13.18 Test condition (30206, ETA-30206)

Radial load (kN)	17.64
Rotational speed (mm^{-1})	2 000
Lubricating oil	Turbine 56 + **NTN** standard foreign matter
Lubrication method	Oil bath

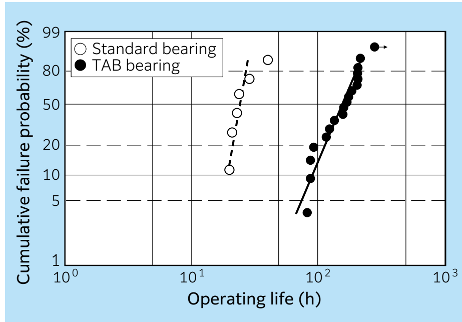


Fig. 13.3 Operating life comparison between TAB deep groove bearing and standard bearing (mixed with foreign matter)

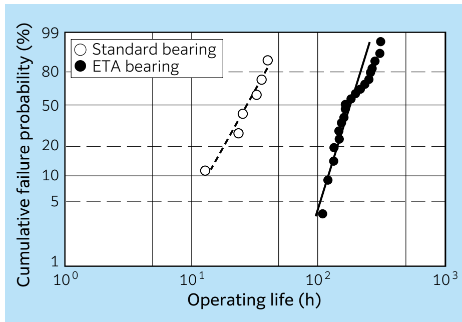


Fig. 13.4 Operating life comparison between ETA tapered roller bearing and standard bearing (mixed with foreign matter)

13.5.2 FA tapered roller bearings

NTN developed special heat treatment (FA treatment) for refining crystal grains of bearing steel to half or less the size of the conventional ones by focusing on refining strengthening of crystal grains. (See **Fig. 13.5**) **NTN** adopted this technique for "FA tapered roller bearings," thereby improving the indentation resistance and realizing long operating life under the lubrication conditions including foreign matter. Further, by combining optimization techniques for the internal bearing design acquired during development of the ECO-Top series, the seizure resistance is improved and the bearing size can be greatly reduced.

Remarks: FA is an abbreviation of fine austenite strengthening treatment.

FA treatment (Fine Austenite Strengthening)

- Longer operating life is realized by crystal grain refinement of bearing steel.
- The crystal grains of bearing steel are refined to half or less the size of the conventional ones.

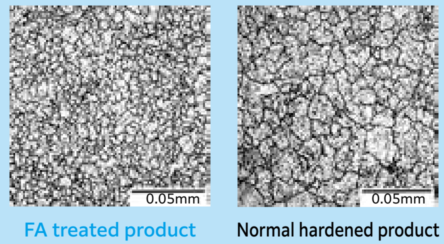


Fig. 13.5 Former austenite crystal grain boundary

1) Longer operating life

- Rolling fatigue life is improved by crystal grain refinement.
- The residual austenite amount is optimized by carbonitriding, and resistance to surface-initiated damage caused by rolling over foreign matter is improved by the crystal grain refinement technique.

- Special crowning that is designed to obtain optimum surface pressure distribution under light to heavy load conditions is adopted.

Thus, the operating life under the lubrication condition including oil types and foreign matter close to the actual machine was greatly extended compared with the standard product.

2) Optimum oil film formation design

The rib area of a tapered roller bearing has sliding contact, and the quality of the oil film forming capability of this area greatly affects the bearing performance.

In the FA tapered roller bearing, the oil film forming capability of the rib area is improved by optimization techniques involving parameters such as the shape, accuracy, and roughness of the contact area of the flange and the roller acquired during ECO-Top bearing development. Thus, the rotational torque is reduced, and the seizure resistance and the preload loss resistance are improved.

3) Seating of assembly width

When a tapered roller bearing is to be used under preload, it is necessary to give sufficient stable rotation to the bearing and bring the bearing into a proper state in which the roller end surface and the inner ring rib surface are brought into contact with each other.

The smaller the number of stable rotations, the more reliably the preload setting can be achieved, and the assembly work becomes more efficient.

With FA tapered roller bearings, preload can reliably be set in a short time by the optimization of the internal bearing design. For example, it may become possible to stop applying gear oil to help achieve early stabilization. The roller becomes stable at a rotation speed equal to that of a conventional bearing by using only rust preventative oil.

4) Improvement in indentation resistance

To make bearings smaller, it is necessary to improve the indentation resistance to prevent safety factor decrease caused by a decrease of the static load rating.

Regarding FA tapered roller bearings, the indentation depth is less than one ten-thousandth of the rolling element diameter even under the static load with a safety factor (S_0) = 0.6.

5) Test data

(1) Operating life

(Condition of linear contact type operating life test)

Test machine : **NTN** linear contact life test machine
Test piece : ϕ12 × L12, R480
The other test piece : ϕ20 Roller(SUJ2)
Load (kN) : 13.74
Contact stress (Mpa) : 4 155 (P_{max})
Lubricating oil : Turbine oil 68

Table 13.19 Result of operating life test under clean lubricating oil condition (Result of comparison test with linear contact type test piece)

Heat treatment method	L_{10} operating life, × 10^4 cycles	L_{10} life ratio
4Top	1 523	1.0
ECO-Top(ETA)	3 140	2.1
FA	4 290	2.8

*L_{10} life ratio is the comparison when 4Top is 1.0.

(Condition of bearing operating life test)

Test machine : **NTN** life test machine
Tested bearings : (1)30206
: (2)30306D
Test load : (1)F_r = 17.64kN, F_a = 1.47kN
: (1)F_r = 19.6kN, F_a = 13.72kN
Rotational speed : 2 000min^{-1}
Lubrication : (1)Turbine oil 56 oil bath (30 ml)
: (2)ATF oil bath (50 ml)
Foreign matter : (1)50μm or below : 90wt%, 100～180μm : 10wt% } 1.0g/l
: (2)50μm or below : 75wt%, 100～180μm : 25wt% } 0.2g/l
Calculated operating life : (1)169h (No foreign matter)
: (2)171h (No foreign matter)

Table 13.20 Result of operating life test under lubrication condition including foreign matter (Result of comparison test by bearings)

Test condition		4Top	ECO-Top(ETA)	FA
Condition (1)	L_{10} operating life (h)	52.4	314.9	415.6
	L_{10} life ratio	1.0	6.0	7.9
Condition (2)	L_{10} operating life (h)	22.5	—	309.7
	L_{10} life ratio	1.0	—	13.8

*L_{10} life ratio is the comparison when 4Top is 1.0.

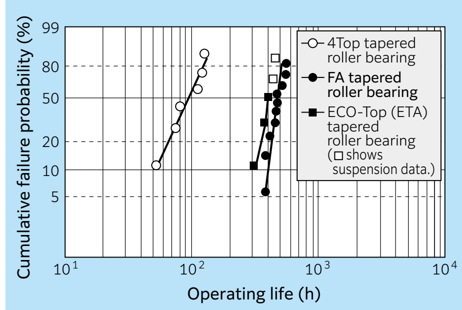


Fig. 13.6 Condition (1) 30206 operating life test result (lubrication condition including foreign matter)

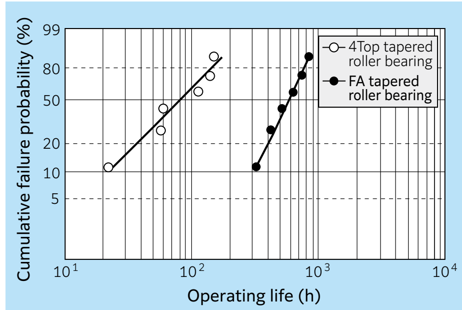


Fig. 13.7 Condition (2) 30306D operating life test result (lubrication condition including foreign matter)

(2) Rotational torque

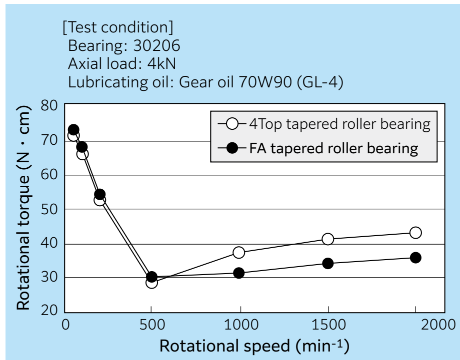


Fig. 13.8 Result of rotational torque measurement

(3) Seizure resistance

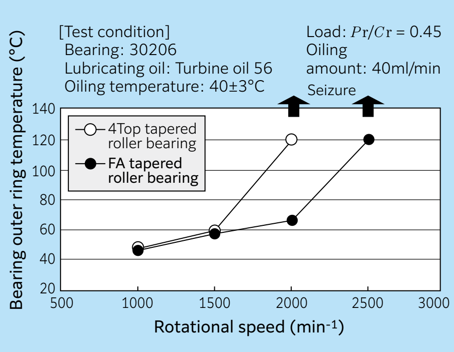


Fig. 13.9 Results of temperature rise test

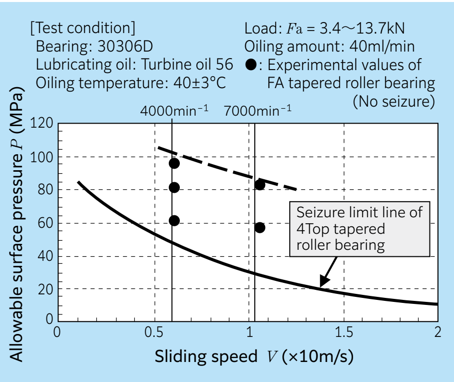


Fig. 13.10 Results of PV limit test

(4) Preload release resistance

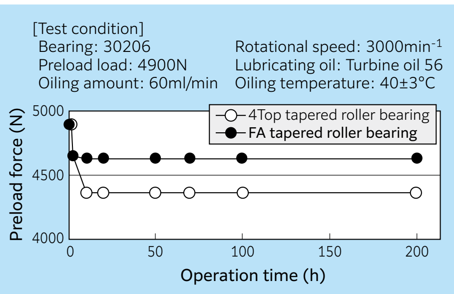


Fig. 13.11 Results of preload release test

(5) Seating of assembly width

Bearing : 30206
Axial load : 29.4N
Test method : A bearing is placed in the configuration shown in the figure, and an axial load (weight) is applied to rotate the inner ring. The drop amount of the inner ring for each rotation is measured to obtain the rotational speed until it is stable.

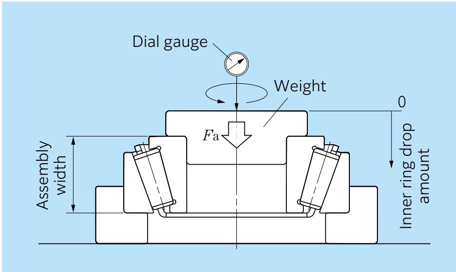


Fig. 13.12 Measurement method of revolutions to seated bearing width

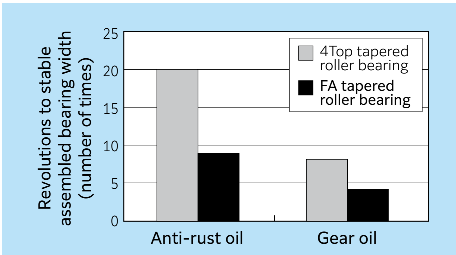


Fig. 13.13 Measurement result of revolutions to seated bearing width

(6) Indentation resistance

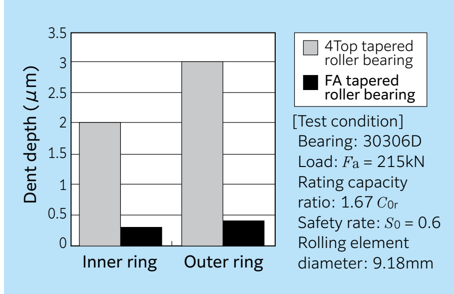


Fig. 13.14 Measurement result of dent depth

6) Downsizing with FA tapered roller bearing

Improvement in the bearing life, seizure resistance, and indentation resistance strength allows the compact ratio below by adopting an FA tapered roller bearing (**Fig. 13.15**).

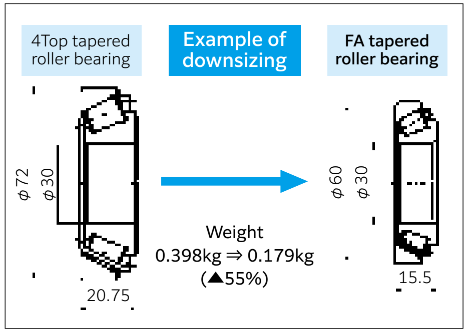


Fig. 13.15 Example of compact ratio

7) Supported bearing size

The target bearings are bearings with an outer diameter of ϕ145 or below. Contact **NTN** Engineering for details.

13.6 Bearing fatigue analysis technique

In a region subjected to plastic deformation due to rolling fatigue, various X-ray analysis parameters obtained by X-ray stress measurements (residual stress, diffraction half-value with, and residual ausentite) may be observed. There is a technique that estimates the degree of progress of rolling fatigue (degree of fatigue) based on the X-ray stress measurement result using this characteristic (**Fig. 13.16**). Since the mid-1980s, **NTN** has been investigating the relationship between the X-ray analysis value (fatigue degree in **Fig. 13.16**) and the life ratio (a value expressed by the percentage of the operating time in which peeling occurred is 100%) for surface-initiated damage (peeling and early peeling starting from dents), which has been frequently observed in the field. Since the relationship changes depending on various rolling conditions (combination of surface roughness, load, and lubrication condition), the values are used for reference; however, the remaining operating life can be estimated by using this relationship diagram.

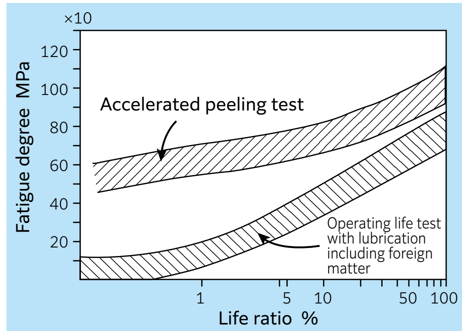


Fig. 13.16 Relationship between degree of fatigue and life ratio

Recently, fatigue degree estimation is being studied using variation in X-ray diffraction ring peak intensity with high sensitivity even in the latter stage of fatigue.

Table 13.1 Chemical composition of representative high carbon chrome bearing steels

Country name	Standard name	Code	Main chemical composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Equivalent/ approximate steel of JIS
Japan	JIS G 4805 (2008)	SUJ2	0.95~1.10	0.15~0.35	≦0.50	≦0.025	≦0.025	≦0.25	1.30~1.60	≦0.08	
		SUJ3	0.95~1.10	0.40~0.70	0.90~1.15	≦0.025	≦0.025	≦0.25	0.90~1.20	≦0.08	
		SUJ4	0.95~1.10	0.15~0.35	≦0.50	≦0.025	≦0.025	≦0.25	1.30~1.60	0.10~0.25	
		SUJ5	0.95~1.10	0.40~0.70	0.90~1.15	≦0.025	≦0.025	≦0.25	0.90~1.20	0.10~0.25	
USA	ASTM A1040 (2010)	50100	0.98~1.10	0.15~0.35	0.25~0.45	≦0.025	≦0.025	≦0.25	0.4~0.6	≦0.10	
		51100	0.98~1.10	0.15~0.35	0.25~0.45	≦0.025	≦0.025	≦0.25	0.90~1.15	≦0.10	
	ASTM A295/295M (2014) AISI A295/295M (2014) SAE AMS 6440S (2015)	52100	0.93~1.05	0.15~0.35	0.25~0.45	≦0.025	≦0.015	≦0.25	1.35~1.60	≦0.10	SUJ2
	ASTM A485 (2014)	A485 Grade1	0.90~1.05	0.45~0.75	0.90~1.20	≦0.025	≦0.015	≦0.25	0.90~1.20	≦0.10	SUJ3
France/ Germany	NF EN ISO 683-17 (2014) · DIN EN ISO 683-17 (2014)	100Cr6	0.93~1.05	0.15~0.35	0.25~0.45	≦0.025	≦0.015	—	1.35~1.60	≦0.10	SUJ2
		100CrMnSi4-4	0.93~1.05	0.45~0.75	0.90~1.20	≦0.025	≦0.015	—	0.9~1.20	≦0.10	SUJ3
		100CrMnSi6-4	0.93~1.05	0.45~0.75	1.00~1.20	≦0.025	≦0.015	—	1.40~1.65	≦0.10	
		100CrMo7	0.93~1.05	0.15~0.45	0.25~0.45	≦0.025	≦0.015	—	1.65~1.95	0.15~0.30	
		100CrMo7-3	0.93~1.05	0.15~0.45	0.60~0.80	≦0.025	≦0.015	—	1.65~1.95	0.20~0.35	
		100CrMnMoSi8-4-6	0.93~1.05	0.40~0.60	0.80~1.10	≦0.025	≦0.015	—	1.80~2.05	0.50~0.60	
Germany	DIN	105Cr4	1.00~1.10	0.15~0.35	0.25~0.40	≦0.030	≦0.025	—	0.90~1.15	—	
China	GB/T 18254 (2002)	GCr4	0.95~1.05	0.15~0.30	0.15~0.30	≦0.025	≦0.020	≦0.25	0.35~0.50	≦0.08	
		GCr15	0.95~1.05	0.15~0.35	0.25~0.45	≦0.025	≦0.025	≦0.30	1.40~1.65	≦0.10	SUJ2
		GCr15SiMn	0.95~1.05	0.45~0.75	0.95~1.25	≦0.025	≦0.025	≦0.30	1.40~1.65	≦0.10	
		GCr15SiMo	0.95~1.10	0.65~0.85	0.20~0.40	≦0.027	≦0.020	≦0.30	1.40~1.70	0.30~0.40	
		GCr18Mo	0.95~1.05	0.20~0.40	0.25~0.40	≦0.025	≦0.020	≦0.25	1.65~1.95	0.15~0.25	

Table 13.2 Comparison table of main material components of each country (carburizing steel)

Country name	Standard name	Code	Main chemical composition (%) C	Si	Mn	P	S	Ni	Cr	Mo	Equivalent/ approximate steel of JIS
Japan	JIS G 4053 (2016)	SCr420	0.18~0.23	0.15~0.35	0.60~0.90	≦0.030	≦0.030	≦0.25	0.90~1.20	—	
		SCr435	0.33~0.38	0.15~0.35	0.60~0.90	≦0.030	≦0.030	≦0.25	0.90~1.20	—	
		SCM420	0.18~0.23	0.15~0.35	0.60~0.90	≦0.030	≦0.030	≦0.25	0.90~1.20	0.15~0.25	
		SCM435	0.33~0.38	0.15~0.35	0.60~0.90	≦0.030	≦0.030	≦0.25	0.90~1.20	0.15~0.30	
		SNCM420	0.17~0.23	0.15~0.35	0.40~0.70	≦0.030	≦0.030	1.60~2.00	0.40~0.60	0.15~0.30	
		SNCM815	0.12~0.18	0.15~0.35	0.30~0.60	≦0.030	≦0.030	4.00~4.50	0.70~1.00	0.15~0.30	
USA	AISI A29/29M (2015) SAE J404 (2009)	5120	0.17~0.22	0.15~0.35	0.70~0.90	≦0.035	≦0.040	≦0.25	0.70~0.90	≦0.06	SCr420
		4118	0.18~0.23	0.15~0.35	0.70~0.90	≦0.035	≦0.040	≦0.25	0.40~0.60	0.08~0.15	SCM420
		4135	0.33~0.38	0.15~0.35	0.70~0.90	≦0.035	≦0.040	≦0.25	0.80~1.10	0.15~0.25	SCM435
		4320	0.17~0.22	0.15~0.35	0.45~0.65	≦0.035	≦0.040	1.65~2.00	0.40~0.60	0.20~0.30	SNCM420
		8620	0.17~0.22	0.15~0.35	0.70~0.90	≦0.035	≦0.040	0.40~0.60	0.40~0.60	0.15~0.25	SNCM220
	AISI A29/29M(2015)	5135	0.33~0.38	0.15~0.35	0.60~0.80	≦0.035	≦0.040	≦0.25	0.80~1.05	≦0.06	SCr435
	AISI SAE AMS 6263M (2016)	9315	0.11~0.17	0.15~0.35	0.40~0.70	≦0.025	≦0.025	3.00~3.50	1.00~1.40	0.08~0.15	SNCM815
France/ Germany	NF EN ISO 683-17 (2014) · DIN EN ISO 683-17 (2014)	20Cr4	0.17~0.23	≦0.40	0.60~0.90	≦0.025	≦0.015	—	0.90~1.20	—	SCr420
		20CrMo4	0.17~0.23	≦0.40	0.60~0.90	≦0.025	≦0.015	—	0.90~1.20	0.15~0.25	SCM420
		20NiCrMo7	0.17~0.23	≦0.40	0.40~0.70	≦0.025	≦0.015	1.60~2.00	0.35~0.65	0.20~0.30	
		18NiCrMo14-6	0.15~0.20	≦0.40	0.40~0.70	≦0.025	≦0.015	3.25~3.75	1.30~1.60	0.15~0.25	
	NF EN 10084(2008) · DIN EN 10084(2008)	17NiCrMo6-4	0.14~0.20	≦0.40	0.60~0.90	≦0.025	≦0.035	1.20~1.50	0.8~1.10	0.15~0.25	
	NF EN 10083-1 (1996) · DIN EN 10083-1 (1996)	37Cr4	0.34~0.41	≦0.40	0.60~0.90	≦0.035	≦0.035	—	0.90~1.20	—	SCr435
		25CrMo4	0.22~0.29	≦0.40	0.60~0.90	≦0.035	≦0.035	—	0.90~1.20	0.15~0.30	SCM420
		34CrMo4	0.30~0.37	≦0.40	0.60~0.90	≦0.035	≦0.035	—	0.90~1.20	0.15~0.30	SCM435
China	GB/T 3203 (1982)	G20CrMo	0.17~0.23	0.20~0.35	0.65~0.95	≦0.030	≦0.030	—	0.35~0.65	0.08~0.15	
		G20CrNiMo	0.17~0.23	0.15~0.40	0.60~0.90	≦0.030	≦0.030	0.40~0.70	0.35~0.65	0.15~0.30	
		G20CrNi2Mo	0.17~0.23	0.15~0.40	0.40~0.70	≦0.030	≦0.030	1.60~2.00	0.35~0.65	0.20~0.30	SNCM420
		G20Cr2Ni4	0.17~0.23	0.15~0.40	0.30~0.60	≦0.030	≦0.030	3.25~3.75	1.25~1.75	—	
		G10CrNi3Mo	0.08~0.13	0.15~0.40	0.40~0.70	≦0.030	≦0.030	3.00~3.50	1.00~1.40	0.08~0.15	
		G20Cr2Mn2Mo	0.17~0.23	0.15~0.40	1.30~1.60	≦0.030	≦0.030	≦0.30	1.70~2.00	0.20~0.30	

Table 13.3 Chemical composition of high-speed steel

Standard		Chemical composition (%)											
		C	Si	Mn	P	S	Cr	Mo	V	Ni	Cu	Co	W
AMS	6491 (M50)	0.77 to 0.85	Max. 0.25	Max. 0.35	Max. 0.015	Max. 0.015	3.75 to 4.25	4.00 to 4.50	0.90 to 1.10	Max. 0.15	Max. 0.10	Max. 0.25	Max. 0.25
	5626	0.65 to 0.80	0.20 to 0.40	0.20 to 0.40	Max. 0.030	Max. 0.030	3.75 to 4.50	Max. 1.00	0.90 to 1.30	—	—	—	17.25 to 18.25
	2315 (M50NiL)	0.11 to 0.15	0.10 to 0.25	0.15 to 0.35	Max. 0.015	Max. 0.010	4.00 to 4.25	4.00 to 4.50	1.13 to 1.33	3.20 to 3.60	Max. 0.10	Max. 0.25	Max. 0.25

Table 13.4 Chemical composition of stainless steel

Standard	Code	Chemical composition (%)						
		C	Si	Mn	P	S	Cr	Mo
JIS G 4303	SUS440C	0.95 to 1.20	Max. 1.00	Max. 1.00	Max. 0.040	Max. 0.030	16.00 to 18.00	Max. 0.75
AISI	440C	0.95 to 1.20	Max. 1.00	Max. 1.00	Max. 0.040	Max. 0.030	16.00 to 18.00	Max. 0.75

Table 13.5 Comparison table of main material components of each country (machine structural carbon steel)

Country name	Standard name	Code	Main chemical composition (%)								Equivalent/approximate steel of JIS
			C	Si	Mn	P	S	Ni	Cr	Mo	
Japan	JIS G 4051 (2016)	S45C	0.42 ~0.48	0.15 ~0.35	0.60 ~0.90	≦0.030	≦0.035	≦0.20	≦0.20	—	
		S53C	0.50 ~0.56	0.15 ~0.35	0.60 ~0.90	≦0.030	≦0.035	≦0.20	≦0.20	—	
		S55C	0.52 ~0.58	0.15 ~0.35	0.60 ~0.90	≦0.030	≦0.035	≦0.20	≦0.20	—	
USA	AISI A29/29M (2015) SAE J403 (2014)	1045	0.43 ~0.50	—	0.60 ~0.90	≦0.040	≦0.050	—	—	—	S45C
		1046	0.43 ~0.50	—	0.70 ~1.00	≦0.040	≦0.050	—	—	—	S45C
		1050	0.48 ~0.53	—	0.60 ~0.90	≦0.040	≦0.050	—	—	—	S50C
		1053	0.48 ~0.55	—	0.70 ~1.00	≦0.040	≦0.050	—	—	—	S53C
		1055	0.50 ~0.60	—	0.60 ~0.90	≦0.040	≦0.050	—	—	—	S55C
France/Germany	NF EN 10083-1,2 (2006) · DIN EN 10083-1,2 (2006)	C45	0.42 ~0.50	≦0.40	0.50 ~0.80	≦0.045	≦0.045	≦0.40	≦0.40	≦0.10	S45C
		C45E	0.42 ~0.50	≦0.40	0.50 ~0.80	≦0.035	≦0.035	≦0.40	≦0.40	≦0.10	S45C
		C45R	0.42 ~0.50	≦0.40	0.50 ~0.80	≦0.035	0.02 ~0.04	≦0.40	≦0.40	≦0.10	S45C
		C55	0.52 ~0.60	≦0.40	0.60 ~0.90	≦0.045	≦0.045	≦0.40	≦0.40	≦0.10	S55C
		C55E	0.52 ~0.60	≦0.40	0.60 ~0.90	≦0.03	≦0.035	≦0.40	≦0.40	≦0.10	S55C
		C55R	0.52 ~0.60	≦0.40	0.60 ~0.90	≦0.03	0.02 ~0.04	≦0.40	≦0.40	≦0.10	S55C
China	GB/T 24595 (2009)	45	0.42 ~0.50	0.17 ~0.37	0.50 ~0.80	≦0.025	≦0.025	≦0.30	≦0.25	≦0.10	S45C
	GB/T 699 (2015)	50Mn	0.48 ~0.56	0.17 ~0.37	0.70 ~1.00	≦0.035	≦0.035	≦0.30	≦0.25	—	S53C
		55	0.52 ~0.60	0.17 ~0.37	0.50 ~0.80	≦0.035	≦0.035	≦0.30	≦0.25	—	S55C

Table 13.6 Physical property values of bearing materials

Steel type	Density ρ (g/cm³)	Longitudinal elasticity factor E(GPa)	Linear expansion coefficient (×10⁻⁶/°C)	Thermal conductivity (W/m·°C)	Specific heat (J/kg·°C)	Remarks
SUJ2	7.83	208	12.5	46	468	Quenching and tempering
SCr420	7.84	208	12.6	47	(470)	Quenching and tempering
SCM420	7.85	208	12.5	45	(470)	Quenching and tempering
SNCM420	7.85	208	12.0	44	(470)	Quenching and tempering
M50	7.85	210	11.4	25.0	460	Quenching and tempering
SUS440C	7.75	205	10.6	24.2	460	Quenching and tempering
SPCC	7.86	206	11.5	59	470	Annealing (not hard)
SUS304	7.93	193	17.3	16.3	500	Annealing
Chrome steel	7.84	206	11.2	42～50	465	0.09～0.25C, 0.55～1.5Cr
Special extra-mild steel	7.86	209	11.6	58.2	473	C<0.08
Extra-mild steel	7.86	206	11.4	58.7	475	0.08～0.12C
Mild steel	7.86	207	11.2	55.2	477	0.12～0.2C
Semi-hard steel	7.85	207	10.8	46.5	485	0.3～0.45C
Hard steel	7.84	205	10.7	44.1	489	0.4～0.5C
High carbon steel	7.82	201	10.2	40.1	510	0.8～1.6C
Mid carbon steel	7.8	202	10.7	38	460	0.5C
Silicon nitride	3.24	308	3.0	20	680	Si_3N_4
Six-four brass	8.4～8.8	103～105	18.4～20.8	81～121	377～381	(Equivalent to CAC301)

Note: ( ) indicates reference values.

Table 13.7 Mechanical property values of bearing materials

Steel type	Hardness (HV)	Yield point (MPa)	Tensile strength (MPa)	Elongation (%)	Reduction of area (%)	Charpy impact value (J/cm²)	Remarks
SUJ2	700～750	(≧1176)	(≧1617)	≦0.5	—	(5～8)	Quenching and tempering
SCr420	250～340	—	≧830	≧14	≧35	≧49	Quenching and tempering
SCM420	275～370	(≧700)	≧930	≧14	≧40	≧59	Quenching and tempering
SNCM420	310～395	—	≧980	≧15	≧40	≧69	Quenching and tempering
SNCM815	330～395	—	≧1050	≧12	≧40	≧69	Quenching and tempering
SPCE	≦100	—	≧270	≧32～43	—	—	Annealing
SUS304	≦195	Proof stress≧206	≧520	≧40	≧60	—	Annealing
S10C	115～160	≧206	≧314	≧33	—	—	900°C furnace cooling
S25C	130～190	≧265	≧411	≧27	—	—	850°C furnace cooling
S45C	175～240	≧343	≧569	≧20	—	—	Quenching and high-temperature tempering
S53C	190～270	≧392	≧647	≧15	—	—	Quenching and high-temperature tempering
Silicon nitride	1500	—	Bending≧300	—	—	—	Si_3N_4
Six-four brass	100～150	—	≧430	≧20	—	—	(Equivalent to CAC301)

Note: Mechanical properties are largely influenced by the sample size. ( ) indicates reference values, and - indicates unknown values.

Table 13.8 Chemical composition of steel plate for pressed cages and carbon steel for machined cages

	Standard	Code	Chemical composition (%)						
			C	Si	Mn	P	S	Ni	Cr
Pressed steel cage	JIS G 3141	SPCC	—	—	—	—	—	—	—
	JIS G 3131	SPHC	—	—	—	Max. 0.050	Max. 0.050	—	—
	BAS 361	SPB2	0.13～0.20	Max. 0.04	0.25～0.60	Max. 0.030	Max. 0.030	—	—
	JIS G 4305	SUS304	Max. 0.08	Max. 1.00	Max.2.00	Max. 0.045	Max. 0.030	8.00～10.50	18.00～20.00
Machined cage	JIS G 4051	S25C	0.22～0.28	0.15～0.35	0.30～0.60	Max. 0.030	Max. 0.035	—	—

Table 13.9 Chemical composition of high-strength cast brass for machined cages

Standard	Code	Chemical composition (%)							Impurities	
		Cu	Zn	Mn	Fe	Al	Sn	Ni	Pb	Si
JIS H 5120	CAC301	55.0 to 60.0	33.0 to 42.0	0.1 to 1.5	0.5 to 1.5	0.5 to 1.5	Max. 1.0	Max. 1.0	Max. 0.4	Max. 0.1

Table 13.10 Representative characteristics of resins used for cages

		Polyamide		Polyphenylene sulfide	Polyetheretherketone	Fabric-reinforced phenolic resin
		66	46	PPS	PEEK	
Type		Crystalline thermoplastics	←	←	←	Thermosetting resin
Melting point °C		265	295	285	343	—
Glassy-transition temperature °C		66	78	88	143	—
Maximum continuous operating temperature°C		120	150	230	260	—
Price 1 (low) to 5 (high)		1	2	3	5	4
Characteristics	Formability	◎	○	○	○	×
	Toughness	◎	◎	△	○	○ to △
	Strength	○	○	○	◎	△
	Oil resistance	○ to △	○ to △	◎	◎	○
	Moisture/water absorption	Large	Large	Slight	Slight	Small
Comprehensive evaluation		The property is generally stable.	The formability is slightly poor compared with polyamide 66, but the heat resistance is high.	The water absorbency is low, and the oil resistance and heat resistance are high.	Polyetheretherketone has properties necessary for cages but is expensive.	The lubricity is high, but complicated shapes cannot be machined.
Applications		All-purpose	Temperature higher than polyamide 66	Applications that require oil resistance and heat resistance higher than polyamide	High-speed bearings for high-temperature and high-speed machine tools	High-speed angular contact ball bearings for machine tools

Note: ◎ Excellen ○ Good △ OK × Poor

Table 13.11 Representative characteristics of rubber materials used for seals

Rubber type		Nitrile rubber	Acrylic rubber	Fluorinated rubber
Abbreviation		NBR	ACM	FKM
Characteristics	Elongation	○	○	△
	Compression set	◎	×	○
	Wear resistance	◎	○	◎
	Aging resistance	○	◎	◎
	Weather and ozone resistance	△	◎	◎
	Water resistance	◎	△	◎
	Operating temperature range °C	−20 to 140	−15 to 150	−30 to 230
Comprehensive evaluation		The oil resistance, heat resistance, and wear resistance are high. It is widely used as rubber seals.	It is used at application temperature higher than that of NBR. It is easily swollen in ester oil. An ester-oil resistant grade is also available.	It is expensive. It has excellent heat resistance and chemical resistance but easily affected by urea grease.

Bearing Materials

NTN

Commentary

Table 13.12 Physical properties of shaft and housing materials

Parts	Material	Density ρ (g/cm^3)	Hardness (HV)	Longitudinal elasticity factor E(GPa)	Linear expansion coefficient ($\times 10^{-6}$/°C)	Thermal conductivity (W/m·°C)	Specific heat (J/kg·°C)	Remarks
Shaft	S25C	7.86	130	212	11.1	53	470	Annealing
	S45C	7.85	230	205	(11.9)	(41)	460	Thermal refining
	SS400	7.86	—	205	11.3	50	460	
	SCM415	7.85	300	200	11.0	42	460	Thermal refining
	SCM425	7.85	320	208	12.8	45	470	Thermal refining
	SCM440	7.85	340	205	12.0	41	460	Thermal refining
	SNCM439	7.85	340	208	12.0	44	470	Thermal refining
Housing	FC200	7.2	≧240	100	10～11	43	530	Gray cast iron
	FC250	7.3	≧250	100	10～11	41	530	
	FCD450	7.2	150～220	154	12.0	34	620	Spherical graphite cast iron
	FCD500	7.2	160～240	154	11.0	30	—	
	FCD700	7.2	190～320	154	10.0	26	—	
	ADC12	2.7	(HRB54)	71	21.0	96	(900)	Al-Si-Cu alloy
	SUS304	8.0	≦200	197	17.3	16	500	Austenitic stainless steel
	SUS410	7.8	≧170	204	10.8	(25)	460	Martensitic stainless steel
	SUS410L	7.8	(200)	204	10.8	(25)	—	Ferritic stainless steel

Note: Inequality signs indicate standard values. ( ) indicates reference values.

Table 13.13 Mechanical properties of shaft and housing materials

Parts	Material	Hardness (HV)	Yield point (MPa)	Tensile strength (MPa)	Elongation (%)	Remarks
Shaft	S25C	180	≧270	≧440	≧27	Normalizing
	S45C	240	≧345	≧570	≧20	Normalizing
	SS400	—	(215)	≧400	≧17	Structural rolled steel
	SCM425	320	670	800	15	Thermal refining
	SCM440	340	835	980	17	Thermal refining
	SNCM439	340	900	980	18	Thermal refining
Housing	FC200	≦235	—	≧200	—	Separate casting sample Gray cast iron
	FC250	≦250	—	≧250	—	
	FCD350-22	≦160	≧220	≧350	≧22	Spherical graphite cast iron Separate casting sample
	FCD450-10	150～220	≧250	≧450	≧10	
	FCD500-7	160～240	≧320	≧500	≧7	
	FCD700-2	190～320	≧420	≧700	≧2	
	ADC12	(HRB54)	150	310	3.5	Al-Si-Cu alloy
	SUS304	≦200	(205)	(520)	≧40	Austenitic stainless steel
	SUS410	≧170	(345)	(540)	≧25	Martensitic stainless steel
	SUS410L	≦200	(195)	(400)	≧20	Ferritic stainless steel

Note: Inequality signs indicate standard values. ( ) indicates reference values.

14. Shaft and housing design

Depending upon the design of a shaft or housing, the shaft may be influenced by an unbalanced load or other factors which can then cause large fluctuations in bearing efficiency. For example, depending on the dimensional accuracy and shape accuracy of the shaft and housing, there could be insufficient interference fit with the bearing, leading to material creep during operation. When the machining accuracy of the shaft or the housing is insufficient or when there is an error in the installation, the inner ring or the outer ring of the bearing can become misaligned. Operation under this condition may cause excessive loading at the edges of the inner and outer rings as well as rolling elements, deteriorating the fatigue life. Furthermore, chipping damage may occur on the flange face of roller bearings due to heavy contact with the rolling element end surface while operating under misalignment. A speed deferential between the rolling elements and cage may apply abnormal force to the cage, causing damage. For this reason, it is necessary to pay attention to the following when designing shaft and housing:

(1) Bearing arrangement; most effective fixing method for bearing arrangement.
(2) Selection of shoulder height and fillet radius of housing and shaft.
(3) Shape precision and fitting dimensions; runout tolerance of shoulder area.
(4) Machining precision and mounting error of housing and shaft suitable for allowable alignment angle and permissible misalignment of bearing.

When the housing rigidity is insufficient, excessive deformation of the inner and outer rings may lead to poor distribution of loading among rolling elements, causing abnormal noise and deterioration of fatigue life. Therefore, the housing requires sufficient rigidity.

When two or more bearings are to be attached to a shaft, one typically serves as a fixed end bearing and the other serves as a floating end bearing to compensate for axial mounting error and allow for thermal expansion. In addition, when two or more bearings are to be attached to a housing, the design must allow through hole machining to improve the accuracy of the housing.

14.1 Fixing of bearings

When a bearing that receives axial loads and preloads is to be attached to a shaft or a housing, an axial fixing method that is sufficient to withstand the axial loading such as a tightening nut, bolts, or snap rings should be selected because a serious problem may be caused when the raceway moves in the axial direction.

In addition, solid type needle roller bearings (with inner ring) and cylindrical roller bearings (NU and N types) that are to be mainly used as floating side bearings also need to be fixed in the axial direction because the raceway may move in the axial direction when the shaft is bent by a moment load, damaging the bearing.

Table 14.1 shows general bearing fixing methods, and **Table 14.2** shows fixing methods for bearings with tapered bores. See section "15. Bearing handling" for more information about bearing installation and removal.

Table 14.1 General bearing fixing methods

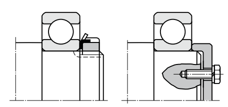
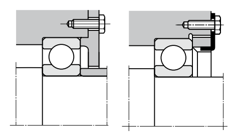
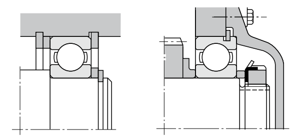
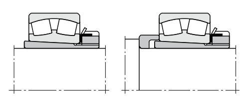
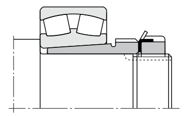
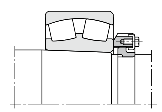
Inner ring clamp	Outer ring clamp	Snap ring
		
The most common method of fixing bearings in place is to use clamping nuts or bolts to hold the shaft or housing abutment against the ring end face. The tightening nuts and bolts must be fixed so that they will not be loosened by axial loads or vibration when the bearing is being used.		Use of snap rings regulated under JIS B 2804, B 2805, and B 2806, makes for a very simple construction. However, interference with chamfers, bearing installation dimensions, and other related specifications must be considered carefully. Snap rings are not suitable for applications requiring high accuracy or where the snap ring receives large axial loads.

Table 14.2 Fixing methods–bearings with tapered bores

Adapter sleeve mounting	Withdrawal sleeve mounting	Split ring mounting
		
When installing bearings on cylindrical shafts, adapter sleeves or withdrawal sleeves can be used to fix bearings in place axially. The adapter sleeve is fastened in place by frictional force between the shaft and inner diameter of the sleeve.		For installation of tapered bore bearings directly on tapered shafts, the bearing is held in place by a split ring inserted into a groove on the shaft, and is fixed in place with a split ring nut or screw.

14.2 Bearing fitting dimensions

14.2.1 Abutment height and fillet radius

The shaft and housing **abutment height** (h) should be **larger than the bearings' maximum allowable chamfer dimensions** ($r_{s\ max}$), such that the abutment directly contacts the flat part of the bearing end face. The **fillet radius** (r_a) must be **smaller than the bearing's minimum allowable chamfer dimension** ($r_{s\ min}$) so that it does not interfere with bearing seating.

Table 14.3 lists abutment height (h) and fillet radius (r_a). For bearings to be subjected to very large axial loads, shaft abutments (h) should be higher than the values in the table.

Table 14.3 Fillet radius and abutment height

Unit: mm

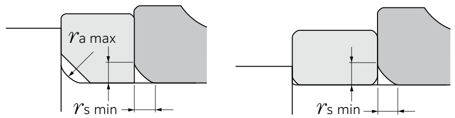
$r_{s\ min}$	$r_{as\ max}$	h (Min.)	
		Normal use [1]	Special use [2]
0.05	0.05	0.3	
0.08	0.08	0.3	
0.1	0.1	0.4	
0.15	0.15	0.6	
0.2	0.2	0.8	
0.3	0.3	1.25	1
0.6	0.6	2.25	2
1	1	2.75	2.5
1.1	1	3.5	3.25
1.5	1.5	4.25	4
2	2	5	4.5
2.1	2	6	5.5
2.5	2	6	5.5
3	2.5	7	6.5
4	3	9	8
5	4	11	10
6	5	14	12
7.5	6	18	16
9.5	8	22	20
12	10	27	24
15	12	32	29
19	15	42	38

1) If a bearing supports a large axial load, the height of the shoulder must exceed the value given here.
2) Used when an axial load is light. These values are not suitable for tapered roller bearings, angular ball bearings and spherical roller bearings.
Note: $r_{as\ max}$ indicates maximum allowable fillet radius.

14.2.2 For spacer and ground undercut

In cases where a fillet radius ($r_{a\ max}$) larger than the bearing chamfer dimension is required to strengthen the shaft or to relieve stress concentration (**Fig. 14.1a**), or abutment height is too low to afford adequate contact surface with the bearing (**Fig. 14.1b**), the use of a spacer may be beneficial.

Relief dimensions for ground shaft and housing fitting surfaces are given in **Table 14.4**.

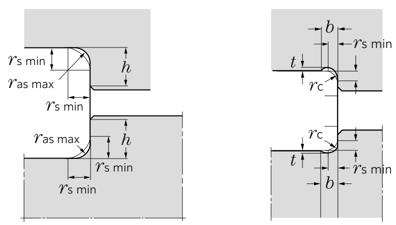


(a) (b)

Fig. 14.1 Bearing mounting with spacer

Table 14.4 Relief dimensions for ground shaft

$r_{s\ min}$	Relief dimensions		
	b	t	r_c
1	2	0.2	1.3
1.1	2.4	0.3	1.5
1.5	3.2	0.4	2
2	4	0.5	2.5
2.1	4	0.5	2.5
2.5	4	0.5	2.5
3	4.7	0.5	3
4	5.9	0.5	4
5	7.4	0.6	5
6	8.6	0.6	6
7.5	10	0.6	7



14.2.3 Fitting dimensions for thrust bearings

For thrust bearings, it is necessary to make the raceway washer back face sufficiently wide in relation to load and rigidity. Consequently, fitting dimensions from the dimension tables should be adopted. (**Figs. 14.2** and **14.3**)

For this reason, **shaft and abutment heights will be larger than for radial bearings**. (Refer to dimension tables for all thrust bearing fitting dimensions.)

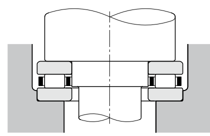


Fig. 14.2

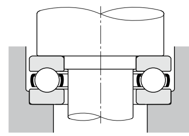


Fig. 14.3

14.3 Shaft and housing accuracy

Table 14.5 shows the required accuracies for shaft and housing fitting surface dimensions and configurations, as well as fitting surface roughness and abutment squareness for normal operating conditions.

Table 14.5 Shaft and housing accuracy

Concern		Shaft	Housing
Dimensional accuracy		IT6 (IT5)	IT7 (IT5)
Roundness (max.) Cylindricity		IT3	IT4
Abutment squareness		IT3	IT3
Fitting surface roughness Ra	Small size bearings	0.8	1.6
	Mid-large size bearings	1.6	3.2

Note: For precision bearings (P4, P5 accuracy), it is necessary to improve the circularity and cylindricity accuracies in this table to approximately 50% of these values. For more specific information, please consult the **Precision rolling bearing catalog (CAT. No. 2260/E).**

14.4 Bearing permitted inclination/ allowable alignment angle

A certain amount of misalignment of a bearing's inner and outer rings occurs as a result of shaft flexure, shaft or housing finishing irregularities, and minor installation error. In situations where the degree of misalignment is liable to be relatively large, **self-aligning ball bearings, spherical roller bearings**, **bearing units** and other bearings with aligning characteristics are advisable. Although permitted inclination and allowable alignment angle will vary according to bearing type, load conditions, internal clearances, etc., **Table 14.6** lists some general misalignment standards for normal applications. In order to avoid shorter bearing life and cage failure, it is necessary to maintain levels of misalignment below these standard levels.

See section 3.7 (A-29) for the relationship between "Inclination angle (installation error) and life."

Table 14.6 Bearing types and allowable misalignment/allowable alignment angle

Allowable misalignment			
Deep groove ball bearings	1/1 000 to 1/300	Tapered roller bearings [1]	
Angular ball bearings [1]		Single row standard	1/2 000
Single row	1/1 000	Single row ULTAGE	1/600
		Needle roller bearings	1/2 000
Cylindrical roller bearings			
Bearing series 10, 2, 3, 4	1/1 000		
Bearing series 22, 23	1/2 000		
ULTAGE	1/500		
Double row [2]	1/2 000		

1) The allowable misalignment of combined bearings is influenced by the load center position, so please consult **NTN** Engineering.
2) Does not include high precision bearings for machine tool main shaft applications.
Note: For thrust bearings, please contact **NTN** Engineering.

Allowable alignment angle				
Self-aligning ball bearings	Normal load	1/15	Thrust spherical roller bearings	
			Normal load	1/60 to 1/30
			Bearing units [3]	1/60 to 1/30
Self-aligning roller bearings	Normal load or more	1/115		
	Light load	1/30		

3) For bearing units, see section "F. Bearing units" on page F-12.

15. Bearing handling

15.1 General information

Bearings are precision parts and in order to preserve their accuracy and reliability, care must be exercised in their handling. In particular, bearing cleanliness must be maintained, sharp impacts avoided, and rust prevented.

Bearings are vulnerable to impact. Do not hit them with a hammer directly or drop them on the floor. (**Fig. 15.1**)

In addition, bearings are sensitive to foreign particle contamination. When foreign particles enters the bearing during rotation, denting and/or scratches may occur, resulting in objectionable noise and vibration levels and rough bearing rotation (**Fig. 15.2**). Therefore, when handling bearings, it is necessary to keep the periphery clean.

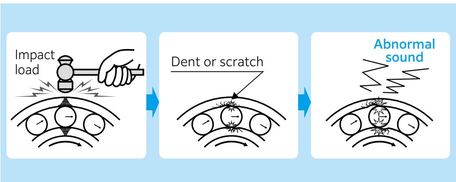


Fig. 15.1 Damage caused by impact

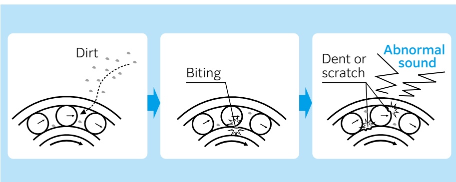


Fig. 15.2 Damage caused by foreign particle contamination

For optimal bearing performance, proper bearing handling methods must be used. The handling methods described herein are general guidelines. Depending on the type and size of bearing needed, special handling "methods" may be necessary. For more detailed information, please consult **NTN** Engineering.

Using proper protective equipment and tools are also essential when installing or removing bearings, to avoid damage to the machinery and ensure the safety of the technician. Further information on proper installation and removal procedures is detailed in the following sections.

15.2 Bearing storage

Most rolling bearings are coated with a rust preventive oil before being packed and shipped. Please observe the following guidelines when storing bearings.

1. Ideally, bearings should be stored indoors at room temperature with a relative humidity of less than 60%. Avoid places in direct sunlight or in contact with outer walls because excessive temperature fluctuation or humidity rise may cause condensation.
2. Bearings should not be stored directly on the ground. Instead, they should be placed on a shelf or pallet at least 20 cm above the ground. The maximum number of shipping boxes to be stacked for storage should limited to four whenever possible (**Fig. 15.3**).
3. Precision rolling bearings, large rolling bearings and thin ring or race rolling bearings must be laid down horizontally for storage (**Fig. 15.4**). Storing them standing vertically may cause raceway deformation.

   To avoid damage during transportation such as fretting or false brinelling, ensure that the individual bearing boxes are packed laying down horizontally within the shipping box. Fill remaining space with dunnage(**Fig. 15.5**).

   Some products have a ↑ symbol on the shipping box to prevent improper storage placement. Follow the indication on the box in this case (**Fig. 15.6**).

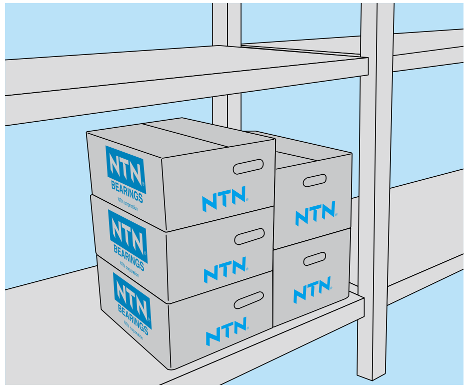


Fig. 15.3 Storing bearings on a shelf

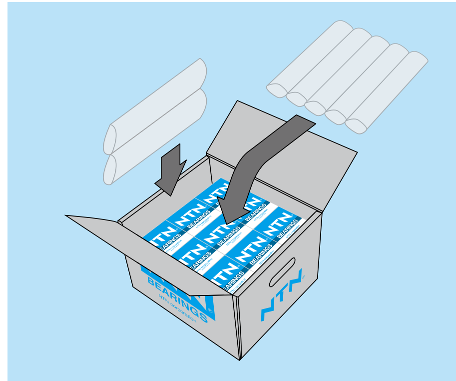


Fig. 15.5 Transportation and storage by shipping box

Fig. 15.4 Storing one-bearing boxes on a shelf

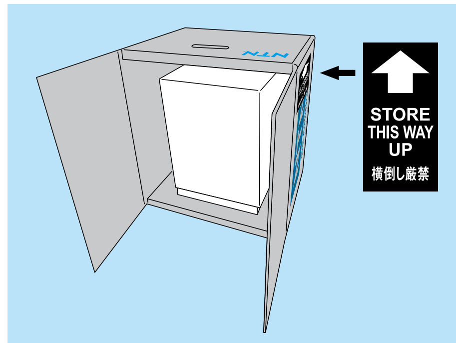


Fig. 15.6 Horizontally placing box prohibited

15.3 Bearing installation

A jig, a measuring instrument, a lubricant, and a clean and dry workshop will be needed for bearing installation. Further, if possible, it is desirable to install miniature/small ball bearings and precision rolling bearings in a clean room because intrusion of dirt and foreign matter significantly affects bearing performance.

Improper installation of bearings may cause marks from the rolling elements on the raceways, adversely affecting the bearing life. For the recommendations on machining accuracy and mounting accuracy of bearings, shafts, and housings, see section "14. Design of shafts and housings."

15.3.1 Installation preparations

(1) Fitting surface of shafts and housings

When a bearing is installed on a shaft or in a housing with surfaces containing burrs or dents, the bearing may not seat properly, causing vibration and noise during operation (see **Figs. 15.7** and **15.8**).

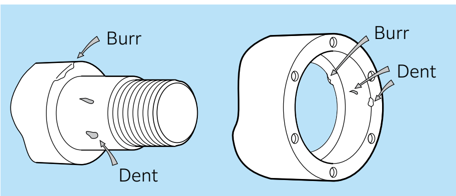


Fig. 15.7 Burrs and dents

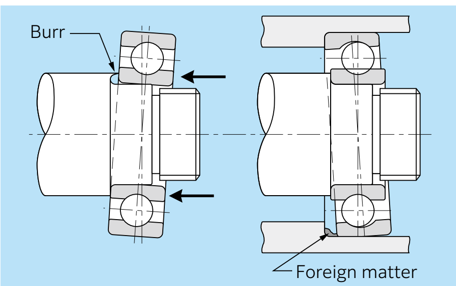


Fig. 15.8 Example of improper bearing installation

Therefore, before mounting bearings, remove any burrs, raised material near dents, rust, or dirt on the shaft, housing, or accessories. (**Fig. 15.9**)

The shaft and housing fitting surfaces should also be checked for roughness, dimensional and design accuracy, and to ensure that they are within allowable tolerance limits. Further, when the bearing is to be press-fitted, using an anti-fretting agent on the fitting surface improves the ease of assembly.

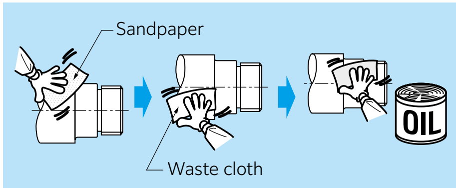


Fig. 15.9 Example of working procedure

(2) Mounting jig

The jig to be used for mounting must have a size suitable for the bearing and be free of dirt or damage.

(3) Opening of bearing

Bearings should be unpackaged directly before use to avoid introducing foreign particle contaminates or condensation which would lead to rust. Gloves should also be worn when handling bearings to avoid rust generation.

(4) Removal of rust preventative oil

In general, bearings with grease lubrication may be installed without cleaning the rust preventative oil.

However, for bearings using oil lubricant, or when lubrication efficiency would be compromised by mixing the grease and rust preventive oil, the rust preventive oil should be removed by washing with a cleaning solvent and dried before installation. The shield type bearings and the seal type bearings filled with grease must not be cleaned.

15.3.2 Installing cylindrical bore bearings

15.3.2.1 Press-fitting

Press-fitting is the most common mounting method and is widely used for small bearings small bearings. Bearings having a relatively small interference can be press-fitted by using a sleeve and applying force to the raceway at room temperature.

When press-fitting a bearing by applying impact with a hammer, use a resin or copper hammer rather than an iron one. To uniformly press the bearing onto the shaft or into the housing, use a sleeve. (Use of a mounting tool kit as shown in **Fig. 15.40**, A-168 is recommended.) Do not directly apply impact to bearing rings or press-fit them by using a punch because the bearings will not be press-fitted uniformly, causing bearing damage (**Fig. 15.10**).

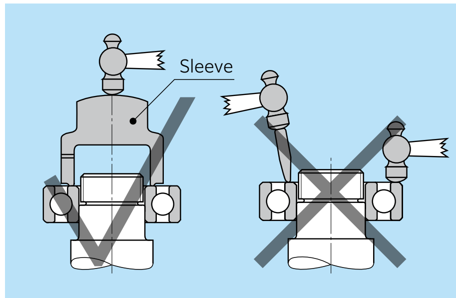


Fig. 15.10 Using hammer for press-fitting

When a large number of bearings are to be installed at one time, a dedicated jig or a hydraulic press may be used.

(1) Press-fitting bearing into shaft

Uniformly apply force by applying a sleeve to the inner ring width surface when press-fitting a bearing onto a shaft. Do not apply force to the outer ring as this will transfer the press force through the rolling elements which may cause dents or scratches on the raceway surface (**Fig. 15.11**).

When press-fitting self-aligning bearings, using a ring-shaped block as shown in **Fig. 15.13** improves ease of installation.

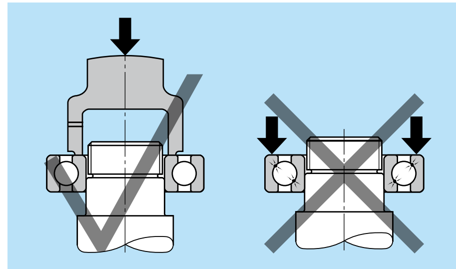


Fig. 15.11 Press-fitting bearing into shaft

(2) Press-fitting bearing into housing

Uniformly apply force by applying a sleeve to the outer ring width surface to press-fit a bearing into a housing. Do not apply force to the inner ring as this will transfer the press force through the rolling elements which may cause dents or scratches on the raceway surface (**Fig. 15.12**).

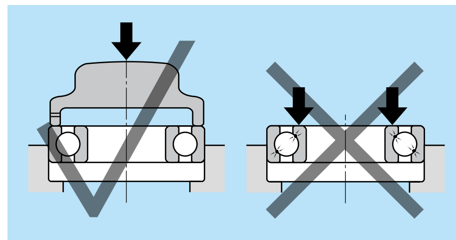


Fig. 15.12 Press-fitting bearing into housing

(3) Simultaneous press-fitting

When press-fitting a non-separable bearing such as a deep groove ball bearing onto the shaft and into the housing at the same time, use a ring-shaped block and uniformly apply force to inner and outer rings simultaneously. Do not apply force on either the inner or outer ring individually because it may cause dents or scratches on the raceway surface (**Fig. 15.13**).

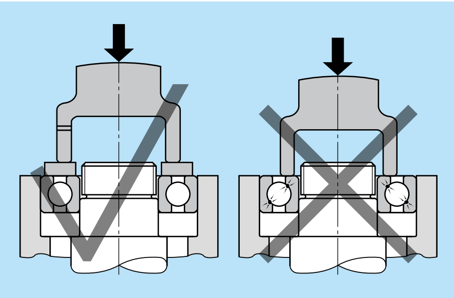


Fig. 15.13 Simultaneous press-fitting

[Caution]

- Excessive interference during installation may cause cracks and excessively small bearing internal clearance, resulting in seizure. For further detail, see section "7. Bearing fits."
- Excessive impact at the time of installation may cause dents and damage.
- No foreign matter should enter the fitting surface during installation.
- For large interference fits and medium/large size bearings, consider other installation methods besides press-fitting at room temperature.

15.3.2.2 Heat fitting (shrink fitting)

When the inner ring interference is large or the bearing is large, press-fitting the inner ring onto the shaft at room temperature requires significant force. Heating the bearing and expanding the inner ring before installation makes the installation onto the shaft easier.

The inner ring expansion amount necessary for heat fitting can be obtained from the interference of the fitting surface between the inner ring and the shaft and the temperature difference before and after the bearing is heated (**Fig. 15.14**).

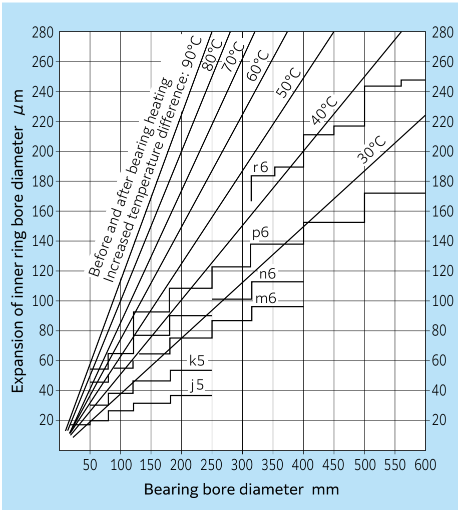


Fig. 15.14 Temperature required for heat-fitting inner ring

Commentary
Bearing Handling
NTN

For heat fitting, any bearing that did not undergo dimension stabilization treatment **must not be heated above 120°C** to avoid permanent bearing damaged and shortened operating life. For sealed bearings, the seal temperature rating must not be exceeded.

In addition, **heat torches and heat guns should not be used for heating bearings** because the bearings may be heated non-uniformly and temperature control is difficult (**Fig. 15.15**).

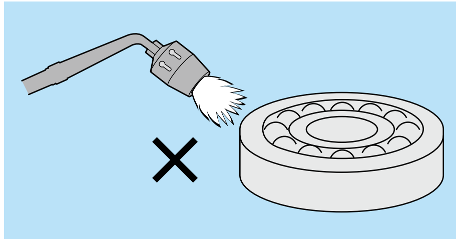


Fig. 15.15 Heating bearings by heat torch

The main methods used to heat bearings uniformly are (1) oil bath, (2) constant temperature oven, and (3) fast therm induction heater.

(1) Heating bearings in oil bath

One bearing heating method is immersing a bearing in a heated clean oil (**Fig. 15.16**). **Foreign particles are often found on the bottom of the oil bath; therefore, do not directly place bearings on the bottom of the oil bath. Instead, place the bearings on a wire rack or suspend it in the oil and then heat it. Shielded bearings and sealed bearings filled with grease must not be heated in the oil bath** (**Fig. 15.17**).

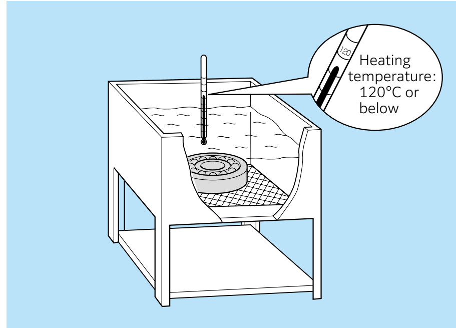


Fig. 15.16 Heating bearings in oil bath

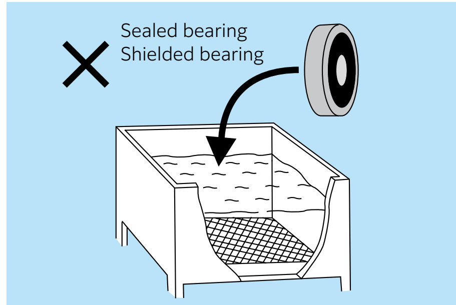


Fig. 15.17 Heating grease filled bearings in oil bath prohibited

(2) Heating bearings in constant temperature oven

With a constant temperature oven, bearings can be heated in a dry state (**Fig. 15.18**).

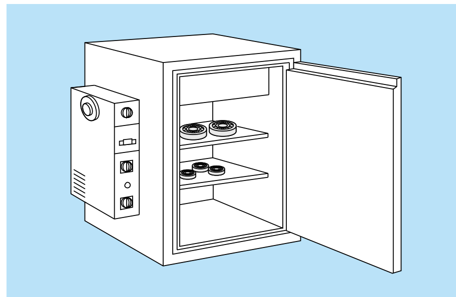


Fig. 15.18 Heating bearings in constant temperature oven

(3) Heating bearings with fast therm induction heater

With a fast therm induction heater, bearings can be heated safely, cleanly, and quickly in a dry state. Heating bearings by induction heating makes the bearings magnetic; therefore, it is necessary to demagnetize bearings after heating. The **NTN** fast therm induction heater (**Fig. 15.42**, A-168) has an automatic demagnetization function.

[Caution]

- Use heat-resistant gloves for safety when handling a heated bearing. **NTN** heat-resistant gloves optimal for bearing handling are available (**Fig. 15.43**, A-168).
- It is important to complete heat fitting quickly. If the bearing cannot be inserted onto the shaft during heat fitting, stop the process and consider removing the bearing.
- When heat fitting is performed, the inner ring contracts in the axial direction during cooling, creating a clearance between the bearing and the shaft shoulder (**Fig. 15.19**). Therefore, it is necessary to tighten the bearing with a nut until it is completely cooled or apply a force in the axial direction while the bearing cools, to bring the bearing into close contact with the shoulder of the shaft.

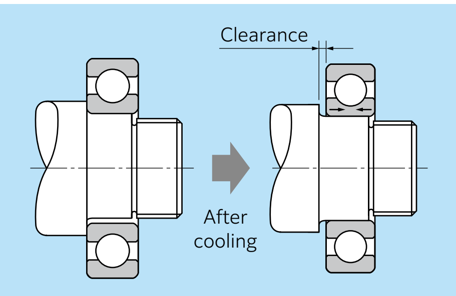


Fig. 15.19 Bearing contraction after heating

15.3.3 Installation of tapered bore bearing

Small tapered bore bearings are installed by inserting a bearing a predetermined amount with locknuts and by using a tapered bore or an adapter sleeve/withdrawal sleeve. Locknuts are tightened by a hook spanner wrench (**Fig. 15.20**).

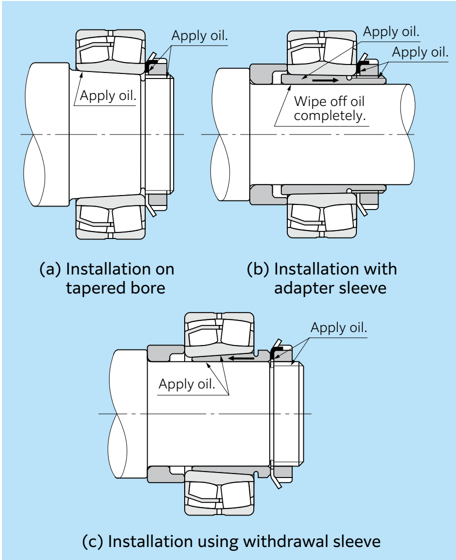


Fig. 15.20 Installation methods using locknuts

Large size bearings require considerable fitting force and must be installed hydraulically.

In **Fig. 15.21** the fitting surface friction and nut tightening torque needed to install bearings with tapered bores directly onto tapered shafts are decreased by injecting high pressure oil between the fitting surfaces.

Commentary
Bearing Handling
NTN

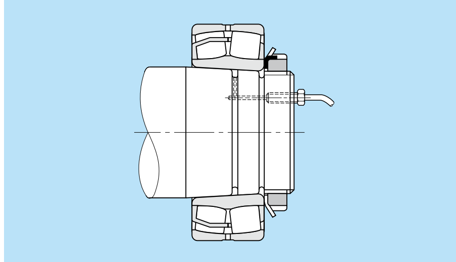


Fig. 15.21 Bearing installation using oil pressure

Fig. 15.22 (a) shows a method of installation where a hydraulic nut is used to drive the bearing onto a tapered shaft. **Fig. 15.19 (b)** and **(c)** show installation methods using a hydraulic nut with adapter sleeves and withdrawal sleeves.

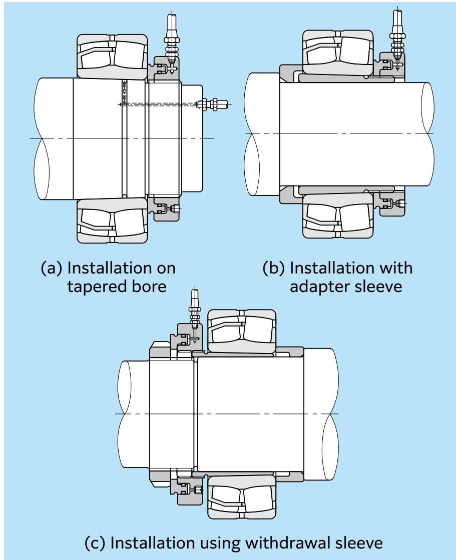


Fig. 15.22 Installation using hydraulic nut

Fig. 15.23 shows an installation method using a hydraulic withdrawal sleeve.

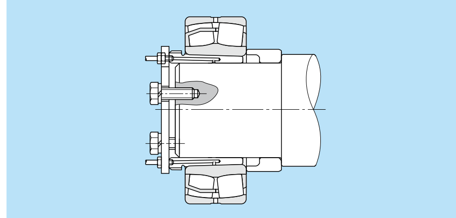


Fig. 15.23 Installation using hydraulic withdrawal sleeve

With tapered bore bearings, as the inner ring is driven axially onto the shaft, adapter or withdrawal sleeve, the interference increases so that the bearing radial internal clearance will decrease. Interference can be estimated by measuring the decrease in radial internal clearance. As shown in **Fig. 15.24**, the radial internal clearance between the rollers and outer ring of spherical roller bearings should be measured with a thickness gauge under no load while the rollers are held in the correct position. Measure the radial internal clearance on both rows, and check that the values are equivalent. Instead of using the decrease in amount of radial internal clearance to estimate the interference, it is possible to estimate the mounted radial internal clearance by measuring the distance the bearing has been driven onto the shaft.

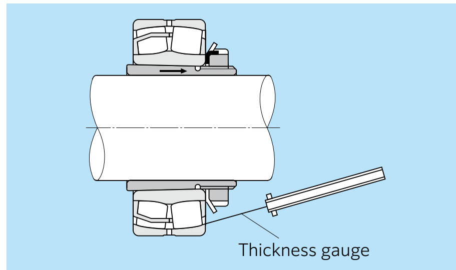


Fig. 15.24 Internal clearance measurement method for spherical roller bearings

For spherical roller bearings, **Table 15.1** (applied to ULTAGE series) and **Table 15.2** (applied to other bearings besides ULTAGE series) indicates the predetermined interference which will be achieved as a result of the radial internal clearance decrease, or the distance the bearing has been driven onto the shaft.

For conditions such as heavy loads, high speeds, or when there is a large temperature differential between inner and outer rings, etc. which require large interference fits, bearings with a minimum radial internal clearance of C3 or greater should be used. **Table 15.1** and **Table 15.2** list the maximum values for radial internal clearance decrease and axial displacement. The remaining clearance in mounted bearings with tapered bores must be greater than the minimum allowable residual clearance listed in **Table 15.1** or **Table 15.2**.

For self-aligning ball bearings, a predetermined interference can be obtained by tightening the nut until the radial internal clearance becomes about half the size before the fitting. After installation, check that the bearing lightly and smoothly rotates.

Table 15.1 Tapered bore spherical roller bearings (ULTAGE series installation)

Unit: mm

Nominal bearing bore diameter *d* mm		Reduction of radial internal clearance		Axial displacement drive up				Nut rotation angle ° (approx.)				Minimum residual radial internal clearance		
				Taper, 1:12		Taper, 1:30		Taper, 1:12		Taper, 1:30				
Over	Inc.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	CN	C3	C4
24	30	0.010	0.015	0.15	0.20	—	—	36	48	—	—	0.015	0.025	0.040
30	40	0.015	0.020	0.25	0.30	—	—	60	72	—	—	0.015	0.030	0.045
40	50	0.020	0.025	0.35	0.40	—	—	84	96	—	—	0.020	0.035	0.055
50	65	0.025	0.030	0.40	0.45	—	—	72	81	—	—	0.025	0.045	0.065
65	80	0.035	0.040	0.50	0.60	—	—	90	108	—	—	0.030	0.055	0.080
80	100	0.040	0.050	0.60	0.70	—	—	108	126	—	—	0.030	0.060	0.090
100	120	0.055	0.065	0.80	0.90	1.80	2.30	144	162	324	414	0.035	0.070	0.105
120	140	0.065	0.075	0.90	1.00	1.95	2.70	162	180	351	486	0.045	0.085	0.125
140	150	0.075	0.090	1.00	1.20	2.35	3.10	180	216	423	558	0.040	0.090	0.140
150	160	0.075	0.090	1.00	1.20	2.35	3.10	120	144	282	372	0.040	0.090	0.140
160	180	0.080	0.100	1.10	1.40	2.80	3.55	132	168	336	426	0.040	0.100	0.160
180	200	0.090	0.110	1.20	1.50	3.20	3.95	144	180	384	474	0.050	0.110	0.180
200	225	0.110	0.130	1.50	1.80	3.85	4.60	135	162	347	414	0.050	0.120	0.190
225	250	0.120	0.140	1.60	1.90	4.20	4.95	144	171	378	446	0.060	0.130	0.210
250	280	0.130	0.160	1.60	2.10	4.25	5.40	144	189	383	486	0.060	0.140	0.230
280	305	0.150	0.180	1.90	2.40	4.45	5.70	171	216	401	513	0.060	0.150	0.250
305	315	0.150	0.180	1.90	2.40	4.45	5.70	137	173	320	410	0.060	0.150	0.250
315	355	0.160	0.190	2.10	2.50	5.10	6.10	151	180	367	439	0.080	0.170	0.280
355	400	0.180	0.220	2.30	3.00	5.75	7.50	166	216	414	540	0.080	0.180	0.300
400	450	0.210	0.250	3.00	3.60	—	—	216	259	—	—	0.080	0.190	0.320

Note: The nut rotation angle may only be applied when a nut having the same inner diameter code as the bearing is used.

Table 15.2 Tapered bore spherical roller bearings (installation of other series besides ULTAGE)

Unit: mm

Nominal bearing bore diameter *d* mm		Reduction of radial internal clearance		Axial displacement drive up				Nut rotation angle ° (approx.)				Minimum residual radial internal clearance		
				Taper, 1:12		Taper, 1:30		Taper, 1:12		Taper, 1:30				
Over	Inc.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	CN	C3	C4
30	40	0.020	0.025	0.35	0.40	—	—	84	96	—	—	0.010	0.025	0.040
40	50	0.025	0.030	0.40	0.45	—	—	96	108	—	—	0.015	0.030	0.050
50	65	0.030	0.035	0.45	0.60	—	—	81	108	—	—	0.020	0.040	0.060
65	80	0.040	0.045	0.60	0.70	—	—	108	126	—	—	0.025	0.050	0.075
80	100	0.045	0.055	0.70	0.80	1.75	2.25	126	144	315	405	0.025	0.055	0.085
100	120	0.050	0.060	0.75	0.90	1.90	2.25	135	162	342	405	0.040	0.075	0.110
120	140	0.065	0.075	1.10	1.20	2.75	3.00	198	216	495	540	0.045	0.085	0.130
140	150	0.075	0.090	1.20	1.40	3.00	3.75	216	252	540	675	0.040	0.090	0.140
150	160	0.075	0.090	1.20	1.40	3.00	3.75	144	168	360	450	0.040	0.090	0.140
160	180	0.080	0.100	1.30	1.60	3.25	4.00	156	192	390	480	0.040	0.100	0.160
180	200	0.090	0.110	1.40	1.70	3.50	4.25	168	204	420	510	0.050	0.110	0.180
200	225	0.100	0.120	1.60	1.90	4.00	4.75	144	171	360	428	0.060	0.130	0.200
225	250	0.110	0.130	1.70	2.00	4.25	5.00	153	180	383	450	0.070	0.140	0.220
250	280	0.120	0.150	1.90	2.40	4.75	6.00	171	216	428	540	0.070	0.150	0.240
280	305	0.130	0.160	2.00	2.50	5.00	6.25	180	225	450	563	0.080	0.170	0.270
305	315	0.130	0.160	2.00	2.50	5.00	6.25	144	180	360	450	0.080	0.170	0.270
315	355	0.150	0.180	2.40	2.80	6.00	7.00	173	202	432	504	0.090	0.180	0.290
355	400	0.170	0.210	2.60	3.30	6.50	8.25	187	238	468	594	0.090	0.190	0.310
400	450	0.200	0.240	3.10	3.70	7.75	9.25	223	266	558	666	0.090	0.200	0.330
450	500	0.210	0.260	3.30	4.00	8.25	10.0	238	288	594	720	0.110	0.230	0.370
500	560	0.240	0.300	3.70	4.60	9.25	11.5	222	276	555	690	0.110	0.240	0.380
560	630	0.260	0.330	4.00	5.10	10.0	12.5	240	306	600	750	0.130	0.270	0.430
630	670	0.300	0.370	4.60	5.70	11.5	14.5	276	342	690	870	0.140	0.300	0.480
670	710	0.300	0.370	4.60	5.70	11.5	14.5	237	293	591	746	0.140	0.300	0.480
710	800	0.340	0.430	5.30	6.70	13.3	16.5	273	345	684	849	0.140	0.320	0.530
800	900	0.370	0.470	5.70	7.30	14.3	18.5	293	375	735	951	0.170	0.370	0.600
900	1 000	0.410	0.530	6.30	8.20	15.8	20.5	284	369	711	923	0.180	0.400	0.660
1 000	1 120	0.450	0.580	6.80	8.70	17.0	22.5	306	392	765	1 013	0.190	0.450	0.720
1 120	1 250	0.490	0.630	7.40	9.40	18.5	24.5	—	—	—	—	0.200	0.490	0.790

Note: The nut rotation angle may only be applied when a nut having the same inner diameter code as the bearing is used.

15.3.4 Installation of outer ring

With tight interference fits, the outer rings of small type bearings can be installed with a hydraulic press at room temperature. Alternately, the housing can be heated and expanded before installing the outer ring, or the outer ring can be cooled with a freezer, etc. before installing. If a freezer or another cooling agent is used, moisture will condense on bearing surfaces. Therefore appropriate rust preventative measures are necessary before cooling the bearing.

15.3.5 Internal clearance adjustment

As shown in **Fig. 15.25**, for angular contact ball bearings and tapered roller bearings the required amount of axial internal clearance can be set at the time of installation by tightening or loosening the adjustment nut.

To adjust the suitable axial internal clearance or amount of bearing preload, the internal clearance can be measured while tightening the adjusting nut as shown in **Fig. 15.26**. Another method is to check rotational torque by rotating the shaft or housing while adjusting the nut.

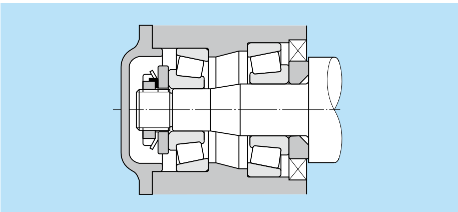


Fig. 15.25 Axial internal clearance adjustment

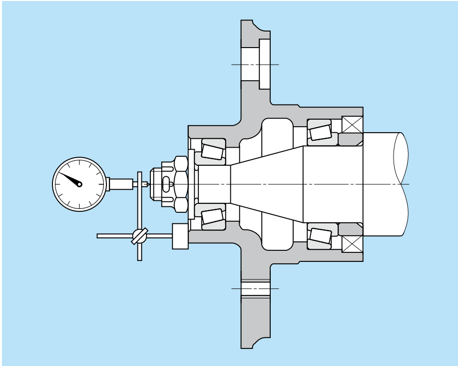


Fig. 15.26 Axial internal clearance measurement

A shim with appropriate thickness may also be used for adjusting the bearing internal clearance. **Fig. 15.27** shows the case in which angular contact ball bearings are used in a face-to-face arrangment on the fixed side. A shim is inserted between the housing front cover and the housing shown by an arrow to change the fixed position of the outer ring.

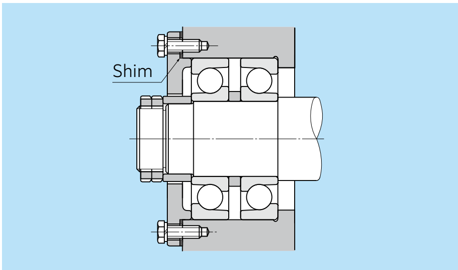


Fig. 15.27 Internal clearance adjustment using shims

15.4 Lubricant enclosure

An appropriate amount of lubricant that is suitable for the use condition of the bearing should be applied if the bearings are not pre-filled with grease. For details, see section "11. Lubrication."

15.5 Post installation running test

To check that the bearing has been properly installed, a running test is performed after installation is completed. The shaft or housing is first rotated by hand and if no problems are observed at low speed, a no-load power test should then be performed. **If no abnormalities are observed, the load and speed are gradually increased to operating conditions. During the test if any unusual noise, vibration, or temperature rise is observed, the test should be stopped and the equipment should be examined. If necessary, the bearing should be disassembled for inspection.**

15.6 Bearing disassembly

Bearings are often removed as part of periodic inspection procedures or during the replacement of other parts. However, the shaft and housing are almost always reinstalled, and in more than a few cases the bearings themselves are reused. These bearings, shafts, housings, and other related parts must be designed to prevent damage during disassembly procedures, and the proper disassembly tools must be employed. When removing bearing rings with interference, pulling force should be applied to the press fit bearing ring only. Do not remove the raceway through the rolling elements.

[Caution]
Bearings and jigs used for disassembly may fall off when the bearing is removed from the shaft or the housing.

15.6.1 Disassembly of bearings with cylindrical bores

For small sized bearings, pullers shown in **Fig. 15.28 (a)** and **(b)** or the press method shown in **Fig. 15.29** can be used for disassembly. When used properly, these methods can improve disassembly efficiency and prevent damage to bearings.

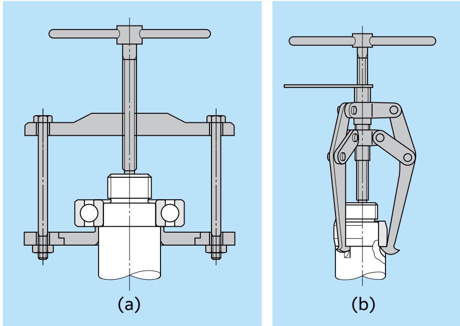


Fig. 15.28 Puller disassembly

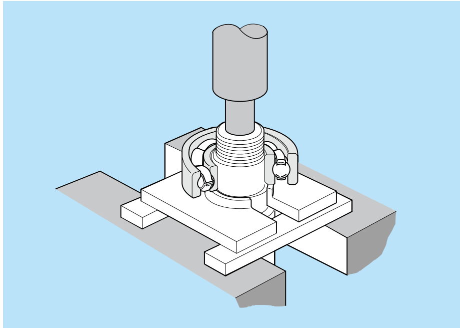


Fig. 15.29 Press disassembly

To facilitate disassembly procedures, attention should be given to planning the designs of shafts and housings, such as providing extraction grooves on the shaft and housing for puller claws as shown in **Figs. 15.30** and **15.31**. Threaded bolt holes could also be provided in housings to facilitate the pressing out of outer rings as shown in **Fig. 15.32**.

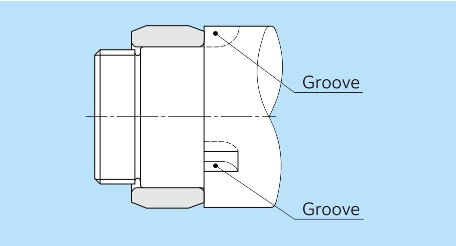


Fig. 15.30 Extracting grooves (example of three positions in circumferential direction)

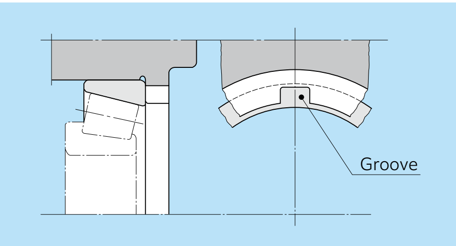


Fig. 15.31 Extraction groove for outer ring disassembly

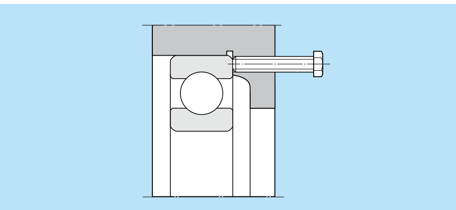


Fig. 15.32 Outer ring disassembly bolt

Large bearings, installed with tight fits, that have been in service for a long period of time, will likely have developed fretting on fitting surfaces and will require considerable dismounting force. In such instances, dismounting friction can be reduced by injecting oil under high pressure between the shaft and inner ring surfaces as shown in **Fig. 15.33**.

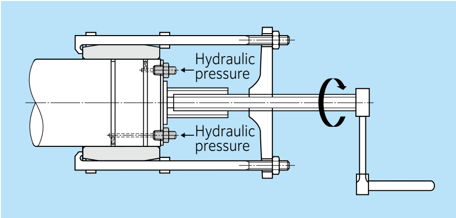


Fig. 15.33 Removal of bearing by hydraulic pressure

Induction heating can be used for removing the inner ring of cylindrical roller bearings having no flange on the inner ring such as NU type and NJ type bearings. With this method, the inner ring is heated until it expands, and can be removed (**Fig. 15.34**).

The bearing becomes magnetized by induction heating; therefore, it is necessary to demagnetize the bearing after heating.

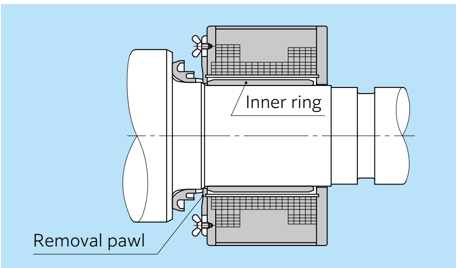


Fig. 15.34 Removal by induction heating

15.6.2 Disassembly of bearings with tapered bores

Small bearings installed using an adapter are removed by loosening the locknut, placing a block on the edge of the inner ring as shown in **Fig. 15.35 (a)** or the edge of the lock nut as shown in **Fig. 15.35 (b)**, and tapping it with a hammer. In such a case, use a resin or copper hammer instead of an iron one. Bearings which have been installed with withdrawal sleeves can be disassembled by tightening down the lock nut as shown in **Fig. 15.36**.

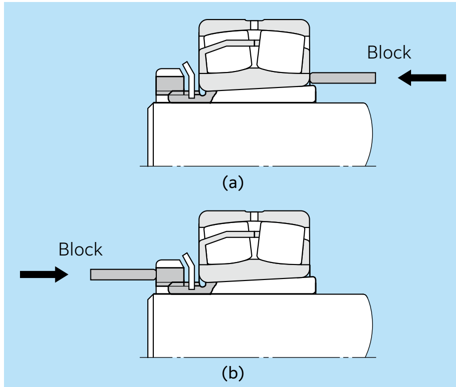


Fig. 15.35 Removal of bearing with adapter

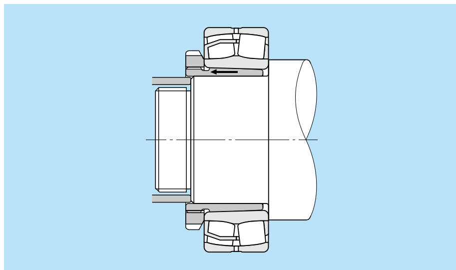


Fig. 15.36 Disassembly of bearing with withdrawal sleeve

For large type bearings on tapered shafts, adapters, or withdrawal sleeves, disassembly is greatly facilitated by hydraulic methods. **Fig. 15.37** shows the case where the bearing is removed by applying hydraulic pressure on the fitting surface of a bearing installed on a tapered shaft.

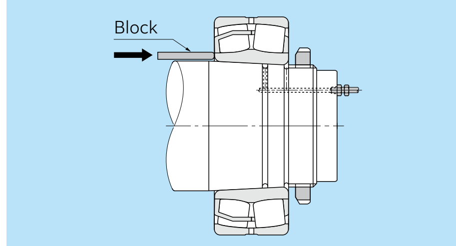


Fig. 15.37 Bearing disassembly using oil pressure

Fig. 15.38 shows two methods of disassembling bearings with adapters or withdrawal sleeves using a hydraulic nut. **Fig. 15.39** shows a disassembly method using a hydraulic withdrawal sleeve where high pressure oil is injected between fitting surfaces and a lock nut is then employed to remove the sleeve.

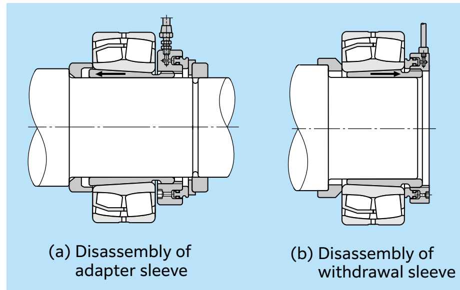


Fig. 15.38 Disassembly using hydraulic nut

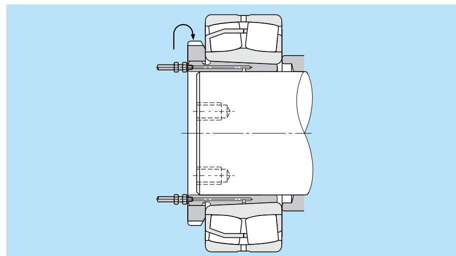


Fig. 15.39 Disassembly using hydraulic withdrawal sleeve

15.7 Bearing maintenance and inspection

Managing the condition of the machine during operation is important for preventing bearing failure. The following items are the general maintenance management methods.

(1) Inspection of machine while running
The interval for replenishing and replacing lubricant is determined by a study of lubricant properties and checking the bearing temperature, noise and vibration.

(2) Observation of bearing after use
Take note of any problem that may appear after the bearing is used or when performing routine inspections, and take measures for preventing reoccurrence of any damage discovered.

Maintenance management requires that the frequency for performing routine inspections be determined according to the importance of the device or machine.

15.7.1 Inspection of machine while running

15.7.1.1 Bearing temperature

In general, the bearing temperature increases after the start of operation and becomes steady at a slightly lower temperature after a certain time elapses (usually 10 to 40°C higher than the room temperature). The time until the temperature becomes steady differs depending on the bearing size, type, rotational speed, lubrication method, and heat dissipation condition of the bearing surroundings. It varies from 20 minutes to several hours.

When the bearing temperature does not become steady and rises excessively, the following may be the cause. Stop the operation and take measures.

<Main causes of abnormal temperature rise>

- Amount of lubricant too small or large
- Improper bearing installation
- Bearing internal clearance too small, or load too large
- Friction of sealing mechanism too large
- Unsuitable lubricant
- Creeping of fitting surface

The bearing temperature should not be too high to maintain suitable bearing operation and prevent the deterioration of lubricant. In general, it is best to use bearings at 100°C or below.

15.7.1.2 Bearing noise

To check bearing running noise, the sound can be checked and the type of noise can be ascertained with a listening instrument placed against the housing. A clear, smooth and continuous running sound is normal; however, determining the exact noise requires significant experience. Although it is difficult to express noise with words and it is different depending on the person, **Table 15.3** shows the characteristics and cause of the typical abnormal noises of bearings.

Table 15.3 Characteristics and cause of typical abnormal noise of bearings

Noise	Characteristics	Cause (probable)
Buzzing noise	—	• Entrance of foreign matter • Roughness of the surfaces of raceway, ball, roller • Scratches on the surfaces of raceway, ball, roller
Whoosh (small size bearings)	—	• Roughness of the surfaces of raceway, ball, roller
Short whoosh noise	• The noise is generated intermittently and regularly.	• Contact with labyrinth part • Contact of case and seal
Rubbing noise/ rumbling noise	• The noise magnitude and pitch change when the rotational speed is changed. The noise becomes loud at a certain rotational speed. The noise becomes loud and quiet. The noise sometimes resembles the sound of sirens and whistles (howling noise).	• Sympathetic vibration, fitting failure (shaft shape failure) • Deformation of raceway • Chattering noise of raceway, ball, roller (a little noise for large size bearings is normal)
Scraping noise/ crunchy noise	• Roughness felt when the bearing is rotated by hand	• Scratches on the raceway surface (regular) • Scratches on the ball or roller (irregular) • Dirt, deformation of raceway (partial negative clearance)
Grumbling noise	• Continuous noise in high speed rotation	• Scratches on the surfaces of raceway, ball, roller
Whirling noise	• The noise stops the moment the power is turned off.	• Electromagnetic sound of motor
Clinking noise (mainly with small size bearings)	• Irregular • The noise does not change when the rotational speed is changed.	• Entrance of foreign matter
Jingling noise (tapered roller bearings) Chattering noise (large size bearings) Flapping noise (small size bearings)	• The noise is regular and becomes continuous in high speed rotation. • Clear cage sound is normal.	• Unsuitable lubricant (use soft grease for low temperature) • Cage pocket abrasion, insufficient lubricant, insufficient bearing load operation
Ticking noise/ clacking noise/ clattering noise	• Conspicuous in low speed rotation • Continuous noise in high speed rotation	• Collision noise from cage pocket, insufficient lubrication. The noise stops by preloading or by making the internal clearance smaller. • Collision noise of rollers for the full component type
Clanging noise	• Loud metallic collision noise • Low-speed thin large size bearings	• Deformation of raceway
Sliding noise/ squeaky noise splashing sound	• Mainly with cylindrical roller bearings, the noise changes when the rotational speed is changed. Large noise sounds like metallic sound. The noise temporarily stops when grease is supplied.	• Lubricant (grease) consistency too high • Radial internal clearance too large • Insufficient lubricant
Squealing noise/ creaking noise/ whining noise	• Metal biting sound • High-pitched sound	• Biting between roller and flange surface of roller bearing • Internal clearance too small • Insufficient lubricant
Splashing noise	• Occurs irregularly with small size bearings	• Sound generated when bubbles in the grease are broken
Groaning noise/	• Irregular squeaky noise	• Slippage of fitting part • Squeakiness of mounting surface
Indistinguishable loud noise during operation.		• Roughness of the surfaces of raceway, ball, roller • Deformation of raceway surface, ball, and roller caused by abrasion • Too large internal clearance caused by abrasion

15.7.1.3 Bearing vibration

Measuring the machine vibration during operation with a vibration measuring instrument can reveal bearing damage at an early stage. The bearing damage degree can be estimated by quantitatively measuring and analyzing the vibration amplitude and frequency. However, measurement values differ depending on the measurement positions and bearing use conditions. Therefore, it is desirable to accumulate measurement data and set criteria for each machine.

When the bearing is damaged, vibration including specific frequencies that depend on the bearing internal specifications and rotational speed occurs. The bearing vibration frequency can be calculated with the bearing technique calculation tool on the **NTN** website (https://www.ntnglobal.com).

15.7.1.4 Leakage/abnormal deterioration of lubricant

The main causes of the leakage/abnormal deterioration of lubricant are as follows. It is necessary to take measures depending on the use conditions and environment.

- Too much lubricant
- Unsuitable lubricant
- Improper installation
- Unsuitable sealing mechanism
- Deterioration caused by use
- Unsuitable operating condition
- Abnormal deterioration

15.7.2 Observation of bearing after use

Carefully observe bearings after use and during periodic inspection, and take appropriate recurrence prevention measures if any damage was found. For details, see section “16. Bearing damage and corrective measures.”

15.8 Bearing maintenance tools

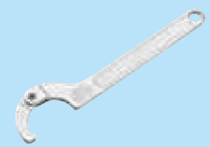
NTN offers maintenance tools for easily and safely installing/disassembling bearings. **NTN** also offers a portable abnormality detection device," a small vibration measurement device that has excellent portability and usability for measuring the vibration generated from the machine.

15.8.1 Maintenance tools

Figs. 15.40 through **15.49** show some of the main maintenance tools that are convenient for installing/disassembling bearings. For details, see the special catalog "**Maintenance tools (CAT. No. 6600/J)**."

The kit allows accurate, safe, and quick bearing installation.

Fig. 15.40 Cold mounting case



The five spanners allow tightening/loosening nuts of 30 different sizes.

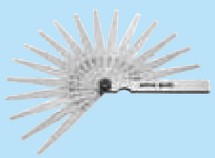
Fig. 15.41 Hook spanners

The device allows safe and secure heat fitting work and has an automatic demagnetization function, an overheat prevention function, and a temperature maintaining function.

Fig. 15.42 Induction heater

The protective gloves allow safe handling of high-temperature bearings up to 350°C.

Fig. 15.43 Heat-resistant gloves

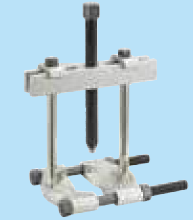


The tool allows simple and high precision measurement of bearing clearance.

Fig. 15.44 Set of calibrated feeler gauges

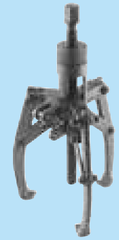
The jig allows quick and easy removal of bearings press-fitted into housings by a tight fit.

Fig. 15.45 Bore puller set



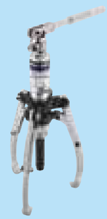
The jig allows safe and easy removal of bearings that are attached to shafts and difficult to remove.

Fig. 15.46 Back puller



The jig is a robust and simple tool for easily removing small and medium size bearings.

Fig. 15.47 Mechanical puller



The jig is efficient for easily and safely removing bearings press-fitted into shafts of large size bearings.

Fig. 15.48 Hydraulic puller

Removal can be done safely and efficiently by using the puller mechanically or hydraulically.

Fig. 15.49 Tri Section Pulling Plates

15.8.2 NTN PORTABLE VIBROSCOPE

NTN offers the "**NTN** PORTABLE VIBROSCOPE", a small vibration measurement device that has excellent portability and usability for performing FFT(Fast Fourier Transform) analysis and OA(Overall) measurement by wireless communication with tablets and smart devices with a dedicated application installed (**Fig. 15.50**).

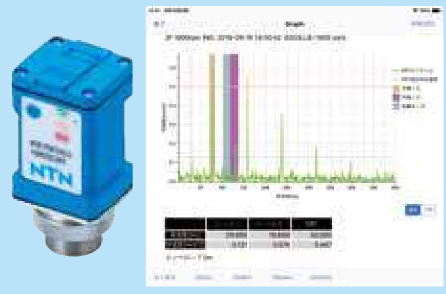


Fig. 15.50 NTN PORTABLE VIBROSCOPE

The FFT analysis clarifies the detailed operational state of the machine. By registering measurement conditions such as bearing part numbers and rotational speed, it is possible to detect the damage inside the bearing and estimate the damaged parts. In addition, selecting measurement conditions allows detecting abnormalities such as unbalance and misalignment of machines having rotating parts. In OA measurement, the acceleration, speed, and displacement can be displayed independently, and the measurement can be used as a general vibrometer.

The raw vibration data and the analysis results can be saved in smart devices for operation and can be downloaded in CSV format as necessary. In addition, the measurement device itself is dust-proof and drip-proof; therefore, the device is suitable for measuring vibration of machines used in various environments.

For the product details, please contact **NTN** Engineering.

For details, see the special catalog "**NTN PORTABLE VIBROSCOPE (CAT. No. 6601/E)**."

16. Bearing damage and corrective measures

16.1 Bearing damage, main causes of bearing damage, and remedies for correcting the problem

If handled correctly, bearings can generally be used for a long time before reaching their fatigue life. If damage occurs prematurely, the problem could stem from improper bearing selection, handling, or lubrication. If this occurs, take note of the application, operating conditions, and environment. By investigating several possible causes surmised from the type of damage and condition at the time the damage occurred, it is possible to prevent the same kind of damage from reoccurring. **Table 16.1** gives the main causes of bearing damage and remedies for correcting the problem.

For details, see the special catalog "**Care and maintenance of bearings (CAT. No. 3017/E)**."

Table 16.1 Bearing damage, main causes of bearing damage and remedies for correcting the problem

Phenomenon

Spalling (Flaking)
The surface of the raceway and rolling elements peel away in flakes leaving a highly irregular and very poor surface.

- Inner ring of spherical roller bearing
- Flaking on one row of the raceway surface in this case.
- An excessive axial load is the cause.

- Outer ring of angular contact ball bearing
- Flaking on the raceway surface with spacing equal to the distance between balls.
- Improper handling is the cause.

Causes
- Excessive load, normal fatigue life, improper handling
- Improper installation
- Insufficient accuracy of shaft or housing
- Insufficient clearance
- Contamination
- Rust
- Insufficient lubrication
- Reduction in hardness due to abnormal temperature rise

Correction
- Select a different type or size of bearing.
- Reevaluate the clearance.
- Improve the precision of the shaft and housing.
- Improve assembly method and handling.
- Reevaluate the layout (design) of the area around the bearing.
- Review lubricant type and lubrication methods.

Seizure
Extreme thermal conditions eventually resulting in seizure of the bearing.

- Inner ring of double-row tapered roller bearing
- Seizure causes discoloration and softening, producing stepped abrasion on the raceway surface with spacing equal to the distance between the rollers.
- Insufficient lubrication is the cause.

- Inner ring of tapered roller bearing
- Evidence of seizure on the large diameter side of raceway surface and large rib surface
- Insufficient lubrication is one possible cause.

Causes
- Insufficient clearance (including clearances reduced by local deformation)
- Insufficient lubrication or improper lubricant
- Excessive loads (including excessive preload)
- Roller skewing due to a misaligned bearing
- Reduction in hardness due to abnormal temperature rise
- High speed or large fluctuating load

Correction
- Review lubricant type and quantity.
- Check for proper clearance. (Increase clearances.)
- Take steps to prevent misalignment.
- Improve assembly method and handling.

Cracks/chips
Localized flaking occurs. Little cracks or notches appear.

- Inner ring of tapered roller bearing
- Chipped large rib.
- Impact due to improper preloading is the cause.

- Outer ring of four-row cylindrical roller bearing
- Cracks in the circumferential direction of raceway surface
- These cracks were initiated by flaking.

Causes
- Excessive shock loads
- Improper handling (use of steel hammer, damage from large particle contamination)
- Formation of decomposed surface layer due to improper lubrication
- Excessive interference
- Flaking
- Friction cracking
- Imprecise mating component (oversized fillet radius)

Correction
- Review lubricant (friction crack prevention).
- Select proper interference and review materials.
- Improve assembly method and handling.

Bearing Damage and Corrective Measures

Table 16.1 (continued)

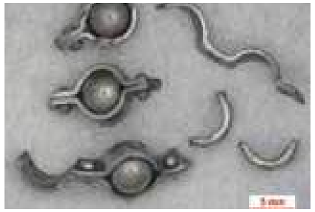
Phenomenon

Cage damage

Rivets break or become loose resulting in cage damage.
Fracture of riveted steel cage at the corner radius.

- Cage of angular contact ball bearing
- Breakage of high strength, machined brass cage
- Insufficient lubrication is the cause.

- Cage of cylindrical roller bearing
- Breakage of partitions between pockets of high strength, machined brass cage



- Cage of deep groove ball bearing
- Breakage of riveted steel cage

- Cage of deep groove ball bearing
- Breakage at corner of riveted steel cage

Causes

- Excessive load or moment loading
- High speed or excessive speed fluctuations
- Insufficient lubrication
- Impact with foreign objects
- Excessive vibration
- Improper mounting (mounted misaligned)

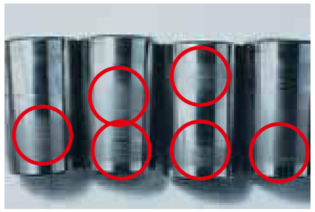
Correction

- Review lubricant type and lubrication methods.
- Review cage type selection.
- Investigate shaft and housing rigidity.
- Improve assembly method and handling.

Rolling path skewing

Abrasion or an irregular, rolling path skewing due to rolling elements along raceway surfaces.

- Spherical roller bearing
- Uneven contact on inner ring, outer ring, and roller
- Improper installation is the cause.



- Roller of tapered roller bearing
- Evidence of uneven contact on rolling element surface

Causes

- Insufficient accuracy of shaft or housing
- Improper installation
- Insufficient shaft or housing rigidity
- Shaft whirling caused by excessive internal bearing clearances

Correction

- Reevaluate the clearance.
- Improve the precision of the shaft and housing.
- Review rigidity of shaft and housing.

Smearing, Scuffing

The surface becomes rough and some small deposits form.
Scuffing generally refers to roughness on the race rib face and the ends of the rollers.

- Inner ring of cylindrical roller bearing
- Scuffing on the rib surface.

- Inner ring of cylindrical roller bearing
- Smearing on the raceway surface.
- The cause is slippage of rollers due to contaminants.

Causes

- Insufficient lubrication
- Contamination ingress
- Roller skewing due to a misaligned bearing
- Bare spots in the collar oil film due to large axial loading
- Excessive slippage of the rolling elements

Correction

- Review lubricant type and lubrication methods.
- Improve sealing performance.
- Review preload.
- Improve assembly method and handling.

Bearing Damage and Corrective Measures

Table 16.1 (continued)

Phenomenon

Rust/ corrosion

The surface becomes either partially or fully rusted, and occasionally rust occurs spaced at equal distances between rolling elements.

- Inner ring of tapered roller bearing
- Rust at equal distances between rolling elements on raceway surface.

- Outer ring of deep groove ball bearing
- Rust on the outer diameter surface.

Causes

- Poor storage conditions
- Poor packaging
- Insufficient rust inhibitor
- Penetration by water, acid, etc.
- Handling with bare hands

Correction

- Take measures to prevent rusting while in storage.
- Periodically inspect the lubricating oil.
- Improve sealing performance.
- Improve assembly method and handling.

Fretting

There are two types of fretting. In one, a rusty wear powder forms on the mating surfaces. In the other, brinelling indentations form on the raceway corresponding to rolling element spacing.

- Inner ring of cylindrical roller bearing
- Ripple-like fretting on the entire circumference of the raceway surface.
- Vibration is the cause.

- Inner ring of deep groove ball bearing
- Fretting on the entire circumference of the raceway surface.
- Vibration is the cause.

Causes

- Insufficient interference
- Small bearing oscillation angle
- Insufficient lubrication
- Fluctuating loads
- Vibration during transport, or while stopped

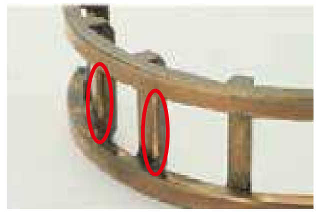
Correction

- Review lubricant type and lubrication methods.
- Review the interference fit and apply a coat of lubricant to fitting surface.
- Pack the inner and outer rings separately for transport.

Wear

The surfaces wear and dimensional deformation results.
Wear is often accompanied by roughness and scratches.

- Inner ring of cylindrical roller bearing
- Stepped wear on the entire circumference of the raceway surface.
- Insufficient lubrication is the cause.



- Cage of cylindrical roller bearing
- Wear of pocket part of high strength, machined brass cage

Causes

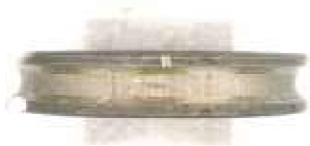
- Entrapment of foreign particles in the lubricant
- Inadequate lubrication
- Roller skewing due to a misaligned bearing

Correction

- Review lubricant type and lubrication methods.
- Improve sealing performance.
- Take steps to prevent misalignment.
- Improve assembly method and handling.

Electrolytic corrosion

Pits form on the raceway. The pits gradually grow into ripples.



- Inner ring of deep groove ball bearing
- Ripple-like electrolytic corrosion on the raceway surface.

- The cross section of the electrolytic corrosion on the roller rolling element surface is enlarged (×400).
- The white layer shows up by nital etching of the cross section.

Causes

- Electric current flowing through the rollers

Correction

- Create a bypass circuit for the current.
- Insulate the bearing.

Bearing Damage and Corrective Measures

Table 16.1 (continued)

Phenomenon

Dents and scratches

Scoring during assembly, gouges due to hard foreign objects, and surface denting due to mechanical shock.

- Roller of cylindrical roller bearing
- Axial direction scratches on the rolling element surface at the time of preloading
- Improper preloading is the cause.

- Inner ring of tapered roller bearing
- Dents on the entire raceway surface
- Impact with hard foreign objects is the cause.

Causes
- Entrapment of hard foreign matter
- Dropping or other mechanical shocks due to careless handling
- Assembled misaligned
- Excessive load or moment loading

Correction
- Improve assembly method and handling.
- Improve sealing performance. (to prevent infiltration of foreign matter)
- Check area surrounding bearing. (when caused by metal fragments)

Creeping

Surface becomes mirrored due to inner and outer diameter bearing surfaces spinning against the mating shaft or housing surface during operation. May be accompanied by discoloration or scoring.

- Inner ring of deep groove ball bearing
- Mirrored bore surface due to creeping on the shaft.

- Inner ring of tapered roller bearing
- Scuffing on bearing bore surface due to creeping on the shaft.

Causes
- Insufficient interference with mating component
- Sleeve not fastened down properly
- Abnormal temperature rise
- Excessive loads
- High speed/rapid acceleration or deceleration

Correction
- Reevaluate the interference fit.
- Review operating conditions.
- Improve the precision of the shaft and housing.
- Fix of the faces of inner/outer ring

Speckles and discoloration

Luster of raceway surfaces is gone; surface is matted, rough, and / or evenly dimpled. Surface covered with minute dents.

- Inner ring of double-row tapered roller bearing
- Speckles and discoloration on the raceway surface.
- Electrolytic corrosion is the cause.

- Ball of deep groove ball bearing
- Large speckles and discoloration
- Impact with hard foreign objects and insufficient lubrication are the cause.

Causes
- Infiltration of bearing by foreign matter
- Insufficient lubrication

Correction
- Review lubricant type and lubrication methods.
- Review sealing mechanisms.
- Examine lubrication oil purity. (filter may be excessively dirty, etc.)

Peeling

Patches of minute flaking or peeling (size, approx. 10 μm). Innumerable hair-line cracks visible though not yet peeling. (This type of damage is frequently seen on roller bearings.)

- Spherical rollers
- Linear peeling on the rolling element surface.
- Insufficient lubrication is the cause.

- Outer ring of deep groove ball bearing
- Peeling on the load zone of the raceway surface.

Causes
- Infiltration of bearing by foreign matter
- Insufficient lubrication

Correction
- Review lubricant type and lubrication methods.
- Improve sealing performance. (to prevent infiltration of foreign matter)
- Perform run-in.

Bearing Damage and Corrective Measures

Table 16.2 gives the main causes of bearing damage. In the table, factors that are likely to be the cause of each damage are marked by ○; however, factors without ○ may be the cause of the damage in special circumstances.

Table 16.2 Bearing damage and causes

Bearing damage	Damaged parts	Handling: Poor storage condition/ vibration during transportation	Handling: Improper handling/ installation	Bearing periphery: Insufficient accuracy of shaft/housing	Bearing periphery: Infiltration of bearing by foreign matter (insufficient sealing performance)	Bearing periphery: Temperature (heat effect)	Lubrication: Lubricant (insufficient/ improper quality)	Lubrication: Lubrication method (insufficient)	Load: Excessively large impact load/preload	Load: Excessively large moment	Load: Excessively small load	Speed: High speed/ rapid acceleration and deceleration	Speed: Large vibration	Speed: Swinging/vibration/ standstill	Bearing selection: Excessively large/ small clearance	Bearing selection: Excessively large/ small interference
Flaking (separation)	Raceway surface/ rolling element surface		○	○	○	○	○	○	○	○					○	
Seizure	Raceway/ rolling element/cage		○			○	○	○	○	○		○			○	
Cracks/chips	Raceway/rolling element		○	○			○		○	○						○
Cage damage	Rivets break or become loose		○		○		○	○	○	○		○	○			
Rolling path skewing	Raceway surface		○	○											○	
Smearing/ scuffing	Raceway surface/ rolling element surface/ rib surface/ roller end surface		○		○		○	○	○		○					
Rust/ corrosion	Rust on a part of or the entire surface of the rolling element pitch	○	○		○		○	○								
Fretting	Red rust on fitting surface		○						○				○			
	Brinelling indentations form on the raceway of the rolling element pitch	○					○	○						○		○
Wear	Raceway surface/ rolling element surface/ rib surface/ roller end surface		○		○		○	○								
Electrolytic corrosion	Pits form on the raceway. The pits gradually grow into ripples.		○													
Dents and scratches	Raceway surface/ rolling element surface		○		○				○	○						
Creeping	Fitting surface		○	○		○			○							○
Speckles and discoloration	Raceway surface/ rolling element surface				○		○	○								
Peeling	Raceway surface/ rolling element surface				○		○	○								

16.2 Rolling paths and how load is applied

When a bearing rotates in response to a load, the raceway surfaces of the inner and outer rings develop a hazy rolling path due to rolling contact with the rolling element. The rolling path on the raceway surface is normal. Evaluation of the rolling path of a used bearing can provide the engineer with useful information regarding the conditions the bearing had been exposed to.

Rolling path observation clarifies if a radial load was applied, an axial load was applied, or a moment load was applied. It can also shows if the bearing experienced a large load or a mounting error. These observations provide extremely important references when determining the cause of bearing damage.

Figure 16.1 shows rolling paths of point and linear contacts caused under various load conditions.

(1) is a general rolling path generated when a radial load is applied to a bearing with inner ring rotation. The width of the rolling path becomes small at the entrance of the load zone of the outer ring, which is the fixed side. On the other hand, (2) shows a rolling path pattern opposite to (1) when a radial load is applied during outer ring rotation. (3) is a rolling path generated when an axial load in one direction is applied to a bearing, and an example of linear contact on a spherical roller bearing. When a combined load is applied during inner ring rotation, a rolling path pattern such as (4) is caused. As shown in (5), when a radial load is applied to a bearing with significant misalignment due to a moment load, rolling paths are generated at two positions separated by 180 degrees in the load zone of the outer ring, which is the fixed side. (6) shows the case where the housing bore diameter is an ellipse. Rolling paths are left on the fixed side outer ring at two positions but are not misaligned. (5) and (6) indicate improper bearing use, and the bearing life may be shorter because of the adverse effect.

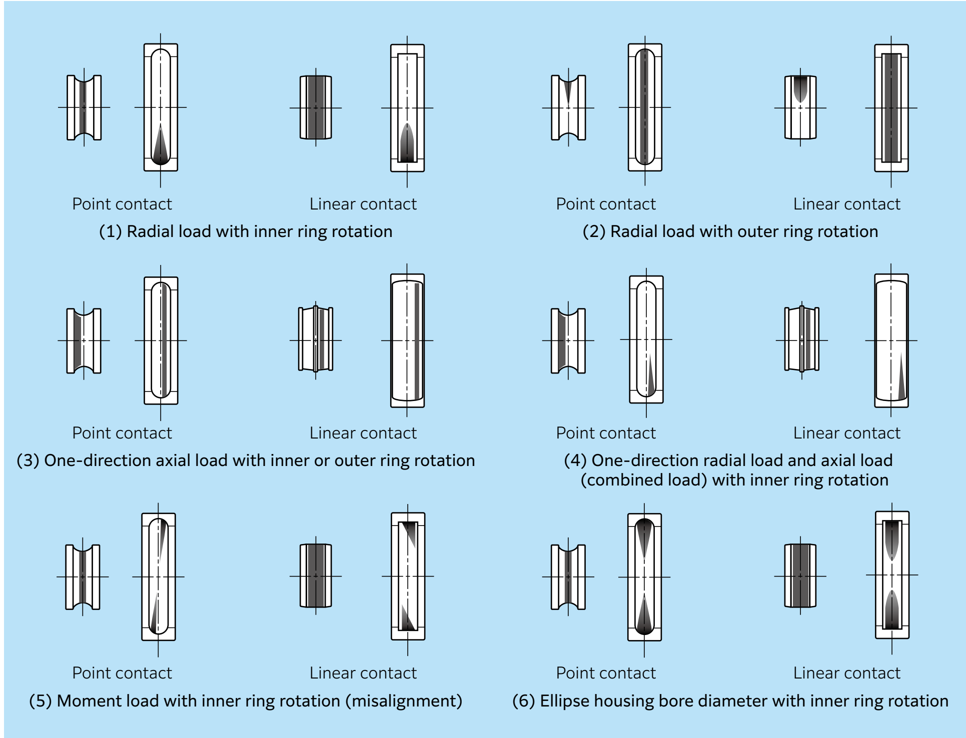


Figure 16.1 Rolling paths and how load is applied

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

17. Technical data

17.1 Radial internal clearances vs. axial internal clearances

17.1.1 Deep groove ball bearings

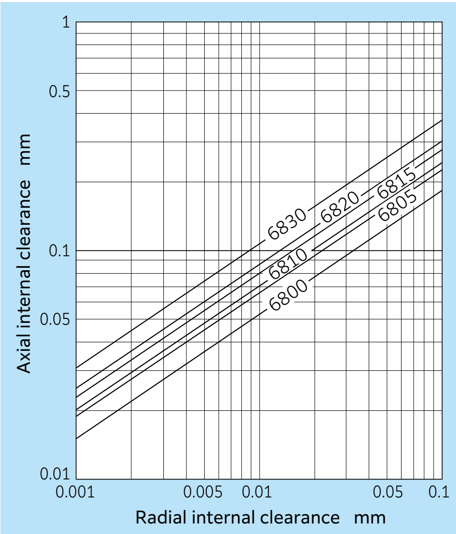


Fig. 17.1.1 Series 68 radial internal/axial internal clearances

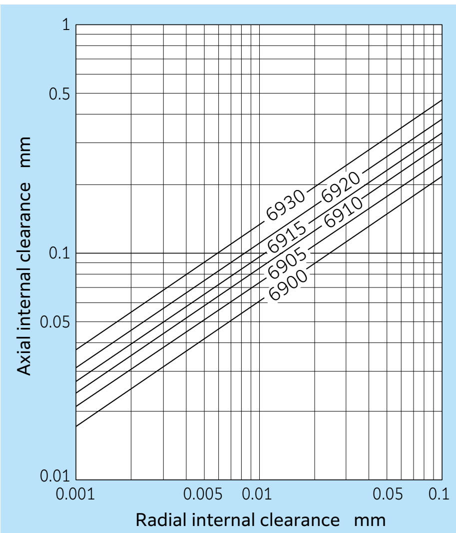


Fig. 17.1.2 Series 69 radial internal/axial internal clearances

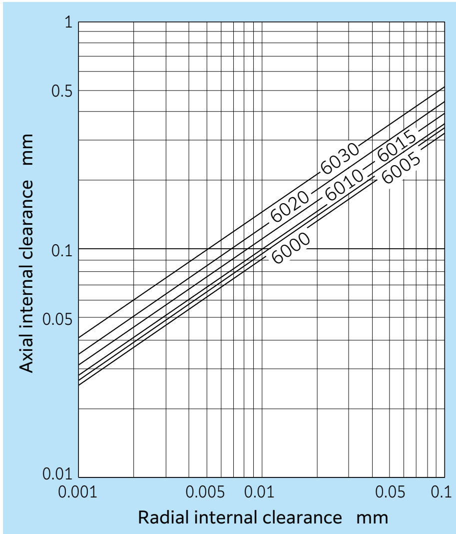


Fig. 17.1.3 Series 60 radial internal/axial internal clearances

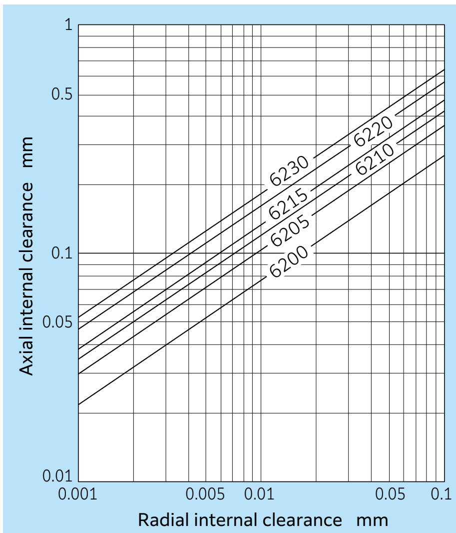


Fig. 17.1.4 Series 62 radial internal/axial internal clearances

Note: Please consult **NTN** Engineering for other types and sizes.

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

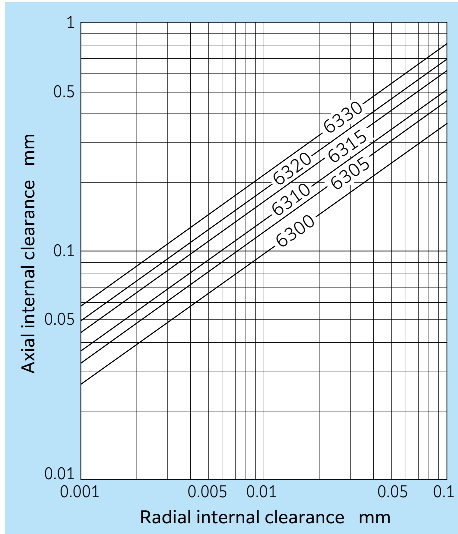


Fig. 17.1.5 Series 63 radial internal/axial internal clearances

Note: Please consult **NTN** Engineering for other types and sizes.

Technical Data

NTN

*This technical data shows calculated values based on representative values,
NTN does not guarantee these values.

17.1.2 Double-row angular contact ball bearings

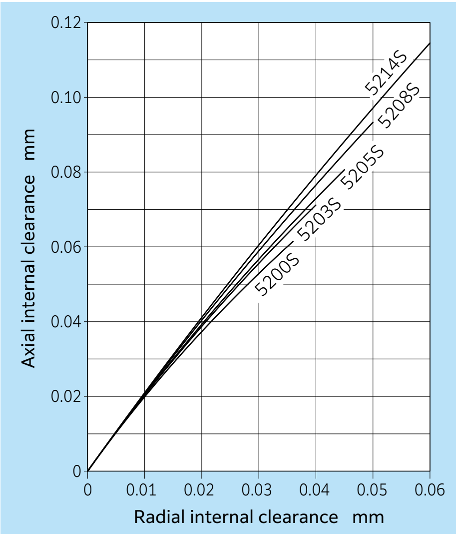


Fig. 17.1.6 Series 52S radial internal/axial internal clearances

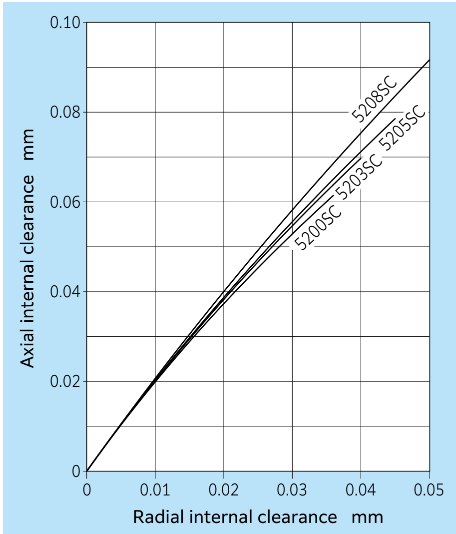


Fig. 17.1.8 Series 52SC radial internal/axial internal clearances

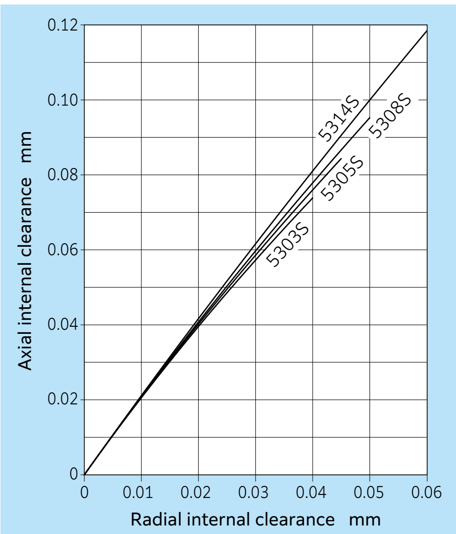


Fig. 17.1.7 Series 53S radial internal/axial internal clearances

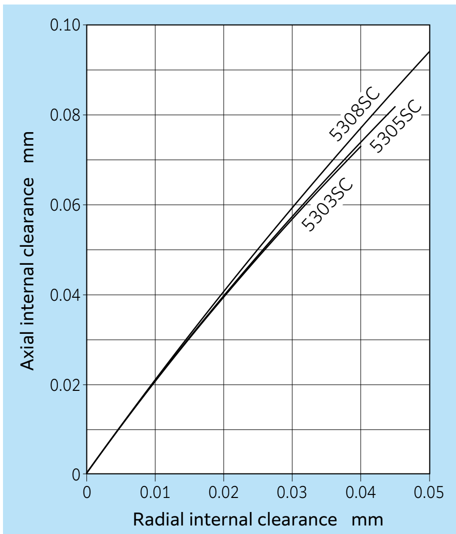


Fig. 17.1.9 Series 53SC radial internal/axial internal clearances

Note: Please consult **NTN** Engineering for other types and sizes.

Technical Data

NTN

*This technical data shows calculated values based on representative values,
NTN does not guarantee these values.

17.1.3 Spherical roller bearings

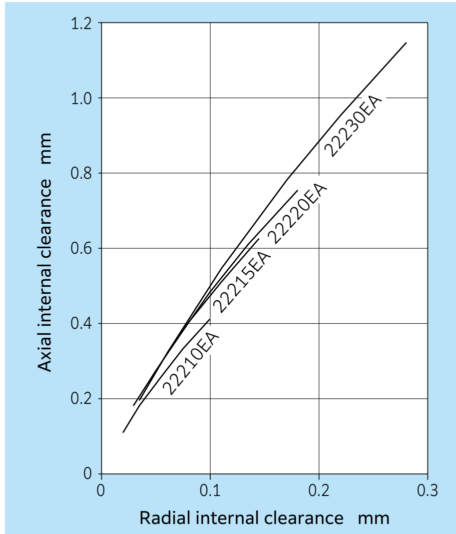


Fig. 17.1.10 Series 222 radial internal/axial internal clearances

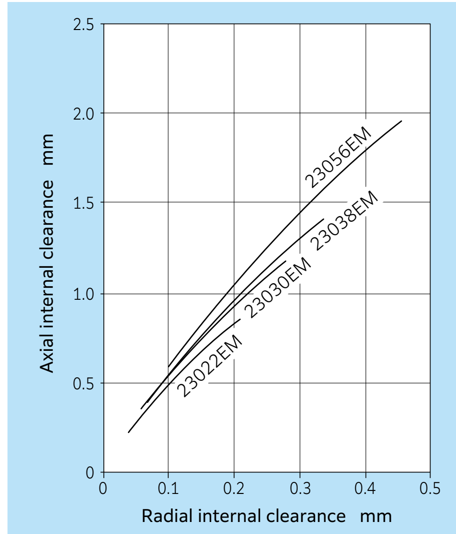


Fig. 17.1.12 Series 230 radial internal/axial internal clearances

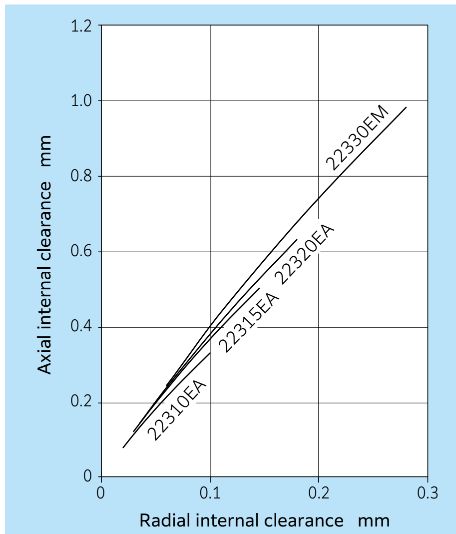


Fig. 17.1.11 Series 223 radial internal/axial internal clearances

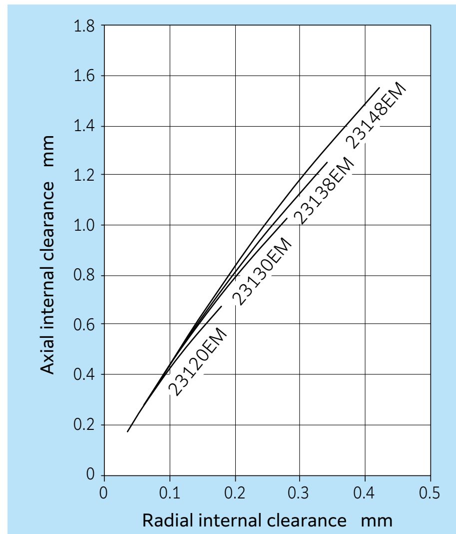


Fig. 17.1.13 Series 231 radial internal/axial internal clearances

Note: Please consult **NTN** Engineering for other types and sizes.

Technical Data

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

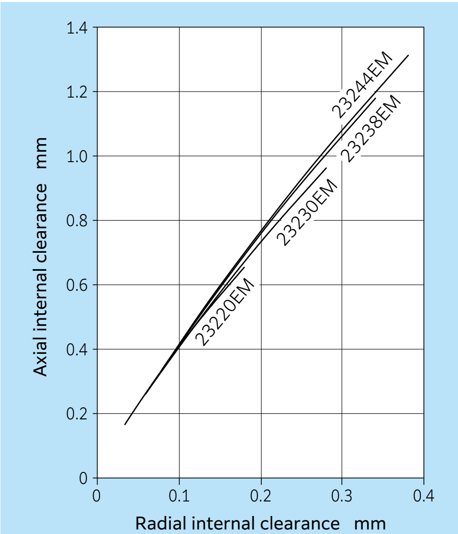


Fig. 17.1.14 Series 232 radial internal/axial internal clearances

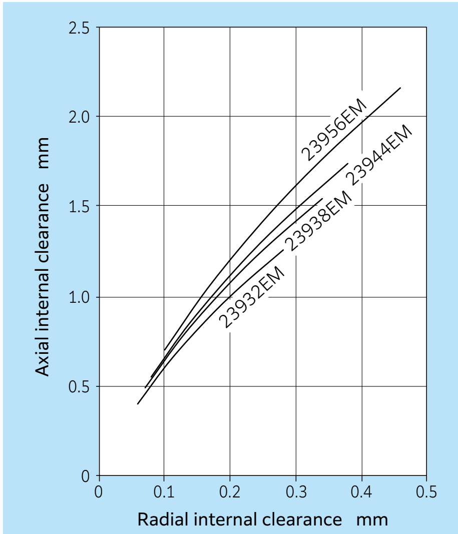


Fig. 17.1.15 Series 239 radial internal/axial internal clearances

Note: Please consult **NTN** Engineering for other types and sizes.

Technical Data

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

17.2 Axial load vs. axial displacement

17.2.1 Angular contact ball bearings

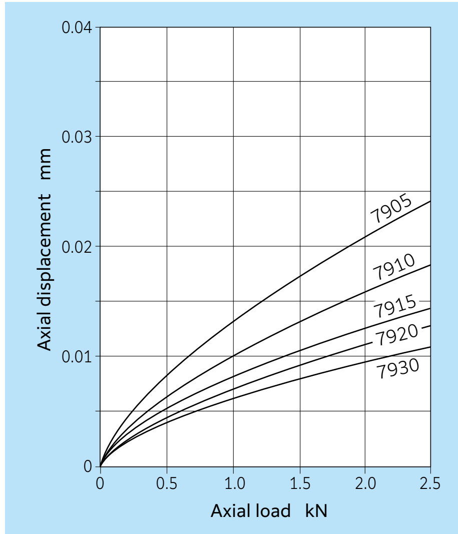


Fig. 17.2.1 Series 79 axial load vs. axial displacement

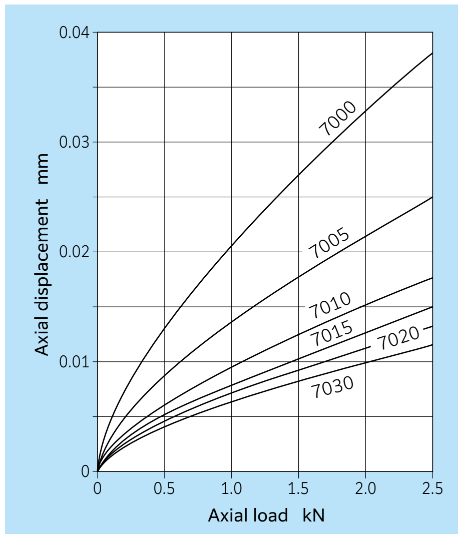


Fig. 17.2.2 Series 70 axial load vs. axial displacement

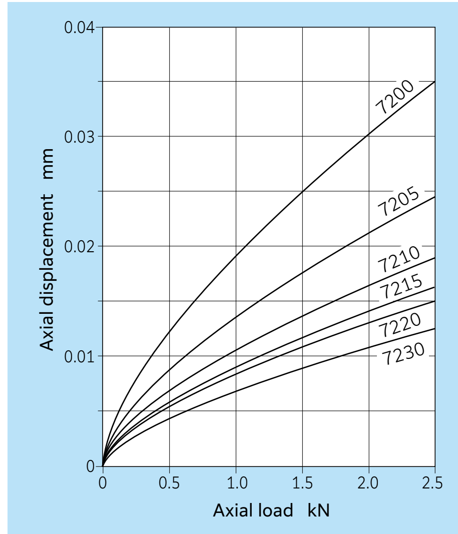


Fig. 17.2.3 Series 72 axial load vs. axial displacement

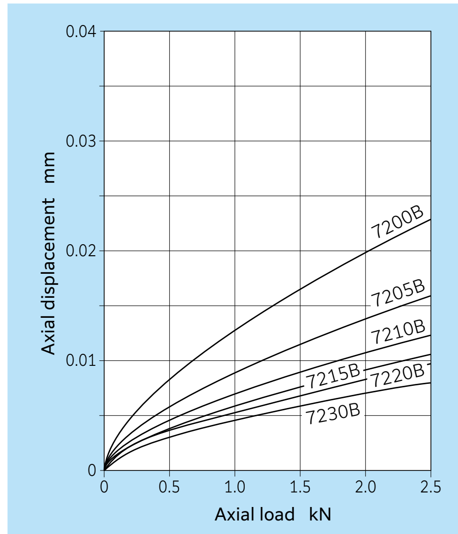


Fig. 17.2.4 Series 72 B axial load vs. axial displacement

Note: Please consult **NTN** Engineering for other types and sizes.

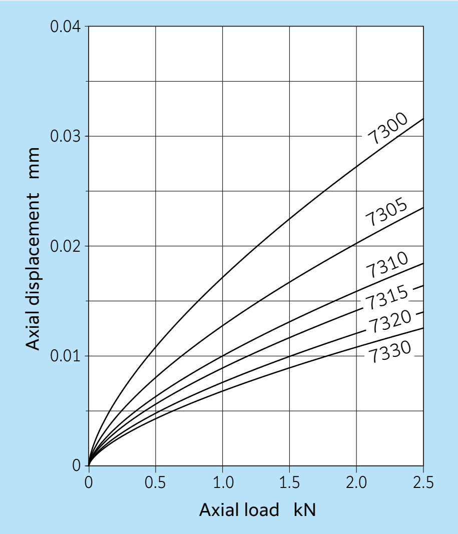


Fig. 17.2.5 Series 73 axial load vs. axial displacement

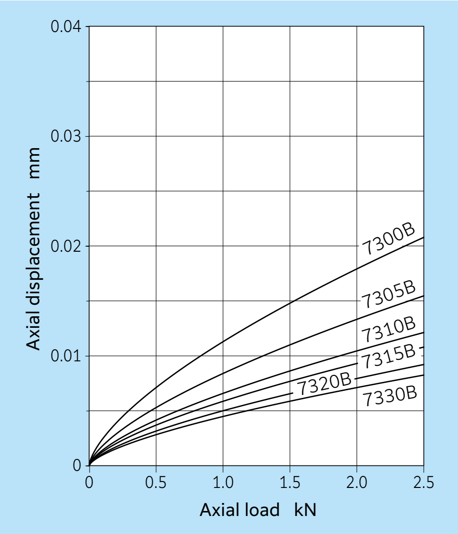


Fig. 17.2.6 Series 73B axial load vs. axial displacement

Note: Please consult **NTN** Engineering for other types and sizes.

17.2.2 Tapered roller bearings

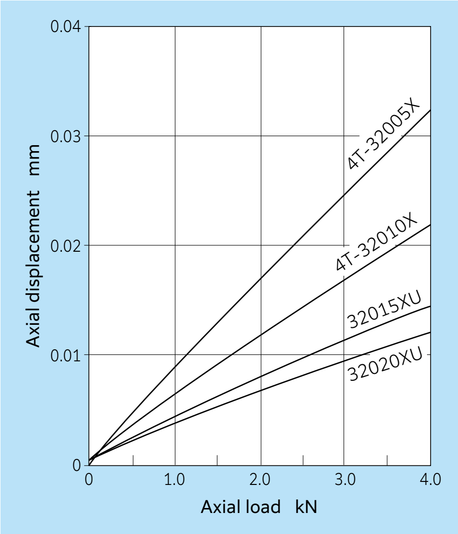


Fig. 17.2.7 Series 320 axial load vs. axial displacement

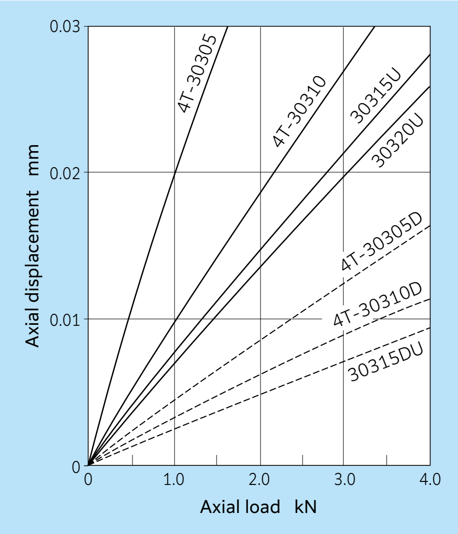


Fig. 17.2.9 Series 303/303 D axial load vs. axial displacement

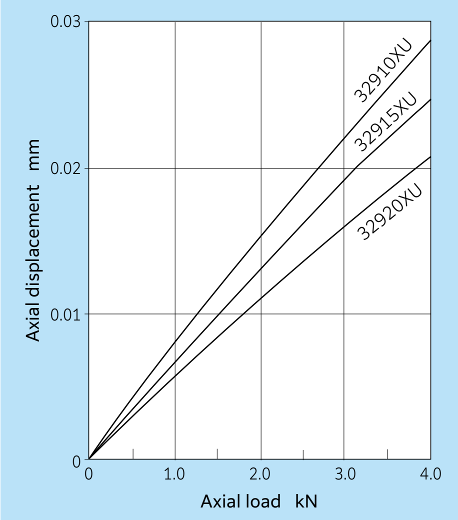


Fig. 17.2.8 Series 329 axial load vs. axial displacement

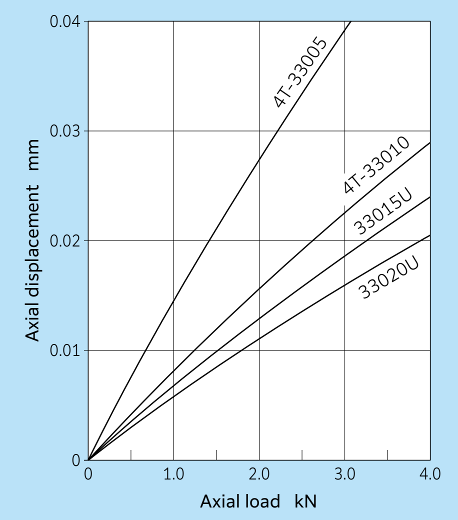


Fig. 17.2.10 Series 330 axial load vs. axial displacement

Note: 1. Values when the shaft and the housing are rigid bodies.
2. Axial displacement may increase depending on the shape of the shaft/housing and fitting conditions.
3. Please consult **NTN** Engineering for other types and sizes.

Technical Data

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

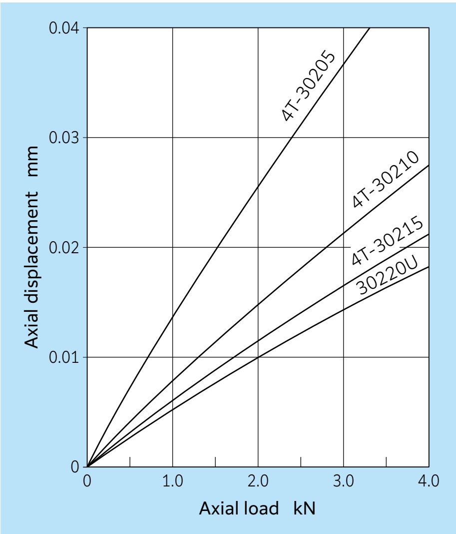


Fig. 17.2.11 Series 302 axial load vs. axial displacement

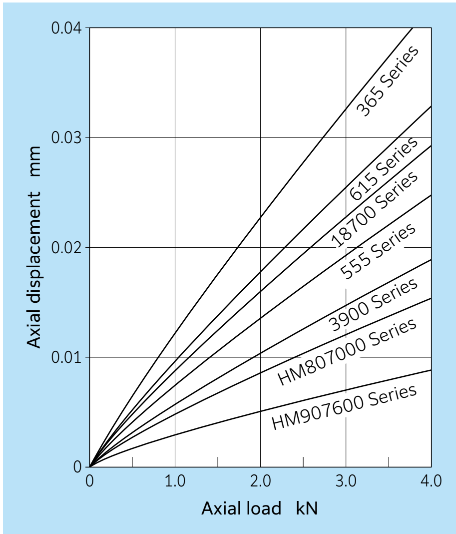


Fig. 17.2.12 Inch series axial load vs. axial displacement

Note: 1. Values when the shaft and the housing are rigid bodies.
2. Axial displacement may increase depending on the shape of the shaft/housing and fitting conditions.
3. Please consult **NTN** Engineering for other types and sizes.

Technical Data

*This technical data shows calculated values based on representative values, **NTN** does not guarantee these values.

17.3 Allowable axial load

17.3.1 Deep groove ball bearings

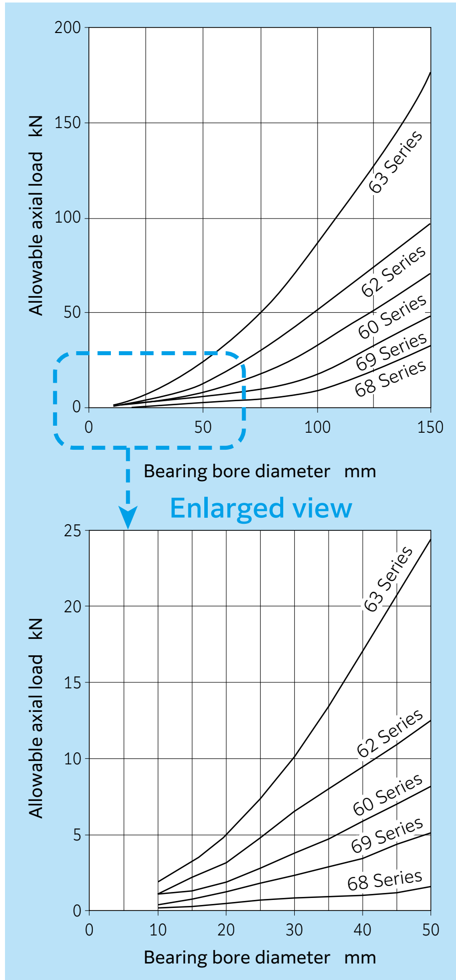


Fig. 17.3.1 Allowable axial load for deep groove ball bearings

Note: 1. Calculation of the allowable axial load uses the median of the radial clearance CN.
2. When an axial load is applied, the allowable axial load is the load whereby the contact ellipse exceeds the shoulder of the raceway.
3. Please consult **NTN** Engineering for other types and sizes.

17.3.2 Angular contact ball bearings

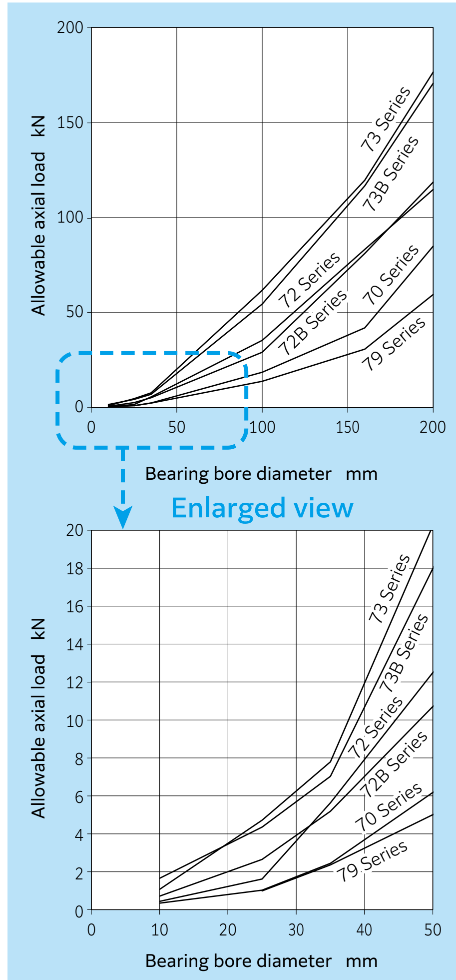


Fig. 17.3.2 Allowable axial load for angular contact ball bearings

Note: 1. When an axial load is applied, the allowable axial load is the load whereby the contact ellipse exceeds the shoulder of the raceway.
2. Please consult **NTN** Engineering for other types and sizes.

17.4 Fitting surface pressure

Table 17.4.1 lists equations for calculating the pressure and maximum stress between fitting surfaces.

Table 17.4.2 can be used to determine the approximate average groove diameter for bearing inner and outer rings.

The effective interference, in other words the actual interference Δ_{deff} after fitting, is smaller than the apparent interference Δd derived from the measured values for the bearing bore diameter and shaft. This difference is due to the roughness or variations of the finished surfaces to be fitted. Due to this, it is necessary to assume the following reductions in effective interference:

For ground shafts: 1.0 to 2.5 μm

For lathed shafts: 5.0 to 7.0 μm

Figure 17.4.1 and **Figure 17.4.2** show the root approximate values of the fitting surface pressure and the maximum stress when the solid steel shaft and the inner ring of 0 class bearings (d/D_i = 0.8) are fit.

Table 17.4.1 Fitting surface pressure and maximum stress

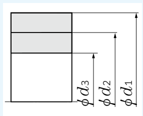
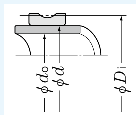
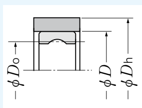
Fit condition		Calculation formula	Symbol (Unit: N, mm)
Fitting surface pressure MPa	Two cylinders General type	$P=\dfrac{E_1 E_2}{E_2\left\{\dfrac{(d_1^2+d_2^2)}{(d_1^2-d_2^2)}+\nu_1\right\}+E_1\left\{\dfrac{(d_2^2+d_3^2)}{(d_2^2-d_3^2)}-\nu_2\right\}}\cdot\dfrac{\Delta d_e}{d_2}$	P : Fitting surface pressure E_1, E_2 : Young's modulus of outer and inner cylinders ν_1, ν_2 : Poisson's ratio of outer and inner cylinders Δd_e : Effective interference of two cylinders 
	Solid steel shaft/ inner ring fit	$P=\dfrac{E}{2}\,\dfrac{\Delta_{deff}}{d}\left[1-\left(\dfrac{d}{D_i}\right)^2\right]$	d : Shaft diameter, inner ring bore diameter d_o : Hollow shaft inner diameter D_i : Inner ring average groove diameter Δ_{deff} : Effective interference E : Longitudinal elasticity factor = 208,000 MPa 
	Hollow steel shaft/ inner ring fit	$P=\dfrac{E}{2}\,\dfrac{\Delta_{deff}}{d}\,\dfrac{[1-(d/D_i)^2]\,[1-(d_o/d)^2]}{[1-(d_o/D_i)^2]}$	
	Steel housing/ outer ring fit	$P=\dfrac{E}{2}\,\dfrac{\Delta_{Deff}}{D}\,\dfrac{[1-(D_o/D)^2]\,[1-(D/D_h)^2]}{[1-(D_o/D_h)^2]}$	D : Housing inner diameter, bearing outer diameter D_o : Outer ring average groove diameter D_h : Housing outer diameter Δ_{Deff} : Effective interference 
Maximum stress MPa	Shaft/ inner ring fit	$\sigma_{t\,max}=P\,\dfrac{1+(d/D_i)^2}{1-(d/D_i)^2}$	Inner ring bore diameter maximum circumferential stress.
	Housing/ outer ring fit	$\sigma_{t\,max}=P\,\dfrac{2}{1-(D_o/D)^2}$	Outer ring outer diameter maximum circumferential stress.

Table 17.4.2 Average groove diameter (approximate expression)

Bearing type		Average groove diameter: Inner ring	Average groove diameter: Outer ring
Deep groove ball bearings	All types	$1.05\,\dfrac{4d+D}{5}$	$0.95\,\dfrac{d+4D}{5}$
Self-aligning ball bearings	12	$1.03\,\dfrac{3d+D}{4}$	$0.97\,\dfrac{d+2D}{3}$
	13, 22	$1.03\,\dfrac{3d+D}{4}$	$0.97\,\dfrac{d+3D}{4}$
	23	$1.03\,\dfrac{4d+D}{5}$	$0.97\,\dfrac{d+4D}{5}$
Cylindrical roller bearing 1)	All types	$1.05\,\dfrac{3d+D}{5}$	$0.98\,\dfrac{d+3D}{4}$
Spherical roller bearings	Type B, type C, type 213	$\dfrac{2d+D}{3}$	$0.97\,\dfrac{d+4D}{5}$
	ULTAGE	$\dfrac{3d+D}{4}$	$0.98\,\dfrac{d+5D}{6}$
Tapered roller bearings	All types	$\dfrac{3d+D}{4}$	$\dfrac{d+3D}{4}$

Note: d: inner ring bore diameter (mm) D: outer ring outer diameter (mm)
1) Average groove diameter values shown for double-flange type.

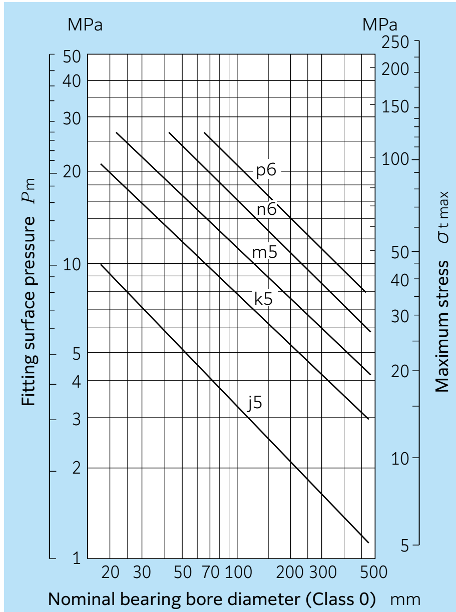


Fig. 17.4.1 Average fit interference as it relates to surface pressure P_m and maximum stress $\sigma_{t\,max}$

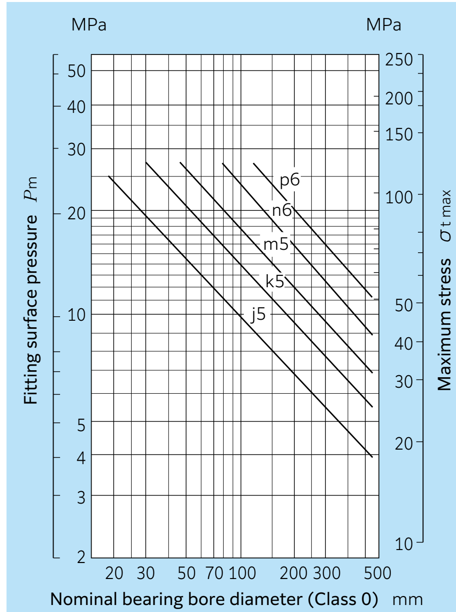


Fig. 17.4.2 Maximum fit interference as it relates to surface pressure P_m and maximum stress $\sigma_{t\,max}$

Note: For the recommended fitting, see the section of "7.3.2 Recommended fitting."

17.5 Necessary press fit and pullout force

Equations (17.1) and (17.2) below can be used to calculate the necessary pullout force for press fits on inner rings and shafts or outer rings and housings. The force obtained by the equations only serves as an approximation, and a larger load may be required for the actual installation and removal.

For shaft and inner rings:

$$K_{\mathrm{d}} = \mu \cdot P \cdot \pi \cdot d \cdot B \quad \cdots\cdots\cdots\cdots\cdots (17.1)$$

For housing and outer rings:

$$K_{\mathrm{D}} = \mu \cdot P \cdot \pi \cdot D \cdot B \quad \cdots\cdots\cdots\cdots\cdots (17.2)$$

Where:

K_{d} : Inner ring press fit or pullout force N
K_{D} : Outer ring press fit or pullout force N
P : Fitting surface pressure MPa (see **Table 17.4.1**)
d : Shaft diameter, inner ring bore diameter mm
D : Housing inner diameter, outer ring outer diameter mm
B : Inner or outer ring width mm
μ : Sliding friction coefficient (see **Table 17.5.1**)

Table 17.5.1 Press fit and pullout sliding friction coefficient

Concern	μ
Inner (outer) ring press fit onto cylindrical shaft (bore)	0.12
Inner (outer) ring pullout from cylindrical shaft (bore)	0.18
Inner ring press fit onto tapered shaft or sleeve	0.17
Inner ring pullout from tapered shaft	0.14
Sleeve press fit onto shaft/bearing	0.30
Sleeve pullout from shaft/bearing	0.33

17.6 Bearing technique calculation tool

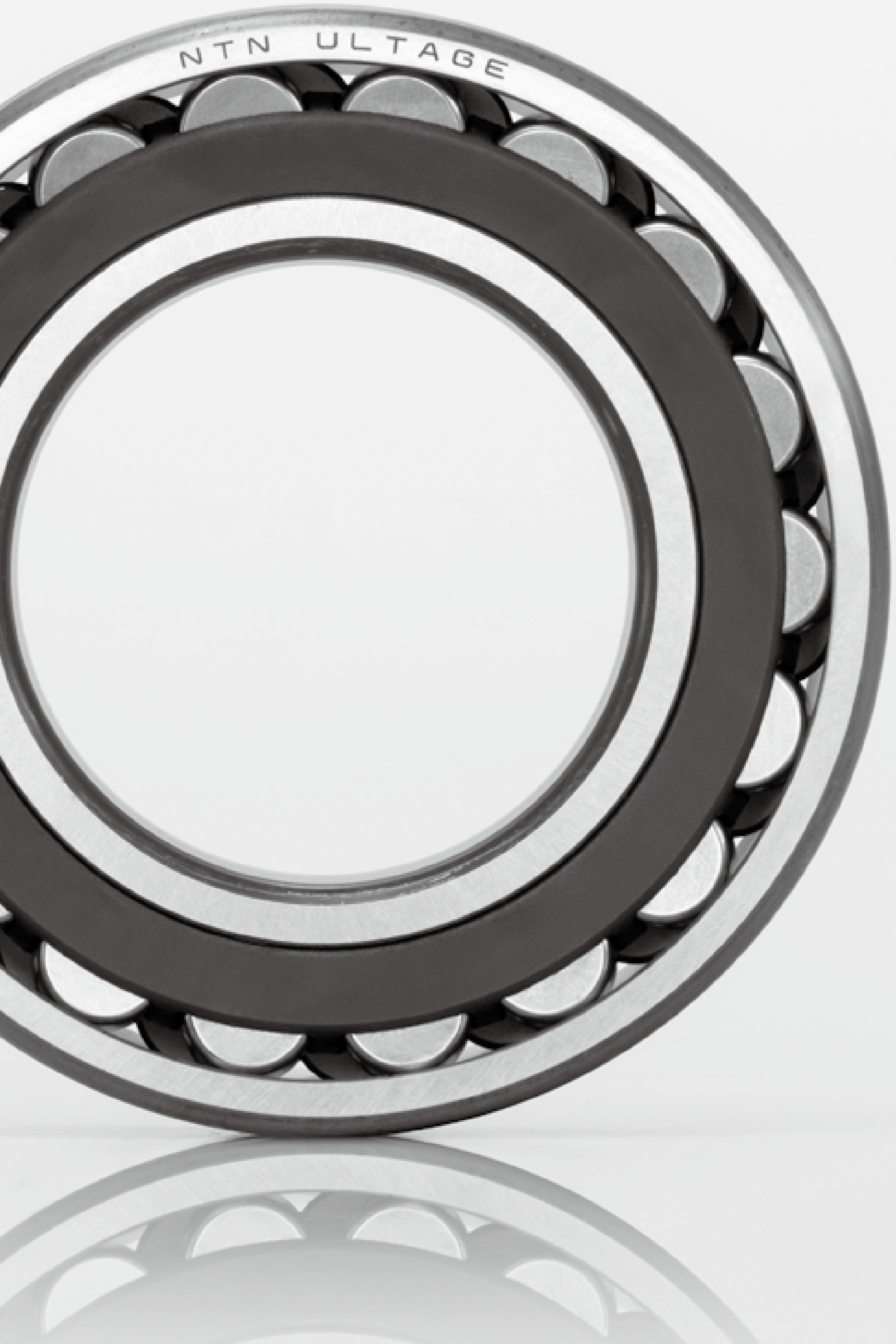
The following calculations can be performed by using the bearing technique calculation tool on the **NTN** website (https://www.ntnglobal.com).

- Basic rating life calculation of single bearing
- Basic rating life calculation of gear load and bearing
- Basic rating life calculation of bearing load and bearing
- Calculation of operating clearance
- Calculation of bearing vibration frequency

Ball and Roller Bearings

INDEX OF BEARING TABLES

NTN New Generation Bearings (ULTAGE Series)



Introduction of ULTAGE series

"ULTAGE" (a name created from the combination of "ultimate," signifying refinement, and "stage," signifying **NTN**'s intention that this series of products be employed in diverse applications) is the general name for **NTN**'s new generation of rolling bearings that are noted for their industry-leading performance. **NTN** is developing and expanding the ULTAGE series of each bearing type. Please see the introductory article on the following pages. The corresponding dimensions are specified in the dimension tables of each bearing type.

For details, see the following **NTN** catalogs.

ULTAGE series	cylindrical roller bearings	CAT.No.3037/E
ULTAGE metric series	large size tapered roller bearings	CAT.No.3035/E
ULTAGE series	spherical roller bearings [Type EA, Type EM]	CAT.No.3033/E

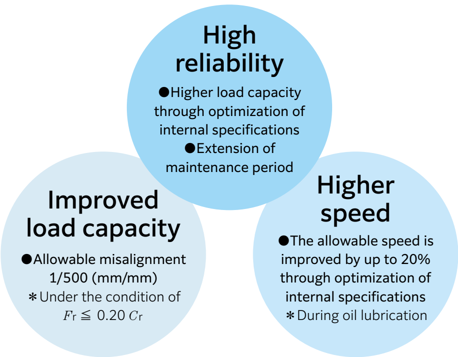
The following ULTAGE series bearings for special applications are also available.

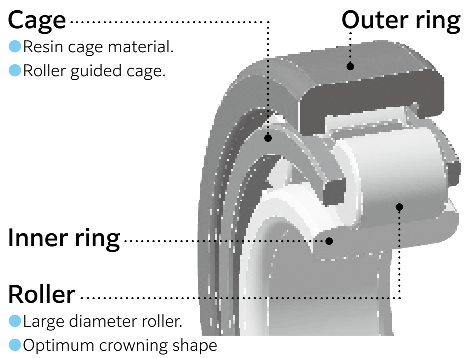
For further details, please refer to the section of "C. Special application bearings."

ULTAGE series	sealed four-row tapered roller bearings for rolling mill roll necks [CROU···LL type]
ULTAGE series	sealed spherical roller bearings [WA type]
ULTAGE series	spherical roller bearings with high-strength cage [EMA type]
ULTAGE series	deep groove ball bearings for high-speed servo motors [MA type]
ULTAGE series	precision rolling bearings for machine tools

Cylindrical roller bearings [ULTAGE series]

ULTAGE series cylindrical roller bearings are the standard series developed to meet the demands of "long operating life," "improved load capability," and "higher speed" that are required for various industrial machinery.





Features

1.Industry leading load rating

Higher load capacity and longer operating life have been realized through the optimization of internal specifications.

(1) Rating life: Up to 1.8 times longer (compared with NTN E type product)

(2) Basic dynamic load rating: Up to 20% higher (compared with NTN E type product)

2. Allowable misalignment (refer to Fig. 1)

Allowable misalignment: 1/500 (mm/mm)

Optimization of the roller crowning allows a combination of heavy loads (0.20 C_r) and allowable misalignment of 1/500 (mm/mm).

∗Necessary minimum load: 0.04 C_{0r}

3. Allowable speed

The allowable speed is increased up to 20% in oil lubrication (compared with NTN E type product).

4. Standard resin cage (refer to Fig. 2)

(1) Higher speed and longer operating life have been realized through the use of a window type combined PA resin cage.

(2) Resin cage materials: reinforced PA + GF

∗When machined cages are necessary for high speed and other special applications, consult **NTN** Engineering.

5. Interchangeability

The boundary dimensions conform to ISO 15, JIS B 1533, and DIN 5412 and are the same as that of the NTN E type products.

6. Allowable axial load

Same as NTN E type product

7. Allowable temperature

Allowable bearing operating temperature:
120°C (instantaneous) 100°C (continuous)

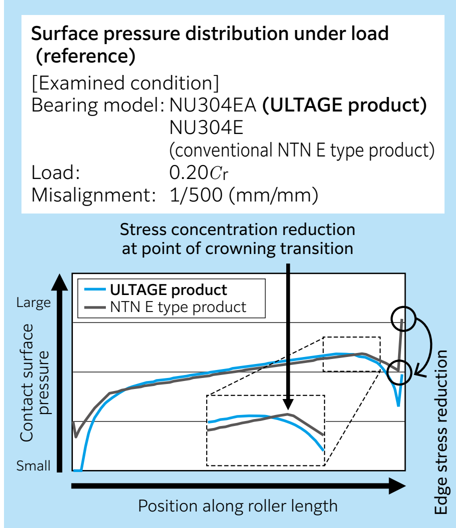


Fig. 1

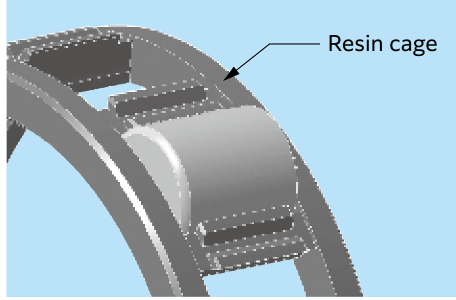


Fig. 2

Bearing number

Cylindrical roller bearing

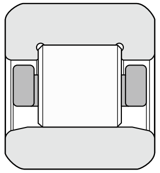
NU 22 04 EA T2X C3

- C3 — Radial internal clearance: C3
- T2X — Cage code: resin cage
- EA — **Type code: ULTAGE**
- 04 — Nominal bearing diameter: 20 mm
- 22 — Dimension series: 22
- NU — Bearing type: cylindrical roller bearing NU type

∗When the bearing is the NUP type, a code U is added at the end of the part number.

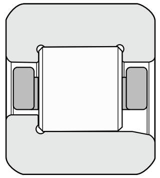
NTN

[Bearing type]



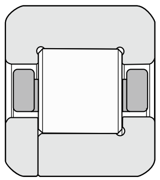
NU type structure
- Outer ring (with double flange)
- Roller
- Cage
- Inner ring (with no flanges)

The outer ring, roller, cage assembly, and inner ring can be separated.



NJ type structure
- Outer ring (with double flange)
- Roller
- Cage
- Inner ring (with single flange)

The outer ring, roller, cage assembly, and inner ring can be separated.

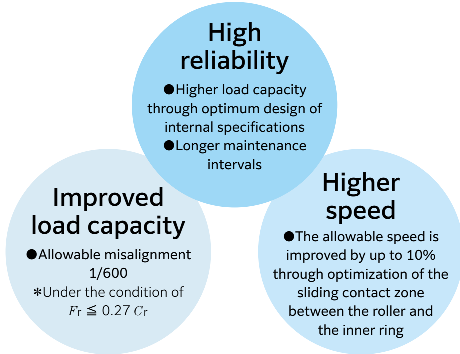


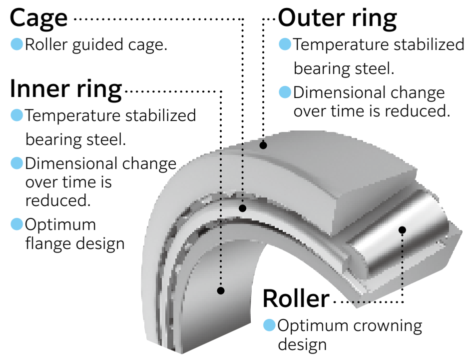
NUP type structure
- Outer ring (with double flange)
- Roller
- Cage
- Inner ring (with single flange)
- Inner ring collar ring

The outer ring, roller, cage assembly, inner ring, and collar ring can be separated.

Large size tapered roller bearings [ULTAGE metric series]

Large size tapered roller bearings (ULTAGE metric series with an outer diameter of ϕ270 mm or more) are the standard series developed to meet the demands of "long operating life," "improved load capability," and "higher speed" that are required for various industrial machinery.





Features

1. Industry leading reliability

The bearing load carrying capability has been improved by optimizing the roller crowning to reduce edge stress and allow a more uniform pressure distribution across the contact surface (see **Fig. 1**).

(1) Rating life: 3 times longer (compared to conventional NTN products)

(2) Basic dynamic rating load: 30% larger (compared to conventional NTN products)

2. Allowable misalignment

Allowable misalignment (single row): 1/600

Optimization of the roller crowning has allowed a combination of heavy loads (0.27 C_r) and allowable misalignment of 1/600.

*Necessary minimum load: 0.04 C_{0r}

Fig. 1 shows the contact surface pressure distribution of rollers considering an applied radial load of $F_r \leqq 0.27\ C_r$. By optimizing the roller crowning, the edge stress is greatly reduced and the contact surface pressure is made uniform compared with conventional products.

[Examined condition]

Bearing model : ULTAGE product and conventional NTN product (ϕ80 × ϕ170 × 42.5)
Load : 0.27 C_r
Allowable misalignment : 1/600

*The allowable misalignment differs depending on the loads and the bearing type. Please consult **NTN** Engineering.

3. Allowable speed

The allowable speed is improved by up to 10% (compared with the conventional NTN products) by optimizing the sliding contact zone between the roller and the inner ring, thus reducing the rotational torque and temperature rise (see **Fig. 2**, **Fig. 3**, and **Fig. 4**).

4. Dimensional change over time

Dimensional change of bearings over time has been reduced compared with conventional products by applying special heat treatment to bearing steel.

- Reduction in dimension change over time
  Conventional heat treatment : 1/10
  Case hardened steel ratio : 1/4

5. Interchangeability

The boundary dimensions conform to JIS B 1512-3 and ISO 355, and the installation dimensions are the same as that of the conventional NTN products.

In addition, the precision also conforms to JIS B 1514-1 and ISO 492.

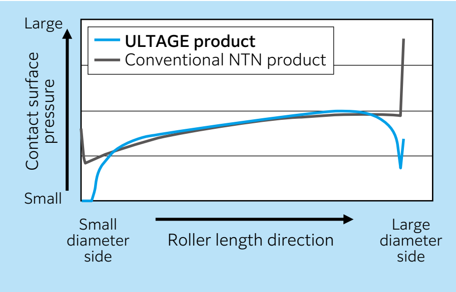


Fig. 1 Contact surface pressure distribution of rollers

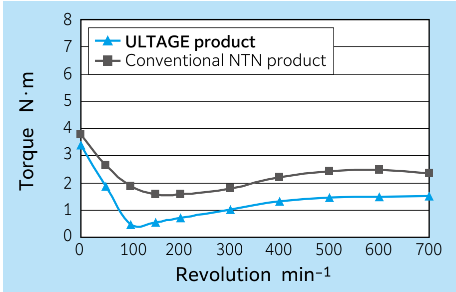


Fig. 3 Torque test result

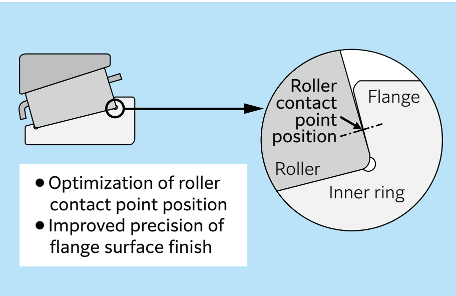


Fig. 2 Optimization of sliding surface between roller and inner ring

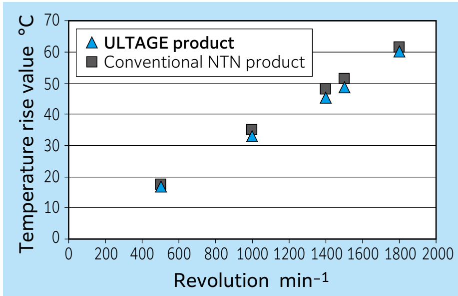


Fig. 4 Temperature rise test result

Bearing number

Single row tapered roller bearing

3 03 28 U UTG

- **UTG** — **Type code: ULTAGE**
- **U** — Internationally interchangeable bearings
- **28** — Nominal bore diameter: 140 mm
- **03** — Dimension series: 03
- **3** — Bearing type: single row tapered roller bearing

Double row back-to-back tapered roller bearing

43 03 28X UTG

- **UTG** — **Type code: ULTAGE**
- **28X** — Nominal bore diameter: 140 mm
- **03** — Dimension series: 03
- **43** — Bearing type: double row back-to-back tapered roller bearing

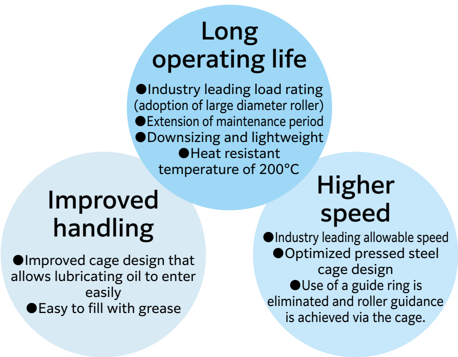
Double row face-to-face tapered roller bearing

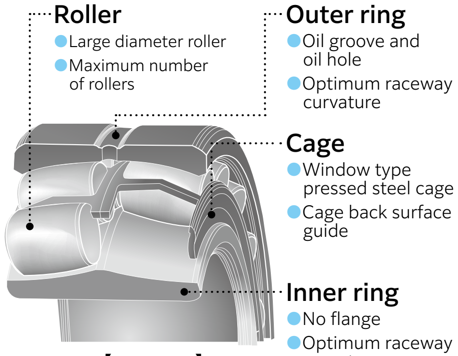
32 31 32 UTG

- **UTG** — **Type code: ULTAGE**
- **32** — Nominal bore diameter: 160 mm
- **31** — Dimension series: 31
- **32** — Bearing type: double row face-to-face tapered roller bearing

Spherical roller bearings [ULTAGE series EA/EM types]

ULTAGE series spherical roller bearings are the standard series developed to meet the demands of "long operating life," "higher speed," and "improved easy handling" that are required for various industrial machinery.





【EA type】

Features【EA type】

1. Industry leading load rating

Higher load capacity and longer operating life are realized by increasing the roller diameter and maximizing the number of rollers. This allows extension of the maintenance period (see **Fig. 1**).

(1) Basic dynamic rating load: Up to 65% higher (compared to conventional products)

(2) Basic static rating load: Up to 35% higher (compared to conventional products)

(3) Rating life: Up to 5 times longer (compared to conventional products)

2. Allowable speed of the world's highest level

Higher speed is realized through the adoption of a new pressed steel cage design.
[Allowable speed: 20% higher (compared to conventional products)]

3. Standard use of pressed steel cage

For the pressed steel cage, "window type" with rigidity is adopted, and the roller pocket is provided with four tabs (projections) (see **Fig. 2** and **Fig. 3**).

(1) Cage back surface used for guidance.

(2) The four pocket tabs stabilize the position of rollers.

(3) The new pocket shape allows consistent supply of lubricating oil and grease to the internal bearing surfaces (see **Fig. 4**).

(4) Special surface treatment is applied to the entire surface to improve the abrasion resistance.

4. Downsizing and lightweight

High-load capacity has allowed for downsizing and a lighter weight.

Comparison example

Bearing number	Rating load (kN)		Boundary dimension (mm)	Bearing volume (cm^3)	Mass (kg)
	C_r	C_{0r}			
22220B	315	415	ϕ100×ϕ180×46	810	4.95
22218EA	**385**	**398**	**ϕ90×ϕ160×40**	**550**	**3.28**

The volume weight and mass weight can be reduced by about 30%.

5. Improved handling

Adoption of the simple window type new pressed steel cage improved the workability at the time of assembly, disassembly, and grease application.

(1) Easy to fill with grease to roller surface

(2) Easy assembly and disassembly due to small roller drop

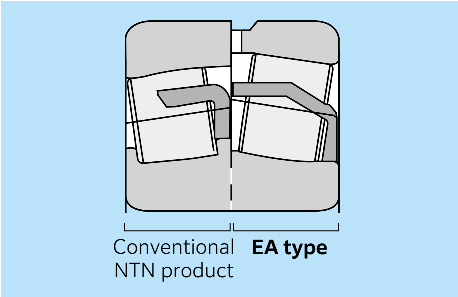


Fig. 1

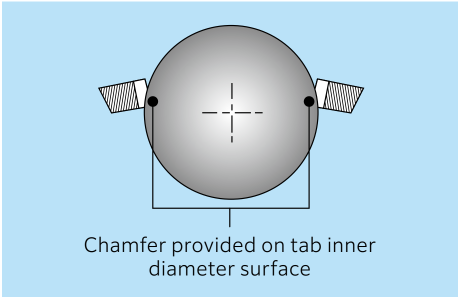


Fig. 3

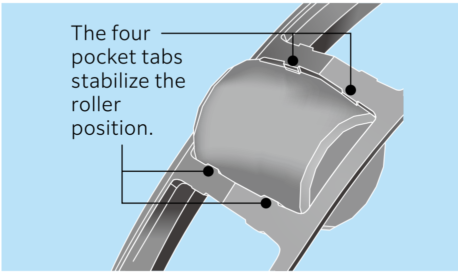


Fig. 2

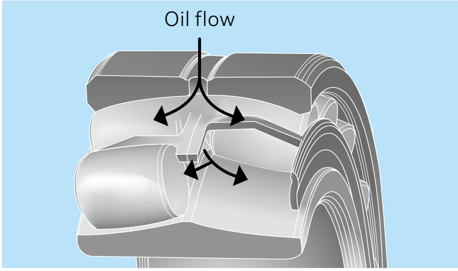


Fig. 4

Bearing number

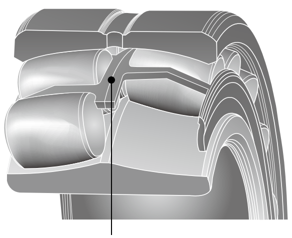
Spherical roller bearing

222 20 EA K D1 C3

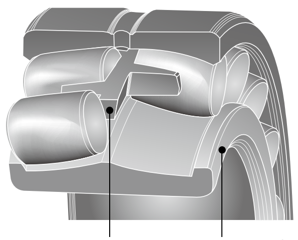
- **C3** — Internal clearance code
  - No code: normal clearance
  - C3: C3 clearance
- **D1** — Oil groove and oil hole code
  - D1 : oil groove and oil hole (Japan specification)
  - W33: oil groove and oil hole (Europe specification)
- **K** — External configuration code
  - No code: inner diameter cylindrical bore
  - K : tapered bore
- **EA** — **Type code**
  - EA : window type pressed steel cage
  - EM: one-piece high strength, machined brass cage
- **20** — Bore diameter code
- **222** — Dimension series code

A combined machined cage (EM type) is recommended for conditions with severe vibration and impact. (EM type and EA type have different inner ring shapes.)

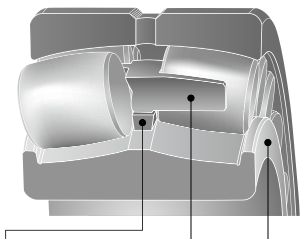
EA type



EM type



EM type (large size)



[Allowable misalignment]

- ●Normal load or more …… 1/115
- ●Light load …………………… 1/30

*Misalignment beyond the above limits may cause the roller to protrude from the outer ring, causing interference with the peripheral components.

Deep Groove Ball Bearings

Open type

Shielded type

Sealed type (non-contact)

Expansion compensating bearing

1. Design features and characteristics

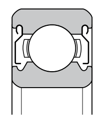
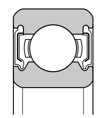
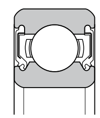
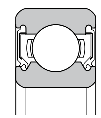
Deep groove ball bearings are very widely used. A deep groove is formed on the inner and outer ring of the bearing enabling the bearing to sustain radial and axial loads in either direction as well as the complex loads which result from the combination of these forces. Deep groove ball bearings are suitable for high speed applications.

When two or more deep groove ball bearings are used in combination and mounted adjacent to each other a duplex set (D2) should be used. Duplex bearings (D2) utilize controlled tolerances to more evenly distribute the loading between the individual bearing rows which improves the overall performance of the assembly.

In addition to unsealed and unlubricated "open" bearings, **NTN** provides deep groove ball bearings that are pre-lubricated with grease and enclosed by seals or shields. See section "11. Lubrication" for a list of some of the greases which can be used.

Table 1 shows the construction and special characteristics of various sealed deep groove ball bearings.

Table 1 Sealed ball bearings: construction and characteristics

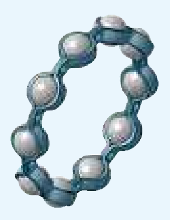
Types and codes		Shielded type	Sealed type		
		Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Construction					
		● Metal shield plate is affixed to the outside ring; the inner ring incorporates a V-groove and labyrinth clearance.	● The outer ring incorporates synthetic rubber molded to a steel plate; seal edge is aligned with V-groove along inner ring surface with labyrinth clearance.	● The outer ring incorporates synthetic rubber molded to a steel plate; seal edge contacts V-groove along inner ring surface.	● Basic construction is the same as LLU type, but a specially designed lip on the edge of the seal prevents foreign matter penetration; low torque construction.
Performance comparison	Torque	Small	Small	Higher	Medium
	Dust proofing	Good	Better than ZZ-type	Excellent	Much better than LLB-type
	Water proofing	Poor	Poor	Very good	Good
	High speed capacity	Same as open type	Same as open type	Limited by contact seals	Much better than LLU-type
	Allowable temp. range[1)]	Depends on lubricant	−25 to 120°C	−25 to 110°C	−25 to 120°C

1) Please consult **NTN** Engineering about applications which exceed the allowable temperature range of products listed on this table.
Note: This chart lists double shielded and double sealed bearings, but single shielded (Z) and single sealed (LB, LU, LH) are also available. Grease lubrication should be used with single shielded and single sealed bearings.

2. Standard cage type

As shown in **Table 2**, pressed steel cages are generally used for most deep groove ball bearings. Larger size deep groove ball bearings, and bearings operating at high rotational speeds often utilize a machined metallic cage.

Table 2 Standard cage for deep groove ball bearings

Cage type / Bearing series	Pressed cages	Machined cages
		
67	6700～ 6706	—
68	6800～ 6834	6836～ 68／600
69	6900～ 6934	6936～ 69／500
160	16001～16052	16056～16072
60	6000～ 6052	6056～ 6084
62	6200～ 6244	—
63	6300～ 6344	—
64	6403～ 6416	—

3. Other deep groove ball bearing enhancements

3.1 Bearings with snap rings

A snap ring grove or snap ring groove with snap ring combination are optional enhancements for the outer diameter of most deep groove ball bearings. Snap rings allow for simpler axial positioning and installation in the housing. Snap rings can be utilized with both open type and sealed or shielded deep groove ball bearings. Consult **NTN** Engineering.

3.2 Expansion compensating bearings (creep prevention bearings)

NTN offers the innovative Expansion Compensating (EC) feature to help with bearing retention when mounted in light alloy housings which is often a problem at elevated temperatures due to property differences between the bearing steel and the housing. This functionality is achieved by machining circumferential grooves into the outer diameter of an otherwise standard outer ring. These grooves are filled with an optimized polymer which has an expansion rate higher than that of the typical light alloy housing. The net result is a more consistent interference fit across a wide operating temperature range. This more consistent fit condition helps prevent the bearing from rotating within the housing (known as bearing creep) which helps ensure good performance and long life.

(1) Allowable load

As a result of having grooves machined in the outer diameter, the ring strength is lower compared with a standard bearing. Thus, **in order to prevent outer ring fracture, it is necessary to limit the maximum load applied to the bearing to be equal to or less than the allowable load C_p (see dimension table)**.

(2) Fit with housing

Table 3 shows the recommended fits for bearings with light metal alloy housings. In cases where the bearing is going to be interference fit with the housing, it is very important not to damage the polymer material. Therefore, it is essential that the lip of the housing diameter be given a 10-15° chamfer as shown in **Fig. 2**. Furthermore, as shown in **Fig. 2**, it is also advisable to apply the interference fit using a press in order not to force the bearing into the housing in a misaligned position.

Deep Groove Ball Bearings NTN

Table 3 Recommended fits for outer ring and housing bore

Condition: Load type, etc.		Condition: Housing material	Suitable bearing	Housing bore tolerance class
Rotating outer ring load Rotating inner ring load	Light load	Light alloys such as Al alloy and Mg alloy	Deep groove ball bearings Cylindrical roller bearings	H6
Indeterminate load	Normal load			
Rotating outer ring load	Heavy load	Light alloys such as Al alloy and Mg alloy	Thick-walled type deep groove ball bearings	N6
Indeterminate load	Impact load			

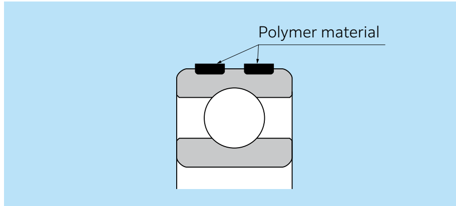


Fig. 1. Expansion compensating bearings

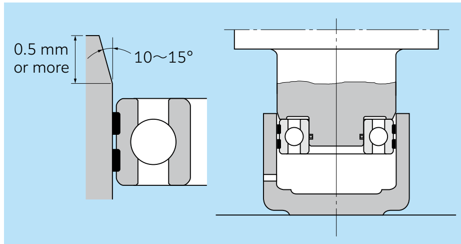


Fig. 2. Fitting method and housing inner diameter chamfer

(3) Radial internal clearance

Radial internal clearance are the same as those for standard deep groove ball bearings. With standard fit and application conditions, a C3 clearance is used. For more detailed information concerning this bearing and the availability of roller bearings contact **NTN** Engineering.

(4) Allowable temperature range

−20 to 120°C

3.3 AC bearings (creep prevention bearings)

NTN Offers the AC type bearing which performs a similar function to the EC bearing. AC bearings have the same outer diameter dimensions as standard bearings with the addition of two O-rings located in circumferential grooves on the outside diameter of the outer ring. (**Fig. 3**) While the EC bearing is more beneficial when using a light alloy housing at elevated temperatures, AC bearings are suitable for applications where a “tight fit” is not possible but outer ring creeping exists under rotating load on the outer ring. AC bearing can also be installed as a floating side bearing to accommodate expansion of shaft by heat as it is more axial. Before installing the bearing into the housing, a high viscosity oil (base oil viscosity, 100 mm^2/s or more) or grease must be applied to the space between two O-rings. This lubricant forms a thin oil layer on the bearing outer ring which prevents contact between the outer ring and housing, lowers the friction, and can minimize the occurrence of creeping by utilizing the friction force of the O-rings.

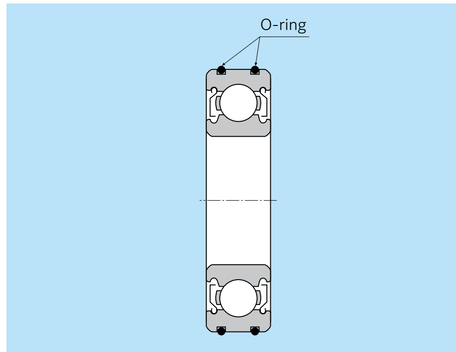


Fig. 3. AC bearing

(1) Allowable load

As is the case with the EC bearing, the load applied to an AC bearing shall be limited to C_p **(see dimension table) in order to ensure the strength limit of the modified outer ring is not exceeded**.

(2) Housing dimensions and shape

Fig. 4 shows the recommended shape of steel housings, and **Table 4** shows the dimensions.

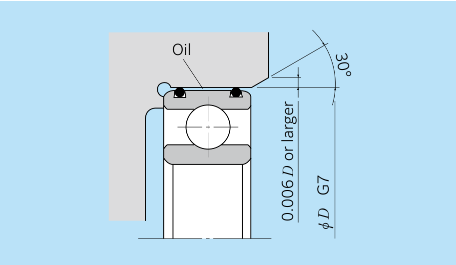


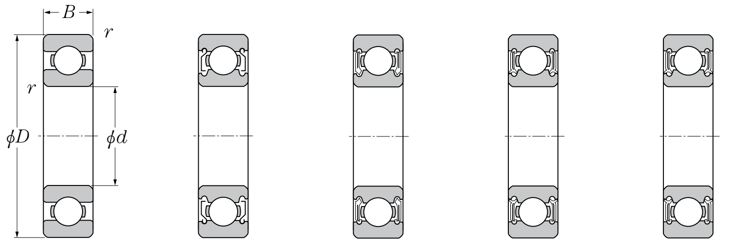
Fig. 4. Design of housing

Table 4 Dimensions and design

Housing bore tolerance	G7
Housing bore entrance chamfer	Max. 30°C
Housing bore chamfer undercut	0.006D or larger
Housing bore surface roughness *Ra*	2.5
Housing bore roundness	1/2 of bearing housing dimension tolerance

(3) Allowable temperature range

−25 to 120°C

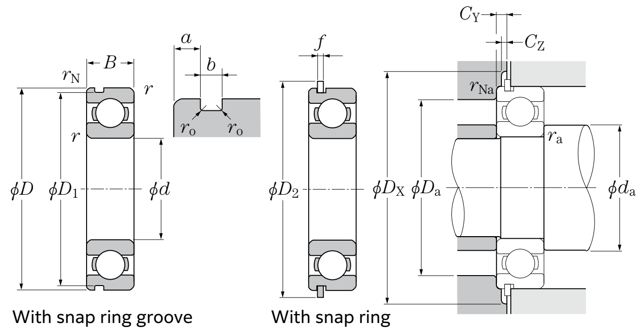


Open type   Shielded type (ZZ)   Non-contact sealed type (LLB, LLF)   Low torque sealed type (LLH)   Contact sealed type (LLU)

d 10 ～ 20mm

									Allowable speed min⁻¹				Bearing number				
Boundary dimensions mm					Basic load rating kN		Fatigue load limit kN	Factor	Grease		Oil						
					dynamic	static			Open type, ZZ, LLB, LLF, Z, LB, LF	LLH LH	Open type, Z, LB, LF	LLU LU	Open type	Shielded or sealed type 2) (See drawings)			
d	D	B	$r_{s\,min}$ 1)	r_{NS} Min.	C_r	C_{0r}	C_u	f_0									
10	15	3	0.1	—	0.950	0.435	0.018	15.7	10 000	12 000	—	—	**6700**	—	—	—	—
	19	5	0.3	—	2.03	0.925	0.072	14.8	32 000	38 000	—	24 000	**6800**	**ZZ**	**LLB**	—	**LLU**
	22	6	0.3	0.3	2.99	1.27	0.099	14.0	30 000	36 000	25 000	21 000	**6900**	**ZZ**	**LLB**	**LLH**	**LLU**
	26	8	0.3	—	5.05	1.96	0.138	12.4	29 000	34 000	25 000	21 000	**6000**	**ZZ**	**LLB**	**LLH**	**LLU**
	30	9	0.6	0.5	5.65	2.39	0.182	13.2	25 000	30 000	21 000	18 000	**6200**	**ZZ**	**LLB**	**LLH**	**LLU**
	35	11	0.6	0.5	9.10	3.50	0.273	11.4	23 000	27 000	20 000	16 000	**6300**	**ZZ**	**LLB**	**LLH**	**LLU**
12	18	4	0.2	—	1.03	0.530	0.021	16.2	8 300	9 500	—	—	**6701**	—	**LLF**	—	—
	21	5	0.3	—	2.12	1.04	0.080	15.3	29 000	35 000	—	20 000	**6801**	**ZZ**	**LLB**	—	**LLU**
	24	6	0.3	0.3	3.20	1.46	0.115	14.5	27 000	32 000	22 000	19 000	**6901**	**ZZ**	**LLB**	**LLH**	**LLU**
	28	7	0.3	—	5.65	2.39	0.187	13.2	26 000	30 000	—	—	**16001JRX**	—	—	—	—
	28	8	0.3	—	5.65	2.39	0.182	13.2	26 000	30 000	21 000	18 000	**6001JRX**	**ZZ**	**LLB**	**LLH**	**LLU**
	32	10	0.6	0.5	6.75	2.75	0.214	12.7	22 000	26 000	20 000	16 000	**6201**	**ZZ**	**LLB**	**LLH**	**LLU**
	37	12	1	0.5	10.8	4.20	0.325	11.1	20 000	24 000	19 000	15 000	**6301**	**ZZ**	**LLB**	**LLH**	**LLU**
15	21	4	0.2	—	1.04	0.585	0.024	16.5	6 600	7 600	—	—	**6702**	—	**LLF**	—	—
	24	5	0.3	—	2.30	1.26	0.091	15.8	26 000	31 000	—	17 000	**6802**	**ZZ**	**LLB**	—	**LLU**
	28	7	0.3	0.3	4.05	2.00	0.157	14.8	24 000	28 000	—	16 000	**6902**	**ZZ**	**LLB**	—	**LLU**
	32	8	0.3	—	6.20	2.84	0.222	13.9	22 000	26 000	—	—	**16002**	—	—	—	—
	32	9	0.3	0.3	6.20	2.84	0.199	13.9	22 000	26 000	18 000	15 000	**6002**	**ZZ**	**LLB**	**LLH**	**LLU**
	35	11	0.6	0.5	8.60	3.60	0.279	12.7	19 000	23 000	18 000	15 000	**6202**	**ZZ**	**LLB**	**LLH**	**LLU**
	42	13	1	0.5	12.7	5.45	0.425	12.3	17 000	21 000	15 000	12 000	**6302**	**ZZ**	**LLB**	**LLH**	**LLU**
17	23	4	0.2	—	1.11	0.660	0.027	16.3	5 000	6 700	—	—	**6703**	—	**LLF**	—	—
	26	5	0.3	—	2.47	1.46	0.102	16.1	24 000	28 000	—	15 000	**6803**	**ZZ**	**LLB**	—	**LLU**
	30	7	0.3	0.3	5.15	2.58	0.202	14.7	22 000	26 000	—	14 000	**6903JRX**	**ZZ**	**LLB**	—	**LLU**
	35	8	0.3	—	7.55	3.35	0.263	13.6	20 000	24 000	—	—	**16003**	—	—	—	—
	35	10	0.3	0.3	7.55	3.35	0.243	13.6	20 000	24 000	16 000	14 000	**6003**	**ZZ**	**LLB**	**LLH**	**LLU**
	40	12	0.6	0.5	10.6	4.60	0.355	12.8	18 000	21 000	15 000	12 000	**6203**	**ZZ**	**LLB**	**LLH**	**LLU**
	47	14	1	0.5	15.0	6.55	0.510	12.2	16 000	19 000	14 000	11 000	**6303**	**ZZ**	**LLB**	**LLH**	**LLU**
	62	17	1.1	—	25.2	10.8	0.840	11.1	14 000	16 000	—	—	**6403**	**ZZ**	—	—	—
20	27	4	0.2	—	1.15	0.730	0.031	16.1	5 000	5 700	—	—	**6704**	—	**LLF**	—	—
	32	7	0.3	0.3	4.45	2.47	0.185	15.5	21 000	25 000	—	13 000	**6804JR**	**ZZ**	**LLB**	—	**LLU**
	37	9	0.3	0.3	7.05	3.70	0.288	14.7	19 000	23 000	—	12 000	**6904**	**ZZ**	**LLB**	—	**LLU**
	42	8	0.3	—	8.75	4.50	0.350	14.5	18 000	21 000	—	—	**16004**	—	—	—	—
	42	12	0.6	0.5	10.4	5.05	0.355	13.9	18 000	21 000	13 000	11 000	**6004**	**ZZ**	**LLB**	**LLH**	**LLU**
	47	14	1	0.5	14.2	6.65	0.505	13.2	16 000	18 000	12 000	10 000	**6204**	**ZZ**	**LLB**	**LLH**	**LLU**
	52	15	1.1	0.5	17.6	7.90	0.615	12.4	14 000	17 000	12 000	10 000	**6304**	**ZZ**	**LLB**	**LLH**	**LLU**

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



With snap ring groove   With snap ring

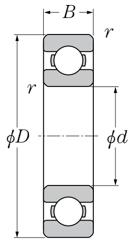
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

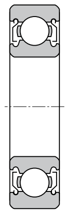
Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number		Snap ring groove dimensions mm				Snap ring dimensions mm		Installation-related dimensions mm								Mass 5) kg
Groove	Snap ring 3) (See drawings)	D_1 Max.	a Max.	b Min.	r_o Max.	D_2 Max.	f Max.	d_a Min.	d_a Max. 4)	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	(approx.)
—	—	—	—	—	—	—	—	10.8	—	14.2	—	—	—	0.1	—	0.0015
—	—	—	—	—	—	—	—	12	12.5	17	—	—	—	0.3	—	0.005
N	**NR**	20.8	1.05	0.8	0.2	24.8	0.7	12	13	20	25.5	1.5	0.7	0.3	0.3	0.009
— 6)	— 6)	—	—	—	—	—	—	12	13.5	24	—	—	—	0.3	—	0.019
N	**NR**	28.17	2.06	1.35	0.4	34.7	1.12	14	16	26	35.5	2.9	1.2	0.6	0.5	0.032
N	**NR**	33.17	2.06	1.35	0.4	39.7	1.12	14	17	31	40.5	2.9	1.2	0.6	0.5	0.053
—	—	—	—	—	—	—	—	13.6	13.8	16.4	—	—	—	0.2	—	0.002
—	—	—	—	—	—	—	—	14	14.5	19	—	—	—	0.3	—	0.006
N	**NR**	22.8	1.05	0.8	0.2	26.8	0.7	14	15	22	27.5	1.5	0.7	0.3	0.3	0.011
—	—	—	—	—	—	—	—	14	—	26	—	—	—	0.3	—	0.019
NX2	**NX2RX3**	26.44	2.20	0.90	0.3	32.7	0.85	14	16	26	33.4	2.8	0.9	0.3	0.3	0.021
N	**NR**	30.15	2.06	1.35	0.4	36.7	1.12	16	17	28	37.5	2.9	1.2	0.6	0.5	0.037
N	**NR**	34.77	2.06	1.35	0.4	41.3	1.12	17	18.5	32	42	2.9	1.2	1	0.5	0.06
—	—	—	—	—	—	—	—	16.6	16.8	19.4	—	—	—	0.2	—	0.0025
—	—	—	—	—	—	—	—	17	17.5	22	—	—	—	0.3	—	0.007
N	**NR**	26.7	1.3	0.95	0.25	30.8	0.85	17	17.5	26	31.5	1.9	0.9	0.3	0.3	0.016
—	—	—	—	—	—	—	—	17	—	30	—	—	—	0.3	—	0.025
N	**NR**	30.15	2.06	1.35	0.4	36.7	1.12	17	19	30	37.5	2.9	1.2	0.3	0.3	0.03
N	**NR**	33.17	2.06	1.35	0.4	39.7	1.12	19	20	31	40.5	2.9	1.2	0.6	0.5	0.045
N	**NR**	39.75	2.06	1.35	0.4	46.3	1.12	20	23	37	47	2.9	1.2	1	0.5	0.082
—	—	—	—	—	—	—	—	18.6	18.8	21.4	—	—	—	0.2	—	0.0025
—	—	—	—	—	—	—	—	19	19.5	24	—	—	—	0.3	—	0.008
N	**NR**	28.7	1.3	0.95	0.25	32.8	0.85	19	20	28	33.5	1.9	0.9	0.3	0.3	0.018
—	—	—	—	—	—	—	—	19	—	33	—	—	—	0.3	—	0.032
N	**NR**	33.17	2.06	1.35	0.4	39.7	1.12	19	21	33	40.5	2.9	1.2	0.3	0.3	0.039
N	**NR**	38.1	2.06	1.35	0.4	44.6	1.12	21	23	36	45.5	2.9	1.2	0.6	0.5	0.066
N	**NR**	44.6	2.46	1.35	0.4	52.7	1.12	22	25	42	53.5	3.3	1.2	1	0.5	0.115
—	—	—	—	—	—	—	—	23.5	30	55.5	—	—	—	1	—	0.27
—	—	—	—	—	—	—	—	21.6	22.3	25.4	—	—	—	0.2	—	0.0045
N	**NR**	30.7	1.3	0.95	0.25	34.8	0.85	22	22.5	30	35.5	1.9	0.9	0.3	0.3	0.019
N	**NR**	35.7	1.7	0.95	0.25	39.8	0.85	22	24	35	40.5	2.3	0.9	0.3	0.3	0.036
—	—	—	—	—	—	—	—	22	—	40	—	—	—	0.3	—	0.051
N	**NR**	39.75	2.06	1.35	0.4	46.3	1.12	24	26	38	47	2.9	1.2	0.6	0.5	0.069
N	**NR**	44.6	2.46	1.35	0.4	52.7	1.12	25	28	42	53.5	3.3	1.2	1	0.5	0.106
N	**NR**	49.73	2.46	1.35	0.4	57.9	1.12	26.5	28.5	45.5	58.5	3.3	1.2	1	0.5	0.144

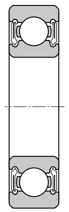
3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings. 6) See **B-54**.



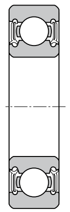
Open type



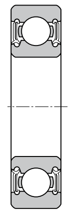
Shielded type (ZZ)



Non-contact sealed type (LLB, LLF)



Low torque sealed type (LLH)

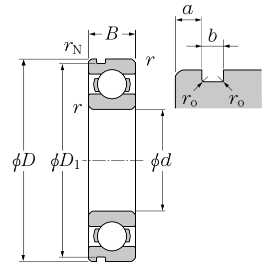


Contact sealed type (LLU)

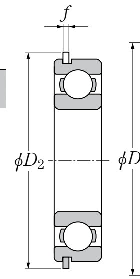
d 20 ～ 35mm

Boundary dimensions (mm) *d*	*D*	*B*	$r_{s\,min}$ 1)	r_{NS} Min.	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Factor f_0	Allowable speed (min⁻¹) Grease: Open type, ZZ, LLB, LLF, Z, LB, LF	Oil: Open type, Z, LB, LF	LLH: LH	LLU: LU	Bearing number Open type	Shielded or sealed type 2) (See drawings)			
20	72	19	1.1	—	31.5	13.9	1.09	11.4	12 000	14 000	—	—	**6404**	**ZZ**	—	—	—
22	44	12	0.6	0.5	10.4	5.05	0.395	13.9	17 000	20 000	13 000	10 000	**60/22**	**ZZ**	**LLB**	**LLH**	**LLU**
	50	14	1	0.5	14.3	6.80	0.500	13.5	14 000	17 000	12 000	9 700	**62/22**	**ZZ**	**LLB**	**LLH**	**LLU**
	56	16	1.1	0.5	20.4	9.25	0.725	12.4	13 000	15 000	11 000	9 200	**63/22**	**ZZ**	**LLB**	**LLH**	**LLU**
25	32	4	0.2	—	1.21	0.840	0.036	15.8	4 000	4 600	—	—	**6705**	—	**LLF**	—	—
	37	7	0.3	0.3	4.75	2.95	0.208	16.1	18 000	21 000	—	10 000	**6805JR**	**ZZ**	**LLB**	—	**LLU**
	42	9	0.3	0.3	7.80	4.55	0.345	15.4	16 000	19 000	11 700	9 800	**6905**	**ZZ**	**LLB**	**LLH**	**LLU**
	47	8	0.3	—	9.25	5.10	0.400	15.1	15 000	18 000	—	—	**16005**	—	—	—	—
	47	12	0.6	0.5	11.2	5.85	0.380	14.5	15 000	18 000	11 000	9 400	**6005**	**ZZ**	**LLB**	**LLH**	**LLU**
	52	15	1	0.5	15.5	7.85	0.550	13.9	13 000	15 000	11 000	8 900	**6205**	**ZZ**	**LLB**	**LLH**	**LLU**
	62	17	1.1	0.5	23.5	10.9	0.855	12.6	12 000	14 000	9 700	8 100	**6305**	**ZZ**	**LLB**	**LLH**	**LLU**
	80	21	1.5	—	38.5	17.5	1.36	11.6	10 000	12 000	—	—	**6405**	**ZZ**	—	—	—
28	52	12	0.6	0.5	13.8	7.40	0.580	14.5	14 000	16 000	10 000	8 400	**60/28**	**ZZ**	**LLB**	**LLH**	**LLU**
	58	16	1	0.5	19.8	9.75	0.720	13.4	12 000	14 000	9 700	8 100	**62/28**	**ZZ**	**LLB**	**LLH**	**LLU**
	68	18	1.1	0.5	29.6	14.0	1.10	12.4	11 000	13 000	8 900	7 400	**63/28**	**ZZ**	**LLB**	**LLH**	**LLU**
30	37	4	0.2	—	1.27	0.950	0.041	15.7	3 300	3 800	—	—	**6706**	—	**LLF**	—	—
	42	7	0.3	0.3	5.20	3.65	0.244	16.5	15 000	18 000	10 500	8 800	**6806JR**	**ZZ**	**LLB**	**LLH**	**LLU**
	47	9	0.3	0.3	8.00	5.00	0.365	15.8	14 000	17 000	10 000	8 400	**6906**	**ZZ**	**LLB**	**LLH**	**LLU**
	55	9	0.3	—	12.5	7.35	0.570	15.2	13 000	15 000	—	—	**16006**	—	—	—	—
	55	13	1	0.5	14.7	8.30	0.650	14.8	13 000	15 000	9 200	7 700	**6006**	**ZZ**	**LLB**	**LLH**	**LLU**
	62	16	1	0.5	21.6	11.3	0.795	13.8	11 000	13 000	8 800	7 300	**6206**	**ZZ**	**LLB**	**LLH**	**LLU**
	72	19	1.1	0.5	29.5	15.0	1.14	13.3	10 000	12 000	7 900	6 600	**6306**	**ZZ**	**LLB**	**LLH**	**LLU**
	90	23	1.5	—	48.0	23.9	1.86	12.3	8 800	10 000	—	—	**6406**	**ZZ**	—	—	—
32	58	13	1	0.5	13.1	8.05	0.615	15.4	12 000	15 000	8 700	7 200	**60/32**	**ZZ**	**LLB**	**LLH**	**LLU**
	65	17	1	0.5	23.0	11.6	0.840	13.6	11 000	12 000	8 400	7 100	**62/32**	**ZZ**	**LLB**	**LLH**	**LLU**
	75	20	1.1	0.5	33.0	16.9	1.30	13.1	9 500	11 000	7 700	6 500	**63/32**	**ZZ**	**LLB**	**LLH**	**LLU**
35	47	7	0.3	0.3	5.45	4.05	0.268	16.4	13 000	16 000	—	7 600	**6807JR**	**ZZ**	**LLB**	—	**LLU**
	55	10	0.6	0.5	10.6	6.85	0.495	15.8	12 000	15 000	8 500	7 100	**6907**	**ZZ**	**LLB**	**LLH**	**LLU**
	62	9	0.3	—	12.9	8.20	0.605	15.6	12 000	14 000	—	—	**16007**	—	—	—	—
	62	14	1	0.5	17.7	10.3	0.805	14.8	12 000	14 000	8 200	6 800	**6007**	**ZZ**	**LLB**	**LLH**	**LLU**
	72	17	1.1	0.5	28.4	15.3	1.09	13.8	9 800	11 000	7 600	6 300	**6207**	**ZZ**	**LLB**	**LLH**	**LLU**
	80	21	1.5	0.5	37.0	19.1	1.47	13.1	8 800	10 000	7 300	6 000	**6307**	**ZZ**	**LLB**	**LLH**	**LLU**
	100	25	1.5	—	61.0	31.0	2.43	12.3	7 800	9 100	—	—	**6407**	**ZZ**	—	—	—

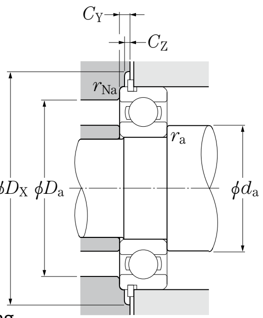
1) Smallest allowable dimension for chamfer dimension *r*. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



With snap ring groove



With snap ring



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	*e*	$\frac{F_a}{F_r} \le e$ *X*	*Y*	$\frac{F_a}{F_r} > e$ *X*	*Y*
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

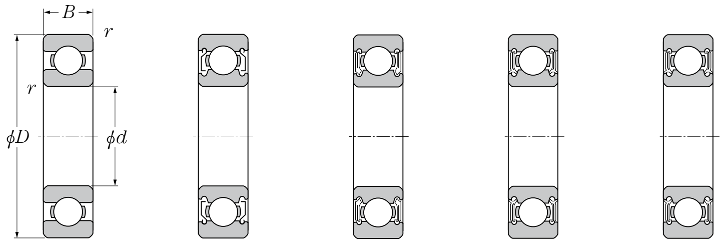
Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number (Open type)	Bearing number Groove / Snap ring 3) (See drawings)		Snap ring groove dimensions (mm) D_1 Max.	*a* Max.	*b* Min.	r_o Max.	Snap ring dimensions (mm) D_2 Max.	*f* Max.	Installation-related dimensions (mm) d_a Min.	d_a Max. 4)	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	Mass 5) (kg) (approx.)
6404	—	—	—	—	—	—	—	—	26.5	35.5	65.5	—	—	—	1	—	0.4
60/22	N	NR	41.75	2.06	1.35	0.4	48.3	1.12	26	26.5	40	49	2.9	1.2	0.6	0.5	0.074
62/22	N	NR	47.6	2.46	1.35	0.4	55.7	1.12	27	29.5	45	56.5	3.3	1.2	1	0.5	0.117
63/22	N	NR	53.6	2.46	1.35	0.4	61.7	1.12	28.5	31	49.5	62.5	3.3	1.2	1	0.5	0.176
6705	—	—	—	—	—	—	—	—	26.6	27.3	30.4	—	—	—	0.2	—	0.005
6805JR	N	NR	35.7	1.3	0.95	0.25	39.8	0.85	27	28	35	40.5	1.9	0.9	0.3	0.3	0.022
6905	N	NR	40.7	1.7	0.95	0.25	44.8	0.85	27	29	40	45.5	2.3	0.9	0.3	0.3	0.042
16005	—	—	—	—	—	—	—	—	27	—	45	—	—	—	0.3	—	0.06
6005	N	NR	44.6	2.06	1.35	0.4	52.7	1.12	29	30.5	43	53.5	2.9	1.2	0.6	0.5	0.08
6205	N	NR	49.73	2.46	1.35	0.4	57.9	1.12	30	32	47	58.5	3.3	1.2	1	0.5	0.128
6305	N	NR	59.61	3.28	1.9	0.6	67.7	1.7	31.5	35	55.5	68.5	4.6	1.7	1	0.5	0.232
6405	—	—	—	—	—	—	—	—	33	41	72	—	—	—	1.5	—	0.53
60/28	N	NR	49.73	2.06	1.35	0.4	57.9	1.12	32	34	48	58.5	2.9	1.2	0.6	0.5	0.098
62/28	N	NR	55.6	2.46	1.35	0.4	63.7	1.12	33	35.5	53	64.5	3.3	1.2	1	0.5	0.171
63/28	N	NR	64.82	3.28	1.9	0.6	74.6	1.7	34.5	38.5	61.5	76	4.6	1.7	1	0.5	0.284
6706	—	—	—	—	—	—	—	—	31.6	32.3	35.4	—	—	—	0.2	—	0.006
6806JR	N	NR	40.7	1.3	0.95	0.25	44.8	0.85	32	33	40	45.5	1.9	0.9	0.3	0.3	0.026
6906	N	NR	45.7	1.7	0.95	0.25	49.8	0.85	32	34	45	50.5	2.3	0.9	0.3	0.3	0.048
16006	—	—	—	—	—	—	—	—	32	—	53	—	—	—	0.3	—	0.091
6006	N	NR	52.6	2.08	1.35	0.4	60.7	1.12	35	37	50	61.5	2.9	1.2	1	0.5	0.116
6206	N	NR	59.61	3.28	1.9	0.6	67.7	1.7	35	39	57	68.5	4.6	1.7	1	0.5	0.199
6306	N	NR	68.81	3.28	1.9	0.6	78.6	1.7	36.5	43	65.5	80	4.6	1.7	1	0.5	0.36
6406	—	—	—	—	—	—	—	—	38	49	82	—	—	—	1.5	—	0.735
60/32	N	NR	55.6	2.08	1.35	0.4	63.7	1.12	37	39	53	64.5	2.9	1.2	1	0.5	0.129
62/32	N	NR	62.6	3.28	1.9	0.6	70.7	1.7	37	40	60	71.5	4.6	1.7	1	0.5	0.226
63/32	N	NR	71.83	3.28	1.9	0.6	81.6	1.7	38.5	43.5	68.5	83	4.6	1.7	1	0.5	0.382
6807JR	N	NR	45.7	1.3	0.95	0.25	49.8	0.85	37	38	45	50.5	1.9	0.9	0.3	0.3	0.029
6907	N	NR	53.7	1.7	0.95	0.25	57.8	0.85	39	40	51	58.5	2.3	0.9	0.6	0.5	0.074
16007	—	—	—	—	—	—	—	—	37	—	60	—	—	—	0.3	—	0.11
6007	N	NR	59.61	2.08	1.9	0.6	67.7	1.7	40	42	57	68.5	3.4	1.7	1	0.5	0.155
6207	N	NR	68.81	3.28	1.9	0.6	78.6	1.7	41.5	45	65.5	80	4.6	1.7	1	0.5	0.288
6307	N	NR	76.81	3.28	1.9	0.6	86.6	1.7	43	47	72	88	4.6	1.7	1.5	0.5	0.457
6407	—	—	—	—	—	—	—	—	43	56.5	92	—	—	—	1.5	—	0.952

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

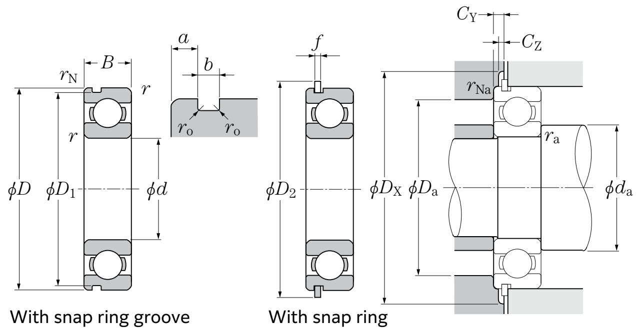


Open type | Shielded type (ZZ) | Non-contact sealed type (LLB) | Low torque sealed type (LLH) | Contact sealed type (LLU)

d 40 ～ 60mm

Boundary dimensions (mm)					Basic load rating (kN)		Fatigue load limit (kN)	Factor	Allowable speed min^{-1}				Bearing number				
					dynamic	static			Grease: Open type, ZZ, LLB, Z, LB	Oil: Open type, Z, LB	LLH, LH	LLU, LU	Open type	Shielded or sealed type[2] (See drawings)			
d	D	B	$r_{s\,min}$[1]	r_{NS} Min.	C_r	C_{0r}	C_u	f_0									
40	52	7	0.3	0.3	5.65	4.40	0.291	16.3	12 000	14 000	8 000	6 700	**6808JR**	ZZ	LLB	LLH	LLU
	62	12	0.6	0.5	13.5	8.90	0.645	15.8	11 000	13 000	7 500	6 300	**6908**	ZZ	LLB	LLH	LLU
	68	9	0.3	—	14.0	9.65	0.685	16.0	10 000	12 000	—	—	**16008**	—	—	—	—
	68	15	1	0.5	18.6	11.5	0.890	15.2	10 000	12 000	7 300	6 100	**6008**	ZZ	LLB	LLH	LLU
	80	18	1.1	0.5	32.5	17.8	1.24	14.0	8 700	10 000	6 700	5 600	**6208**	ZZ	LLB	LLH	LLU
	90	23	1.5	0.5	45.0	24.0	1.83	13.2	7 800	9 200	6 400	5 300	**6308**	ZZ	LLB	LLH	LLU
	110	27	2	—	70.5	36.5	2.85	12.3	7 000	8 200	—	—	**6408**	ZZ	—	—	—
45	58	7	0.3	0.3	5.95	4.95	0.325	16.1	11 000	12 000	—	5 900	**6809JR**	ZZ	LLB	—	LLU
	68	12	0.6	0.5	14.5	10.4	0.730	16.1	9 800	12 000	—	5 600	**6909**	ZZ	LLB	—	LLU
	75	10	0.6	—	14.3	10.5	0.725	16.2	9 200	11 000	—	—	**16009**	—	—	—	—
	75	16	1	0.5	23.2	15.1	1.16	15.3	9 200	11 000	6 500	5 400	**6009**	ZZ	LLB	LLH	LLU
	85	19	1.1	0.5	36.0	20.4	1.60	14.1	7 800	9 200	6 200	5 200	**6209**	ZZ	LLB	LLH	LLU
	100	25	1.5	0.5	58.5	32.0	2.50	13.1	7 000	8 200	5 600	4 700	**6309**	ZZ	LLB	LLH	LLU
	120	29	2	—	85.5	45.0	3.50	12.1	6 300	7 400	—	—	**6409**	ZZ	—	—	—
50	65	7	0.3	0.3	7.30	6.10	0.405	16.1	9 600	11 000	—	5 300	**6810JR**	ZZ	LLB	—	LLU
	72	12	0.6	0.5	14.9	11.2	0.765	16.3	8 900	11 000	6 100	5 100	**6910**	ZZ	LLB	LLH	LLU
	80	10	0.6	—	14.7	11.3	0.760	16.4	8 400	9 800	—	—	**16010**	—	—	—	—
	80	16	1	0.5	24.2	16.6	1.24	15.5	8 400	9 800	6 000	5 000	**6010**	ZZ	LLB	LLH	LLU
	90	20	1.1	0.5	39.0	23.2	1.82	14.4	7 100	8 300	5 700	4 700	**6210**	ZZ	LLB	LLH	LLU
	110	27	2	0.5	68.5	38.5	2.99	13.2	6 400	7 500	5 000	4 200	**6310**	ZZ	LLB	LLH	LLU
	130	31	2.1	—	92.0	49.5	3.85	12.5	5 700	6 700	—	—	**6410**	ZZ	—	—	—
55	72	9	0.3	0.3	9.75	8.10	0.540	16.2	8 700	10 000	—	4 800	**6811JR**	ZZ	LLB	—	LLU
	80	13	1	0.5	17.7	13.3	0.915	16.2	8 200	9 600	5 500	4 600	**6911**	ZZ	LLB	LLH	LLU
	90	11	0.6	—	20.6	15.3	1.06	16.2	7 700	9 000	—	—	**16011**	—	—	—	—
	90	18	1.1	0.5	31.5	21.2	1.62	15.3	7 700	9 000	—	4 500	**6011**	ZZ	LLB	—	LLU
	100	21	1.5	0.5	48.0	29.2	2.29	14.3	6 400	7 600	—	4 300	**6211**	ZZ	LLB	—	LLU
	120	29	2	0.5	79.5	45.0	3.50	13.2	5 800	6 800	—	3 900	**6311**	ZZ	LLB	—	LLU
	140	33	2.1	—	98.5	54.0	4.20	12.7	5 200	6 100	—	—	**6411**	ZZ	—	—	—
60	78	10	0.3	0.3	12.7	10.6	0.705	16.3	8 000	9 400	—	4 400	**6812**	ZZ	LLB	—	LLU
	85	13	1	0.5	18.2	14.3	0.965	16.4	7 600	8 900	—	4 300	**6912**	ZZ	LLB	—	LLU
	95	11	0.6	—	22.1	17.5	1.20	16.3	7 000	8 300	—	—	**16012**	—	—	—	—
	95	18	1.1	0.5	32.5	23.2	1.73	15.6	7 000	8 300	—	4 100	**6012**	ZZ	LLB	—	LLU
	110	22	1.5	0.5	58.0	36.0	2.83	14.3	6 000	7 000	4 500	3 800	**6212**	ZZ	LLB	LLH	LLU
	130	31	2.1	0.5	90.5	52.0	4.10	13.2	5 400	6 300	—	3 600	**6312**	ZZ	LLB	—	LLU
	150	35	2.1	—	113	64.5	4.90	12.6	4 800	5 700	—	—	**6412**	ZZ	—	—	—

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



With snap ring groove | With snap ring

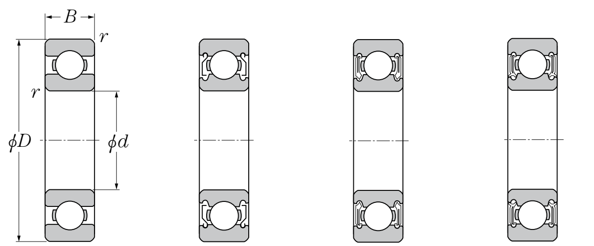
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number Groove / Snap ring[3] (See drawings)		Snap ring groove dimensions (mm)				Snap ring dimensions (mm)		Installation-related dimensions (mm)								Mass[5] (kg)
		D_1 Max.	a Max.	b Min.	r_o Max.	D_2 Max.	f Max.	d_a Min.	d_a Max.[4]	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	(approx.)
N	NR	50.7	1.3	0.95	0.25	54.8	0.85	42	43	50	55.5	1.9	0.9	0.3	0.3	0.033
N	NR	60.7	1.7	0.95	0.25	64.8	0.85	44	45	58	65.5	2.3	0.9	0.6	0.5	0.11
—	—	—	—	—	—	—	—	42	—	66	—	—	—	0.3	—	0.125
N	NR	64.82	2.49	1.9	0.6	74.6	1.7	45	47	63	76	3.8	1.7	1	0.5	0.19
N	NR	76.81	3.28	1.9	0.6	86.6	1.7	46.5	51	73.5	88	4.6	1.7	1	0.5	0.366
N	NR	86.79	3.28	2.7	0.6	96.5	2.46	48	54	82	98	5.4	2.5	1.5	0.5	0.63
—	—	—	—	—	—	—	—	49	61.5	101	—	—	—	2.0	—	1.23
N	NR	56.7	1.3	0.95	0.25	60.8	0.85	47	48	56	61.5	1.9	0.9	0.3	0.3	0.04
N	NR	66.7	1.7	0.95	0.25	70.8	0.85	49	51	64	72	2.3	0.9	0.6	0.5	0.128
—	—	—	—	—	—	—	—	49	—	71	—	—	—	0.6	—	0.171
N	NR	71.83	2.49	1.9	0.6	81.6	1.7	50	52.5	70	83	3.8	1.7	1	0.5	0.237
N	NR	81.81	3.28	1.9	0.6	91.6	1.7	51.5	55.5	78.5	93	4.6	1.7	1	0.5	0.398
N	NR	96.8	3.28	2.7	0.6	106.5	2.46	53	61.5	92	108	5.4	2.5	1.5	0.5	0.814
—	—	—	—	—	—	—	—	54	66.5	111	—	—	—	2	—	1.53
N	NR	63.7	1.3	0.95	0.25	67.8	0.85	52	54	63	68.5	1.9	0.9	0.3	0.3	0.052
N	NR	70.7	1.7	0.95	0.25	74.8	0.85	54	55.5	68	76	2.3	0.9	0.6	0.5	0.132
—	—	—	—	—	—	—	—	54	—	76	—	—	—	0.6	—	0.18
N	NR	76.81	2.49	1.9	0.6	86.6	1.7	55	57.5	75	88	3.8	1.7	1	0.5	0.261
N	NR	86.79	3.28	2.7	0.6	96.5	2.46	56.5	60	83.5	98	5.4	2.5	1	0.5	0.454
N	NR	106.81	3.28	2.7	0.6	116.6	2.46	59	68.5	101	118	5.4	2.5	2	0.5	1.07
—	—	—	—	—	—	—	—	61	73.5	119	—	—	—	2	—	1.88
N	NR	70.7	1.7	0.95	0.25	74.8	0.85	57	59	70	76	2.3	0.9	0.3	0.3	0.083
N	NR	77.9	2.1	1.3	0.4	84.4	1.12	60	61.5	75	86	2.9	1.2	1	0.5	0.18
—	—	—	—	—	—	—	—	59	—	86	—	—	—	0.6	—	0.258
N	NR	86.79	2.87	2.7	0.6	96.5	2.46	61.5	64	83.5	98	5	2.5	1	0.5	0.388
N	NR	96.8	3.28	2.7	0.6	106.5	2.46	63	67	92	108	5.4	2.5	1.5	0.5	0.601
N	NR	115.21	4.06	3.1	0.6	129.7	2.82	64	74	111	131.5	6.5	2.9	2	0.5	1.37
—	—	—	—	—	—	—	—	66	80	129	—	—	—	2	—	2.29
N	NR	76.2	1.7	1.3	0.4	82.7	1.12	62	64.5	76	84	2.5	1.2	0.3	0.3	0.106
N	NR	82.9	2.1	1.3	0.4	89.4	1.12	65	66.5	80	91	2.9	1.2	1	0.5	0.193
—	—	—	—	—	—	—	—	64	—	91	—	—	—	0.6	—	0.283
N	NR	91.82	2.87	2.7	0.6	101.6	2.46	66.5	69	88.5	103	5	2.5	1	0.5	0.414
N	NR	106.81	3.28	2.7	0.6	116.6	2.46	68	75	102	118	5.4	2.5	1.5	0.5	0.783
N	NR	125.22	4.06	3.1	0.6	139.7	2.82	71	80.5	119	141.5	6.5	2.9	2	0.5	1.73
—	—	—	—	—	—	—	—	71	86	139	—	—	—	2	—	2.77

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

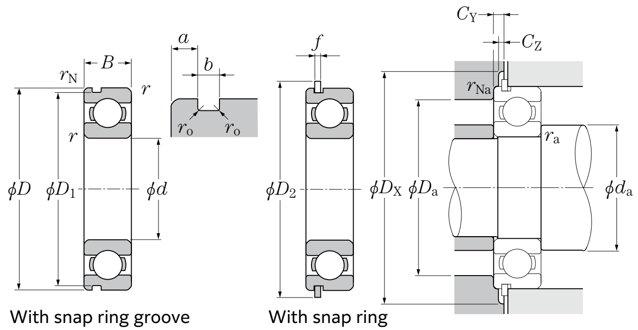


Open type | Shielded type (ZZ) | Non-contact sealed type (LLB) | Contact sealed type (LLU)

d 65 ～ 85mm

Boundary dimensions mm					Basic load rating kN		Fatigue load limit kN	Factor	Allowable speed min^{-1}			Bearing number			
					dynamic	static			Grease Open type, ZZ, LLB Z, LB	Oil Open type, Z, LB	LLU LU	Open type	Shielded or sealed type 2) (See drawings)		
d	D	B	$r_{s\,min}$ 1)	r_{NS} Min.	C_r	C_{0r}	C_u	f_0							
65	85	10	0.6	0.5	12.8	11.0	0.730	16.2	7 400	8 700	4 100	**6813**	ZZ	LLB	LLU
	90	13	1	0.5	19.3	16.1	1.07	16.6	7 000	8 200	4 000	**6913**	ZZ	LLB	LLU
	100	11	0.6	—	22.7	18.7	1.26	16.5	6 500	7 700	—	**16013**	—	—	—
	100	18	1.1	0.5	34.0	25.2	1.83	15.8	6 500	7 700	3 900	**6013**	ZZ	LLB	LLU
	120	23	1.5	0.5	63.5	40.0	3.15	14.4	5 500	6 500	3 600	**6213**	ZZ	LLB	LLU
	140	33	2.1	0.5	103	60.0	4.60	13.2	4 900	5 800	3 300	**6313**	ZZ	LLB	LLU
	160	37	2.1	—	123	72.5	5.35	12.7	4 400	5 200	—	**6413**	—	—	—
70	90	10	0.6	0.5	13.4	11.9	0.795	16.1	6 900	8 100	3 800	**6814**	ZZ	LLB	LLU
	100	16	1	0.5	26.3	21.2	1.45	16.3	6 500	7 700	3 700	**6914**	ZZ	LLB	LLU
	110	13	0.6	—	27.0	22.6	1.52	16.5	6 100	7 100	—	**16014**	—	—	—
	110	20	1.1	0.5	42.0	31.0	2.30	15.6	6 100	7 100	3 600	**6014**	ZZ	LLB	LLU
	125	24	1.5	0.5	69.0	44.0	3.45	14.5	5 100	6 000	3 400	**6214**	ZZ	LLB	LLU
	150	35	2.1	0.5	115	68.0	5.10	13.2	4 600	5 400	3 100	**6314**	ZZ	LLB	LLU
	180	42	3	—	142	89.5	6.25	12.7	4 100	4 800	—	**6414**	—	—	—
75	95	10	0.6	0.5	13.9	12.9	0.855	16.0	6 400	7 600	3 600	**6815**	ZZ	LLB	LLU
	105	16	1	0.5	27.0	22.6	1.52	16.5	6 100	7 200	3 500	**6915**	ZZ	LLB	LLU
	115	13	0.6	—	27.6	24.0	1.60	16.6	5 700	6 700	—	**16015**	—	—	—
	115	20	1.1	0.5	44.0	33.5	2.44	15.8	5 700	6 700	3 300	**6015**	ZZ	LLB	LLU
	130	25	1.5	0.5	73.5	49.5	3.80	14.7	4 800	5 600	3 200	**6215**	ZZ	LLB	LLU
	160	37	2.1	0.5	126	77.0	5.55	13.2	4 300	5 000	2 900	**6315**	ZZ	LLB	LLU
	190	45	3	—	152	99.0	6.70	12.7	3 800	4 500	—	**6415**	—	—	—
80	100	10	0.6	0.5	14.0	13.3	0.885	16.0	6 000	7 100	3 400	**6816**	ZZ	LLB	LLU
	110	16	1	0.5	27.6	24.0	1.59	16.6	5 700	6 700	3 200	**6916**	ZZ	LLB	LLU
	125	14	0.6	—	28.1	25.1	1.64	16.4	5 300	6 200	—	**16016**	—	—	—
	125	22	1.1	0.5	53.0	40.0	2.91	15.6	5 300	6 200	3 100	**6016**	ZZ	LLB	LLU
	140	26	2	0.5	80.5	53.0	3.95	14.6	4 500	5 300	3 000	**6216**	ZZ	LLB	LLU
	170	39	2.1	0.5	136	86.5	6.05	13.3	4 000	4 700	2 700	**6316**	ZZ	LLB	LLU
	200	48	3	—	181	125	8.20	12.3	3 600	4 200	—	**6416**	—	—	—
85	110	13	1	0.5	20.7	19.0	1.26	16.2	5 700	6 700	3 100	**6817**	ZZ	LLB	LLU
	120	18	1.1	0.5	35.5	29.6	1.99	16.4	5 400	6 300	3 000	**6917**	ZZ	LLB	LLU
	130	14	0.6	—	28.7	26.2	1.68	16.4	5 000	5 900	—	**16017**	—	—	—
	130	22	1.1	0.5	55.0	43.0	3.00	15.8	5 000	5 900	2 900	**6017**	ZZ	LLB	LLU
	150	28	2	0.5	92.0	64.0	4.60	14.7	4 200	5 000	2 800	**6217**	ZZ	LLB	LLU
	180	41	3	0.5	147	97.0	6.55	13.3	3 800	4 500	2 600	**6317**	ZZ	LLB	LLU

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



With snap ring groove | With snap ring

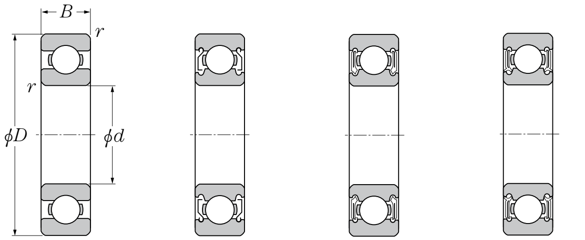
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number (Open type)	Bearing number Groove / Snap ring 3) (See drawings)		Snap ring groove dimensions mm D_1 Max.	a Max.	b Min.	r_o Max.	Snap ring dimensions mm D_2 Max.	f Max.	Installation-related dimensions mm d_a Min.	d_a Max. 4)	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	Mass 5) kg (approx.)
6813	N	NR	82.9	1.7	1.3	0.4	89.4	1.12	69	70	81	91	2.5	1.2	0.6	0.5	0.128
6913	N	NR	87.9	2.1	1.3	0.4	94.4	1.12	70	71.5	85	96	2.9	1.2	1	0.5	0.206
16013	—	—	—	—	—	—	—	—	69	—	96	—	—	—	0.6	—	0.307
6013	N	NR	96.8	2.87	2.7	0.6	106.5	2.46	71.5	74	93.5	108	5	2.5	1	0.5	0.421
6213	N	NR	115.21	4.06	3.1	0.6	129.7	2.82	73	80.5	112	131.5	6.5	2.9	1.5	0.5	0.99
6313	N	NR	135.23	4.9	3.1	0.6	149.7	2.82	76	86	129	152	7.3	2.9	2	0.5	2.08
6413	—	—	—	—	—	—	—	—	76	—	149	—	—	—	2	—	3.3
6814	N	NR	87.9	1.7	1.3	0.4	94.4	1.12	74	75.5	86	96	2.5	1.2	0.6	0.5	0.137
6914	N	NR	97.9	2.5	1.3	0.4	104.4	1.12	75	77.5	95	106	3.3	1.2	1	0.5	0.334
16014	—	—	—	—	—	—	—	—	74	—	106	—	—	—	0.6	—	0.441
6014	N	NR	106.81	2.87	2.7	0.6	116.6	2.46	76.5	80.5	103.5	118	5	2.5	1	0.5	0.604
6214	N	NR	120.22	4.06	3.1	0.6	134.7	2.82	78	85	117	136.5	6.5	2.9	1.5	0.5	1.07
6314	N	NR	145.24	4.9	3.1	0.6	159.7	2.82	81	92.5	139	162	7.3	2.9	2	0.5	2.52
6414	—	—	—	—	—	—	—	—	83	—	167	—	—	—	2.5	—	4.83
6815	N	NR	92.9	1.7	1.3	0.4	99.4	1.12	79	80	91	101	2.5	1.2	0.6	0.5	0.145
6915	N	NR	102.6	2.5	1.3	0.4	110.7	1.12	80	82.5	100	112	3.3	1.2	1	0.5	0.353
16015	—	—	—	—	—	—	—	—	79	—	111	—	—	—	0.6	—	0.464
6015	N	NR	111.81	2.87	2.7	0.6	121.6	2.46	81.5	85.5	108.5	123	5	2.5	1	0.5	0.649
6215	N	NR	125.22	4.06	3.1	0.6	139.7	2.82	83	90.5	122	141.5	6.5	2.9	1.5	0.5	1.18
6315	N	NR	155.22	4.9	3.1	0.6	169.7	2.82	86	99	149	172	7.3	2.9	2	0.5	3.02
6415	—	—	—	—	—	—	—	—	88	—	177	—	—	—	2.5	—	5.72
6816	N	NR	97.9	1.7	1.3	0.4	104.4	1.12	84	85	96	106	2.5	1.2	0.6	0.5	0.154
6916	N	NR	107.6	2.5	1.3	0.4	115.7	1.12	85	88	105	117	3.3	1.2	1	0.5	0.373
16016	—	—	—	—	—	—	—	—	84	—	121	—	—	—	0.6	—	0.597
6016	N	NR	120.22	2.87	3.1	0.6	134.7	2.82	86.5	91.5	118.5	136.5	5.3	2.9	1	0.5	0.854
6216	N	NR	135.23	4.9	3.1	0.6	149.7	2.82	89	95.5	131	152	7.3	2.9	2	0.5	1.4
6316	N	NR	163.65	5.69	3.5	0.6	182.9	3.1	91	105	159	185	8.4	3.1	2	0.5	3.59
6416	—	—	—	—	—	—	—	—	93	—	187	—	—	—	2.5	—	6.76
6817	N	NR	107.6	2.1	1.3	0.4	115.7	1.12	90	91	105	117	2.9	1.2	1	0.5	0.27
6917	N	NR	117.6	3.3	1.3	0.4	125.7	1.12	91.5	94	113.5	127	4.1	1.2	1	0.5	0.536
16017	—	—	—	—	—	—	—	—	89	—	126	—	—	—	0.6	—	0.626
6017	N	NR	125.22	2.87	3.1	0.6	139.7	2.82	91.5	97	123.5	141.5	5.3	2.9	1	0.5	0.89
6217	N	NR	145.24	4.9	3.1	0.6	159.7	2.82	94	103	141	162	7.3	2.9	2	0.5	1.79
6317	N	NR	173.66	5.69	3.5	0.6	192.9	3.1	98	112	167	195	8.4	3.1	2.5	0.5	4.23

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

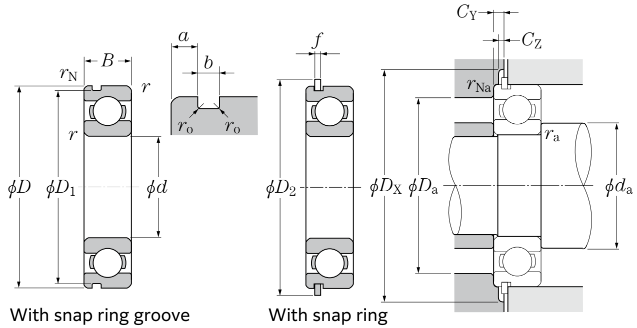


Open type   Shielded type (ZZ)   Non-contact sealed type (LLB)   Contact sealed type (LLU)

d 90 ~ 120mm

Boundary dimensions mm					Basic load rating kN dynamic	static	Fatigue load limit kN	Factor	Allowable speed min⁻¹ Grease Open type, ZZ, LLB Z, LB	Oil Open type, Z, LB	LLU LU	Bearing number Open type	Shielded or sealed type 2) (See drawings)		
d	D	B	$r_{s\,min}$ 1)	r_{NS} Min.	C_r	C_{0r}	C_u	f_0							
90	115	13	1	0.5	21.1	19.7	1.30	16.1	5 400	6 300	3 000	**6818**	ZZ	LLB	LLU
	125	18	1.1	0.5	36.5	31.5	2.05	16.5	5 100	6 000	2 900	**6918**	ZZ	LLB	LLU
	140	16	1	—	37.0	33.5	2.07	16.5	4 700	5 600	—	**16018**	—	—	—
	140	24	1.5	0.5	64.5	49.5	3.45	15.6	4 700	5 600	2 800	**6018**	ZZ	LLB	LLU
	160	30	2	0.5	106	71.5	5.00	14.5	4 000	4 700	2 600	**6218**	ZZ	LLB	LLU
	190	43	3	0.5	158	107	7.10	13.3	3 600	4 200	2 400	**6318**	ZZ	LLB	LLU
95	120	13	1	0.5	21.4	20.5	1.31	16.1	5 000	5 900	2 800	**6819**	ZZ	LLB	LLU
	130	18	1.1	0.5	37.5	33.5	2.10	16.6	4 800	5 700	2 800	**6919**	ZZ	LLB	LLU
	145	16	1	—	38.0	35.0	2.13	16.5	4 500	5 300	—	**16019**	—	—	—
	145	24	1.5	0.5	67.0	54.0	3.55	15.8	4 500	5 300	2 600	**6019**	ZZ	LLB	LLU
	170	32	2.1	0.5	121	82.0	5.55	14.4	3 700	4 400	2 500	**6219**	ZZ	LLB	LLU
	200	45	3	0.5	169	119	7.65	13.3	3 300	3 900	2 300	**6319**	ZZ	LLB	LLU
100	125	13	1	0.5	21.7	21.2	1.33	16.0	4 800	5 600	2 700	**6820**	ZZ	LLB	LLU
	140	20	1.1	0.5	45.5	39.5	2.44	16.4	4 500	5 300	2 600	**6920**	ZZ	LLB	LLU
	150	16	1	—	39.0	36.5	2.18	16.4	4 200	5 000	—	**16020**	—	—	—
	150	24	1.5	0.5	66.5	54.0	3.50	15.9	4 200	5 000	2 600	**6020**	ZZ	LLB	LLU
	180	34	2.1	0.5	135	93.0	6.15	14.4	3 500	4 200	2 300	**6220**	ZZ	LLB	LLU
	215	47	3	—	192	141	8.75	13.2	3 200	3 700	2 200	**6320**	ZZ	LLB	LLU
105	130	13	1	0.5	22.0	22.0	1.35	15.9	4 600	5 400	2 500	**6821**	ZZ	—	LLU
	145	20	1.1	0.5	47.0	42.0	2.52	16.5	4 300	5 100	2 500	**6921**	ZZ	LLB	LLU
	160	18	1	—	57.5	50.5	3.00	16.3	4 000	4 700	—	**16021**	—	—	—
	160	26	2	0.5	80.5	65.5	4.15	15.8	4 000	4 700	2 400	**6021**	ZZ	LLB	LLU
	190	36	2.1	0.5	147	105	6.75	14.4	3 400	4 000	2 300	**6221**	ZZ	LLB	LLU
	225	49	3	—	204	153	9.35	13.2	3 000	3 600	2 100	**6321**	ZZ	—	LLU
110	140	16	1	0.5	27.5	28.2	1.68	16.0	4 300	5 100	2 400	**6822**	ZZ	LLB	LLU
	150	20	1.1	0.5	48.5	44.5	2.60	16.6	4 100	4 800	2 400	**6922**	ZZ	LLB	LLU
	170	19	1	—	63.5	56.5	3.25	16.3	3 800	4 500	—	**16022**	—	—	—
	170	28	2	0.5	91.0	73.0	4.55	15.6	3 800	4 500	2 300	**6022**	ZZ	LLB	LLU
	200	38	2.1	0.5	160	117	7.35	14.3	3 200	3 800	2 200	**6222**	ZZ	LLB	LLU
	240	50	3	—	227	179	10.5	13.1	2 900	3 400	1 900	**6322**	ZZ	LLB	LLU
120	150	16	1	0.5	32.0	33.0	1.89	16.0	4 000	4 700	2 200	**6824**	ZZ	LLB	LLU
	165	22	1.1	0.5	59.0	54.0	3.05	16.5	3 800	4 400	2 100	**6924**	ZZ	—	LLU
	180	19	1	—	70.0	63.5	3.50	16.4	3 500	4 100	—	**16024**	—	—	—
	180	28	2	0.5	94.0	79.5	4.65	15.9	3 500	4 100	2 100	**6024**	ZZ	LLB	LLU

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



With snap ring groove   With snap ring

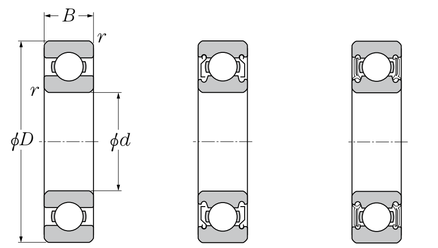
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	Y	$\frac{F_a}{F_r} > e$ X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number Groove / Snap ring 3) (See drawings)		Snap ring groove dimensions mm D_1 Max.	a Max.	b Min.	r_o Max.	Snap ring dimensions mm D_2 Max.	f Max.	Installation-related dimensions mm d_a Min.	d_a Max. 4)	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	Mass 5) kg (approx.)
N	NR	112.6	2.1	1.3	0.4	120.7	1.12	95	96	110	122	2.9	1.2	1	0.5	0.285
N	NR	122.6	3.3	1.3	0.4	130.7	1.12	96.5	99	118.5	132	4.1	1.2	1	0.5	0.554
—	—	—	—	—	—	—	—	95	—	135	—	—	—	1	—	0.848
N	NR	135.23	3.71	3.1	0.6	149.7	2.82	98	102	132	152	6.1	2.9	1.5	0.5	1.02
N	NR	155.22	4.9	3.1	0.6	169.7	2.82	99	109	151	172	7.3	2.9	2	0.5	2.15
N	NR	183.64	5.69	3.5	0.6	202.9	3.1	103	118	177	205	8.4	3.1	2.5	0.5	4.91
N	NR	117.6	2.1	1.3	0.4	125.7	1.12	100	101	115	127	2.9	1.2	1	0.5	0.3
N	NR	127.6	3.3	1.3	0.4	135.7	1.12	101.5	104	123.5	137	4.1	1.2	1	0.5	0.579
—	—	—	—	—	—	—	—	100	—	140	—	—	—	1	—	0.885
N	NR	140.23	3.71	3.1	0.6	154.7	2.82	103	109	137	157	6.1	2.9	1.5	0.5	1.08
N	NR	163.65	5.69	3.5	0.6	182.9	3.1	106	116	159	185	8.4	3.1	2	0.5	2.62
N	NR	193.65	5.69	3.5	0.6	212.9	3.1	108	125	187	215	8.4	3.1	2.5	0.5	5.67
N	NR	122.6	2.1	1.3	0.4	130.7	1.12	105	106	120	132	2.9	1.2	1	0.5	0.313
N	NR	137.6	3.3	1.9	0.6	145.7	1.7	106.5	110	133.5	147	4.7	1.7	1	0.5	0.785
—	—	—	—	—	—	—	—	105	—	145	—	—	—	1	—	0.91
N	NR	145.24	3.71	3.1	0.6	159.7	2.82	108	110	142	162	6.1	2.9	1.5	0.5	1.15
N	NR	173.66	5.69	3.5	0.6	192.9	3.1	111	122	169	195	8.4	3.1	2	0.5	3.14
N	NR	208.6	5.69	3.5	1	227.8	3.1	113	133	202	230	8.4	3.1	2.5	0.5	7
N	NR	127.6	2.1	1.3	0.4	135.7	1.12	110	111	125	137	2.9	1.2	1	0.5	0.33
N	NR	142.6	3.3	1.9	0.6	150.7	1.7	111.5	115	138.5	152	4.7	1.7	1	0.5	0.816
—	—	—	—	—	—	—	—	110	—	155	—	—	—	1	—	1.2
N	NR	155.22	3.71	3.1	0.6	169.7	2.82	114	119	151	172	6.1	2.9	2	0.5	1.59
N	NR	183.64	5.69	3.5	0.6	202.9	3.1	116	125	179	205	8.4	3.1	2	0.5	3.7
N	NR	217.0	6.5	4.5	1	237	3.5	118	134	212	239	9.6	3.5	2.5	0.5	8.05
N	NR	137.6	2.5	1.9	0.6	145.7	1.7	115	118	135	147	3.9	1.7	1	0.5	0.515
N	NR	147.6	3.3	1.9	0.6	155.7	1.7	116.5	120	143.5	157	4.7	1.7	1	0.5	0.849
—	—	—	—	—	—	—	—	115	—	165	—	—	—	1	—	1.46
N	NR	163.65	3.71	3.5	0.6	182.9	3.1	119	126	161	185	6.4	3.1	2	0.5	1.96
N	NR	193.65	5.69	3.5	0.6	212.9	3.1	121	132	189	215	8.4	3.1	2	0.5	4.36
N	NR	232.0	6.5	4.5	1	252	3.5	123	149	227	254	9.6	3.5	2.5	0.5	9.54
N	NR	147.6	2.5	1.9	0.6	155.7	1.7	125	128	145	157	3.9	1.7	1	0.5	0.555
N	NR	161.8	3.7	1.9	0.6	171.5	1.7	126.5	132	158.5	173	5.1	1.7	1	0.5	1.15
—	—	—	—	—	—	—	—	125	—	175	—	—	—	1	—	1.56
N	NR	173.66	3.71	3.5	0.6	192.9	3.1	129	136	171	195	6.4	3.1	2	0.5	2.07

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

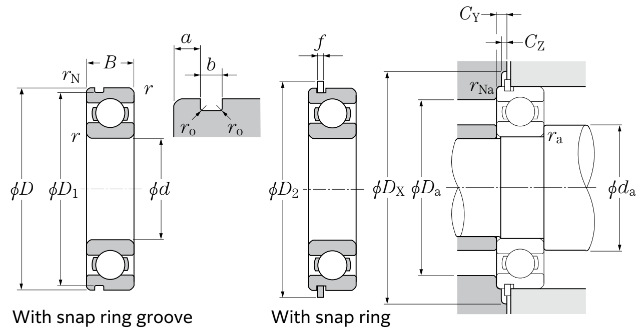


d 120 ～ 170mm

d (mm)	D (mm)	B (mm)	$r_{s\,min}$ [1] (mm)	r_{NS} Min. (mm)	Basic load rating dynamic C_r (kN)	Basic load rating static C_{0r} (kN)	Fatigue load limit C_u (kN)	Factor f_0	Allowable speed min⁻¹ Grease Open type, ZZ, Z	Allowable speed min⁻¹ Oil Open type, Z	Allowable speed min⁻¹ LLU LU	Bearing number Open type	Bearing number Shielded or sealed type [2] (See drawings)	
120	215	40	2.1	—	172	131	7.95	14.4	2 900	3 400	2 000	**6224**	**ZZ**	**LLU**
	260	55	3	—	229	185	10.5	13.5	2 600	3 100	1 700	**6324**	**ZZ**	**LLU**
130	165	18	1.1	0.5	41.0	41.0	2.25	16.1	3 700	4 300	2 000	**6826**	**ZZ**	**LLU**
	180	24	1.5	0.5	72.0	67.5	3.65	16.5	3 500	4 100	1 900	**6926**	**ZZ**	**LLU**
	200	22	1.1	—	88.5	79.5	4.25	16.2	3 200	3 800	—	**16026**	—	—
	200	33	2	0.5	118	101	5.70	15.8	3 200	3 800	1 900	**6026**	**ZZ**	**LLU**
	230	40	3	—	185	146	8.55	14.5	2 700	3 100	1 800	**6226**	**ZZ**	**LLU**
	280	58	4	—	254	214	11.7	13.6	2 400	2 800	—	**6326**	—	—
140	175	18	1.1	0.5	42.5	44.5	2.35	16.0	3 400	4 000	1 900	**6828**	**ZZ**	**LLU**
	190	24	1.5	0.5	74.0	71.5	3.70	16.6	3 200	3 800	1 800	**6928**	**ZZ**	**LLU**
	210	22	1.1	—	91.0	85.0	4.35	16.4	3 000	3 500	—	**16028**	—	—
	210	33	2	—	122	109	5.85	15.9	3 000	3 500	1 800	**6028**	**ZZ**	**LLU**
	250	42	3	—	184	150	8.40	14.8	2 500	2 900	1 600	**6228**	**ZZ**	**LLU**
	300	62	4	—	280	246	13.0	13.6	2 200	2 600	—	**6328**	—	—
150	190	20	1.1	0.5	53.0	55.0	2.80	16.1	3 100	3 700	1 700	**6830**	**ZZ**	**LLU**
	210	28	2	—	94.0	90.5	4.55	16.5	3 000	3 500	1 700	**6930**	**ZZ**	**LLU**
	225	24	1.1	—	107	101	5.00	16.4	2 800	3 200	—	**16030**	—	—
	225	35	2.1	—	139	126	6.55	15.9	2 800	3 200	1 700	**6030**	**ZZ**	**LLU**
	270	45	3	—	195	168	9.05	15.1	2 300	2 700	1 500	**6230**	**ZZ**	**LLU**
	320	65	4	—	305	284	14.5	13.9	2 100	2 400	—	**6330**	—	—
160	200	20	1.1	0.5	53.5	57.0	2.82	16.1	2 900	3 400	1 600	**6832**	**ZZ**	**LLU**
	220	28	2	—	96.5	96.0	4.65	16.6	2 800	3 300	—	**6932**	**ZZ**	**LLU**
	240	25	1.5	—	109	108	5.10	16.5	2 600	3 000	—	**16032**	—	—
	240	38	2.1	—	158	144	7.30	15.9	2 600	3 000	1 600	**6032**	**ZZ**	**LLU**
	290	48	3	—	205	186	9.45	15.4	2 100	2 500	—	**6232**	—	—
	340	68	4	—	310	286	14.2	13.9	1 900	2 300	—	**6332**	—	—
170	215	22	1.1	—	66.5	70.5	3.35	16.1	2 700	3 200	—	**6834**	**ZZ**	—
	230	28	2	—	95.0	95.5	4.50	16.5	2 600	3 100	—	**6934**	**ZZ**	—
	260	28	1.5	—	131	128	5.90	16.4	2 400	2 800	—	**16034**	—	—
	260	42	2.1	—	187	172	8.55	15.8	2 400	2 800	—	**6034**	**ZZ**	—
	310	52	4	—	235	223	11.1	15.3	2 000	2 400	—	**6234**	—	—
	360	72	4	—	360	355	17.0	13.6	1 800	2 100	—	**6334**	—	—

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

Deep Groove Ball Bearings NTN



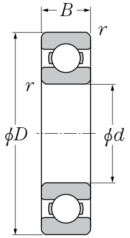
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

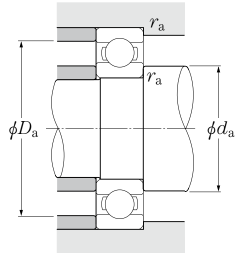
Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number Groove	Bearing number Snap ring [3] (See drawings)	Snap ring groove dimensions D_1 Max. (mm)	a Max. (mm)	b Min. (mm)	r_o Max. (mm)	Snap ring dimensions D_2 Max. (mm)	f Max. (mm)	Installation-related dimensions d_a Min. (mm)	d_a Max. [4] (mm)	D_a Max. (mm)	D_X (approx.) (mm)	C_Y Max. (mm)	C_Z Min. (mm)	r_{as} Max. (mm)	r_{Nas} Max. (mm)	Mass [5] (approx.) (kg)
N	**NR**	217.0	6.5	4.5	1	227.8	3.1	131	143	204	230	9.2	3.1	2	0.5	5.15
—	—	—	—	—	—	—	—	133	162	247	—	—	—	2.5	—	12.4
N	**NR**	161.8	3.3	1.9	0.6	171.5	1.7	136.5	139.5	158.5	173	4.7	1.7	1	0.5	0.8
N	**NR**	176.8	3.7	1.9	0.6	186.5	1.7	138	144	172	188	5.1	1.7	1.5	0.5	1.52
—	—	—			—	—	—	136.5	—	193.5	—	—	—	1	—	2.31
N	**NR**	193.65	5.69	3.5	0.6	212.9	3.1	139	148	191	215	8.4	3.1	2	0.5	3.16
N	**NR**	222.0	6.5	4.5	1	242	3.5	143	158	217	244	9.6	3.5	2.5	0.5	5.82
—	—	—	—	—	—	—	—	146	—	264	—	—	—	3	—	15.3
N	**NR**	171.8	3.3	1.9	0.6	181.5	1.7	146.5	150	168.5	183	4.7	1.7	1	0.5	0.85
N	**NR**	186.8	3.7	1.9	0.6	196.5	1.7	148	154	182	198	5.1	1.7	1.5	0.5	1.62
—	—	—	—	—	—	—	—	146.5	—	203.5	—	—	—	1	—	2.45
—	—	—	—	—	—	—	—	149	158	201	—	—	—	2	—	3.35
N	**NR**	242.0	6.5	4.5	1	262	3.5	153	173	237	264	9.6	3.5	2.5	0.5	7.57
—	—	—	—	—	—	—	—	156	—	284	—	—	—	3	—	18.5
N	**NR**	186.8	3.3	1.9	0.6	196.5	1.7	156.5	161	183.5	198	4.7	1.7	1	0.5	1.16
—	—	—	—	—	—	—	—	159	167	201	—	—	—	2	—	2.47
—	—	—	—	—	—	—	—	156.5	—	218.5	—	—	—	1	—	3.07
—	—	—	—	—	—	—	—	161	169	214	—	—	—	2	—	4.08
—	—	—	—	—	—	—	—	163	188	257	—	—	—	2.5	—	9.41
—	—	—	—	—	—	—	—	166	—	304	—	—	—	3	—	22
N	**NR**	196.8	3.3	1.9	0.6	206.5	1.7	166.5	171	193.5	208	4.7	1.7	1	0.5	1.23
—	—	—	—	—	—	—	—	169	178	211	—	—	—	2	—	2.61
—	—	—	—	—	—	—	—	168	—	232	—	—	—	1.5	—	3.64
—	—	—	—	—	—	—	—	171	183	229	—	—	—	2	—	5.05
—	—	—	—	—	—	—	—	173	—	277	—	—	—	2.5	—	11.7
—	—	—	—	—	—	—	—	176	—	324	—	—	—	3	—	26
—	—	—	—	—	—	—	—	176.5	182	208.5	—	—	—	1	—	1.63
—	—	—	—	—	—	—	—	179	188	221	—	—	—	2	—	2.74
—	—	—	—	—	—	—	—	178	—	252	—	—	—	1.5	—	4.93
—	—	—	—	—	—	—	—	181	196	249	—	—	—	2	—	6.76
—	—	—	—	—	—	—	—	186	—	294	—	—	—	3	—	14.5
—	—	—	—	—	—	—	—	186	—	344	—	—	—	3	—	30.7

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.



Open type



d 180 ～ 260mm

Boundary dimensions (mm)				Basic load rating dynamic (kN)	Basic load rating static (kN)	Fatigue load limit (kN)	Factor	Allowable speed (min^{-1}) Grease lubrication	Allowable speed (min^{-1}) Oil lubrication	Bearing number	Installation-related dimensions (mm)			Mass (kg)
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	f_0			Open type	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
180	225	22	1.1	67.0	73.0	3.40	16.1	2 600	3 000	**6836**	186.5	218.5	1	2.03
	250	33	2	122	119	5.45	16.5	2 400	2 900	**6936**	189	241	2	4.76
	280	31	2	129	134	5.85	16.5	2 300	2 700	**16036**	189	271	2	6.49
	280	46	2.1	210	199	9.70	15.6	2 300	2 700	**6036**	191	269	2	8.8
	320	52	4	252	241	11.9	15.1	1 900	2 200	**6236**	196	304	3	15.1
	380	75	4	390	405	19.0	13.9	1 700	2 000	**6336**	196	364	3	35.6
190	240	24	1.5	81.0	88.0	4.00	16.1	2 400	2 900	**6838**	198	232	1.5	2.62
	260	33	2	125	127	5.65	16.6	2 300	2 700	**6938**	199	251	2	4.98
	290	31	2	149	156	6.70	16.6	2 100	2 500	**16038**	199	281	2	6.77
	290	46	2.1	218	215	10.1	15.8	2 100	2 500	**6038**	201	279	2	9.18
	340	55	4	282	281	13.5	15.0	1 800	2 100	**6238**	206	324	3	18.2
	400	78	5	395	415	18.9	14.1	1 600	1 900	**6338**	210	380	4	41
200	250	24	1.5	82.0	91.5	4.05	16.1	2 300	2 700	**6840**	208	242	1.5	2.73
	280	38	2.1	174	168	7.45	16.2	2 200	2 600	**6940**	211	269	2	7.1
	310	34	2	157	160	6.65	16.6	2 000	2 400	**16040**	209	301	2	8.68
	310	51	2.1	241	243	11.2	15.6	2 000	2 400	**6040**	211	299	2	11.9
	360	58	4	298	310	14.4	15.2	1 700	2 000	**6240**	216	344	3	21.6
	420	80	5	455	500	22.3	13.8	1 500	1 800	**6340**	220	400	4	46.3
220	270	24	1.5	84.5	98.0	4.15	16.0	2 100	2 400	**6844**	228	262	1.5	3
	300	38	2.1	178	180	7.55	16.4	2 000	2 300	**6944**	231	289	2	7.69
	340	37	2.1	200	216	8.65	16.5	1 800	2 200	**16044**	231	329	2	11.3
	340	56	3	267	289	12.5	15.8	1 800	2 200	**6044**	233	327	2.5	15.7
	400	65	4	330	365	15.8	15.3	1 500	1 800	**6244**	236	384	3	30.2
	460	88	5	455	520	22.0	14.3	1 400	1 600	**6344**	240	440	4	60.8
240	300	28	2	94.0	112	4.55	15.9	1 900	2 200	**6848**	249	291	2	4.6
	320	38	2.1	188	203	8.05	16.5	1 800	2 100	**6948**	251	309	2	8.28
	360	37	2.1	197	217	8.30	16.5	1 700	2 000	**16048**	251	349	2	12.1
	360	56	3	276	310	12.8	16.0	1 700	2 000	**6048**	253	347	2.5	16.8
260	320	28	2	96.5	120	4.65	15.8	1 700	2 000	**6852**	269	311	2	5
	360	46	2.1	245	280	10.9	16.3	1 600	1 900	**6952**	271	349	2	13.9
	400	44	3	252	299	11.1	16.5	1 500	1 800	**16052**	273	387	2.5	18.5
	400	65	4	325	375	15.1	15.8	1 500	1 800	**6052**	276	384	3	25

1) Smallest allowable dimension for chamfer dimension r.

Dynamic equivalent radial load

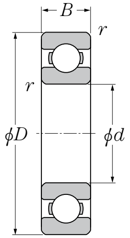
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

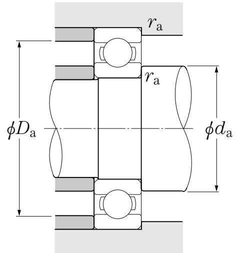
Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.



Open type



d 280 ～ 440mm

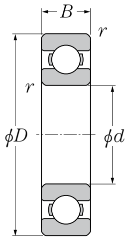
Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	Basic load rating (kN) dynamic C_r	static C_{0r}	Fatigue load limit (kN) C_u	Factor f_0	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number Open type	Installation-related dimensions (mm) d_a Min.	D_a Max.	r_{as} Max.	Mass kg (approx.)
280	350	33	2	151	177	6.65	16.1	1 600	1 900	**6856**	289	341	2	7.4
	380	46	2.1	252	299	11.1	16.5	1 500	1 800	**6956**	291	369	2	14.8
	420	44	3	257	315	11.3	16.5	1 400	1 600	**16056**	293	407	2.5	23
	420	65	4	360	420	16.9	15.5	1 400	1 600	**6056**	296	404	3	31
300	380	38	2.1	179	210	7.60	16.1	1 500	1 700	**6860**	311	369	2	10.5
	420	56	3	305	375	13.7	16.2	1 400	1 600	**6960**	313	407	2.5	23.5
	460	50	4	325	410	14.5	16.3	1 300	1 500	**16060**	316	444	3	32.5
	460	74	4	395	480	18.4	15.6	1 300	1 500	**6060**	316	444	3	43.8
320	400	38	2.1	186	228	7.95	16.1	1 400	1 600	**6864**	331	389	2	10.9
	440	56	3	315	405	14.1	16.4	1 300	1 500	**6964**	333	427	2.5	24.8
	480	50	4	335	440	14.9	16.4	1 200	1 400	**16064**	336	464	3	34.2
	480	74	4	410	530	19.3	15.7	1 200	1 400	**6064**	336	464	3	46.1
340	420	38	2.1	189	236	8.05	16.0	1 300	1 500	**6868**	351	409	2	11.5
	460	56	3	325	430	14.4	16.5	1 200	1 400	**6968**	353	447	2.5	26.2
	520	57	4	380	515	17.0	16.3	1 100	1 300	**16068**	356	504	3	47.1
	520	82	5	465	610	21.9	15.6	1 100	1 300	**6068**	360	500	4	61.8
360	440	38	2.1	207	258	8.55	16.0	1 200	1 400	**6872**	371	429	2	12.3
	480	56	3	330	455	14.8	16.5	1 100	1 300	**6972**	373	467	2.5	27.5
	540	57	4	390	550	17.6	16.4	1 100	1 200	**16072**	376	524	3	49.3
	540	82	5	485	670	23.0	15.7	1 100	1 200	**6072**	380	520	4	64.7
380	480	46	2.1	256	340	10.8	16.1	1 100	1 300	**6876**	391	469	2	19.7
	520	65	4	360	510	15.9	16.6	1 100	1 200	**6976**	396	504	3	39.8
	560	82	5	505	725	24.1	15.9	990	1 200	**6076**	400	540	4	67.5
400	500	46	2.1	251	340	10.6	16.0	1 100	1 200	**6880**	411	489	2	20.6
	540	65	4	370	535	16.4	16.5	990	1 200	**6980**	416	524	3	41.6
	600	90	5	565	825	26.9	15.7	930	1 100	**6080**	420	580	4	87.6
420	520	46	2.1	288	405	12.4	16.1	1 000	1 200	**6884**	431	509	2	21.6
	560	65	4	380	560	16.8	16.4	940	1 100	**6984**	436	544	3	43.4
	620	90	5	590	895	28.3	15.8	880	1 000	**6084**	440	600	4	91.1
440	540	46	2.1	292	420	12.6	16.0	950	1 100	**6888**	451	529	2	22.5
	600	74	4	405	615	18.0	16.4	890	1 000	**6988**	456	584	3	60

1) Smallest allowable dimension for chamfer dimension r.

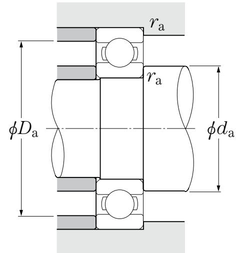
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$ X	Y	$\frac{F_a}{F_r} > e$ X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22	1	0	0.56	1.99
0.689	0.26	1	0	0.56	1.71
1.03	0.28	1	0	0.56	1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38	1	0	0.56	1.15
5.17	0.42	1	0	0.56	1.04
6.89	0.44	1	0	0.56	1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.



Open type



d 460 ～ 600mm

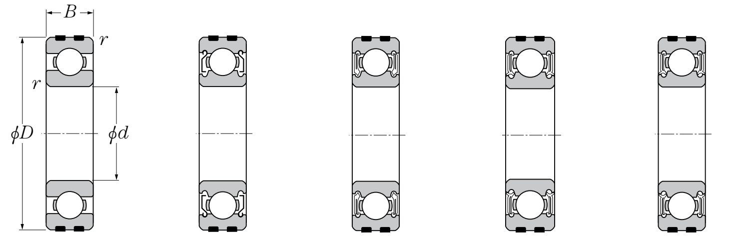
d (mm)	D (mm)	B (mm)	$r_{s\,min}$[1)] (mm)	Basic load rating dynamic C_r (kN)	Basic load rating static C_{0r} (kN)	Fatigue load limit C_u (kN)	Factor f_0	Allowable speed (min⁻¹) Grease lubrication	Allowable speed (min⁻¹) Oil lubrication	Bearing number Open type	Installation-related dimensions d_a Min. (mm)	D_a Max. (mm)	r_{as} Max. (mm)	Mass kg (approx.)
460	580	56	3	350	515	15.1	16.2	900	1 100	**6892**	473	567	2.5	34.8
	620	74	4	415	645	18.5	16.4	850	1 000	**6992**	476	604	3	62.2
480	600	56	3	355	540	15.4	16.1	860	1 000	**6896**	493	587	2.5	36.2
	650	78	5	480	770	21.5	16.5	810	950	**6996**	500	630	4	73
500	620	56	3	360	560	15.7	16.1	820	970	**68/500**	513	607	2.5	37.5
	670	78	5	490	805	22.2	16.5	770	910	**69/500**	520	650	4	75.5
530	650	56	3	365	580	15.9	16.0	770	900	**68/530**	543	637	2.5	39.5
560	680	56	3	370	600	16.1	16.0	710	840	**68/560**	573	667	2.5	41.5
600	730	60	3	415	705	18.2	16.0	660	780	**68/600**	613	717	2.5	51.7

1) Smallest allowable dimension for chamfer dimension *r*.

Dynamic equivalent radial load
$P_r = XF_r + YF_a$

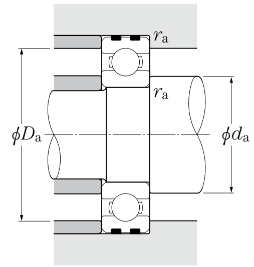
$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.



Open type | Shielded type (ZZ) | Non-contact sealed type (LLB) | Low torque sealed type (LLH) | Contact sealed type (LLU)

d 10～50mm



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$

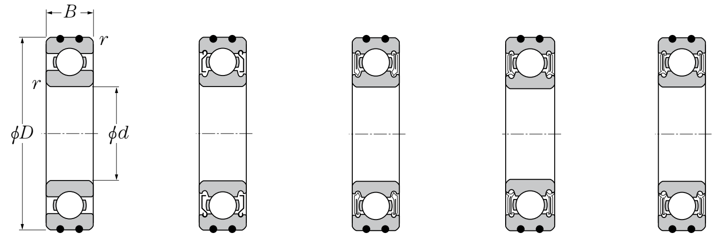
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable load (kN) C_p	Factor f_0	Allowable speed (min⁻¹) Grease Open type, ZZ, LLB Z, LB	Oil Open type, Z, LB	LLH LH	LLU LU	Bearing number Open type	Shielded or sealed type 2) (See drawings)	Installation-related dimensions (mm) d_a Min.	d_a Max. 3)	D_a Max.	r_{as} Max.	Mass (kg) Open type (approx.)
10	26	8	0.3	5.05	1.96	0.138	1.65	12.4	29 000	34 000	25 000	21 000	**EC-6000**	**ZZ LLB LLH LLU**	12	13.5	24	0.3	0.019
	30	9	0.6	5.65	2.39	0.182	2.39	13.2	25 000	30 000	21 000	18 000	**EC-6200**	**ZZ LLB LLH LLU**	14	16	26	0.6	0.031
	35	11	0.6	9.10	3.50	0.273	3.45	11.4	23 000	27 000	20 000	16 000	**EC-6300**	**ZZ LLB LLH LLU**	14	17	31	0.6	0.051
12	28	8	0.3	5.65	2.39	0.182	1.78	13.2	26 000	30 000	21 000	18 000	**EC-6001JRX**	**ZZ LLB LLH LLU**	14	16	26	0.3	0.021
	32	10	0.6	6.75	2.75	0.214	2.29	12.7	22 000	26 000	20 000	16 000	**EC-6201**	**ZZ LLB LLH LLU**	16	17.5	28	0.6	0.036
	37	12	1	10.8	4.20	0.325	3.65	11.1	20 000	24 000	19 000	15 000	**EC-6301**	**ZZ LLB LLH LLU**	17	18.5	32	1	0.058
15	32	9	0.3	6.20	2.83	0.199	2.83	13.9	22 000	26 000	18 000	15 000	**EC-6002**	**ZZ LLB LLH LLU**	17	19	30	0.3	0.029
	35	11	0.6	8.60	3.60	0.279	2.78	12.7	19 000	23 000	18 000	15 000	**EC-6202**	**ZZ LLB LLH LLU**	19	20.5	31	0.6	0.043
	42	13	1	12.7	5.45	0.425	4.40	12.3	17 000	21 000	15 000	12 000	**EC-6302**	**ZZ LLB LLH LLU**	20	23	37	1	0.079
17	35	10	0.3	7.55	3.35	0.263	2.88	13.6	20 000	24 000	16 000	14 000	**EC-6003**	**ZZ LLB LLH LLU**	19	21	33	0.3	0.037
	40	12	0.6	10.6	4.60	0.243	3.45	12.8	18 000	21 000	15 000	12 000	**EC-6203**	**ZZ LLB LLH LLU**	21	23	36	0.6	0.062
	47	14	1	15.0	6.55	0.355	6.55	12.2	16 000	19 000	14 000	11 000	**EC-6303**	**ZZ LLB LLH LLU**	22	25	42	1	0.11
20	42	12	0.6	10.4	5.05	0.355	5.05	13.9	18 000	21 000	13 000	11 000	**EC-6004**	**ZZ LLB LLH LLU**	24	26	38	0.6	0.066
	47	14	1	14.2	6.65	0.505	5.05	13.2	16 000	18 000	12 000	10 000	**EC-6204**	**ZZ LLB LLH LLU**	25	28	42	1	0.101
	52	15	1.1	17.6	7.90	0.615	7.90	12.4	14 000	17 000	12 000	10 000	**EC-6304**	**ZZ LLB LLH LLU**	26.5	28.5	45.5	1	0.139
25	47	12	0.6	11.2	5.85	0.380	5.85	14.5	15 000	18 000	11 000	9 400	**EC-6005**	**ZZ LLB LLH LLU**	29	30.5	43	0.6	0.075
	52	15	1	15.5	7.85	0.550	6.55	13.9	13 000	15 000	11 000	8 900	**EC-6205**	**ZZ LLB LLH LLU**	30	32	47	1	0.122
	62	17	1.1	23.5	10.9	0.855	10.9	12.6	12 000	14 000	9 700	8 100	**EC-6305**	**ZZ LLB LLH LLU**	31.5	35	55.5	1	0.223
30	55	13	1	14.7	8.30	0.650	8.30	14.8	13 000	15 000	9 200	7 700	**EC-6006**	**ZZ LLB LLH LLU**	35	37	50	1	0.11
	62	16	1	21.6	11.3	0.795	9.85	13.8	11 000	13 000	8 800	7 300	**EC-6206**	**ZZ LLB LLH LLU**	35	39	57	1	0.191
	72	19	1.1	29.5	15.0	1.14	15.0	13.3	10 000	12 000	7 900	6 600	**EC-6306**	**ZZ LLB LLH LLU**	36.5	43	65.5	1	0.334
35	62	14	1	17.7	10.3	0.805	10.3	14.8	12 000	14 000	8 200	6 800	**EC-6007**	**ZZ LLB LLH LLU**	40	42	57	1	0.148
	72	17	1.1	28.4	15.3	1.09	14.5	13.8	9 800	11 000	7 600	6 300	**EC-6207**	**ZZ LLB LLH LLU**	41.5	45	65.5	1	0.277
	80	21	1.5	37.0	19.1	1.47	18.5	13.1	8 800	10 000	7 300	6 000	**EC-6307**	**ZZ LLB LLH LLU**	43	47	72	1.5	0.44
40	68	15	1	18.6	11.5	0.890	11.5	15.2	10 000	12 000	7 300	6 100	**EC-6008**	**ZZ LLB LLH LLU**	45	47	63	1	0.183
	80	18	1.1	32.5	17.8	1.24	17.5	14.0	8 700	10 000	6 700	5 600	**EC-6208**	**ZZ LLB LLH LLU**	46.5	51	73.5	1	0.352
	90	23	1.5	45.0	24.0	1.83	23.4	13.2	7 800	9 200	6 400	5 300	**EC-6308**	**ZZ LLB LLH LLU**	48	54	82	1.5	0.609
45	75	16	1	23.2	15.1	1.16	15.1	15.3	9 200	11 000	6 500	5 400	**EC-6009**	**ZZ LLB LLH LLU**	50	52.5	70	1	0.233
	85	19	1.1	36.0	20.4	1.60	20.3	14.1	7 800	9 200	6 200	5 200	**EC-6209**	**ZZ LLB LLH LLU**	51.5	55.5	78.5	1	0.391
	100	25	1.5	58.5	32.0	2.50	27.4	13.1	7 000	8 200	5 600	4 700	**EC-6309**	**ZZ LLB LLH LLU**	53	61.5	92	1.5	0.80
50	80	16	1	24.2	16.6	1.24	16.6	15.5	8 400	9 800	6 000	5 000	**EC-6010**	**ZZ LLB LLH LLU**	55	57.5	75	1	0.246
	90	20	1.1	39.0	23.2	1.82	17.7	14.4	7 100	8 300	5 700	4 700	**EC-6210**	**ZZ LLB LLH LLU**	56.5	60	83.5	1	0.444
	110	27	2	68.5	38.5	2.99	33.0	13.2	6 400	7 500	5 000	4 200	**EC-6310**	**ZZ LLB LLH LLU**	59	68.5	101	2	1.03

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

3) This dimension applies to sealed and shielded bearings.

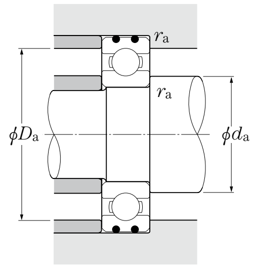
AC Bearings



Open type | Shielded type (ZZ) | Non-contact sealed type (LLB) | Low torque sealed type (LLH) | Contact sealed type (LLU)

d 10～45mm

AC Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

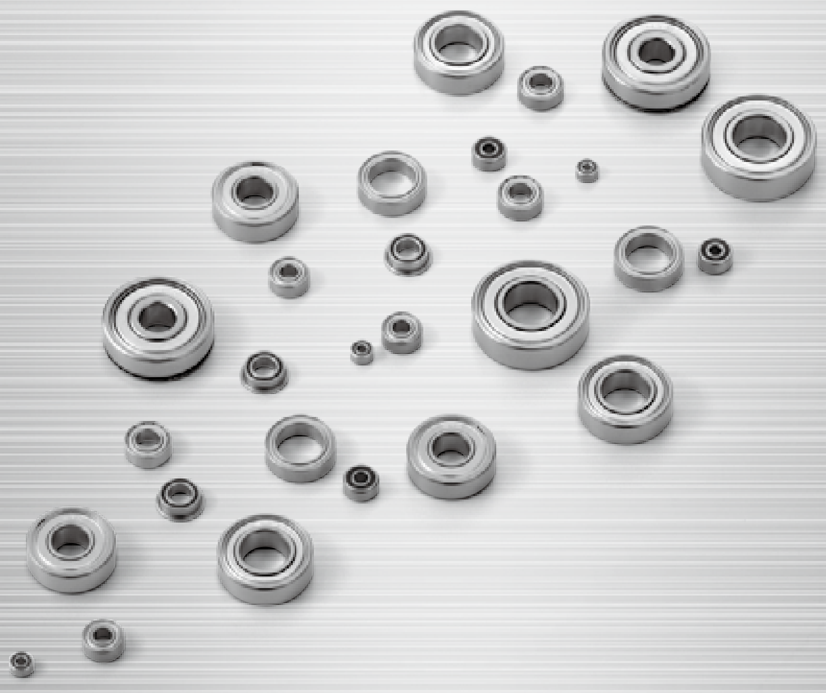
Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable load (kN) C_p	Factor f_0	Allowable speed (min⁻¹) Grease Open type, ZZ, LLB Z, LB	Oil Open type, Z, LB	LLH LH	LLU LU	Bearing number Open type	Shielded or sealed type 2) (See drawings)	Installation-related dimensions (mm) d_a Min.	d_a Max. 3)	D_a Max.	r_a Max.	Mass (kg) Open type (approx.)
10	26	8	0.3	5.05	1.96	0.138	1.53	12.4	29 000	34 000	25 000	21 000	**AC-6000**	**ZZ LLB LLH LLU**	12	13.5	24	0.3	0.019
	30	9	0.6	5.65	2.39	0.182	2.39	13.2	25 000	30 000	21 000	18 000	**AC-6200**	**ZZ LLB LLH LLU**	14	16	26	0.6	0.031
	35	11	0.6	9.10	3.50	0.273	2.98	11.4	23 000	27 000	20 000	16 000	**AC-6300**	**ZZ LLB LLH LLU**	14	17	31	0.6	0.051
12	28	8	0.3	5.65	2.39	0.182	1.73	13.2	26 000	30 000	21 000	18 000	**AC-6001JRX**	**ZZ LLB LLH LLU**	14	16	26	0.3	0.021
	32	10	0.6	6.75	2.75	0.214	2.75	12.7	22 000	26 000	20 000	16 000	**AC-6201**	**ZZ LLB LLH LLU**	16	17.5	28	0.6	0.036
	37	12	1	10.8	4.20	0.325	3.00	11.1	20 000	24 000	19 000	15 000	**AC-6301**	**ZZ LLB LLH LLU**	17	18.5	32	1	0.058
15	32	9	0.3	6.20	2.83	0.199	2.43	13.9	22 000	26 000	18 000	15 000	**AC-6002**	**ZZ LLB LLH LLU**	17	19	30	0.3	0.029
	35	11	0.6	8.60	3.60	0.279	2.71	12.7	19 000	23 000	18 000	15 000	**AC-6202**	**ZZ LLB LLH LLU**	19	20.5	31	0.6	0.043
	42	13	1	12.7	5.45	0.425	3.90	12.3	17 000	21 000	15 000	12 000	**AC-6302**	**ZZ LLB LLH LLU**	20	23	37	1	0.079
17	35	10	0.3	7.55	3.35	0.263	2.44	13.6	20 000	24 000	16 000	14 000	**AC-6003**	**ZZ LLB LLH LLU**	19	21	33	0.3	0.037
	40	12	0.6	10.6	4.60	0.243	3.50	12.8	18 000	21 000	15 000	12 000	**AC-6203**	**ZZ LLB LLH LLU**	21	23	36	0.6	0.062
	47	14	1	15.0	6.55	0.355	5.10	12.2	16 000	19 000	14 000	11 000	**AC-6303**	**ZZ LLB LLH LLU**	22	25	42	1	0.11
20	42	12	0.6	10.4	5.05	0.355	3.80	13.9	18 000	21 000	13 000	11 000	**AC-6004**	**ZZ LLB LLH LLU**	24	26	38	0.6	0.066
	47	14	1	14.2	6.65	0.505	4.20	13.2	16 000	18 000	12 000	10 000	**AC-6204**	**ZZ LLB LLH LLU**	25	28	42	1	0.101
	52	15	1.1	17.6	7.90	0.615	5.40	12.4	14 000	17 000	12 000	10 000	**AC-6304**	**ZZ LLB LLH LLU**	26.5	28.5	45.5	1	0.139
25	47	12	0.6	11.2	5.85	0.380	4.50	14.5	15 000	18 000	11 000	9 400	**AC-6005**	**ZZ LLB LLH LLU**	29	30.5	43	0.6	0.075
	52	15	1	15.5	7.85	0.550	5.80	13.9	13 000	15 000	11 000	8 900	**AC-6205**	**ZZ LLB LLH LLU**	30	32	47	1	0.122
	62	17	1.1	23.5	10.9	0.855	7.30	12.6	12 000	14 000	9 700	8 100	**AC-6305**	**ZZ LLB LLH LLU**	31.5	35	55.5	1	0.223
30	55	13	1	14.7	8.30	0.650	6.85	14.8	13 000	15 000	9 200	7 700	**AC-6006**	**ZZ LLB LLH LLU**	35	37	50	1	0.11
	62	16	1	21.6	11.3	0.795	7.55	13.8	11 000	13 000	8 800	7 300	**AC-6206**	**ZZ LLB LLH LLU**	35	39	57	1	0.191
	72	19	1.1	29.5	15.0	1.14	11.0	13.3	10 000	12 000	7 900	6 600	**AC-6306**	**ZZ LLB LLH LLU**	36.5	43	65.5	1	0.334
35	62	14	1	17.7	10.3	0.805	8.95	14.8	12 000	14 000	8 200	6 800	**AC-6007**	**ZZ LLB LLH LLU**	40	42	57	1	0.148
	72	17	1.1	28.4	15.3	1.09	9.65	13.8	9 800	11 000	7 600	6 300	**AC-6207**	**ZZ LLB LLH LLU**	41.5	45	65.5	1	0.277
	80	21	1.5	37.0	19.1	1.47	13.4	13.1	8 800	10 000	7 300	6 000	**AC-6307**	**ZZ LLB LLH LLU**	43	47	72	1.5	0.44
40	80	18	1.1	32.5	17.8	1.24	11.6	14.0	8 700	10 000	6 700	5 600	**AC-6208**	**ZZ LLB LLH LLU**	46.5	51	73.5	1	0.352
	90	23	1.5	45.0	24.0	1.83	16.6	13.2	7 800	9 200	6 400	5 300	**AC-6308**	**ZZ LLB LLH LLU**	48	54	82	1.5	0.609
45	85	19	1.1	36.0	20.4	1.60	14.7	14.1	7 800	9 200	6 200	5 200	**AC-6209**	**ZZ LLB LLH LLU**	51.5	55.5	78.5	1	0.391
	100	25	1.5	58.5	32.0	2.50	21.8	13.1	7 000	8 200	5 600	4 700	**AC-6309**	**ZZ LLB LLH LLU**	53	61.5	92	1.5	0.8

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

3) This dimension applies to sealed and shielded bearings.

Miniature and Small Size Ball Bearings



Open type

Shielded type

Shielded type with snap ring

1. Design features and characteristics

The dimensional range of miniature and extra small bearings can be found in **Table 1**. Boundary dimensions for both metric and inch series are in accordance with the internationally specified ISO and ANSI/ABMA standards. The most widely used sealed and shielded type ball bearings generally have a 1 - 2 mm wider width dimension than open type bearings.

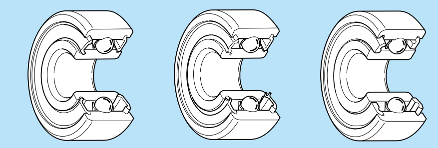
The main variations of these bearings are shown in **Table 2**. Miniature and extra small size ball bearings can also utilize snap rings, which simplify assembly within the housing. These bearings with snap rings can also be found in the dimensional tables in this catalog.

Among the most generally used sealed and shielded bearings are standard ZZ and ZZA type which incorporate non-contact steel shield plates. **Fig. 1** also shows non-contact type rubber sealed LLB and resin sealed SSA type bearings, as well as the contact-type rubber sealed LLU bearing.

Section "11. Lubrication" provides additional information on grease filled within the sealed and shielded bearings.

Table 1 Dimensional range

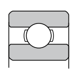
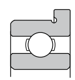
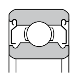
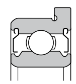
Bearing	Dimensional range
Miniature ball bearings	Nominal outer diameter $D <$ 9mm
Extra small ball bearings	Nominal bore diameter $d <$ 10mm Nominal outer diameter $D \geqq$ 9mm



Rubber sealed (non-contact type) LLB   Rubber sealed (contact type) LLU   Resin sealed (non-contact type) SSA

Fig. 1

Table 2 Main types and construction

Type	Standard type code			Flange-attached type code		
	Construction	Metric series	Inch series	Construction	Metric series	Inch series
Open type		6 BC	R		FL6 FLBC	FLR
Shielded type		6 X X ZZ W6 X X ZZ WBC X X X ZZ	RA X X ZZ		FL6 X X X ZZ FLW6 X X X ZZ FLWBC X X ZZ	FLRA X X ZZ

Note: 1. Representative codes are shown. For further details, please refer to dimension tables.
2. May change to ZA or SA for shielded type bearings, according to the bearing number.

2. Standard cage type

Pressed steel cages are standard for miniature and small size bearings.

3. Dimensional and rotational accuracy

The accuracy of miniature and extra small ball bearings complies with JIS standards. Accuracy of these bearings is defined by Table A-54 in section "6. Bearing Accuracy." Flange accuracies are listed in **Table 3**.

Table 3 Tolerance and tolerance values for outer ring flange

Unit: μm

Accuracy class		Outer diameter dimensional tolerance Δ_{D1s} or Δ_{D2s} Upper	Lower	Outer ring surface runout for rear surface S_{D1} Max.	Back face axial runout S_{ea1} Max.	Width deviation Δ_{C1s} or Δ_{C2s} Upper	Lower	Width unevenness V_{C1s} or V_{C2s} Max.
ISO standard	Class 0	* (see table below)		—	—	Identical to same bearing's inner ring Δ_{Bs}.		Identical to same bearing's inner ring V_{Bs}.
	Class 6			—	—			
	Class 5			8	11			5
	Class 4			4	7			2.5
	Class 2			1.5	3 [1)] 4			1.5

1) Applies to nominal outer diameter D of 18 mm or less.

*

Unit: μm

Flange nominal outer diameter D_1 or D_2 mm Over	Incl.	Outer diameter dimensional tolerance Δ_{D1s} or Δ_{D2s} Upper	Lower
—	10	+220	−36
10	18	+270	−43
18	30	+330	−52
30	50	+390	−62

Miniature and Small Size Ball Bearings NTN

4. Radial internal clearance

Radial internal clearance is defined by Table A-88 in section "8. Internal Clearance and Preload."

The radial clearance values for high precision miniature and extra small bearings can be found in **Table 4**.

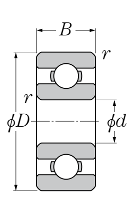
Table 4 Radial internal clearance for high precision bearings

Unit: μm

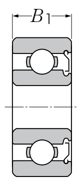
MIL Standard	Tight				Standard						Loose		Extra Loose	
Code	C2S		CNS		CNM		CNL		C3S		C3M		C3L	
Internal clearance	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	0	5	3	8	5	10	8	13	10	15	13	20	20	28

Note: 1. These standards are specified in accordance with MIL B23063. However, **NTN** codes are shown.
2. Clearance values do not include compensation for measuring load.

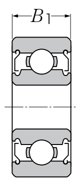
Metric series



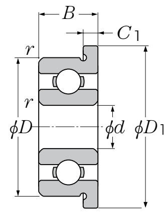
Open type



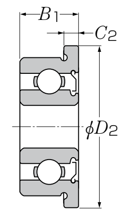
With single shield (Z)



With double shield (ZZ)



Open type with flange (FL)

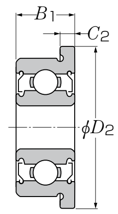


With flanged OR and single shield (FL…Z)

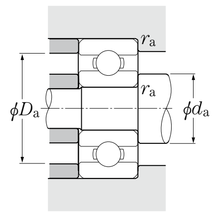
d 1.5 ~ 5mm

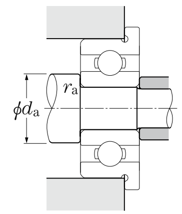
d	D	B	B_1	D_1	D_2	C_1	C_2	$r_{s\,min}$[1]	C_r (dynamic, N)	C_{0r} (static, N)	C_u Fatigue load limit N	f_0 Factor	Allowable speed min⁻¹ Grease lubrication	Allowable speed min⁻¹ Oil lubrication
1.5	4	1.2	2	5	5	0.4	0.6	0.15	113	29.0	0.775	13.6	88 000	100 000
	5	2	2.6	6.5	6.5	0.6	0.8	0.15	189	51.0	1.35	13.3	79 000	93 000
	6	2.5	3	7.5	7.5	0.6	0.8	0.15	305	86.0	2.28	12.3	71 000	84 000
2	4	1.2	—	—	—	—	—	0.05	115	37.0	0.970	14.8	83 000	98 000
	5	1.5	2.3	6.1	6.1	0.5	0.6	0.08	189	51.0	1.35	13.3	74 000	87 000
	5	2	2.5	—	—	—	—	0.1	189	51.0	1.35	13.3	74 000	87 000
	6	2.3	3	7.5	7.5	0.6	0.8	0.15	310	89.0	2.37	12.8	67 000	79 000
	6	2.5	—	7.2	—	0.6	—	0.15	310	89.0	2.37	12.8	67 000	79 000
	7	2.5	—	—	—	—	—	0.15	430	120	3.20	11.9	59 000	70 000
	7	2.8	3.5	8.5	8.5	0.7	0.9	0.15	425	125	3.30	12.4	62 000	73 000
2.5	5	1.5	2.3	—	—	—	—	0.08	169	59.0	1.56	15.0	70 000	82 000
	6	1.8	2.6	7.1	7.1	0.5	0.8	0.08	231	73.0	1.92	14.2	65 000	76 000
	7	—	3	—	8.2	—	0.6	0.15	315	96.0	2.53	13.7	59 000	70 000
	7	2.5	3.5	8.5	8.5	0.7	0.9	0.15	315	96.0	2.53	13.7	59 000	70 000
	8	2.5	2.8	9.2	—	0.6	—	0.15	475	152	4.05	13.2	56 000	66 000
	8	2.8	4	9.5	9.5	0.7	0.9	0.15	610	174	7.05	11.5	56 000	66 000
3	6	2	2.5	7.2	7.2	0.6	0.6	0.08	268	94.0	2.47	14.7	60 000	71 000
	7	2	3	8.1	8.1	0.5	0.8	0.1	430	130	3.45	12.9	58 000	68 000
	8	2.5	—	9.2	—	0.6	—	0.15	620	180	7.25	11.9	54 000	63 000
	8	3	4	9.5	9.5	0.7	0.9	0.15	620	180	7.25	11.9	54 000	63 000
	9	2.5	4	10.2	10.6	0.6	0.8	0.15	700	219	8.85	12.4	50 000	59 000
	9	3	5	10.5	10.5	0.7	1	0.15	700	219	8.85	12.4	50 000	59 000
	10	4	4	11.5	11.5	1	1	0.15	710	224	9.05	12.7	50 000	58 000
4	7	2	2.5	8.2	8.2	0.6	0.6	0.08	246	88.0	2.31	15.3	54 000	63 000
	8	2	3	9.2	9.2	0.6	0.6	0.08	440	140	5.65	13.9	52 000	61 000
	9	2.5	4	10.3	10.3	0.6	1	0.15	710	224	9.05	12.7	49 000	57 000
	10	3	4	11.2	11.6	0.6	0.8	0.15	720	235	9.50	13.3	46 000	55 000
	11	4	4	12.5	12.5	1	1	0.15	790	276	11.1	13.7	45 000	52 000
	12	4	4	13.5	13.5	1	1	0.2	1 080	360	14.4	12.8	43 000	51 000
	13	5	5	15	15	1	1	0.2	1 450	490	19.8	12.4	42 000	49 000
	16	5	5	—	—	—	—	0.3	1 940	680	23.1	12.4	37 000	44 000
5	8	2	2.5	9.2	9.2	0.6	0.6	0.08	241	91.0	2.39	15.8	49 000	57 000
	9	2.5	3	10.2	10.2	0.6	0.6	0.15	555	211	5.55	14.6	46 000	55 000
	10	3	4	11.2	11.6	0.6	0.8	0.15	790	276	11.1	13.7	45 000	52 000

1) Smallest allowable dimension for chamfer dimension r.



With flanged OR and double shield (FL…ZZ)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

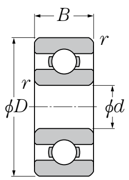
Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$

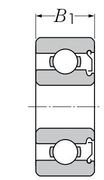
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Open type	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	d_a Min.	d_a Max.[2]	D_a Max.	r_{as} Max.	Mass (approx.) g Open type	Mass (approx.) g Open type with flange
68/1.5	**W68/1.5SA**	**SSA**	**FL68/1.5**	**FLW68/1.5SA**	**SSA**	2.3	2.4	3.2	0.05	0.07	0.09
69/1.5A	**W69/1.5ASA**	**SSA**	**FL69/1.5A**	**FLW69/1.5ASA**	**SSA**	2.7	2.9	3.8	0.15	0.18	0.24
60/1.5	**W60/1.5ZA**	**ZZA**	**FL60/1.5**	**FLW60/1.5ZA**	**ZZA**	2.7	3	4.8	0.15	0.35	0.42
672	—	—	—	—	—	2.5	2.6	3.5	0.05	0.06	—
682	**W682SA**	**SSA**	**FL682**	**FLW682SA**	**SSA**	2.8	2.9	4.2	0.08	0.13	0.17
BC2-5	**WBC2-5SA**	**SSA**	—	—	—	2.8	2.9	4.2	0.1	0.16	—
692	**W692SA**	**SSA**	**FL692**	**FLW692SA**	**SSA**	3.2	3.3	4.8	0.15	0.31	0.38
BC2-6	—	—	**FLBC2-6**	—	—	3.2	3.3	4.8	0.15	0.32	0.38
BC2-7A	—	—	—	—	—	3.2	3.6	5.8	0.15	0.44	—
602	**W602ZA**	**ZZA**	**FL602**	**FLW602ZA**	**ZZA**	3.2	3.7	5.8	0.15	0.54	0.64
67/2.5	**W67/2.5ZA**	**ZZA**	—	—	—	3.1	3.3	4.4	0.08	0.11	—
68/2.5	**W68/2.5ZA**	**ZZA**	**FL68/2.5**	**FLW68/2.5ZA**	**ZZA**	3.1	3.6	4.8	0.08	0.22	0.26
—	**WBC2.5-7ZA**	**ZZA**	—	**FLWBC2.5-7ZA**	**ZZA**	3.7	4	5.8	0.15	0.6[3]	0.67[3]
69/2.5	**W69/2.5SA**	**SSA**	**FL69/2.5**	**FLW69/2.5SA**	**SSA**	3.7	4	5.8	0.15	0.43	0.53
BC2.5-8	**WBC2.5-8ZA**	**ZZA**	**FLBC2.5-8**	—	—	3.7	4.3	6.8	0.15	0.57	0.65
60/2.5	**W60/2.5ZA**	**ZZA**	**FL60/2.5**	**FLW60/2.5ZA**	**ZZA**	3.7	4.1	6.8	0.15	0.72	0.83
673	**WA673SA**	**SSA**	**FL673**	**FLWA673SA**	**SSA**	3.6	4.1	5.4	0.08	0.2	0.26
683	**W683Z**	**ZZ**	**FL683**	**FLW683Z**	**ZZ**	3.9	4.1	5.8	0.1	0.33	0.38
BC3-8	—	—	**FLBC3-8**	—	—	4.2	4.4	6.8	0.15	0.52	0.6
693	**W693Z**	**ZZ**	**FL693**	**FLW693Z**	**ZZ**	4.2	4.4	6.8	0.15	0.61	0.72
BC3-9	**WBC3-9ZA**	**ZZA**	**FLBC3-9**	**FLAWBC3-9ZA**	**ZZA**	4.2	5	7.8	0.15	0.71	0.79
603	**W603Z**	**ZZ**	**FL603**	**FLW603Z**	**ZZ**	4.2	5	7.8	0.15	0.92	1
623	**623Z**	**ZZ**	**FL623**	**FL623Z**	**ZZ**	4.2	5.2	8.8	0.15	1.6	1.8
674A	**WA674ASA**	**SSA**	**FL674A**	**FLWA674ASA**	**SSA**	4.6	5	6.4	0.08	0.28	0.35
BC4-8	**WBC4-8Z**	**ZZ**	**FLBC4-8**	**FLWBC4-8Z**	**ZZ**	4.8	5	6.8	0.08	0.38	0.46
684AX50	**W684AX50Z**	**ZZ**	**FL684AX50**	**FLW684AX50Z**	**ZZ**	5	5.2	7.8	0.1	0.67	0.76
BC4-10	**WBC4-10Z**	**ZZ**	**FLBC4-10**	**FLAWBC4-10Z**	**ZZ**	5.2	6	8.8	0.15	1	1.1
694	**694Z**	**ZZ**	**FL694**	**FL694Z**	**ZZ**	5.2	6.4	9.8	0.15	1.8	2
604	**604Z**	**ZZ**	**FL604**	**FL604Z**	**ZZ**	5.6	6.6	10.4	0.2	2.1	2.3
624	**624Z**	**ZZ**	**FL624**	**FL624Z**	**ZZ**	5.6	6.2	11.4	0.2	3.2	3.5
634	**634Z**	**ZZ**	—	—	—	6	7.6	14	0.3	5.1	—
675	**WA675Z**	**ZZ**	**FL675**	**FLWA675Z**	**ZZ**	5.6	6	7.4	0.08	0.32	0.4
BC5-9	**WBC5-9Z**	**ZZ**	**FLBC5-9**	**FLWBC5-9Z**	**ZZ**	5.2	6.1	7.8	0.15	0.55	0.63
BC5-10	**WBC5-10Z**	**ZZ**	**FLBC5-10**	**FLAWBC5-10Z**	**ZZ**	6.2	6.4	8.8	0.15	0.88	0.97

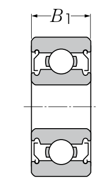
2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.



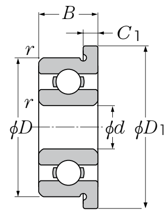
Open type



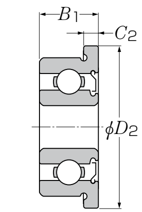
With single shield (Z)



With double shield (ZZ)



Open type with flange (FL)



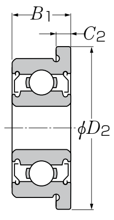
With flanged OR and single shield (FL…Z)

d 5 ～ 9mm

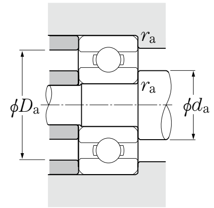
d	D	B	B_1	D_1	D_2	C_1	C_2	$r_{s\,min}$[1]	C_r	C_{0r}	C_u	f_0	Grease lubrication	Oil lubrication
Boundary dimensions mm									Basic load rating dynamic / static N		Fatigue load limit N	Factor	Allowable speed min⁻¹	
5	11	—	4	—	12.6	—	0.8	0.15	795	282	11.4	14.0	43 000	51 000
	11	3	5	12.5	12.5	0.8	1	0.15	795	282	11.4	14.0	43 000	51 000
	13	4	4	15	15	1	1	0.2	1 190	430	17.3	13.4	40 000	47 000
	13	—	5	—	15	—	1	0.2	1 190	430	17.3	13.4	40 000	47 000
	14	5	5	16	16	1	1	0.2	1 470	505	20.5	12.8	39 000	46 000
	16	5	5	18	18	1	1	0.3	1 940	680	23.1	12.4	37 000	44 000
	19	6	6	—	—	—	—	0.3	2 590	885	64.5	12.1	34 000	40 000
6	10	2.5	3	11.2	11.2	0.6	0.6	0.1	515	196	5.15	15.2	43 000	51 000
	12	3	4	13.2	13.6	0.6	0.8	0.15	920	365	14.8	14.5	40 000	47 000
	13	3.5	5	15	15	1.0	1.1	0.15	1 200	440	17.5	13.7	39 000	46 000
	15	5	5	17	17	1.2	1.2	0.2	1 490	530	21.3	13.3	37 000	44 000
	16	6	6	—	—	—	—	0.2	1 960	695	28.1	12.7	36 000	42 000
	17	6	6	19	19	1.2	1.2	0.3	2 430	865	35.0	12.3	35 000	42 000
	19	6	6	22	22	1.5	1.5	0.3	2 590	885	64.5	12.1	34 000	40 000
7	11	2.5	3	12.2	12.2	0.6	0.6	0.1	610	269	7.05	15.6	40 000	47 000
	13	3	4	14.2	14.6	0.6	0.8	0.15	915	375	15.2	14.9	38 000	45 000
	14	3.5	5	16	16	1	1.1	0.15	1 300	505	20.4	14.0	37 000	44 000
	17	5	5	19	19	1.2	1.2	0.3	1 780	715	28.8	14.0	35 000	41 000
	19	6	6	—	—	—	—	0.3	2 480	910	60.0	12.9	34 000	40 000
	22	7	7	—	—	—	—	0.3	3 700	1 400	97.0	12.5	32 000	37 000
8	12	2.5	3.5	13.2	13.6	0.6	0.8	0.1	570	252	6.60	15.9	38 000	45 000
	14	3.5	4	15.6	15.6	0.8	0.8	0.15	910	385	15.5	15.2	36 000	43 000
	16	4	5	18	18	1	1.1	0.2	1 780	715	28.8	14.0	35 000	41 000
	19	6	6	22	22	1.5	1.5	0.3	2 200	865	35.0	13.8	33 000	39 000
	22	7	7	25	25	1.5	1.5	0.3	3 700	1 400	97.0	12.5	32 000	37 000
	24	8	8	—	—	—	—	0.3	4 450	1 590	122	11.7	31 000	36 000
9	14	3	4.5	—	—	—	—	0.1	1 020	465	18.8	15.5	36 000	42 000
	17	4	5	19	19	1	1.1	0.2	1 910	820	33.0	14.4	33 000	39 000
	20	6	6	—	—	—	—	0.3	2 750	1 090	44.0	13.5	32 000	38 000
	24	7	7	—	—	—	—	0.3	3 750	1 450	94.5	12.9	31 000	36 000
	26	8	8	—	—	—	—	0.6	5 050	1 960	138	12.4	30 000	35 000

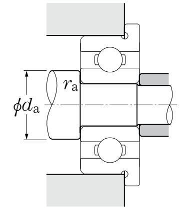
1) Smallest allowable dimension for chamfer dimension r.

Miniature and Small Size Ball Bearings NTN



With flanged OR and double shield (FL…ZZ)





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

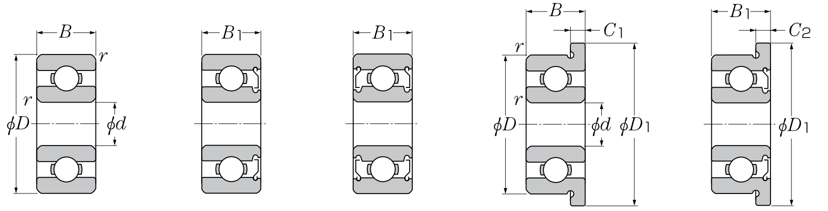
$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leqq e$ X	$\frac{F_a}{F_r} \leqq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

d	Open type	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	d_a Min.	d_a Max.[2]	D_a Max.	r_{as} Max.	Mass Open type	Mass Open type with flange
	Bearing numbers						Installation-related dimensions mm				Mass (approx.) g	
5	—	WBC5-11Z	ZZ	—	FLWBC5-11Z	ZZ	6.2	6.8	9.8	0.2	1.8[3]	2[3]
	685	W685Z	ZZ	FL685	FLW685Z	ZZ	6.2	6.8	9.8	0.15	1.1	1.3
	695A	695AZ	ZZ	FL695A	FL695AZ	ZZ	6.6	6.9	11.4	0.2	2.4	2.7
	—	WBC5-13Z	ZZ	—	FLWBC5-13Z	ZZ	6.6	6.9	11.4	0.2	3.4[3]	3.7[3]
	605	605Z	ZZ	FL605	FL605Z	ZZ	6.6	7.4	12.4	0.2	3.5	3.9
	625	625Z	ZZ	FL625	FL625Z	ZZ	7	7.6	14	0.3	4.8	5.2
	635	635Z	ZZ	—	—	—	7	9.5	17	0.3	8	—
6	676A	WA676AZ	ZZ	FL676A	FLWA676AZ	ZZ	6.6	6.7	9.2	0.1	0.65	0.74
	BC6-12	WBC6-12Z	ZZ	FLBC6-12	FLAWBC6-12Z	ZZ	7.2	7.9	10.8	0.15	1.3	1.4
	686	W686Z	ZZ	FL686	FLW686Z	ZZ	7	7.2	11.8	0.15	1.9	2.2
	696	696Z	ZZ	FL696	FL696Z	ZZ	7.6	7.8	13.4	0.2	3.8	4.3
	BC6-16A	BC6-16AZ	ZZ	—	—	—	7.6	8	14.4	0.2	5.2	—
	606	606Z	ZZ	FL606	FL606Z	ZZ	8	8.6	15	0.3	6	6.5
	626	626Z	ZZ	FL626	FL626Z	ZZ	8	9.5	17	0.3	8.1	9.2
7	677	WA677Z	ZZ	FL677	FLWA677Z	ZZ	7.8	8.1	10.2	0.1	0.67	0.77
	BC7-13	WBC7-13Z	ZZ	FLBC7-13	FLAWBC7-13Z	ZZ	8.2	8.9	11.8	0.15	1.4	1.5
	687A	W687AZ	ZZ	FL687A	FLW687AZ	ZZ	8.2	8.7	12.8	0.15	2.1	2.4
	697	697Z	ZZ	FL697	FL697Z	ZZ	9	10	15	0.3	5.2	5.7
	607	607Z	ZZ	—	—	—	9	10.4	17	0.3	8	—
	627	627Z	ZZ	—	—	—	9	12.2	20	0.3	13	—
8	678A	W678AZ	ZZ	FL678A	FLAW678AZ	ZZ	8.8	9.1	11.2	0.1	0.75	0.86
	BC8-14	WBC8-14Z	ZZ	FLBC8-14	FLWBC8-14Z	ZZ	9.2	9.5	12.8	0.15	1.8	1.9
	688A	W688AZ	ZZ	FL688A	FLW688AZ	ZZ	9.6	10	14.4	0.2	3.1	3.5
	698	698Z	ZZ	FL698	FL698Z	ZZ	10	10.6	17	0.3	7.3	8.4
	608	608Z	ZZ	FL608	FL608Z	ZZ	10	12.2	20	0.3	12	13
	628	628Z	ZZ	—	—	—	10	12.1	22	0.3	17	—
9	679	W679Z	ZZ	—	—	—	9.8	10.4	13.2	0.1	1.4	—
	689	W689Z	ZZ	FL689	FLW689Z	ZZ	10.6	10.7	15.4	0.2	3.2	3.6
	699	699Z	ZZ	—	—	—	11	11.6	18	0.3	8.2	—
	609JX2	609JX2Z	ZZ	—	—	—	11	13.1	22	0.3	14	—
	629X50	629X50Z	ZZ	—	—	—	13	13.9	22	0.3	20	—

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

Inch series

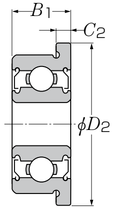


Open type | With single shield (Z) | With double shield (ZZ) | Open type with flange (FL) | With flanged OR and single shield (FL···Z)

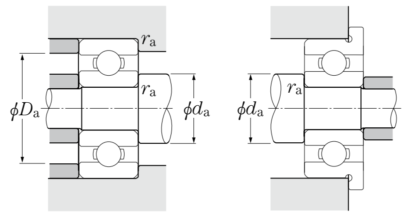
d 1.984 ~ 9.525mm

Boundary dimensions mm								Basic load rating N		Fatigue load limit N	Factor	Allowable speed min^{-1}	
								dynamic	static			Grease lubrication	Oil lubrication
d	D	B	B_1	D_1	C_1	C_2	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	f_0		
1.984	6.35	2.38	3.571	7.52	0.58	0.79	0.08	310	89.0	2.37	12.8	67 000	79 000
2.380	4 762	1.588	2.38	5.94	0.46	0.79	0.08	137	42.0	1.12	14.8	73 000	85 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.13	475	152	4.05	13.2	56 000	66 000
3.175	6.35	2.38	2.779	7.52	0.58	0.79	0.08	315	96.0	2.53	13.7	59 000	70 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.08	620	180	7.25	11.9	54 000	63 000
	9.525	2.779	3.571	10.72	0.58	0.79	0.13	710	224	9.05	12.7	49 000	58 000
	9.525	3.967	3.967	11.18	0.76	0.76	0.3	710	224	9.05	12.7	49 000	58 000
	12.7	4.366	4.366	—	—	—	0.3	1 270	395	16.1	11.7	43 000	51 000
3.967	7.938	2.779	3.175	9.12	0.58	0.91	0.08	370	133	3.50	14.8	51 000	60 000
4.762	7.938	2.779	3.175	9.12	0.58	0.91	0.08	440	143	3.80	14.2	49 000	58 000
	9.525	3.175	3.175	10.72	0.58	0.79	0.08	785	268	10.8	13.3	46 000	55 000
	12.7	3.967	—	—	—	—	0.3	1 450	490	19.8	12.4	41 000	48 000
	12.7	4.978	4.978	14.35	1.07	1.07	0.3	1 450	490	19.8	12.4	41 000	48 000
6.350	9.525	3.175	3.175	10.72	0.58	0.91	0.08	232	94.0	2.47	16.4	43 000	51 000
	12.7	3.175	4.762	13.89	0.58	1.14	0.13	920	370	15.0	14.7	39 000	46 000
	15.875	4.978	4.978	17.53	1.07	1.07	0.3	1 640	615	24.9	13.6	36 000	43 000
	19.05	—	7.142	—	—	—	0.41	2 590	885	64.5	12.1	34 000	40 000
9.525	22.225	—	7.142	24.61	—	1.57	0.41	3700	1 400	94.5	12.7	31 000	37 000

1) Smallest allowable dimension for chamfer dimension r.



With flanged OR and double shield (FL···ZZ)



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

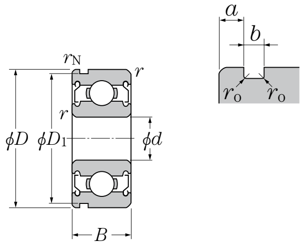
$P_{0r} = 0.6F_r + 0.5F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

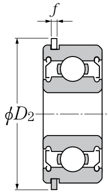
Bearing numbers						Installation-related dimensions mm				Mass (approx.) g	
Open type	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	d_a Min.	d_a Max.2)	D_a Max.	r_{as} Max.	Open type	Open type with flange
R1-4	**RA1-4ZA**	**ZZA**	**FLR1-4**	**FLRA1-4ZA**	**ZZA**	2.8	3.3	5.5	0.08	0.35	0.41
R133	**RA133ZA**	**ZZA**	**FLR133**	**FLRA133ZA**	**ZZA**	2.9	3.1	4	0.08	0.12	0.16
R1-5	**RA1-5ZA**	**ZZA**	**FLR1-5**	**FLRA1-5ZA**	**ZZA**	3.2	4.3	7.1	0.1	0.69	0.76
R144	**RA144ZA**	**ZZA**	**FLR144**	**FLRA144ZA**	**ZZA**	3.9	4	5.5	0.08	0.27	0.33
R2-5	**RA2-5Z**	**ZZ**	**FLR2-5**	**FLRA2-5Z**	**ZZ**	4	4.4	7	0.08	0.61	0.68
RA2-6	**RA2-6ZA**	**ZZA**	**FLR2-6**	**FLRA2-6ZA**	**ZZA**	4	5.2	8.7	0.1	0.88	0.96
R2	**RA2ZA**	**ZZA**	**FLR2**	**FLRA2ZA**	**ZZA**	4.8	5.2	7.8	0.3	1.3	1.5
RA2	**RA2Z**	**ZZ**	—	—	—	4.8	5.4	11	0.3	2.5	—
RA155	**RA155ZA**	**ZZA**	**FLR155**	**FLRA155ZA**	**ZZA**	4.8	5.3	7	0.08	0.54	0.61
R156	**RA156Z**	**ZZ**	**FLR156**	**FLRA156Z**	**ZZ**	5.5	5.6	7	0.08	0.44	0.51
R166	**R166Z**	**ZZ**	**FLR166**	**FLAR166Z**	**ZZ**	5.6	5.9	8.7	0.08	0.8	0.89
R3	—	—	—	—	—	6.4	7.2	11	0.3	2.2	—
RA3	**RA3Z**	**ZZ**	**FLRA3**	**FLRA3Z**	**ZZ**	6	6.4	11	0.3	2.4	2.7
R168A	**R168AZ**	**AZZ**	—	**FLAR168AZ**	**ZZ**	7.1	7.3	8.7	0.08	0.6	0.69
R188	**RA188ZA**	**ZZA**	**FLR188**	**FLRA188ZA**	**ZZA**	7.2	8.2	11.8	0.1	1.6	1.7
R4	**R4Z**	**ZZ**	**FLR4**	**FLR4Z**	**ZZ**	8	8.6	14.2	0.3	4.4	4.8
—	**RA4Z**	**ZZ**	—	—	—	8.4	9.5	17	0.4	11 3)	—
—	**R6Z**	**ZZ**	—	**FLR6Z**	**ZZ**	11.5	11.9	20.2	0.4	14 3)	15 3)

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

With snap ring groove
With snap ring



Shielded type with snap ring groove (ZZ)

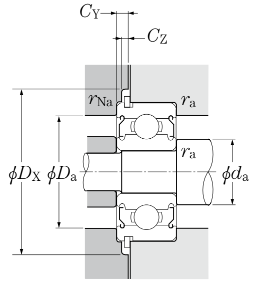


Shielded type with snap ring (ZZ)

d 5 ～ 10mm

Boundary dimensions (mm)					Basic load rating (N)		Fatigue load limit (N)	Factor	Allowable speed (min^{-1})		Bearing numbers 2)	
d	D	B	$r_{s\,min}$ 1)	r_{Na} Min.	dynamic C_r	static C_{0r}	C_u	f_0	Grease lubrication	Oil lubrication	Shielded type with snap ring groove	Shielded type with snap ring
5	13	4	0.2	0.1	1 190	430	17.3	13.4	40 000	47 000	SC559ZZN	ZZNR
	14	5	0.2	0.2	1 470	505	20.5	12.8	39 000	46 000	SC571ZZN	ZZNR
6	12	4	0.15	0.1	640	365	—	14.5	40 000	47 000	∗F-SC6A06ZZ1N	ZZ1NR
	13	5	0.15	0.1	1 200	440	17.5	13.7	39 000	46 000	SC6A04ZZN	ZZNR
	15	5	0.2	0.2	1 490	530	21.3	13.3	37 000	44 000	SC6A17ZZN	ZZNR
	19	6	0.3	0.3	2 590	885	64.5	12.1	34 000	40 000	SC669ZZN	ZZNR
8	16	5	0.2	0.1	1 390	585	23.6	14.6	35 000	41 000	SC890ZZN	ZZNR
	22	7	0.3	0.4	3 700	1 400	97.0	12.5	32 000	37 000	SC850ZZN	ZZNR
10	26	8	0.3	0.3	5 050	1 960	138	12.4	29 000	34 000	SC0039ZZN	ZZNR

1) Smallest allowable dimension for chamfer dimension r.
2) "∗" mark indicates that stainless steel is used.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$ X	Y	$\frac{F_a}{F_r} > e$ X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Snap ring groove dimensions (mm)				Snap ring dimensions (mm)		Installation-related dimensions (mm)								Mass (kg)
D_1 Max.	a Max.	b Min.	r_o Max.	D_2 Max.	f Max.	d_a Min.	d_a Max.	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	With snap ring (approx.)
12.15	0.88	0.55	0.2	15.2	0.55	6.6	6.9	11.4	15.9	1.2	0.6	0.2	0.1	0.002
13.03	1.28	0.65	0.06	16.13	0.54	6.6	7.4	12.4	16.9	1.6	0.6	0.2	0.2	0.004
11.15	0.78	0.60	0.02	14.2	0.55	7.2	7.9	10.8	14.9	1.1	0.6	0.15	0.1	0.001
12.15	1.08	0.55	0.2	15.2	0.55	7	7.2	11.8	15.9	1.4	0.6	0.15	0.1	0.002
14.03	1.03	0.65	0.06	17.2	0.6	7.6	7.8	13.4	17.9	1.4	0.7	0.2	0.2	0.004
17.9	0.93	0.80	0.2	22	0.7	8	9.5	17	22.8	1.4	0.7	0.3	0.3	0.008
14.95	0.53	0.65	0.05	18.2	0.54	9.6	10	14.4	18.9	0.9	0.6	0.2	0.1	0.003
20.8	2.35	0.80	0.2	24.8	0.7	10	12.7	20	25.5	2.8	0.7	0.3	0.4	0.013
24.5	2.20	0.90	0.3	28.8	0.85	12	13.5	24	29.5	2.8	0.9	0.3	0.3	0.02

Angular Contact Ball Bearings

Angular contact ball bearing

Four-point contact ball bearing

Double row angular contact ball bearing

1. Design features and characteristics

1.1 Angular contact ball bearing

Angular contact ball bearings are non-separable bearings with a defined contact angle in the radial direction relative to the straight line that runs through the point where each ball makes contact with the inner and outer rings (see **Fig. 1**). **Table 1** provides information on contact angles and their designated codes.

In addition to radial loads, angular contact ball bearings can accommodate single direction axial loads. Since an axial load is generated from a radial force, these bearings are generally used in pairs. **Table 2** shows general angular contact ball bearing characteristics, **Table 3** shows information on using duplex (side by side) angular contact ball bearings, and **Table 4** shows information on multiple-row angular contact ball bearings.

For bearings with a contact angle of 15° and bearing tolerance JIS Class 5 or higher, see special catalog "**Precision rolling bearings (CAT. No. 2260/E)**".

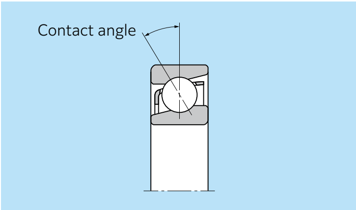


Fig. 1

Table 1 Contact angle and contact angle codes

Contact angle	15°	30°	40°
Contact angle code	C	A 1)	B

1) Contact angle symbol A is omitted from part number.

Table 2 Angular contact ball bearing types and characteristics

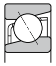
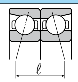
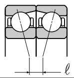
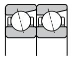
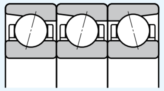
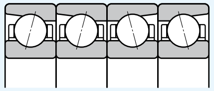
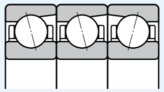
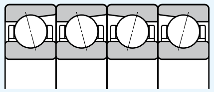
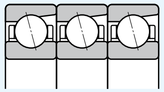
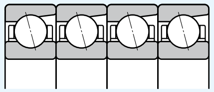
Type	Design	Characteristics
Standard type		● Available in bearing series 79, 70, 72, 72B, 73, and 73B. ● Contact angles: 30° and 40° (with B) available. ● Standard bearing cage type differs depending on bearing number. (see **Table 5**)

Table 3 Duplex angular contact ball bearings — types and characteristics

Duplex type		Characteristics
Back-to-back arrangement (DB)		● Can accommodate radial loads and axial loads in either direction. ● Has a large distance between the acting load centers of the bearings, and therefore a large momentary force load capacity. ● Allowable misalignment angle is small.
Face-to-face arrangement (DF)		● Can accommodate radial loads and axial loads in either direction. ● Has a smaller distance between the acting load centers of the bearings, and therefore a smaller momentary force load capacity. ● Has a larger allowable misalignment angle than back-to-back duplex type.
Tandem arrangement (DT)		● Can accommodate radial loads and single direction axial loads. ● Axial loads are received by both bearings as a set, and therefore heavy axial loads can be accommodated.

Note: 1. Duplex angular contact ball bearings are manufactured in a set to specified clearance and preload values; therefore, they must be assembled side by side with identically numbered bearings and not be mixed with other arrangements.
2. To satisfy specified clearance and preload values, tightening must be performed until the inner ring width surfaces or outer ring width surfaces come in contact with each other.

Table 4 Combination examples of multiple-row angular contact ball bearings

Duplex type	3-row arrangement	4-row arrangement
Back-to-back arrangement	 (DBT)	 (DTBT)
Face-to-face arrangement	 (DFT)	 (DTFT)
Tandem arrangement	 (DTT)	 (DTTT)

Note: Other combinations are also available. Consult **NTN** Engineering for details.

1.2 Four-point angular contact ball bearings

Four-point angular contact ball bearings have a contact angle of 30° and a split inner ring. As shown in **Fig. 2**, when the inner and outer rings receive a radial load, the ball contacts the inner and outer rings at four points. This construction enables a single bearing to accommodate axial loads from either direction, and when under a simple axial load or heavy axial load, the bearing relies on two contact points like ordinary bearings.

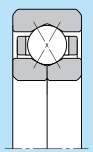


Fig. 2

■Flush ground

"Flush ground" is the name given to the finishing method shown in **Fig. 3** where the offset of the front and back faces of the bearing are ground to the same value. This allows a designated clearance or preload value to be achieved when using bearings with identical codes in DB or DF orientations. DT series bearings can also be used in various arrangements to achieve uniform load distribution.

General angular contact ball bearings are not flush ground. If it is necessary to flush grind any of these other bearings, please consult **NTN** Engineering.

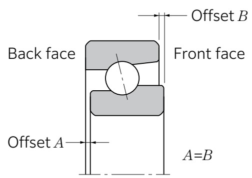


Fig. 3

1.3 Double row angular contact ball bearings

The structure of double row angular contact ball bearings is designed by arranging two single row angular contact bearings back-to-back in duplex (DB) to form a single bearing with a contact angle of 25°.

These bearings are capable of accommodating radial loads, axial loads in either direction, and have a high capacity for moment loads.

As shown in **Fig. 4**, sealed and shielded type double row angular contact ball bearings are also available. Standard loads vary from those of open type bearings.

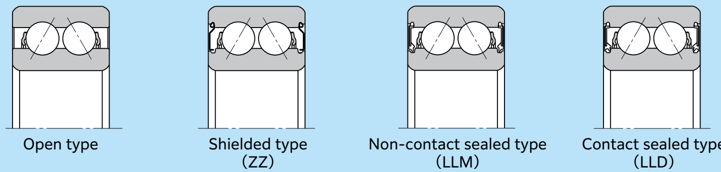


Fig. 4

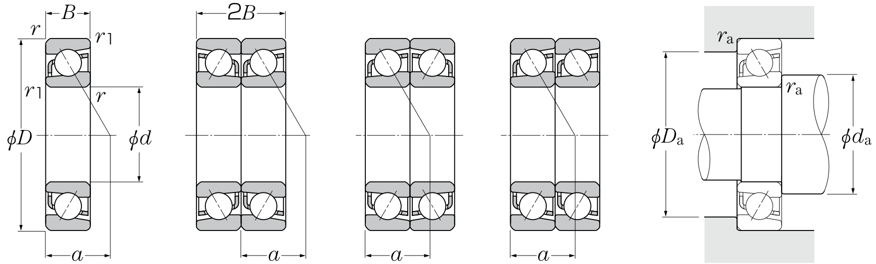
2. Standard cage type

Table 5 lists the standard cage types for angular contact ball bearings.

Table 5 Standard cages for angular contact ball bearings

Type	Bearing series	Resin cage	Pressed steel cage	Machined cage
Standard type	79	7904~7913	—	7914~7960
	70	7000~7024	—	7026~7040
	72	—	7200~7222	7224~7240
	73	—	7300~7322	7324~7340
	72B	—	7200B~7222B	7224B~7240B
	73B	—	7300B~7322B	7324B~7340B
				
4-point contact	QJ2	—	—	QJ208~QJ224
	QJ3	—	—	QJ306~QJ324
				
Multi row	52	—	5200S~5217S	—
	53	—	5302S~5314S	—
				

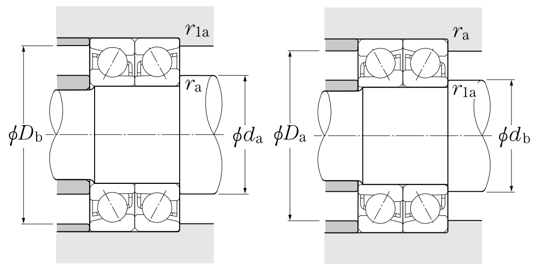
Note: Depending on the usage conditions, some cage types may not be suitable. For example, due to the material characteristics of resin cages, use at application temperatures in excess of 120°C is not possible.
For details, please contact **NTN** Engineering.



d 10 ～ 30mm

d	*D*	*B*	2B	$r_{s\,min}$ [3]	$r_{1s\,min}$ [3]	C_r dynamic (kN)	C_{0r} static (kN)	Fatigue load limit C_u (kN)	Allowable speed [1] Grease lubrication (min⁻¹)	Allowable speed [1] Oil lubrication (min⁻¹)	Bearing number [2]	Load center *a* (mm)	Mass kg Single row (approx.)
10	26	8	16	0.3	0.15	5.10	2.07	0.162	29 000	39 000	**7000**	9	0.023
	30	9	18	0.6	0.3	6.00	2.74	0.214	28 000	37 000	**7200**	10.5	0.029
	30	9	18	0.6	0.3	5.50	2.52	0.197	24 000	32 000	**7200B**	13	0.029
	35	11	22	0.6	0.3	11.2	4.95	0.385	26 000	34 000	**7300**	12	0.04
	35	11	22	0.6	0.3	10.5	4.60	0.360	22 000	29 000	**7300B**	15	0.041
12	28	8	16	0.3	0.15	5.60	2.46	0.193	26 000	35 000	**7001**	10	0.025
	32	10	20	0.6	0.3	8.40	3.95	0.310	25 000	33 000	**7201**	11.5	0.035
	32	10	20	0.6	0.3	7.75	3.65	0.287	21 000	28 000	**7201B**	14	0.036
	37	12	24	1	0.6	12.4	5.25	0.410	23 000	30 000	**7301**	13	0.044
	37	12	24	1	0.6	11.7	4.95	0.385	19 000	26 000	**7301B**	16.5	0.045
15	32	9	18	0.3	0.15	6.40	3.15	0.246	23 000	31 000	**7002**	11.5	0.035
	35	11	22	0.6	0.3	10.0	4.70	0.370	22 000	29 000	**7202**	12.5	0.046
	35	11	22	0.6	0.3	9.25	4.35	0.340	18 000	25 000	**7202B**	16	0.046
	42	13	26	1	0.6	14.9	7.20	0.560	19 000	26 000	**7302**	15	0.055
	42	13	26	1	0.6	13.8	6.65	0.520	17 000	22 000	**7302B**	19	0.057
17	35	10	20	0.3	0.15	7.95	3.85	0.299	21 000	28 000	**7003**	12.5	0.046
	40	12	24	0.6	0.3	13.2	6.60	0.515	19 000	26 000	**7203**	14.5	0.064
	40	12	24	0.6	0.3	12.2	6.10	0.480	17 000	22 000	**7203B**	18	0.066
	47	14	28	1	0.6	17.7	8.65	0.675	18 000	24 000	**7303**	16	0.107
	47	14	28	1	0.6	16.4	8.05	0.630	15 000	20 000	**7303B**	20.5	0.109
20	42	12	24	0.6	0.3	10.7	5.60	0.440	19 000	25 000	**7004**	15	0.08
	47	14	28	1	0.6	16.1	8.40	0.655	17 000	23 000	**7204**	17	0.1
	47	14	28	1	0.6	14.7	7.70	0.605	15 000	20 000	**7204B**	21.5	0.102
	52	15	30	1.1	0.6	20.7	10.4	0.815	16 000	21 000	**7304**	18	0.138
	52	15	30	1.1	0.6	19.2	9.65	0.755	13 000	18 000	**7304B**	22.5	0.141
25	42	9	18	0.3	0.15	7.90	4.95	0.360	17 000	22 000	**7905**	14	0.05
	47	12	24	0.6	0.3	11.9	6.85	0.535	16 000	21 000	**7005**	16.5	0.093
	52	15	30	1	0.6	18.0	10.3	0.805	14 000	19 000	**7205**	19	0.125
	52	15	30	1	0.6	16.4	9.40	0.740	12 000	16 000	**7205B**	24	0.129
	62	17	34	1.1	0.6	29.3	15.8	1.24	13 000	17 000	**7305**	21	0.23
	62	17	34	1.1	0.6	27.0	14.6	1.14	11 000	15 000	**7305B**	27	0.234
30	47	9	18	0.3	0.15	8.35	5.75	0.395	14 000	19 000	**7906**	15.5	0.058
	55	13	26	1	0.6	15.4	9.45	0.725	13 000	18 000	**7006**	19	0.135

1) This value achieved with machined cages; when pressed cages are used, 80% of this value is acceptable. 2) Bearing numbers appended with the code "B" have a contact angle of 40°; bearings without this code have a contact angle of 30°. 3) Smallest allowable dimension for chamfer dimension *r* or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle	*e*	Single, DT $F_a/F_r \leqq e$ *X*	Single, DT $F_a/F_r \leqq e$ *Y*	Single, DT $F_a/F_r > e$ *X*	Single, DT $F_a/F_r > e$ *Y*	DB, DF $F_a/F_r \leqq e$ *X*	DB, DF $F_a/F_r \leqq e$ *Y*	DB, DF $F_a/F_r > e$ *X*	DB, DF $F_a/F_r > e$ *Y*
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Static equivalent radial load

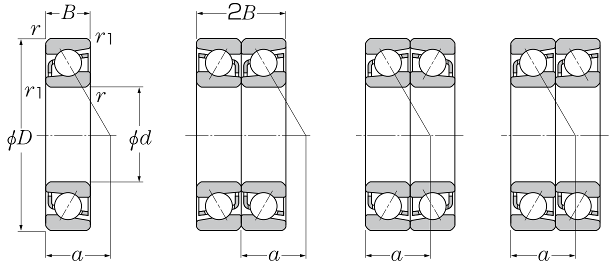
$P_{0r} = X_0 F_r + Y_0 F_a$

Contact angle	Single, DT X_0	Single, DT Y_0	DB, DF X_0	DB, DF Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

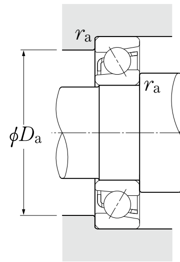
For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

Basic load rating dynamic (duplex) C_r (kN)	Basic load rating static (duplex) C_{0r} (kN)	Allowable speed [1] (duplex) Grease lubrication (min⁻¹)	Allowable speed [1] (duplex) Oil lubrication (min⁻¹)	Bearing number DB	Bearing number DF	Bearing number DT	d_a Min. (mm)	d_b Min. (mm)	D_a Max. (mm)	D_b Max. (mm)	r_{as} Max. (mm)	r_{1as} Max. (mm)
8.30	4.15	23 000	31 000	**DB**	**DF**	**DT**	12.5	12.5	23.5	24.8	0.3	0.15
9.75	5.45	22 000	30 000	**DB**	**DF**	**DT**	14.5	12.5	25.5	27.5	0.6	0.3
8.95	5.05	19 000	26 000	**DB**	**DF**	**DT**	14.5	12.5	25.5	27.5	0.6	0.3
18.2	9.85	20 000	27 000	**DB**	**DF**	**DT**	14.5	12.5	30.5	32.5	0.6	0.3
17.1	9.20	18 000	24 000	**DB**	**DF**	**DT**	14.5	12.5	30.5	32.5	0.6	0.3
9.10	4.90	21 000	28 000	**DB**	**DF**	**DT**	14.5	14.5	25.5	26.8	0.3	0.15
13.7	7.95	20 000	26 000	**DB**	**DF**	**DT**	16.5	14.5	27.5	29.5	0.6	0.3
12.6	7.35	17 000	23 000	**DB**	**DF**	**DT**	16.5	14.5	27.5	29.5	0.6	0.3
20.1	10.5	18 000	24 000	**DB**	**DF**	**DT**	17.5	16.5	31.5	32.5	1	0.6
19.0	9.90	16 000	21 000	**DB**	**DF**	**DT**	17.5	16.5	31.5	32.5	1	0.6
10.4	6.30	18 000	24 000	**DB**	**DF**	**DT**	17.5	17.5	29.5	30.8	0.3	0.15
16.3	9.40	17 000	23 000	**DB**	**DF**	**DT**	19.5	17.5	30.5	32.5	0.6	0.3
15.1	8.70	15 000	20 000	**DB**	**DF**	**DT**	19.5	17.5	30.5	32.5	0.6	0.3
24.2	14.4	15 000	21 000	**DB**	**DF**	**DT**	20.5	19.5	36.5	37.5	1	0.6
22.5	13.3	13 000	18 000	**DB**	**DF**	**DT**	20.5	19.5	36.5	37.5	1	0.6
12.9	7.65	17 000	22 000	**DB**	**DF**	**DT**	19.5	19.5	32.5	33.8	0.3	0.15
21.5	13.2	15 000	21 000	**DB**	**DF**	**DT**	21.5	19.5	35.5	37.5	0.6	0.3
19.8	12.2	13 000	18 000	**DB**	**DF**	**DT**	21.5	19.5	35.5	37.5	0.6	0.3
28.7	17.3	14 000	19 000	**DB**	**DF**	**DT**	22.5	21.5	41.5	42.5	1	0.6
26.6	16.1	12 000	16 000	**DB**	**DF**	**DT**	22.5	21.5	41.5	42.5	1	0.6
17.5	11.2	15 000	20 000	**DB**	**DF**	**DT**	24.5	24.5	37.5	39.5	0.6	0.3
26.1	16.8	14 000	18 000	**DB**	**DF**	**DT**	25.5	24.5	41.5	42.5	1	0.6
23.9	15.4	12 000	16 000	**DB**	**DF**	**DT**	25.5	24.5	41.5	42.5	1	0.6
33.5	20.8	12 000	17 000	**DB**	**DF**	**DT**	27	24.5	45	47.5	1	0.6
31.0	19.3	11 000	14 000	**DB**	**DF**	**DT**	27	24.5	45	47.5	1	0.6
12.9	9.95	13 000	18 000	**DB**	**DF**	**DT**	27.5	27.5	39.5	40.8	0.3	0.15
19.3	13.7	12 000	17 000	**DB**	**DF**	**DT**	29.5	29.5	42.5	44.5	0.6	0.3
29.2	20.6	11 000	15 000	**DB**	**DF**	**DT**	30.5	29.5	46.5	47.5	1	0.6
26.6	18.8	10 000	13 000	**DB**	**DF**	**DT**	30.5	29.5	46.5	47.5	1	0.6
47.5	31.5	10 000	14 000	**DB**	**DF**	**DT**	32	29.5	55	57.5	1	0.6
44.0	29.3	9 100	12 000	**DB**	**DF**	**DT**	32	29.5	55	57.5	1	0.6
13.6	11.5	12 000	15 000	**DB**	**DF**	**DT**	32.5	32.5	44.5	45.8	0.3	0.15
25.0	18.9	11 000	14 000	**DB**	**DF**	**DT**	35.5	35.5	49.5	50.5	1	0.6

Note: For bearing series 79 and 70, inner rings are constructed with groove abutments on both sides. Therefore, the inner ring chamfer dimension r_1 is identical to dimension *r*. Furthermore, the radius r_{1a} of the shaft corner roundness is likewise identical to r_a.



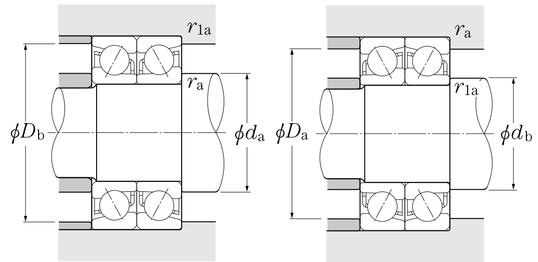
Single row | Back-to-back arrangement (DB) | Face-to-face arrangement (DF) | Tandem arrangement (DT)



d 30 ～ 55mm

Boundary dimensions (mm) d	D	B	2B	$r_{s\,min}$[3]	$r_{1s\,min}$[3]	Basic load rating (kN) dynamic C_r	static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed[1] (min⁻¹) Grease lubrication	Oil lubrication	Bearing number[2]	Load center (mm) a	Mass (kg) Single row (approx.)
30	62	16	32	1	0.6	24.9	14.8	1.16	12 000	16 000	**7206**	21.5	0.193
	62	16	32	1	0.6	22.7	13.5	1.06	11 000	14 000	**7206B**	27.5	0.197
	72	19	38	1.1	0.6	37.5	22.3	1.75	11 000	15 000	**7306**	24.5	0.345
	72	19	38	1.1	0.6	34.0	20.5	1.61	9 600	13 000	**7306B**	31.5	0.352
35	55	10	20	0.6	0.3	13.3	8.85	0.640	13 000	17 000	**7907**	18	0.088
	62	14	28	1	0.6	19.4	12.6	0.955	12 000	16 000	**7007**	21	0.18
	72	17	34	1.1	0.6	33.0	20.1	1.57	11 000	14 000	**7207**	24	0.281
	72	17	34	1.1	0.6	30.0	18.4	1.44	9 300	12 000	**7207B**	31	0.287
	80	21	42	1.5	1	44.0	26.3	2.05	9 800	13 000	**7307**	27	0.462
	80	21	42	1.5	1	40.5	24.2	1.89	8 400	11 000	**7307B**	34.5	0.469
40	62	12	24	0.6	0.3	14.0	10.2	0.705	11 000	15 000	**7908**	20.5	0.13
	68	15	30	1	0.6	20.8	14.6	1.07	10 000	14 000	**7008**	23	0.222
	80	18	36	1.1	0.6	39.0	25.1	1.97	9 600	13 000	**7208**	26.5	0.355
	80	18	36	1.1	0.6	35.5	23.0	1.80	8 300	11 000	**7208B**	34	0.375
	90	23	46	1.5	1	54.0	33.0	2.58	8 600	12 000	**7308**	30.5	0.625
	90	23	46	1.5	1	49.5	30.5	2.37	7 400	9 900	**7308B**	39	0.636
45	68	12	24	0.6	0.3	17.4	12.9	0.895	10 000	14 000	**7909**	22.5	0.15
	75	16	32	1	0.6	24.7	17.7	1.29	9 500	13 000	**7009**	25.5	0.282
	85	19	38	1.1	0.6	44.0	28.7	2.25	8 700	12 000	**7209**	28.5	0.404
	85	19	38	1.1	0.6	40.0	26.2	2.04	7 400	9 900	**7209B**	37	0.41
	100	25	50	1.5	1	70.5	44.0	3.45	7 800	10 000	**7309**	33.5	0.837
	100	25	50	1.5	1	64.5	40.5	3.15	6 600	8 900	**7309B**	43	0.854
50	72	12	24	0.6	0.3	18.4	14.5	0.985	9 200	12 000	**7910**	23.5	0.157
	80	16	32	1	0.6	26.2	20.1	1.42	8 600	11 000	**7010**	27	0.306
	90	20	40	1.1	0.6	45.5	31.5	2.46	7 900	10 000	**7210**	30	0.457
	90	20	40	1.1	0.6	41.5	28.6	2.16	6 700	9 000	**7210B**	39.5	0.466
	110	27	54	2	1	82.5	52.5	4.10	7 100	9 400	**7310**	36.5	1.09
	110	27	54	2	1	75.5	48.5	3.80	6 000	8 100	**7310B**	47	1.11
55	80	13	26	1	0.6	19.2	16.1	1.07	8 400	11 000	**7911**	26	0.214
	90	18	36	1.1	0.6	34.5	26.3	1.90	7 900	11 000	**7011**	30	0.447
	100	21	42	1.5	1	56.5	39.5	3.10	7 100	9 500	**7211**	33	0.6
	100	21	42	1.5	1	51.5	36.0	2.74	6 100	8 200	**7211B**	43	0.612
	120	29	58	2	1	95.0	61.5	4.80	6 400	8 600	**7311**	40	1.39
	120	29	58	2	1	87.0	56.5	4.45	5 500	7 300	**7311B**	52	1.42

1) This value achieved with machined cages; when pressed cages are used, 80% of this value is acceptable. 2) Bearing numbers appended with the code "B" have a contact angle of 40˚; bearings without this code have a contact angle of 30˚. 3) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle	e	Single, DT $F_a/F_r \leq e$ X	Y	Single, DT $F_a/F_r > e$ X	Y	DB, DF $F_a/F_r \leq e$ X	Y	DB, DF $F_a/F_r > e$ X	Y
30˚	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40˚	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Static equivalent radial load

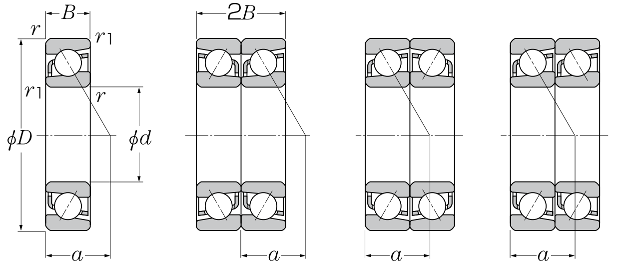
$P_{0r} = X_0 F_r + Y_0 F_a$

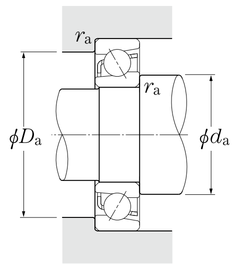
Contact angle	Single, DT X_0	Y_0	DB, DF X_0	Y_0
30˚	0.5	0.33	1	0.66
40˚	0.5	0.26	1	0.52

For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

Basic load rating dynamic (duplex) (kN) C_r	static C_{0r}	Allowable speed[1] (duplex) (min⁻¹) Grease lubrication	Oil lubrication	Bearing number DB	DF	DT	Installation-related dimensions (mm) d_a Min.	d_b Min.	D_a Max.	D_b Max.	r_{as} Max.	r_{1as} Max.
40.5	29.6	9 800	13 000	**DB**	**DF**	**DT**	35.5	34.5	56.5	57.5	1	0.6
37.0	27.1	8 600	11 000	**DB**	**DF**	**DT**	35.5	34.5	56.5	57.5	1	0.6
60.5	44.5	8 900	12 000	**DB**	**DF**	**DT**	37	34.5	65	67.5	1	0.6
55.5	41.0	7 700	10 000	**DB**	**DF**	**DT**	37	34.5	65	67.5	1	0.6
21.6	17.7	10 000	13 000	**DB**	**DF**	**DT**	39.5	39.5	50.5	52.5	0.6	0.3
31.5	25.1	9 400	13 000	**DB**	**DF**	**DT**	40.5	40.5	56.5	57.5	1	0.6
53.5	40.0	8 600	11 000	**DB**	**DF**	**DT**	42	39.5	65	67.5	1	0.6
49.0	36.5	7 500	10 000	**DB**	**DF**	**DT**	42	39.5	65	67.5	1	0.6
72.0	52.5	7 800	10 000	**DB**	**DF**	**DT**	43.5	40.5	71.5	74.5	1.5	1
66.0	48.5	6 800	9 000	**DB**	**DF**	**DT**	43.5	40.5	71.5	74.5	1.5	1
22.8	20.4	9 000	12 000	**DB**	**DF**	**DT**	44.5	44.5	57.5	59.5	0.6	0.3
34.0	29.2	8 300	11 000	**DB**	**DF**	**DT**	45.5	45.5	62.5	63.5	1	0.6
63.5	50.5	7 700	10 000	**DB**	**DF**	**DT**	47	44.5	73	75.5	1	0.6
58.0	46.0	6 700	8 900	**DB**	**DF**	**DT**	47	44.5	73	75.5	1	0.6
88.0	66.0	6 900	9 200	**DB**	**DF**	**DT**	48.5	45.5	81.5	84.5	1.5	1
80.5	60.5	6 000	8 000	**DB**	**DF**	**DT**	48.5	45.5	81.5	84.5	1.5	1
28.3	25.7	8 100	11 000	**DB**	**DF**	**DT**	49.5	49.5	63.5	65.5	0.6	0.3
40.0	35.5	7 500	10 000	**DB**	**DF**	**DT**	50.5	50.5	69.5	70.5	1	0.6
71.5	57.5	6 900	9 200	**DB**	**DF**	**DT**	52	49.5	78	80.5	1	0.6
65.0	52.5	6 000	8 000	**DB**	**DF**	**DT**	52	49.5	78	80.5	1	0.6
114	88.0	6 200	8 200	**DB**	**DF**	**DT**	53.5	50.5	91.5	94.5	1.5	1
105	81.0	5 400	7 200	**DB**	**DF**	**DT**	53.5	50.5	91.5	94.5	1.5	1
29.9	28.9	7 300	9 800	**DB**	**DF**	**DT**	54.5	54.5	67.5	69.5	0.6	0.3
42.5	40.0	6 800	9 100	**DB**	**DF**	**DT**	55.5	55.5	74.5	75.5	1	0.6
74.5	63.0	6 300	8 300	**DB**	**DF**	**DT**	57	54.5	83	85.5	1	0.6
67.5	57.0	5 500	7 300	**DB**	**DF**	**DT**	57	54.5	83	85.5	1	0.6
134	105	5 600	7 500	**DB**	**DF**	**DT**	60	55.5	100	104.5	2	1
123	96.5	4 900	6 500	**DB**	**DF**	**DT**	60	55.5	100	104.5	2	1
31.0	32.0	6 700	8 900	**DB**	**DF**	**DT**	60.5	60.5	74.5	75.5	1	0.6
56.0	52.5	6 300	8 400	**DB**	**DF**	**DT**	62	62	83	85.5	1	0.6
92.0	79.0	5 700	7 600	**DB**	**DF**	**DT**	63.5	60.5	91.5	94.5	1.5	1
83.5	72.0	5 000	6 600	**DB**	**DF**	**DT**	63.5	60.5	91.5	94.5	1.5	1
154	123	5 100	6 800	**DB**	**DF**	**DT**	65	60.5	110	114.5	2	1
142	113	4 500	5 900	**DB**	**DF**	**DT**	65	60.5	110	114.5	2	1

Note: For bearing series 79 and 70, inner rings are constructed with groove abutments on both sides. Therefore, the inner ring chamfer dimension r_1 is identical to dimension r. Furthermore, the radius r_{1a} of the shaft corner roundness is likewise identical to r_a.



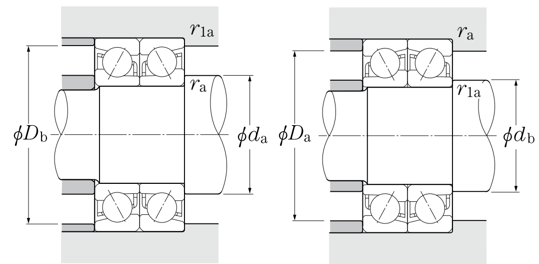


d 60 ～ 85mm

d	D	B	2B	$r_{s\,min}$ 3)	$r_{1s\,min}$ 3)	dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed 1) Grease lubrication (min⁻¹)	Allowable speed 1) Oil lubrication (min⁻¹)	Bearing number 2)	Load center a (mm)	Mass kg Single row (approx.)
60	85	13	26	1	0.6	20.0	17.4	1.16	7 800	10 000	**7912**	27.5	0.23
	95	18	36	1.1	0.6	35.5	28.1	1.99	7 200	9 600	**7012**	31.5	0.478
	110	22	44	1.5	1	68.5	49.0	3.85	6 600	8 800	**7212**	36	0.765
	110	22	44	1.5	1	62.0	44.5	3.40	5 700	7 600	**7212B**	47.5	0.78
	130	31	62	2.1	1.1	109	71.5	5.60	5 900	7 900	**7312**	43	1.74
	130	31	62	2.1	1.1	99.5	66.0	5.15	5 100	6 800	**7312B**	56	1.77
65	90	13	26	1	0.6	20.2	18.0	1.20	7 200	9 600	**7913**	29	0.245
	100	18	36	1.1	0.6	37.5	31.5	2.18	6 700	9 000	**7013**	33	0.509
	120	23	46	1.5	1	78.0	58.0	4.55	6 100	8 100	**7213**	38	0.962
	120	23	46	1.5	1	70.5	52.5	3.95	5 200	7 000	**7213B**	50.5	0.981
	140	33	66	2.1	1.1	123	82.0	6.35	5 500	7 300	**7313**	46	2.11
	140	33	66	2.1	1.1	113	75.5	5.85	4 700	6 300	**7313B**	59.5	2.15
70	100	16	32	1	0.6	29.0	26.2	1.74	6 700	9 000	**7914**	32.5	0.397
	110	20	40	1.1	0.6	47.5	39.5	2.78	6 200	8 300	**7014**	36	0.705
	125	24	48	1.5	1	84.5	63.5	5.00	5 700	7 600	**7214**	40	1.09
	125	24	48	1.5	1	76.5	58.0	4.35	4 900	6 500	**7214B**	53	1.11
	150	35	70	2.1	1.1	138	93.5	6.95	5 100	6 800	**7314**	49.5	2.56
	150	35	70	2.1	1.1	127	86	6.40	4 400	5 800	**7314B**	63.5	2.61
75	105	16	32	1	0.6	29.4	27.1	1.80	6 300	8 400	**7915**	34	0.42
	115	20	40	1.1	0.6	48.5	41.5	2.90	5 800	7 800	**7015**	37.5	0.745
	130	25	50	1.5	1	87.5	68.5	5.20	5 300	7 100	**7215**	42.5	1.17
	130	25	50	1.5	1	79.0	62.0	4.50	4 500	6 000	**7215B**	56	1.19
	160	37	74	2.1	1.1	150	106	7.65	4 800	6 300	**7315**	52.5	3.07
	160	37	74	2.1	1.1	138	97.5	7.00	4 100	5 400	**7315B**	68	3.13
80	110	16	32	1	0.6	29.8	28.0	1.86	5 900	7 800	**7916**	35.5	0.444
	125	22	44	1.1	0.6	59.0	50.5	3.50	5 500	7 300	**7016**	40.5	0.994
	140	26	52	2	1	98.5	76.0	5.65	5 000	6 600	**7216**	45	1.39
	140	26	52	2	1	89.0	69.5	4.90	4 300	5 700	**7216B**	59	1.42
	170	39	78	2.1	1.1	163	119	8.30	4 500	5 900	**7316**	55.5	3.65
	170	39	78	2.1	1.1	149	109	7.65	3 800	5 100	**7316B**	72	3.72
85	120	18	36	1.1	0.6	40.0	38.0	2.49	5 500	7 400	**7917**	38.5	0.628
	130	22	44	1.1	0.6	60.5	53.5	3.60	5 100	6 900	**7017**	42	1.04
	150	28	56	2	1	110	88.5	6.25	4 700	6 200	**7217**	48	1.78
	150	28	56	2	1	99.5	80.5	5.45	4 000	5 300	**7217B**	63.5	1.82

Boundary dimensions: mm.

1) This value achieved with machined cages; when pressed cages are used, 80% of this value is acceptable. 2) Bearing numbers appended with the code "B" have a contact angle of 40˚; bearings without this code have a contact angle of 30˚. 3) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle	e	Single, DT $F_a/F_r \leqq e$ X	Single, DT $F_a/F_r \leqq e$ Y	Single, DT $F_a/F_r > e$ X	Single, DT $F_a/F_r > e$ Y	DB, DF $F_a/F_r \leqq e$ X	DB, DF $F_a/F_r \leqq e$ Y	DB, DF $F_a/F_r > e$ X	DB, DF $F_a/F_r > e$ Y
30˚	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40˚	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Static equivalent radial load

$P_{0r} = X_0 F_r + Y_0 F_a$

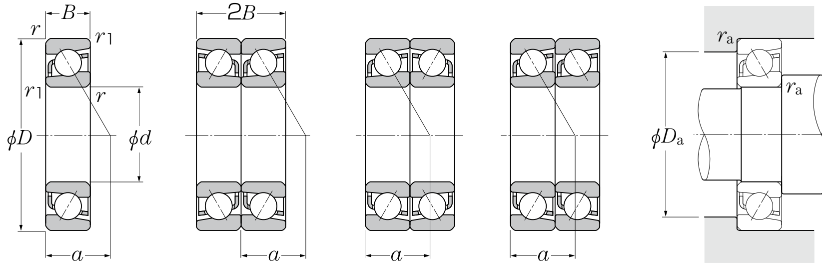
Contact angle	Single, DT X_0	Single, DT Y_0	DB, DF X_0	DB, DF Y_0
30˚	0.5	0.33	1	0.66
40˚	0.5	0.26	1	0.52

For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

dynamic (duplex) C_r (kN)	static (duplex) C_{0r} (kN)	Allowable speed 1) (duplex) Grease lubrication (min⁻¹)	Allowable speed 1) (duplex) Oil lubrication (min⁻¹)	Bearing number DB	Bearing number DF	Bearing number DT	d_a Min.	d_b Min.	D_a Max.	D_b Max.	r_{as} Max.	r_{1as} Max.
32.5	35.0	6 200	8 300	**DB**	**DF**	**DT**	65.5	65.5	79.5	80.5	1	0.6
57.5	56.0	5 800	7 700	**DB**	**DF**	**DT**	67	67	88	90.5	1	0.6
111	98.0	5 300	7 000	**DB**	**DF**	**DT**	68.5	65.5	101.5	104.5	1.5	1
101	89.0	4 600	6 100	**DB**	**DF**	**DT**	68.5	65.5	101.5	104.5	1.5	1
176	143	4 700	6 300	**DB**	**DF**	**DT**	72	67	118	123	2	1
162	132	4 100	5 500	**DB**	**DF**	**DT**	72	67	118	123	2	1
33.0	36.0	5 700	7 600	**DB**	**DF**	**DT**	70.5	70.5	84.5	85.5	1	0.6
60.5	62.5	5 400	7 100	**DB**	**DF**	**DT**	72	72	93	95.5	1	0.6
126	116	4 900	6 500	**DB**	**DF**	**DT**	73.5	70.5	111.5	114.5	1.5	1
115	105	4 200	5 600	**DB**	**DF**	**DT**	73.5	70.5	111.5	114.5	1.5	1
200	164	4 400	5 800	**DB**	**DF**	**DT**	77	72	128	133	2	1
183	151	3 800	5 100	**DB**	**DF**	**DT**	77	72	128	133	2	1
47.0	52.5	5 300	7 100	**DB**	**DF**	**DT**	75.5	75.5	94.5	95.5	1	0.6
77.0	78.5	5 000	6 600	**DB**	**DF**	**DT**	77	77	103	105.5	1	0.6
137	127	4 500	6 000	**DB**	**DF**	**DT**	78.5	75.5	116.5	119.5	1.5	1
124	116	3 900	5 200	**DB**	**DF**	**DT**	78.5	75.5	116.5	119.5	1.5	1
224	187	4 100	5 400	**DB**	**DF**	**DT**	82	77	138	143	2	1
206	172	3 500	4 700	**DB**	**DF**	**DT**	82	77	138	143	2	1
48.0	54.0	5 000	6 700	**DB**	**DF**	**DT**	80.5	80.5	99.5	100.5	1	0.6
78.5	83.5	4 600	6 200	**DB**	**DF**	**DT**	82	82	108	110.5	1	0.6
142	137	4 200	5 600	**DB**	**DF**	**DT**	83.5	80.5	121.5	124.5	1.5	1
128	124	3 700	4 900	**DB**	**DF**	**DT**	83.5	80.5	121.5	124.5	1.5	1
244	212	3 800	5 000	**DB**	**DF**	**DT**	87	82	148	153	2	1
224	195	3 300	4 400	**DB**	**DF**	**DT**	87	82	148	153	2	1
48.5	56.0	4 700	6 200	**DB**	**DF**	**DT**	85.5	85.5	104.5	105.5	1	0.6
96.0	101	4 400	5 800	**DB**	**DF**	**DT**	87	87	118	120.5	1	0.6
160	152	3 900	5 300	**DB**	**DF**	**DT**	90	85.5	130	134.5	2	1
145	139	3 400	4 600	**DB**	**DF**	**DT**	90	85.5	130	134.5	2	1
265	238	3 500	4 700	**DB**	**DF**	**DT**	92	87	158	163	2	1
243	218	3 100	4 100	**DB**	**DF**	**DT**	92	87	158	163	2	1
65.0	76.0	4 400	5 900	**DB**	**DF**	**DT**	92	92	113	115.5	1	0.6
98.5	107	4 100	5 500	**DB**	**DF**	**DT**	92	92	123	125.5	1	0.6
179	177	3 700	5 000	**DB**	**DF**	**DT**	95	90.5	140	144.5	2	1
162	161	3 200	4 300	**DB**	**DF**	**DT**	95	90.5	140	144.5	2	1

Installation-related dimensions: mm.

Note: For bearing series **79** and **70**, inner rings are constructed with groove abutments on both sides. Therefore, the inner ring chamfer dimension r_1 is identical to dimension r. Furthermore, the radius r_{1a} of the shaft corner roundness is likewise identical to r_a.

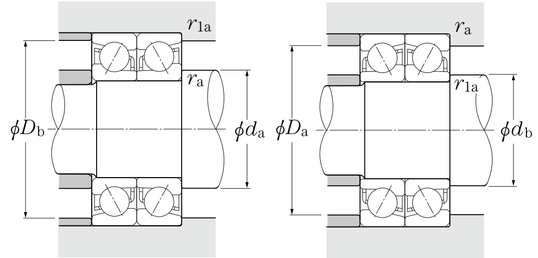


Single row | Back-to-back arrangement (DB) | Face-to-face arrangement (DF) | Tandem arrangement (DT)

d 85 ～ 120mm

Boundary dimensions (mm) d	D	B	$2B$	$r_{s\,min}$[3]	$r_{1s\,min}$[3]	Basic load rating dynamic (kN) C_r	static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed[1] (min⁻¹) Grease lubrication	Oil lubrication	Bearing number[2]	Load center (mm) a	Mass (kg) Single row (approx.)
85	180	41	82	3	1.1	176	133	9.00	4 200	5 600	**7317**	59	4.34
	180	41	82	3	1.1	161	122	8.30	3 600	4 800	**7317B**	76	4.43
90	125	18	36	1.1	0.6	39.5	38.0	2.42	5 200	7 000	**7918**	40	0.658
	140	24	48	1.5	1	72.0	63.5	4.15	4 900	6 500	**7018**	45	1.35
	160	30	60	2	1	130	103	7.20	4 400	5 900	**7218**	51	2.18
	160	30	60	2	1	118	94.0	6.30	3 800	5 000	**7218B**	67.5	2.22
	190	43	86	3	1.1	189	147	9.70	4 000	5 300	**7318**	62	5.06
	190	43	86	3	1.1	173	135	8.95	3 400	4 500	**7318B**	80.5	5.16
95	130	18	36	1.1	0.6	41.5	40.5	2.54	5 000	6 600	**7919**	41.5	0.688
	145	24	48	1.5	1	74.0	67.0	4.25	4 600	6 100	**7019**	46.5	1.41
	170	32	64	2.1	1.1	148	118	8.05	4 100	5 500	**7219**	54.5	2.67
	170	32	64	2.1	1.1	134	107	7.00	3 500	4 700	**7219B**	71.5	2.72
	200	45	90	3	1.1	202	162	10.5	3 700	5 000	**7319**	65	5.89
	200	45	90	3	1.1	185	149	9.60	3 200	4 200	**7319B**	84.5	6
100	140	20	40	1.1	0.6	53.0	52.5	3.20	4 700	6 200	**7920**	44.5	0.934
	150	24	48	1.5	1	75.5	70.5	4.35	4 400	5 800	**7020**	48	1.47
	180	34	68	2.1	1.1	159	126	8.30	3 900	5 200	**7220**	57.5	3.2
	180	34	68	2.1	1.1	144	114	7.30	3 400	4 500	**7220B**	76	3.26
	215	47	94	3	1.1	230	193	12.0	3 500	4 700	**7320**	69	7.18
	215	47	94	3	1.1	211	178	11.1	3 000	4 000	**7320B**	89.5	7.32
105	145	20	40	1.1	0.6	54.0	54.5	3.25	4 400	5 900	**7921**	46	0.972
	160	26	52	2	1	88.5	81.5	4.95	4 100	5 500	**7021**	51.5	1.86
	190	36	72	2.1	1.1	173	142	9.10	3 700	5 000	**7221**	60.5	3.79
	190	36	72	2.1	1.1	157	129	8.05	3 200	4 300	**7221B**	80	3.87
	225	49	98	3	1.1	244	210	12.8	3 400	4 500	**7321**	72	8.2
	225	49	98	3	1.1	224	194	11.8	2 900	3 800	**7321B**	93.5	8.36
110	150	20	40	1.1	0.6	54.5	56.0	3.25	4 200	5 700	**7922**	47.5	1.01
	170	28	56	2	1	102	93.0	5.50	3 900	5 300	**7022**	54.5	2.3
	200	38	76	2.1	1.1	188	158	9.95	3 500	4 700	**7222**	64	4.45
	200	38	76	2.1	1.1	170	144	8.80	3 000	4 000	**7222B**	84	4.54
	240	50	100	3	1.1	273	246	14.5	3 200	4 300	**7322**	76	9.6
	240	50	100	3	1.1	250	226	13.3	2 700	3 700	**7322B**	99	9.8
120	165	22	44	1.1	0.6	67.5	69.5	3.90	3 900	5 200	**7924**	52	1.66

1) This value achieved with machined cages; when pressed cages are used, 80% of this value is acceptable. 2) Bearing numbers appended with the code "B" have a contact angle of 40°; bearings without this code have a contact angle of 30°. 3) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle	e	Single, DT $F_a/F_r \leq e$ X	Y	$F_a/F_r > e$ X	Y	DB, DF $F_a/F_r \leq e$ X	Y	$F_a/F_r > e$ X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Static equivalent radial load

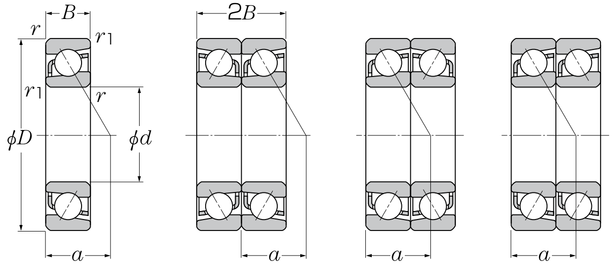
$P_{0r} = X_0 F_r + Y_0 F_a$

Contact angle	Single, DT X_0	Y_0	DB, DF X_0	Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

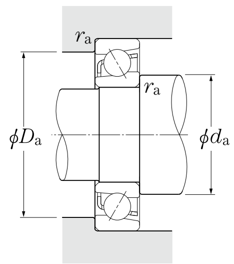
For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

Basic load rating dynamic (duplex) (kN) C_r	static C_{0r}	Allowable speed[1] (duplex) (min⁻¹) Grease lubrication	Oil lubrication	Bearing number DB	DF	DT	Installation-related dimensions (mm) d_a Min.	d_b Min.	D_a Max.	D_b Max.	r_{as} Max.	r_{1as} Max.
286	265	3 300	4 500	**DB**	**DF**	**DT**	99	92	166	173	2.5	1
262	244	2 900	3 900	**DB**	**DF**	**DT**	99	92	166	173	2.5	1
65.5	75.5	4 200	5 500	**DB**	**DF**	**DT**	97	97	118	120.5	1	0.6
117	127	3 900	5 200	**DB**	**DF**	**DT**	98.5	98.5	131.5	134.5	1.5	1
212	206	3 500	4 700	**DB**	**DF**	**DT**	100	95.5	150	154.5	2	1
192	188	3 100	4 100	**DB**	**DF**	**DT**	100	95.5	150	154.5	2	1
305	294	3 200	4 200	**DB**	**DF**	**DT**	104	97	176	183	2.5	1
281	270	2 700	3 700	**DB**	**DF**	**DT**	104	97	176	183	2.5	1
67.0	81.5	3 900	5 300	**DB**	**DF**	**DT**	102	102	123	125.5	1	0.6
120	134	3 700	4 900	**DB**	**DF**	**DT**	103.5	103.5	136.5	139.5	1.5	1
240	236	3 300	4 400	**DB**	**DF**	**DT**	107	102	158	163	2	1
218	215	2 900	3 800	**DB**	**DF**	**DT**	107	102	158	163	2	1
330	325	3 000	3 900	**DB**	**DF**	**DT**	109	102	186	193	2.5	1
300	298	2 600	3 400	**DB**	**DF**	**DT**	109	102	186	193	2.5	1
86.0	105	3 700	5 000	**DB**	**DF**	**DT**	107	107	133	135.5	1	0.6
123	141	3 500	4 600	**DB**	**DF**	**DT**	108.5	108.5	141.5	144.5	1.5	1
259	251	3 100	4 200	**DB**	**DF**	**DT**	112	107	168	173	2	1
234	229	2 700	3 600	**DB**	**DF**	**DT**	112	107	168	173	2	1
375	385	2 800	3 700	**DB**	**DF**	**DT**	114	107	201	208	2.5	1
340	355	2 400	3 300	**DB**	**DF**	**DT**	114	107	201	208	2.5	1
87.5	109	3 500	4 700	**DB**	**DF**	**DT**	112	112	138	140.5	1	0.6
144	163	3 300	4 400	**DB**	**DF**	**DT**	115	115	150	154.5	2	1
282	283	3 000	4 000	**DB**	**DF**	**DT**	117	112	178	183	2	1
255	258	2 600	3 500	**DB**	**DF**	**DT**	117	112	178	183	2	1
395	420	2 700	3 600	**DB**	**DF**	**DT**	119	112	211	218	2.5	1
365	385	2 300	3 100	**DB**	**DF**	**DT**	119	112	211	218	2.5	1
89.0	112	3 400	4 500	**DB**	**DF**	**DT**	117	117	143	145.5	1	0.6
165	186	3 100	4 200	**DB**	**DF**	**DT**	120	120	160	164.5	2	1
305	315	2 800	3 800	**DB**	**DF**	**DT**	122	117	188	193	2	1
277	289	2 500	3 300	**DB**	**DF**	**DT**	122	117	188	193	2	1
445	490	2 600	3 400	**DB**	**DF**	**DT**	124	117	226	233	2.5	1
405	455	2 200	3 000	**DB**	**DF**	**DT**	124	117	226	233	2.5	1
109	139	3 100	4 100	**DB**	**DF**	**DT**	127	127	158	160.5	1	0.6

Note: For bearing series 79 and 70, inner rings are constructed with groove abutments on both sides. Therefore, the inner ring chamfer dimension r_1 is identical to dimension r. Furthermore, the radius r_{1a} of the shaft corner roundness is likewise identical to r_a.



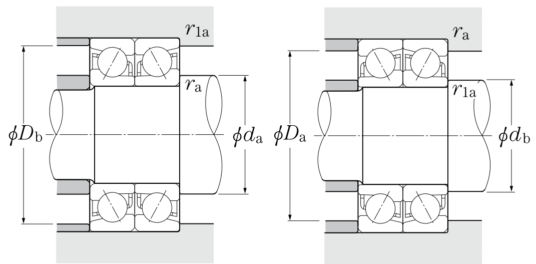
Single row | Back-to-back arrangement (DB) | Face-to-face arrangement (DF) | Tandem arrangement (DT)



d 120 ～ 170mm

d	D	B	2B	$r_{s\,min}$ 2)	$r_{1s\,min}$ 2)	C_r dynamic (kN)	C_{0r} static (kN)	Fatigue load limit C_u kN	Allowable speed min⁻¹ Grease lubrication	Allowable speed min⁻¹ Oil lubrication	Bearing number 1)	Load center mm a	Mass kg Single row (approx.)
120	180	28	56	2	1	104	98.5	5.55	3 600	4 800	**7024**	57.5	2.47
	215	40	80	2.1	1.1	202	177	10.7	3 200	4 300	**7224**	68.5	6.26
	215	40	80	2.1	1.1	183	162	9.40	2 800	3 700	**7224B**	90.5	6.26
	260	55	110	3	1.1	273	252	14.3	2 900	3 900	**7324**	82.5	14.7
	260	55	110	3	1.1	249	231	13.1	2 500	3 300	**7324B**	107	14.7
130	180	24	48	1.5	1	83.0	87.5	4.65	3 600	4 700	**7926**	56.5	1.82
	200	33	66	2	1	130	125	6.75	3 300	4 400	**7026**	64	3.73
	230	40	80	3	1.1	217	198	11.5	3 000	4 000	**7226**	72	7.15
	230	40	80	3	1.1	196	180	10.0	2 500	3 400	**7226B**	95.5	7.15
	280	58	116	4	1.5	305	293	16.0	2 700	3 600	**7326**	88	17.6
	280	58	116	4	1.5	277	268	14.7	2 300	3 100	**7326B**	115	17.6
140	190	24	48	1.5	1	83.5	90.0	4.65	3 300	4 400	**7928**	59.5	1.94
	210	33	66	2	1	133	133	6.85	3 100	4 100	**7028**	67	3.96
	250	42	84	3	1.1	225	215	11.7	2 700	3 600	**7228**	77.5	8.78
	250	42	84	3	1.1	203	195	10.1	2 300	3 100	**7228B**	103	8.78
	300	62	124	4	1.5	335	335	17.7	2 500	3 300	**7328**	94.5	21.5
	300	62	124	4	1.5	305	310	16.3	2 100	2 800	**7328B**	123	21.5
150	210	28	56	2	1	108	117	5.80	3 100	4 100	**7930**	66	2.96
	225	35	70	2.1	1.1	152	154	7.65	2 800	3 800	**7030**	71.5	4.82
	270	45	90	3	1.1	257	259	13.7	2 500	3 400	**7230**	83	11
	270	45	90	3	1.1	232	235	11.9	2 200	2 900	**7230B**	111	11
	320	65	130	4	1.5	365	380	19.5	2 300	3 100	**7330**	100	25.1
	320	65	130	4	1.5	335	350	17.9	2 000	2 600	**7330B**	131	25.1
160	220	28	56	2	1	109	121	5.80	2 800	3 800	**7932**	69	3.13
	240	38	76	2.1	1.1	172	176	8.55	2 700	3 600	**7032**	77	5.96
	290	48	96	3	1.1	291	305	15.8	2 400	3 200	**7232**	89	13.7
	290	48	96	3	1.1	263	279	13.7	2 000	2 700	**7232B**	118	13.7
	340	68	136	4	1.5	385	420	20.9	2 100	2 800	**7332**	106	29.8
	340	68	136	4	1.5	350	385	19.1	1 800	2 400	**7332B**	139	29.8
170	230	28	56	2	1	115	129	6.05	2 700	3 600	**7934**	71.5	3.29
	260	42	84	2.1	1.1	206	214	10.2	2 500	3 300	**7034**	83	7.96
	310	52	104	4	1.5	325	360	18.0	2 200	3 000	**7234**	95.5	17
	310	52	104	4	1.5	295	325	15.6	1 900	2 500	**7234B**	127	17
	360	72	144	4	1.5	430	485	23.3	2 000	2 700	**7334**	113	35.3

1) Bearing numbers appended with the code "B" have a contact angle of 40°; bearings without this code have a contact angle of 30°.
2) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle	e	Single, DT $F_a/F_r \leqq e$ X	Y	Single, DT $F_a/F_r > e$ X	Y	DB, DF $F_a/F_r \leqq e$ X	Y	DB, DF $F_a/F_r > e$ X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

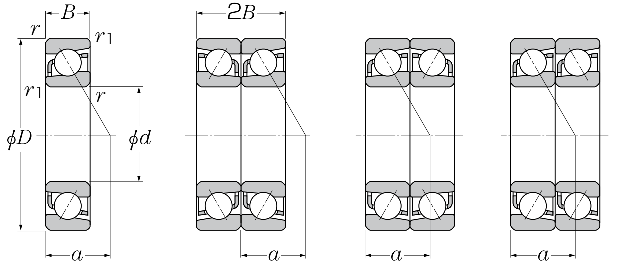
Static equivalent radial load

$P_{0r} = X_0 F_r + Y_0 F_a$

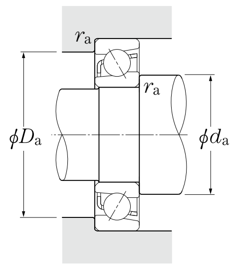
Contact angle	Single, DT X_0	Single, DT Y_0	DB, DF X_0	DB, DF Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

d	Basic load rating dynamic (duplex) kN C_r	static C_{0r}	Allowable speed 1) (duplex) min⁻¹ Grease lubrication	Oil lubrication	Bearing number DB	DF	DT	d_a Min. (mm)	D_a Max.	D_b Max.	r_{as} Max.	r_{1as} Max.
120	169	197	2 900	3 800	**DB**	**DF**	**DT**	130	170	174.5	2	1
	330	355	2 600	3 400	**DB**	**DF**	**DT**	132	203	208	2	1
	298	325	2 300	3 000	**DB**	**DF**	**DT**	132	203	208	2	1
	445	505	2 300	3 100	**DB**	**DF**	**DT**	134	246	253	2.5	1
	405	460	2 000	2 700	**DB**	**DF**	**DT**	134	246	253	2.5	1
130	135	175	2 800	3 800	**DB**	**DF**	**DT**	138.5	171.5	174.5	1.5	1
	211	251	2 600	3 500	**DB**	**DF**	**DT**	140	190	194.5	2	1
	355	395	2 400	3 100	**DB**	**DF**	**DT**	144	216	223	2.5	1
	320	360	2 100	2 700	**DB**	**DF**	**DT**	144	216	223	2.5	1
	490	585	2 100	2 800	**DB**	**DF**	**DT**	148	262	271.5	3	1.5
	450	535	1 900	2 500	**DB**	**DF**	**DT**	148	262	271.5	3	1.5
140	136	180	2 600	3 500	**DB**	**DF**	**DT**	148.5	181.5	184.5	1.5	1
	215	265	2 400	3 300	**DB**	**DF**	**DT**	150	200	204.5	2	1
	365	430	2 200	2 900	**DB**	**DF**	**DT**	154	236	243	2.5	1
	330	390	1 900	2 500	**DB**	**DF**	**DT**	154	236	243	2.5	1
	540	670	2 000	2 600	**DB**	**DF**	**DT**	158	282	291.5	3	1.5
	495	615	1 700	2 300	**DB**	**DF**	**DT**	158	282	291.5	3	1.5
150	175	234	2 400	3 300	**DB**	**DF**	**DT**	160	200	204.5	2	1
	246	305	2 300	3 000	**DB**	**DF**	**DT**	162	213	218	2	1
	420	515	2 000	2 700	**DB**	**DF**	**DT**	164	256	263	2.5	1
	375	470	1 800	2 400	**DB**	**DF**	**DT**	164	256	263	2.5	1
	595	765	1 800	2 400	**DB**	**DF**	**DT**	168	302	311.5	3	1.5
	540	700	1 600	2 100	**DB**	**DF**	**DT**	168	302	311.5	3	1.5
160	177	241	2 300	3 000	**DB**	**DF**	**DT**	170	210	214.5	2	1
	279	355	2 100	2 800	**DB**	**DF**	**DT**	172	228	233	2	1
	475	615	1 900	2 500	**DB**	**DF**	**DT**	174	276	283	2.5	1
	430	555	1 600	2 200	**DB**	**DF**	**DT**	174	276	283	2.5	1
	625	845	1 700	2 300	**DB**	**DF**	**DT**	178	322	331.5	3	1.5
	570	770	1 500	2 000	**DB**	**DF**	**DT**	178	322	331.5	3	1.5
170	183	257	2 100	2 800	**DB**	**DF**	**DT**	180	220	224.5	2	1
	335	430	2 000	2 600	**DB**	**DF**	**DT**	182	248	253	2	1
	530	715	1 800	2 400	**DB**	**DF**	**DT**	188	292	301.5	3	1.5
	480	650	1 500	2 100	**DB**	**DF**	**DT**	188	292	301.5	3	1.5
	700	970	1 600	2 100	**DB**	**DF**	**DT**	188	342	351.5	3	1.5



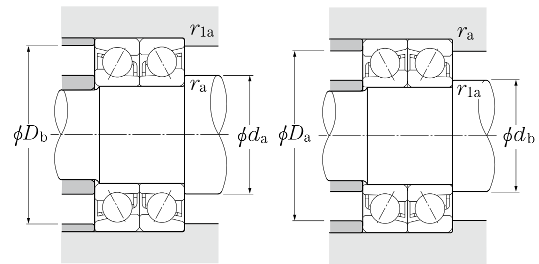
Single row | Back-to-back arrangement (DB) | Face-to-face arrangement (DF) | Tandem arrangement (DT)



d 170 ～ 300mm

d	D	B	2B	$r_{s\,min}$ 2)	$r_{1s\,min}$ 2)	Basic load rating dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 1)	Load center a (mm)	Mass kg Single row (approx.)
170	360	72	144	4	1.5	395	445	21.3	1 700	2 300	**7334B**	147	35.3
180	250	33	66	2	1	145	163	7.40	2 500	3 300	**7936**	78.5	4.87
	280	46	92	2.1	1.1	242	266	12.3	2 300	3 100	**7036**	89.5	10.4
	320	52	104	4	1.5	340	385	18.6	2 100	2 800	**7236**	98	17.7
	320	52	104	4	1.5	305	350	16.1	1 800	2 400	**7236B**	131	17.7
	380	75	150	4	1.5	455	535	24.9	1 900	2 500	**7336**	118	40.9
	380	75	150	4	1.5	415	490	22.8	1 600	2 100	**7336B**	155	40.9
190	260	33	66	2	1	147	169	7.45	2 400	3 200	**7938**	81.5	5.1
	290	46	92	2.1	1.1	248	280	12.6	2 200	2 900	**7038**	92.5	10.8
	340	55	110	4	1.5	335	390	17.9	2 000	2 600	**7238**	104	21.3
	340	55	110	4	1.5	300	355	15.5	1 700	2 200	**7238B**	139	21.3
	400	78	156	5	2	475	585	26.6	1 800	2 300	**7338**	124	47
	400	78	156	5	2	430	535	24.0	1 500	2 000	**7338B**	163	47
200	280	38	76	2.1	1.1	205	231	9.90	2 200	3 000	**7940**	88.5	7.15
	310	51	102	2.1	1.1	279	325	14.3	2 100	2 800	**7040**	99	14
	360	58	116	4	1.5	375	450	20.2	1 900	2 500	**7240**	110	25.3
	360	58	116	4	1.5	335	410	17.6	1 600	2 100	**7240B**	146	25.3
	420	80	160	5	2	500	610	27.0	1 700	2 200	**7340**	130	53.1
	420	80	160	5	2	455	555	24.7	1 400	1 900	**7340B**	170	53.1
220	300	38	76	2.1	1.1	207	239	9.85	2 000	2 700	**7944**	94	7.74
240	320	38	76	2.1	1.1	213	255	10.1	1 800	2 400	**7948**	100	8.34
260	360	46	92	2.1	1.1	285	375	14.1	1 700	2 200	**7952**	112	14
280	380	46	92	2.1	1.1	289	385	14.1	1 500	2 100	**7956**	118	14.8
300	420	56	112	3	1.1	360	520	18.2	1 400	1 900	**7960**	132	23.7

1) Bearing numbers appended with the code "**B**" have a contact angle of 40°; bearings without this code have a contact angle of 30°.
2) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

Contact angle	e	Single, DT $F_a/F_r \leqq e$ X	Y	$F_a/F_r > e$ X	Y	DB, DF $F_a/F_r \leqq e$ X	Y	$F_a/F_r > e$ X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Static equivalent radial load
$P_{0r} = X_0 F_r + Y_0 F_a$

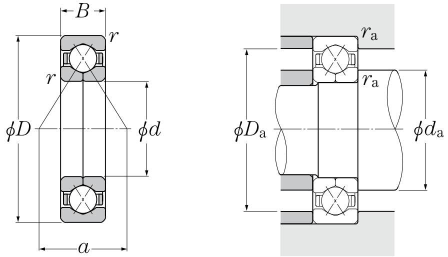
Contact angle	Single, DT X_0	Y_0	DB, DF X_0	Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single and DT arrangement, when $P_{0r} < F_r$ use $P_{0r} = F_r$.

d	Basic load rating dynamic (duplex) C_r (kN)	static C_{0r} (kN)	Allowable speed 1) (duplex) (min⁻¹) Grease lubrication	Oil lubrication	Bearing number DB	DF	DT	d_a Min. (mm)	D_a Max.	D_b Max.	r_{as} Max.	r_{1as} Max.
170	640	890	1 400	1 800	**DB**	**DF**	**DT**	188	342	351.5	3	1.5
180	236	325	2 000	2 700	**DB**	**DF**	**DT**	190	240	244.5	2	1
	395	530	1 900	2 500	**DB**	**DF**	**DT**	192	268	273	2	1
	550	770	1 700	2 200	**DB**	**DF**	**DT**	198	302	311.5	3	1.5
	495	700	1 400	1 900	**DB**	**DF**	**DT**	198	302	311.5	3	1.5
	735	1 070	1 500	2 000	**DB**	**DF**	**DT**	198	362	371.5	3	1.5
	670	975	1 300	1 700	**DB**	**DF**	**DT**	198	362	371.5	3	1.5
190	239	335	1 900	2 500	**DB**	**DF**	**DT**	200	250	254.5	2	1
	405	560	1 800	2 300	**DB**	**DF**	**DT**	202	278	283	2	1
	545	780	1 600	2 100	**DB**	**DF**	**DT**	208	322	331.5	3	1.5
	490	705	1 400	1 800	**DB**	**DF**	**DT**	208	322	331.5	3	1.5
	770	1 170	1 400	1 900	**DB**	**DF**	**DT**	212	378	390	4	2
	700	1 070	1 200	1 600	**DB**	**DF**	**DT**	212	378	390	4	2
200	335	465	1 800	2 400	**DB**	**DF**	**DT**	212	268	273	2	1
	455	650	1 700	2 200	**DB**	**DF**	**DT**	212	298	303	2	1
	605	900	1 500	2 000	**DB**	**DF**	**DT**	218	342	351.5	3	1.5
	545	815	1 300	1 700	**DB**	**DF**	**DT**	218	342	351.5	3	1.5
	810	1 220	1 300	1 800	**DB**	**DF**	**DT**	222	398	410	4	2
	740	1 110	1 200	1 500	**DB**	**DF**	**DT**	222	398	410	4	2
220	335	475	1 600	2 100	**DB**	**DF**	**DT**	232	288	293	2	1
240	345	510	1 500	1 900	**DB**	**DF**	**DT**	252	308	313	2	1
260	465	750	1 300	1 800	**DB**	**DF**	**DT**	272	348	353	2	1
280	470	775	1 200	1 600	**DB**	**DF**	**DT**	292	368	373	2	1
300	590	1 040	1 100	1 500	**DB**	**DF**	**DT**	314	406	413	2.5	1

●Four-Point Contact Ball Bearings

QJ type



Dynamic equivalent axial load
$P_a = F_a$

Static equivalent axial load
$P_{0a} = F_a$

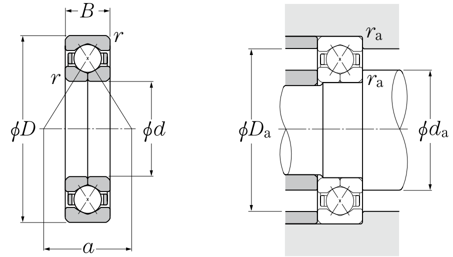
d 30 ～ 90mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing number	Installation-related dimensions mm			Load center mm	Mass kg
				dynamic	static		Grease lubrication	Oil lubrication		Min.	Max.	Max.		
d	D	B	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u				d_a	D_a	r_{as}	a	(approx.)
30	72	19	1.1	44.0	57.5	2.46	8 000	11 000	**QJ306**	37	65	1	30	0.42
35	80	21	1.5	55.0	73.0	3.15	7 000	9 300	**QJ307**	43.5	71.5	1.5	33	0.57
40	80	18	1.1	49.0	70.5	3.05	6 900	9 200	**QJ208**	47	73	1	34.5	0.45
	90	23	1.5	67.0	91.5	3.95	6 200	8 200	**QJ308**	48.5	81.5	1.5	37.5	0.78
45	85	19	1.1	55.0	81.0	3.50	6 200	8 200	**QJ209**	52	78	1	37.5	0.52
	100	25	1.5	87.0	121	5.20	5 500	7 400	**QJ309**	53.5	91.5	1.5	42	1.05
50	90	20	1.1	57.5	89.0	3.80	5 600	7 500	**QJ210**	57	83	1	40.5	0.603
	110	27	2	102	145	6.20	5 000	6 700	**QJ310**	60	100	2	46	1.38
55	100	21	1.5	71.0	112	4.80	5 100	6 800	**QJ211**	63.5	91.5	1.5	44.5	0.78
	120	29	2	118	170	7.30	4 600	6 100	**QJ311**	65	110	2	50.5	1.76
60	110	22	1.5	86.0	138	5.90	4 700	6 300	**QJ212**	68.5	101.5	1.5	49	0.98
	130	31	2.1	135	198	8.50	4 200	5 700	**QJ312**	72	118	2	55	2.18
65	120	23	1.5	93.5	153	6.55	4 400	5 800	**QJ213**	73.5	111.5	1.5	53.5	1.24
	140	33	2.1	153	228	9.70	3 900	5 200	**QJ313**	77	128	2	59	2.7
70	125	24	1.5	102	168	7.15	4 000	5 400	**QJ214**	78.5	116.5	1.5	56.5	1.36
	150	35	2.1	172	260	10.7	3 600	4 800	**QJ314**	82	138	2	63.5	3.27
75	130	25	1.5	106	183	7.55	3 800	5 000	**QJ215**	83.5	121.5	1.5	59	1.53
	160	37	2.1	187	294	11.7	3 400	4 500	**QJ315**	87	148	2	68	3.9
80	140	26	2	124	217	8.65	3 500	4 700	**QJ216**	90	130	2	63.5	1.83
	170	39	2.1	202	330	12.7	3 200	4 200	**QJ316**	92	158	2	72	4.64
85	150	28	2	139	252	9.65	3 300	4 400	**QJ217**	95	140	2	68	2.3
	180	41	3	218	370	13.8	3 000	4 000	**QJ317**	99	166	2.5	76.5	5.43
90	160	30	2	164	293	11.1	3 100	4 200	**QJ218**	100	150	2	72	2.76
	190	43	3	235	410	14.8	2 800	3 800	**QJ318**	104	176	2.5	81	6.31

1) Smallest allowable dimension for chamfer dimension *r*.
Note: 1. These bearings are also manufactured with a slot in the chamfer section of the outer ring to stop whirling.
2. This bearing is widely used in applications where the only type of load is axial. When considering it for use where radial loads are applied, consult **NTN** Engineering.

●Four-Point Contact Ball Bearings

QJ type



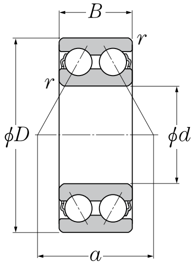
Dynamic equivalent axial load
$P_a = F_a$

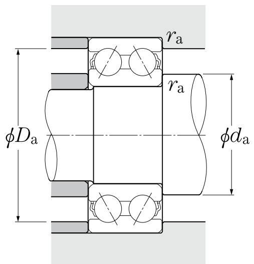
Static equivalent axial load
$P_{0a} = F_a$

d 95 ～ 120mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing number	Installation-related dimensions mm			Load center mm	Mass kg
				dynamic	static		Grease lubrication	Oil lubrication		Min.	Max.	Max.		
d	D	B	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u				d_a	D_a	r_{as}	a	(approx.)
95	170	32	2.1	186	335	12.4	3 000	3 900	**QJ219**	107	158	2	76.5	3.35
	200	45	3	251	450	16.0	2 700	3 500	**QJ319**	109	186	2.5	85	7.41
100	180	34	2.1	200	355	12.9	2 800	3 700	**QJ220**	112	168	2	81	4.02
	215	47	3	302	585	20.0	2 500	3 400	**QJ320**	114	201	2.5	91	9.14
105	190	36	2.1	218	400	14.2	2 700	3 600	**QJ221**	117	178	2	85	4.75
	225	49	3	303	585	19.6	2 400	3 200	**QJ321**	119	211	2.5	95.5	10.4
110	200	38	2.1	236	450	15.5	2 500	3 400	**QJ222**	122	188	2	89.5	5.62
	240	50	3	338	680	22.1	2 300	3 100	**QJ322**	124	226	2.5	101	12
120	215	40	2.1	266	540	17.7	2 300	3 100	**QJ224**	132	203	2	96.5	6.75
	260	55	3	359	765	23.8	2 100	2 800	**QJ324**	134	246	2.5	110	15.9

1) Smallest allowable dimension for chamfer dimension *r*.
Note: 1. These bearings are also manufactured with a slot in the chamfer section of the outer ring to stop whirling.
2. This bearing is widely used in applications where the only type of load is axial. When considering it for use where radial loads are applied, consult **NTN** Engineering.





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

e	$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

Static equivalent radial load

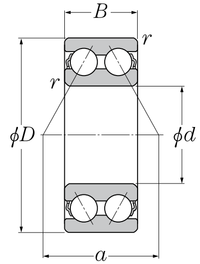
$P_{0r} = F_r + 0.76F_a$

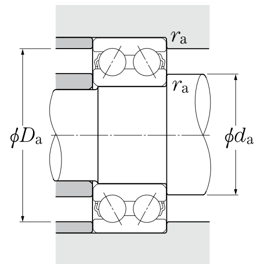
d 10 ~ 65mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing number	Installation-related dimensions mm			Load center mm	Mass kg
				dynamic	static									
d	D	B	$r_{s\,min}$ [1)]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		d_a Min.	D_a Max.	r_{as} Max.	a	(approx.)
10	30	14.3	0.6	7.15	3.90	0.230	17 000	22 000	**5200S**	15	25	0.6	14.5	0.05
12	32	15.9	0.6	10.5	5.80	0.350	15 000	20 000	**5201S**	17	27	0.6	16.7	0.06
15	35	15.9	0.6	11.7	7.05	0.420	13 000	17 000	**5202S**	20	30	0.6	18.3	0.07
	42	19	1	17.6	10.2	0.620	11 000	15 000	**5302S**	21	36	1	22	0.13
17	40	17.5	0.6	14.6	9.05	0.540	11 000	15 000	**5203S**	22	35	0.6	20.8	0.1
	47	22.2	1	21.0	12.6	0.770	10 000	13 000	**5303S**	23	41	1	25	0.18
20	47	20.6	1	19.6	12.4	0.750	10 000	13 000	**5204S**	26	41	1	24.3	0.16
	52	22.2	1.1	24.6	15.0	0.930	9 000	12 000	**5304S**	27	45	1	26.7	0.22
25	52	20.6	1	21.3	14.7	0.880	8 500	11 000	**5205S**	31	46	1	26.8	0.18
	62	25.4	1.1	32.5	20.7	1.30	7 500	10 000	**5305S**	32	55	1	31.8	0.35
30	62	23.8	1	29.6	21.1	1.30	7 100	9 500	**5206S**	36	56	1	31.6	0.3
	72	30.2	1.1	40.5	28.1	1.70	6 300	8 500	**5306S**	37	65	1	36.5	0.57
35	72	27	1.1	39.0	28.7	1.70	6 300	8 000	**5207S**	42	65	1	36.6	0.46
	80	34.9	1.5	51.0	36.0	2.20	5 600	7 500	**5307S**	44	71	1.5	41.6	0.76
40	80	30.2	1.1	44.0	33.5	2.00	5 600	7 100	**5208S**	47	73	1	41.5	0.62
	90	36.5	1.5	56.5	41.0	2.50	5 300	6 700	**5308S**	49	81	1.5	45.5	1.03
45	85	30.2	1.1	49.5	38.0	2.30	5 000	6 700	**5209S**	52	78	1	43.4	0.67
	100	39.7	1.5	68.5	51.0	3.10	4 500	6 000	**5309S**	54	91	1.5	50.6	1.37
50	90	30.2	1.1	53.0	43.5	2.70	4 800	6 000	**5210S**	57	83	1	45.9	0.72
	110	44.4	2	81.5	61.5	3.80	4 300	5 600	**5310S**	60	100	2	55.6	1.84
55	100	33.3	1.5	56.0	49.0	3.00	4 300	5 600	**5211S**	64	91	1.5	50.1	1.01
	120	49.2	2	95.0	73.0	4.50	3 800	5 000	**5311S**	65	110	2	60.6	2.4
60	110	36.5	1.5	69.0	62.0	3.80	3 800	5 000	**5212S**	69	101	1.5	56.5	1.33
	130	54	2.1	125	98.5	6.00	3 400	4 500	**5312S**	72	118	2	69.2	2.92
65	120	38.1	1.5	76.5	69.0	4.20	3 600	4 500	**5213S**	74	111	1.5	59.7	1.71
	140	58.7	2.1	142	113	7.00	3 200	4 300	**5313S**	77	128	2	72.8	3.67

1) Smallest allowable dimension for chamfer dimension r.

Double Row Angular Contact Ball Bearings NTN





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

e	$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

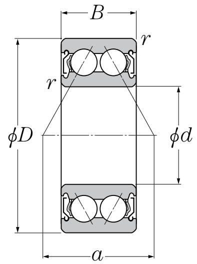
Static equivalent radial load

$P_{0r} = F_r + 0.76F_a$

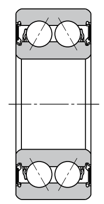
d 70 ~ 85mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing number	Installation-related dimensions mm			Load center mm	Mass kg
				dynamic	static									
d	D	B	$r_{s\,min}$ [1)]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		d_a Min.	D_a Max.	r_{as} Max.	a	(approx.)
70	125	39.7	1.5	94.0	82.0	5.00	3 400	4 500	**5214S**	79	116	1.5	63.8	1.75
	150	63.5	2.1	159	128	7.90	3 000	3 800	**5314S**	82	138	2	78.3	4.55
75	130	41.3	1.5	93.5	83.0	5.10	3 200	4 300	**5215S**	84	121	1.5	66.1	1.88
80	140	44.4	2	99.0	93.0	5.70	3 000	3 800	**5216S**	90	130	2	69.6	2.51
85	150	49.2	2	116	110	6.70	2 800	3 600	**5217S**	95	140	2	75.3	3.16

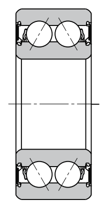
1) Smallest allowable dimension for chamfer dimension r.



Shielded type (ZZ)



Non-contact sealed type (LLM)



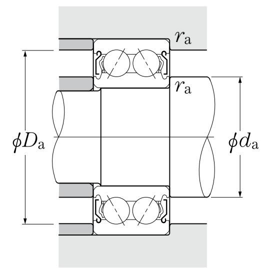
Contact sealed type (LLD)

d 10～40mm

Boundary dimensions (mm)				Basic load rating (kN) dynamic	static	Fatigue load limit (kN)	Allowable speed (min⁻¹) Grease lubrication ZZ, LLM Z, LM	Oil lubrication Z, LM	LLD, LD	Bearing number [2)] Shielded type	Non-contact sealed type	Contact sealed type
d	D	B	$r_{s\,min}$ [1)]	C_r	C_{0r}	C_u						
10	30	14.3	0.6	7.15	3.90	0.230	17 000	22 000	15 000	**5200SCZZ**	**LLM**	**LLD**
12	32	15.9	0.6	8.50	5.30	0.310	15 000	20 000	12 000	**5201SCZZ**	**LLM**	**LLD**
15	35	15.9	0.6	8.50	5.30	0.310	13 000	17 000	12 000	**5202SCZZ**	**LLM**	**LLD**
17	40	17.5	0.6	12.7	8.30	0.490	11 000	15 000	10 000	**5203SCZZ**	**LLM**	**LLD**
	47	22.2	1	19.6	12.4	0.750	10 000	13 000	9 500	**5303SCZZ**	**LLM**	**LLD**
20	47	20.6	1	15.9	10.7	0.640	10 000	13 000	9 000	**5204SCZZ**	**LLM**	**LLD**
25	52	20.6	1	16.9	12.3	0.740	8 500	11 000	7 500	**5205SCZZ** [3)]	**LLM**	**LLD**
	62	25.4	1.1	25.2	18.2	1.10	7 500	10 000	6 300	**5305SCZZ**	**LLM**	**LLD**
30	62	23.8	1	25.2	18.2	1.10	7 100	9 500	6 300	**5206SCZZ**	**LLM**	**LLD**
	72	30.2	1.1	39.0	28.7	1.70	6 300	8 500	5 300	**5306SCZZ**	**LLM**	**LLD**
35	72	27.0	1.1	34.0	25.3	1.50	6 300	8 500	5 300	**5207SCZZ**	**LLM**	**LLD**
	80	34.9	1.5	44.0	33.5	2.00	5 600	7 500	4 800	**5307SCZZ**	**LLM**	**LLD**
40	80	30.2	1.1	36.5	29.0	1.70	5 600	7 100	4 800	**5208SCZZ** [3)]	**LLM**	**LLD**
	90	36.5	1.5	49.5	38.0	2.30	5 300	6 700	4 500	**5308SCZZ**	**LLM**	**LLD**

1) Smallest allowable dimension for chamfer dimension *r*.
2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded types are also available.
3) Resin formed cage is standard for 5205SC and 5208SC.

Sealed and Shielded Double Row Angular Contact Ball Bearings NTN



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

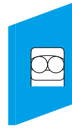
e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

Static equivalent radial load

$P_{0r} = F_r + 0.76F_a$

Installation-related dimensions (mm) d_a Min.	d_a Max.	D_a Max.	r_{as} Max.	Load center (mm) a
14	15.5	26	0.6	14.5
16	19	28	0.6	16.3
19	19	31	0.6	16.3
21	23.5	36	0.6	20.1
23	25.5	41	1	24.3
26	26.5	41	1	23
31	32	46	1	25.4
32	38.5	55	1	30.9
36	38.5	56	1	30.9
37	44.5	65	1	36.6
42	45	65	1	36.3
44	50.5	71	1.5	41.5
47	50.5	73	1	39.4
49	53	81	1.5	43

Self-Aligning Ball Bearings



1. Design features and characteristics

The outer ring raceway of self-aligning ball bearings forms a spherical surface whose center is common to the bearing center. The inner ring of the bearing has two raceways.

The balls, cage, and inner ring of these bearings are capable of shifting in order to compensate for a certain degree of misalignment with the outer rings. As a result, the bearing is able to align itself and compensate for shaft / housing finishing unevenness, bearing fitting error, and other sources of misalignment as shown in **Fig. 1**.

Since axial load capacity is limited, self-aligning ball bearing are not suitable for applications with heavy axial loads.

It is recommended to use an adapter on a self-aligning ball bearing with a tapered bore inner diameter for ease of installation and disassembly. These bearings and adapters are often used on drive shaft applications.

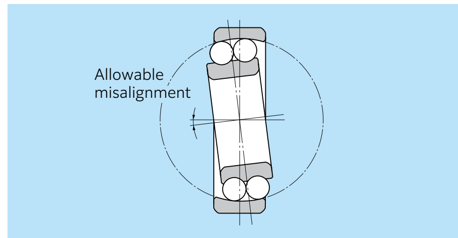
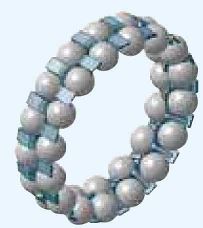
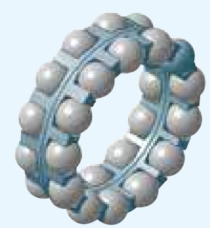


Fig. 1

2. Standard cage type

All bearing series are equipped with a pressed cage, except 2321S and 2322S, which are equipped with a machined cage.

Table 1 Standard cage types of spherical ball bearings

	Pressed steel cage		Machined cage
Cage type			
Bearing series or model	12 and 13 series	22 and 23 series	2321S , 2322S

3. Ball protrusion

Bearings with part numbers listed in **Table 2** below have balls which protrude slightly from the bearing face as illustrated in **Fig. 2**. The total width dimensions are shown in **Table 2**.

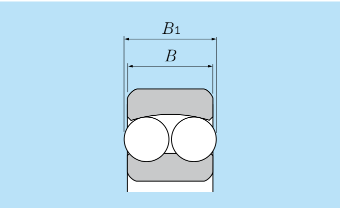


Fig. 2

Table 2

Unit: mm

Bearing numbers	Width dimension B	Total width dimension B_1
2222S (K)	53	54
2316S (K)	58	59
2319S (K)	67	68
2320S (K)	73	74
2321S	77	78
2322S (K)	80	81
1318S (K)	43	46
1319S (K)	45	49
1320S (K)	47	53
1321S	49	55
1322S (K)	50	56

4. Allowable misalignment angle

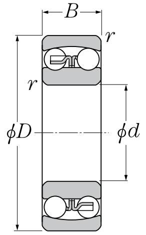
The allowable misalignment angle can be determined by the following function. This degree of allowable misalignment may be limited by the design of mating components around the bearing.

Normal load ······················ 1/15

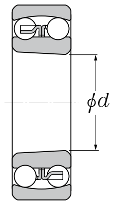
5. Precautions for using self-aligning ball bearings

Self-aligning ball bearings are unable to support large axial loads and therefore axial loading shall be limited.

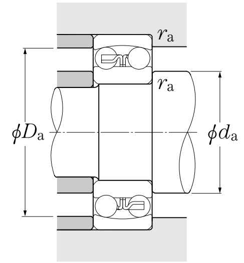
Please consider using self-aligning roller bearings when a large axial load is to be applied.



Cylindrical bore



Tapered bore



d 10 ～ 35mm

Boundary dimensions (mm)				Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers		Installation-related dimensions (mm)		
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)	d_a Min.	D_a Max.	r_{as} Max.
10	30	9	0.6	5.55	1.19	0.049	22 000	28 000	**1200S**	—	14.0	26.0	0.6
	30	14	0.6	7.45	1.59	0.067	24 000	28 000	**2200S**	—	14.0	26.0	0.6
	35	11	0.6	7.35	1.62	0.074	20 000	24 000	**1300S**	—	14.0	31.0	0.6
	35	17	0.6	9.20	2.01	0.096	18 000	22 000	**2300S**	—	14.0	31.0	0.6
12	32	10	0.6	5.70	1.27	0.053	22 000	26 000	**1201S**	—	16.0	28.0	0.6
	32	14	0.6	7.75	1.73	0.089	22 000	26 000	**2201S**	—	16.0	28.0	0.6
	37	12	1	9.65	2.16	0.078	18 000	22 000	**1301S**	—	17.0	32.0	1
	37	17	1	12.1	2.73	0.120	17 000	22 000	**2301S**	—	17.0	32.0	1
15	35	11	0.6	7.60	1.75	0.072	18 000	22 000	**1202S**	—	19.0	31.0	0.6
	35	14	0.6	7.80	1.85	0.095	18 000	22 000	**2202S**	—	19.0	31.0	0.6
	42	13	1	9.70	2.29	0.081	16 000	20 000	**1302S**	—	20.0	37.0	1
	42	17	1	12.3	2.91	0.130	14 000	18 000	**2302S**	—	20.0	37.0	1
17	40	12	0.6	8.00	2.01	0.083	16 000	20 000	**1203S**	—	21.0	36.0	0.6
	40	16	0.6	9.95	2.42	0.130	16 000	20 000	**2203S**	—	21.0	36.0	0.6
	47	14	1	12.7	3.20	0.110	14 000	17 000	**1303S**	—	22.0	42.0	1
	47	19	1	14.7	3.55	0.160	13 000	16 000	**2303S**	—	22.0	42.0	1
20	47	14	1	10.0	2.61	0.110	14 000	17 000	**1204S**	**1204SK**	25.0	42.0	1
	47	18	1	12.8	3.30	0.140	14 000	17 000	**2204S**	**2204SK**	25.0	42.0	1
	52	15	1.1	12.6	3.35	0.140	12 000	15 000	**1304S**	**1304SK**	26.5	45.5	1
	52	21	1.1	18.5	4.70	0.210	11 000	14 000	**2304S**	**2304SK**	26.5	45.5	1
25	52	15	1	12.2	3.30	0.130	12 000	14 000	**1205S**	**1205SK**	30.0	47.0	1
	52	18	1	12.4	3.45	0.200	12 000	14 000	**2205S**	**2205SK**	30.0	47.0	1
	62	17	1.1	18.2	5.00	0.150	10 000	13 000	**1305S**	**1305SK**	31.5	55.5	1
	62	24	1.1	24.9	6.60	0.290	9 500	12 000	**2305S**	**2305SK**	31.5	55.5	1
30	62	16	1	15.8	4.65	0.190	10 000	12 000	**1206S**	**1206SK**	35.0	57.0	1
	62	20	1	15.3	4.55	0.260	10 000	12 000	**2206S**	**2206SK**	35.0	57.0	1
	72	19	1.1	21.4	6.30	0.190	8 500	11 000	**1306S**	**1306SK**	36.5	65.5	1
	72	27	1.1	32.0	8.75	0.380	8 000	10 000	**2306S**	**2306SK**	36.5	65.5	1
35	72	17	1.1	15.9	5.10	0.210	8 500	10 000	**1207S**	**1207SK**	41.5	65.5	1
	72	23	1.1	21.7	6.60	0.320	8 500	10 000	**2207S**	**2207SK**	41.5	65.5	1
	80	21	1.5	25.3	7.85	0.280	7 500	9 500	**1307S**	**1307SK**	43.0	72.0	1.5
	80	31	1.5	40.0	11.3	0.480	7 100	9 000	**2307S**	**2307SK**	43.0	72.0	1.5

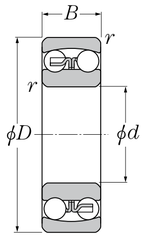
1) Smallest allowable dimension for chamfer dimension r. 2) "**K**" indicates bearings having a tapered bore with a taper ratio of 1:12

Dynamic equivalent radial load
$P_r = XF_r + YF_a$

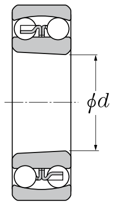
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

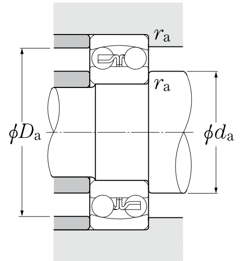
Constant	Axial load factors			Mass (kg)
e	Y_1	Y_2	Y_0	(approx.)
0.32	2.00	3.10	2.10	0.034
0.64	0.98	1.50	1.00	0.046
0.35	1.80	2.80	1.90	0.059
0.71	0.89	1.40	0.93	0.078
0.36	1.80	2.70	1.80	0.041
0.58	1.10	1.70	1.10	0.051
0.33	1.90	2.90	2.00	0.068
0.60	1.10	1.60	1.10	0.087
0.32	2.00	3.10	2.10	0.050
0.50	1.30	1.90	1.30	0.058
0.33	1.90	2.90	2.00	0.101
0.51	1.20	1.90	1.30	0.113
0.31	2.00	3.10	2.10	0.074
0.50	1.30	1.90	1.30	0.089
0.32	2.00	3.10	2.10	0.130
0.51	1.20	1.90	1.30	0.160
0.29	2.20	3.40	2.30	0.120
0.47	1.30	2.10	1.40	0.142
0.29	2.20	3.40	2.30	0.164
0.50	1.20	1.90	1.30	0.207
0.28	2.30	3.50	2.40	0.140
0.41	1.50	2.40	1.60	0.160
0.28	2.30	3.50	2.40	0.261
0.47	1.40	2.10	1.40	0.332
0.25	2.50	3.90	2.60	0.220
0.38	1.60	2.50	1.70	0.262
0.26	2.40	3.70	2.50	0.391
0.44	1.40	2.20	1.50	0.500
0.23	2.70	4.20	2.80	0.330
0.37	1.70	2.60	1.80	0.403
0.26	2.50	3.80	2.60	0.520
0.46	1.40	2.10	1.40	0.671



Cylindrical bore



Tapered bore



Self-Aligning Ball Bearings NTN

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load

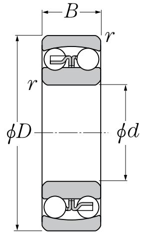
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

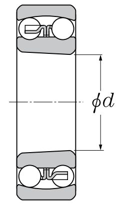
d 40 ～ 75mm

Boundary dimensions (mm)				Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers		Installation-related dimensions (mm)			Constant	Axial load factors			Mass (kg)
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)	d_a Min.	D_a Max.	r_{as} Max.	e	Y_1	Y_2	Y_0	(approx.)
40	80	18	1.1	19.3	6.50	0.260	7 500	9 000	**1208S**	**1208SK**	46.5	73.5	1	0.22	2.8	4.3	2.9	0.420
	80	23	1.1	22.4	7.35	0.390	7 500	9 000	**2208S**	**2208SK**	46.5	73.5	1	0.33	1.9	3.0	2.0	0.506
	90	23	1.5	29.8	9.70	0.300	6 700	8 500	**1308S**	**1308SK**	48.0	82.0	1.5	0.24	2.6	4.0	2.7	0.727
	90	33	1.5	45.5	13.5	0.580	6 300	8 000	**2308S**	**2308SK**	48.0	82.0	1.5	0.43	1.5	2.3	1.5	0.918
45	85	19	1.1	22.0	7.35	0.290	7 100	8 500	**1209S**	**1209SK**	51.5	78.5	1	0.21	3.0	4.7	3.1	0.470
	85	23	1.1	23.3	8.15	0.510	7 100	8 500	**2209S**	**2209SK**	51.5	78.5	1	0.30	2.1	3.2	2.2	0.556
	100	25	1.5	38.5	12.7	0.330	6 000	7 500	**1309S**	**1309SK**	53.0	92.0	1.5	0.25	2.6	4.0	2.7	0.971
	100	36	1.5	55.0	16.7	0.710	5 600	7 100	**2309S**	**2309SK**	53.0	92.0	1.5	0.41	1.5	2.4	1.6	1.200
50	90	20	1.1	22.8	8.10	0.330	6 300	8 000	**1210S**	**1210SK**	56.5	83.5	1	0.21	3.1	4.7	3.2	0.535
	90	23	1.1	23.3	8.45	0.570	6 300	8 000	**2210S**	**2210SK**	56.5	83.5	1	0.28	2.2	3.4	2.3	0.598
	110	27	2	43.5	14.1	0.350	5 600	6 700	**1310S**	**1310SK**	59.0	101	2	0.23	2.7	4.2	2.8	1.230
	110	40	2	65.0	20.2	0.860	5 000	6 300	**2310S**	**2310SK**	59.0	101	2	0.42	1.5	2.3	1.6	1.630
55	100	21	1.5	26.9	10.0	0.400	6 000	7 100	**1211S**	**1211SK**	63.0	92.0	1.5	0.20	3.2	4.9	3.3	0.708
	100	25	1.5	26.7	9.90	0.720	6 000	7 100	**2211S**	**2211SK**	63.0	92.0	1.5	0.28	2.3	3.5	2.4	0.807
	120	29	2	51.5	17.9	0.400	5 000	6 300	**1311S**	**1311SK**	64.0	111	2	0.23	2.7	4.2	2.8	1.600
	120	43	2	76.5	24.0	1.00	4 800	6 000	**2311S**	**2311SK**	64.0	111	2	0.41	1.5	2.4	1.6	2.080
60	110	22	1.5	30.5	11.5	0.460	5 300	6 300	**1212S**	**1212SK**	68.0	102	1.5	0.18	3.4	5.3	3.6	0.910
	110	28	1.5	34.0	12.6	0.840	5 300	6 300	**2212S**	**2212SK**	68.0	102	1.5	0.28	2.3	3.5	2.4	1.100
	130	31	2.1	57.5	20.8	0.510	4 500	5 600	**1312S**	**1312SK**	71.0	119	2	0.23	2.8	4.3	2.9	2.000
	130	46	2.1	88.5	28.3	1.20	4 300	5 300	**2312S**	**2312SK**	71.0	119	2	0.40	1.6	2.4	1.6	2.580
65	120	23	1.5	31.0	12.5	0.500	4 800	6 000	**1213S**	**1213SK**	73.0	112	1.5	0.17	3.7	5.7	3.8	1.160
	120	31	1.5	43.5	16.4	0.920	4 800	6 000	**2213S**	**2213SK**	73.0	112	1.5	0.28	2.3	3.5	2.4	1.500
	140	33	2.1	62.5	22.9	0.670	4 300	5 300	**1313S**	**1313SK**	76.0	129	2	0.23	2.7	4.2	2.9	2.470
	140	48	2.1	97.0	32.5	1.40	3 800	4 800	**2313S**	**2313SK**	76.0	129	2	0.39	1.6	2.5	1.7	3.200
70	125	24	1.5	35.0	13.8	0.550	4 800	5 600	**1214S**	—	78.0	117	1.5	0.18	3.4	5.3	3.6	1.300
	125	31	1.5	44.0	17.1	1.10	4 500	5 600	**2214S**	—	78.0	117	1.5	0.26	2.4	3.7	2.5	1.550
	150	35	2.1	75.0	27.7	0.690	4 000	5 000	**1314S**	—	81.0	139	2	0.22	2.8	4.4	3.0	3.030
	150	51	2.1	111	37.5	1.60	3 600	4 500	**2314S**	—	81.0	139	2	0.38	1.7	2.6	1.8	3.900
75	130	25	1.5	39.0	15.7	0.630	4 300	5 300	**1215S**	**1215SK**	83.0	122	1.5	0.17	3.6	5.6	3.8	1.360
	130	31	1.5	44.5	17.8	1.20	4 300	5 300	**2215S**	**2215SK**	83.0	122	1.5	0.25	2.5	3.9	2.6	1.600
	160	37	2.1	80.0	30.0	0.720	3 800	4 500	**1315S**	**1315SK**	86.0	149	2	0.22	2.8	4.4	2.9	3.630
	160	55	2.1	125	43.0	1.80	3 400	4 300	**2315S**	**2315SK**	86.0	149	2	0.38	1.6	2.5	1.7	4.780

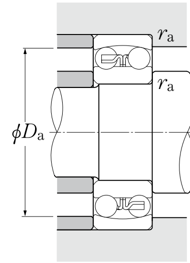
1) Smallest allowable dimension for chamfer dimension r. 2) "**K**" indicates bearings having a tapered bore with a taper ratio of 1:12



Cylindrical bore



Tapered bore



Self-Aligning Ball Bearings NTN

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

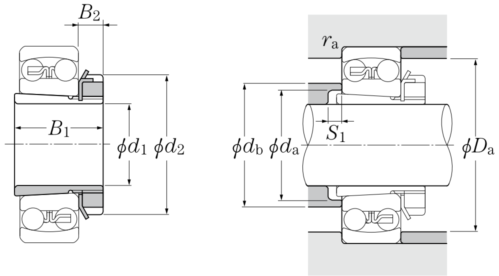
d 80 ～ 110mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers		Installation-related dimensions mm			Constant	Axial load factors			Mass kg
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)	d_a Min.	D_a Max.	r_{as} Max.	e	Y_1	Y_2	Y_0	(approx.)
80	140	26	2	40.0	17.0	0.680	4 000	5 000	**1216S**	**1216SK**	89	131	2	0.16	3.9	6.0	4.1	1.68
	140	33	2	49.0	19.9	1.30	4 000	5 000	**2216S**	**2216SK**	89	131	2	0.25	2.5	3.9	2.7	2.02
	170	39	2.1	89.0	33.0	0.800	3 600	4 300	**1316S**	**1316SK**	91	159	2	0.22	2.9	4.5	3.1	4.24
	170	58	2.1	130	45.0	1.90	3 200	4 000	**2316S**	**2316SK**	91	159	2	0.39	1.6	2.5	1.7	5.63
85	150	28	2	49.5	20.8	0.830	3 800	4 500	**1217S**	**1217SK**	94	141	2	0.17	3.7	5.7	3.8	2.10
	150	36	2	58.5	23.6	1.50	3 800	4 800	**2217S**	**2217SK**	94	141	2	0.25	2.5	3.9	2.6	2.56
	180	41	3	98.5	38.0	0.950	3 400	4 000	**1317S**	**1317SK**	98	167	2.5	0.21	2.9	4.6	3.1	5.03
	180	60	3	142	51.5	2.10	3 000	3 800	**2317S**	**2317SK**	98	167	2.5	0.37	1.7	2.6	1.8	6.56
90	160	30	2	57.5	23.5	0.940	3 600	4 300	**1218S**	**1218SK**	99	151	2	0.17	3.8	5.8	3.9	2.56
	160	40	2	70.5	28.7	1.80	3 600	4 300	**2218S**	**2218SK**	99	151	2	0.27	2.4	3.7	2.5	3.22
	190	43	3	117	44.5	1.20	3 200	3 800	**1318S**	**1318SK**	103	177	2.5	0.22	2.8	4.3	2.9	5.83
	190	64	3	154	57.5	2.40	2 800	3 600	**2318S**	**2318SK**	103	177	2.5	0.38	1.7	2.6	1.7	7.75
95	170	32	2.1	64.0	27.1	1.10	3 400	4 000	**1219S**	**1219SK**	106	159	2	0.17	3.7	5.8	3.9	3.12
	170	43	2.1	84.0	34.5	2.00	3 400	4 000	**2219S**	**2219SK**	106	159	2	0.27	2.4	3.7	2.5	3.96
	200	45	3	129	51.0	1.40	3 000	3 600	**1319S**	**1319SK**	108	187	2.5	0.23	2.8	4.3	2.9	6.79
	200	67	3	161	64.5	2.70	2 800	3 400	**2319S**	**2319SK**	108	187	2.5	0.38	1.7	2.6	1.8	8.97
100	180	34	2.1	69.5	29.7	1.20	3 200	3 800	**1220S**	**1220SK**	111	169	2	0.17	3.6	5.6	3.8	3.74
	180	46	2.1	94.5	38.5	2.30	3 200	3 800	**2220S**	**2220SK**	111	169	2	0.27	2.4	3.7	2.5	4.71
	215	47	3	140	57.5	1.60	2 800	3 400	**1320S**	**1320SK**	113	202	2.5	0.24	2.7	4.1	2.8	8.40
	215	73	3	187	79.0	3.30	2 400	3 200	**2320S**	**2320SK**	113	202	2.5	0.38	1.7	2.6	1.8	11.5
105	190	36	2.1	75.0	32.5	1.30	3 000	3 600	**1221S**	—	116	179	2	0.18	3.6	5.5	3.7	4.43
	190	50	2.1	109	45.0	2.60	3 000	3 600	**2221S**	—	116	179	2	0.28	2.3	3.5	2.4	5.73
	225	49	3	154	64.5	1.80	2 600	3 200	**1321S**	—	118	212	2.5	0.23	2.7	4.2	2.9	9.58
	225	77	3	200	87.0	3.60	2 400	3 000	**2321S** 3)	—	118	212	2.5	0.38	1.7	2.6	1.7	14.5
110	200	38	2.1	87.0	38.5	1.50	2 800	3 400	**1222S**	**1222SK**	121	189	2	0.18	3.7	5.7	3.9	5.21
	200	53	2.1	122	51.5	2.90	2 800	3 400	**2222S**	**2222SK**	121	189	2	0.28	2.2	3.5	2.3	6.75
	240	50	3	161	72.5	2.10	2 400	3 000	**1322S**	**1322SK**	123	227	2.5	0.22	2.8	4.4	3.0	11.5
	240	80	3	211	94.5	3.90	2 200	2 800	**2322S** 3)	**2322SK**	123	227	2.5	0.37	1.7	2.6	1.8	17.5

1) Smallest allowable dimension for chamfer dimension r. 2) "**K**" indicates bearings having a tapered bore with a taper ratio of 1:12.
3) A machined cage is the standard for 2321S and 2322S(K).

Adapters

(For self-aligning ball bearings)



d 17 ~ 50mm

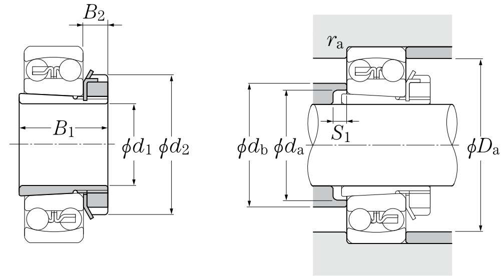
Boundary dimensions mm				Numbers		Installation-related dimensions mm					Mass[1) kg
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
17	24	32	7	1204SK;	**H 204**	23	27	5	41	1	0.041
	28	32	7	2204SK;	**H 304**	24	28	5	41	1	0.045
	28	32	7	1304SK;	**H 304**	24	31	8	45	1	0.045
	31	32	7	2304SK;	**H2304**	24	28	5	45	1	0.049
20	26	38	8	1205SK;	**H 205X**	28	33	5	46	1	0.07
	29	38	8	2205SK;	**H 305X**	29	33	5	46	1	0.075
	29	38	8	1305SK;	**H 305X**	29	37	6	55	1	0.075
	35	38	8	2305SK;	**H2305X**	29	34	5	55	1	0.087
25	27	45	8	1206SK;	**H 206X**	33	39	5	56	1	0.099
	31	45	8	2206SK;	**H 306X**	34	39	5	56	1	0.109
	31	45	8	1306SK;	**H 306X**	34	44	6	65	1	0.109
	38	45	8	2306SK;	**H2306X**	35	40	5	65	1	0.126
30	29	52	9	1207SK;	**H 207X**	38	46	5	65	1	0.125
	35	52	9	2207SK;	**H 307X**	39	45	5	65	1	0.142
	35	52	9	1307SK;	**H 307X**	39	50	7	71.5	1.5	0.142
	43	52	9	2307SK;	**H2307X**	40	46	5	71.5	1.5	0.165
35	31	58	10	1208SK;	**H 208X**	44	52	5	73	1	0.174
	36	58	10	2208SK;	**H 308X**	44	50	5	73	1	0.189
	36	58	10	1308SK;	**H 308X**	44	56	5	81.5	1.5	0.189
	46	58	10	2308SK;	**H2308X**	45	52	5	81.5	1.5	0.224
40	33	65	11	1209SK;	**H 209X**	49	57	5	78	1	0.227
	39	65	11	2209SK;	**H 309X**	49	57	8	78	1	0.248
	39	65	11	1309SK;	**H 309X**	49	61	5	91.5	1.5	0.248
	50	65	11	2309SK;	**H2309X**	50	58	5	91.5	1.5	0.28
45	35	70	12	1210SK;	**H 210X**	53	62	5	83	1	0.274
	42	70	12	2210SK;	**H 310X**	54	63	10	83	1	0.303
	42	70	12	1310SK;	**H 310X**	54	67	5	100	2	0.303
	55	70	12	2310SK;	**H2310X**	56	65	5	100	2	0.362
50	37	75	12	1211SK;	**H 211X**	60	70	6	91.5	1.5	0.308

1) Indicates adapter mass.

Note: 1. Refer to pages **B-82** to **B-85** for bearing dimensions, basic rated loads, and mass.
2. Adapters for series **12** bearings can also be used with **H2** and **H3** series bearings. Caution: the B_1 dimension of **H3** series bearings is longer than that of **H2** series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages **D-2** to **D-7** and **D-12** to **D-14** for adapter locknut and washer dimensions.

Adapters

(For self-aligning ball bearings)



d 50 ~ 85mm

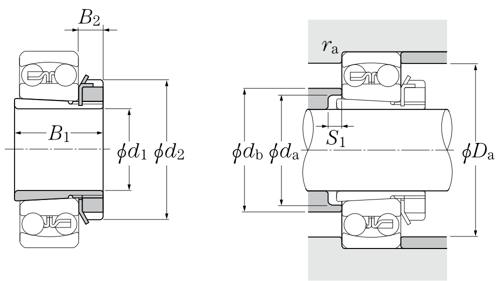
Boundary dimensions mm				Numbers		Installation-related dimensions mm					Mass[1) kg
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
50	45	75	12	2211SK;	**H 311X**	60	69	11	91.5	1.5	0.345
	45	75	12	1311SK;	**H 311X**	60	73	6	110	2	0.345
	59	75	12	2311SK;	**H2311X**	61	71	6	110	2	0.42
55	38	80	13	1212SK;	**H 212X**	64	76	5	101.5	1.5	0.346
	47	80	13	2212SK;	**H 312X**	65	75	9	101.5	1.5	0.394
	47	80	13	1312SK;	**H 312X**	65	79	5	118	2	0.394
	62	80	13	2312SK;	**H2312X**	66	77	5	118	2	0.481
60	40	85	14	1213SK;	**H 213X**	70	83	5	111.5	1.5	0.401
	50	85	14	2213SK;	**H 313X**	70	81	8	111.5	1.5	0.458
	50	85	14	1313SK;	**H313X**	70	85	5	128	2	0.458
	65	85	14	2313SK;	**H2313X**	72	84	5	128	2	0.557
65	43	98	15	1215SK;	**H 215X**	80	93	5	121.5	1.5	0.707
	55	98	15	2215SK;	**H 315X**	80	93	12	121.5	1.5	0.831
	55	98	15	1315SK;	**H 315X**	80	97	5	148	2	0.831
	73	98	15	2315SK;	**H2315X**	82	96	5	148	2	1.05
70	46	105	17	1216SK;	**H 216X**	85	100	5	130	2	0.882
	59	105	17	2216SK;	**H 316X**	86	98	12	130	2	1.03
	59	105	17	1316SK;	**H 316X**	86	103	5	158	2	1.03
	78	105	17	2316SK;	**H2316X**	87	103	5	158	2	1.28
75	50	110	18	1217SK;	**H 217X**	90	106	6	140	2	1.02
	63	110	18	2217SK;	**H 317X**	91	104	12	140	2	1.18
	63	110	18	1317SK;	**H 317X**	91	110	6	166	2.5	1.18
	82	110	18	2317SK;	**H2317X**	94	110	6	166	2.5	1.45
80	52	120	18	1218SK;	**H 218X**	95	111	6	150	2	1.19
	65	120	18	2218SK;	**H 318X**	96	112	10	150	2	1.37
	65	120	18	1318SK;	**H 318X**	96	116	6	176	2.5	1.37
	86	120	18	2318SK;	**H2318X**	99	117	6	176	2.5	1.69
85	55	125	19	1219SK;	**H 219X**	101	118	7	158	2	1.37
	68	125	19	2219SK;	**H 319X**	102	117	9	158	2	1.56

1) Indicates adapter mass.

Note: 1. Refer to pages **B-84** to **B-87** for bearing dimensions, basic rated loads, and mass.
2. Adapters for series **12** bearings can also be used with **H2** and **H3** series bearings. Caution: the B_1 dimension of **H3** series bearings is longer than that of **H2** series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages **D-2** to **D-7** and **D-12** to **D-14** for adapter locknut and washer dimensions.

Adapters

(For self-aligning ball bearings)

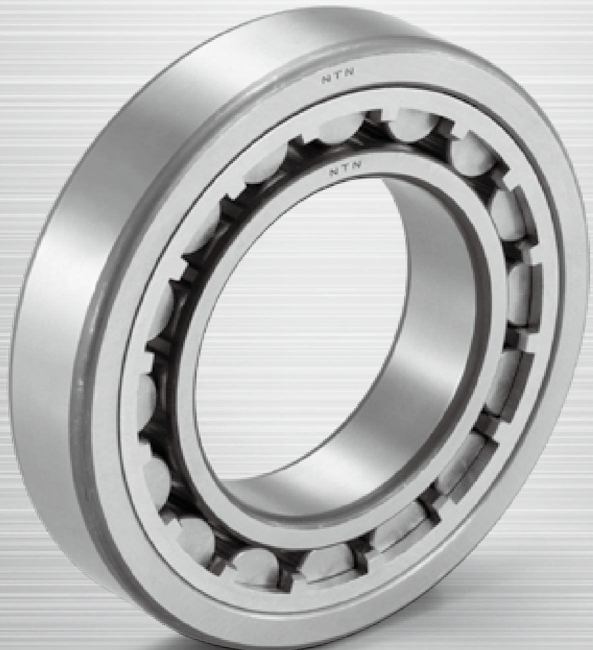


d 85 ~ 100mm

Boundary dimensions				Numbers		Installation-related dimensions					Mass[1)]
mm						mm					kg
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
85	68	125	19	1319SK;	**H 319X**	102	123	7	186	2.5	1.56
	90	125	19	2319SK;	**H2319X**	105	123	7	186	2.5	1.92
90	58	130	20	1220SK;	**H 220X**	106	125	7	168	2	1.49
	71	130	20	2220SK;	**H 320X**	107	123	8	168	2	1.69
	71	130	20	1320SK;	**H 320X**	107	130	7	201	2.5	1.69
	97	130	20	2320SK;	**H2320X**	110	129	7	201	2.5	2.15
100	63	145	21	1222SK;	**H 222X**	116	138	7	188	2	1.93
	77	145	21	2222SK;	**H 322X**	117	137	6	188	2	2.18
	77	145	21	1322SK;	**H 322X**	117	150	9	226	2.5	2.18
	105	145	21	2322SK;	**H2322X**	121	142	7	226	2.5	2.74

1) Indicates adapter mass.
Note: 1. Refer to pages **B-86** to **B-87** for bearing dimensions, basic rated loads, and mass.
2. Adapters for series **12** bearings can also be used with **H2** and **H3** series bearings. Caution: the B_1 dimension of **H3** series bearings is longer than that of **H2** series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages **D-2** to **D-9** and **D-12** to **D-14** for adapter locknut and washer dimensions.

Cylindrical Roller Bearings



Cylindrical roller bearing

E Type cylindrical roller bearing

Double-row cylindrical roller bearing

1. Types, design features, and characteristics

Cylindrical roller bearings can accommodate heavy radial loads due to the line contact formed between their rolling elements and raceways. These bearings are also suitable for high speed applications since the rollers are guided by either inner or outer ring ribs. Cylindrical roller bearings are separable, allowing them to be easily installed and disassembled even when interference fits are required.

Among the various types of cylindrical roller bearings, E type and EA type have a high load capacity while maintaining standard boundary dimensions. HT type has a large axial load capacity, and HL type provides extended fatigue life in poor lubrication conditions. Multiple row bearing arrangements are also available.

For extremely heavy load applications, the non-separable full complement SL type bearing offers special advantages. For SL type and four-row cylindrical roller bearings, see section "C. Special application bearings."

Table 1 shows the various types and characteristics of single row cylindrical roller bearings. **Table 2** shows the characteristics of non-standard type cylindrical roller bearings.

Table 1 Cylindrical roller bearing types and characteristics

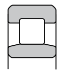
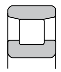
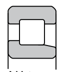
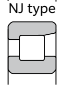
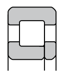
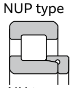
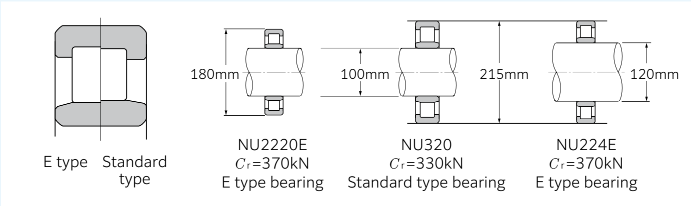
Type code	Design	Characteristics
NU type N type	 NU type  N type	● NU type outer rings have two ribs. The outer ring, roller, and cage assembly can be separated from the inner ring. N type inner rings have two ribs. The inner ring, roller, and cage assembly can be separated from the outer ring. ● Unable to accommodate any axial loading. ● This is widely used as the floating side bearing in a fixed-float arrangement.
NJ type NF type	 NJ type  NF type	● NJ type has two ribs on the outer ring, a single rib on the inner ring; NF type has a single rib on the outer ring, and two ribs on the inner ring. ● Can receive single direction axial loads. ● When there is no distinction between the fixed side and floating side bearing, these types can be used as a pair in close proximity.
NUP type NH type (NJ+HJ)	 NUP type  NH type	● NUP type has a collar ring attached to the ribless side of the inner ring; NH type is NJ type with an L type collar ring attached. All of these collar rings are separable, and therefore it is necessary to fix the inner ring axially. ● Can accommodate axial loads in either direction. ● Widely used as the shaft's fixed-side bearing.

Table 2 Non-standard type cylindrical roller bearing characteristics

Designation	Characteristics
E type and EA type Cylindrical roller bearing	● Boundary dimensions are the same as the standard type, but the diameter, length and number of the rollers have been increased, resulting in higher load capacity. ● Identified by the addition of "E" to the end of the basic roller number. ● Enables compact design due increased load rating. ● Rollers' inscribed circle diameter differs from the standard type rollers and therefore cannot be interchanged. ● EA type bearings are ULTAGE series[1).  Note: In the dimension tables, both E type and EA type are listed.
Cylindrical roller bearing for axial loads (HT type)	● Can accommodate larger axial loads than the standard type due to improved geometry of the rib roller end surface. ● Please consult **NTN** Engineering concerning necessary considerations, such as load, lubricant, and installation conditions.
Double-row cylindrical roller bearing	● NN type and NNU type are available. ● Widely used for applications requiring thin-walled bearings, such the main shafts of machine tools, rolling machine rollers, and in printing equipment. ● Internal radial clearance is adjusted for the spindle of machine tools by pressing the tapered bore of the inner ring on a tapered shaft. Remarks: For precision bearings for machine tools, see **precision rolling bearings (CAT. No. 2260/E)**.

1) **ULTAGE series cylindrical roller bearings** has been developed for "longer life," "improved loading capability," and "higher speed," which are required for various types of industrial machinery. For details, see **the special catalog (CAT. No. 3037/E)**.

Cylindrical Roller Bearings NTN

2. Standard cage type

Table 3 shows the standard cage types for cylindrical roller bearings.

The basic load ratings listed in the dimension charts correspond to use of the standard cages listed in **Table 3**. The basic load ratings listed in the dimension tables are for standard configurations. These ratings can change when a different cage type and number of rolling elements is utilized.

Table 3 Standard cage types

Cage type / Bearing series	Resin cage	Pressed cage	Machined cage	
			Single type	Studded double type
				
NU10	—	—	—	1005 to 10/500
NU2 NU2E NU2EA	— — 204EA to 219EA	208 to 230 — —	232 to 240 220E to 240E —	244 to 264 — —
NU22 NU22E NU22EA	— — 2204EA to 2218EA	2208 to 2230 — —	2232 to 2240 2219E to 2240E —	2244 to 2264 — —
NU3 NU3E NU3EA	— — 304EA to 315EA	308 to 324 — —	326 to 330 316E to 332E —	332 to 356 — —
NU23 NU23E NU23EA	— — 2304EA to 2315EA	2308 to 2320 — —	2322 to 2330 2316E to 2332E —	2332 to 2356 — —
NU4	—	405 to 416	—	—

Note: 1. Within the same bearing series, cage type is constant regardless of the cylindrical roller bearing type (NJ, NUP, N, NF).
2. For high speed and other special applications, machined cages can be manufactured when necessary. Consult **NTN** Engineering.
3. Among EA type bearings that use resin cages as standard, certain varieties use pressed cages. Consult **NTN** Engineering.
4. Although machined cages are the standard for two-row cylindrical roller bearings, resin cages may also be used in some of these bearings for machine tool applications.

3. Allowable misalignment

Edge loading due to misalignment under general load conditions should be avoided to prevent premature bearing failure, The maximum allowable misalignment based on bearing series can be found below. The values apply when the bearings are to be used as the floating side of NU and N types. For NJ, NUP, and NH types that are to be used for the fixed side, consult **NTN** Engineering. Depending on the magnitude of the axial load, the edge loading may exceed recommended limits, which could lead to a reduction in bearing life.

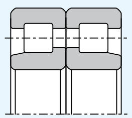
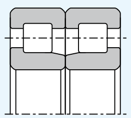
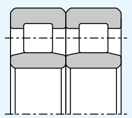
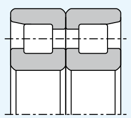
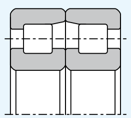
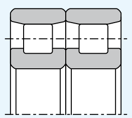
- Bearing series 0 or 1 ··············· 1/1 000
- Bearing series 2 ························ 1/2 000
- Bearing series 0, 1, and 2 single-row ULTAGE ·· 1/500
- Double-row cylindrical roller bearings[1)] ·· 1/2 000

1) Does not include high precision bearings for machine tool main shaft applications.

4. Combinations of cylindrical roller bearings

Table 4 shows the representative combinations of bearings.

Table 4 Combination type

Back-to-back arrangement (DB)	Face-to-face arrangement (DF)	Symmetrical parts arrangement (D2)
 NJ type	 NJ type	 NU type
 NF type	 NF type	 N type

Note: 1. Bearings are manufactured in a set so that two bearings receive a load evenly; therefore, they must be assembled together with identically numbered bearings and not mixed with other arrangements.
2. Triplex arrangements of bearings are also available. Consult **NTN** Engineering for details.

5. Tolerance of inscribed circle diameter and circumscribed circle diameter of rollers of interchangeable cylindrical roller bearings

Table 5 Tolerance of inscribed circle diameter and circumscribed circle diameter of rollers of interchangeable cylindrical roller bearings

Unit: μm

Nominal bore diameter d (mm)		Dimensional tolerance of roller inscribed circle diameter Δ_{Fw}		Dimensional tolerance of roller circumscribed circle diameter Δ_{Ew}	
Over	Incl.	Upper	Lower	Upper	Lower
17[1)]	20	+10	0	0	−10
20	50	+15	0	0	−15
50	120	+20	0	0	−20
120	200	+25	0	0	−25
200	250	+30	0	0	−30
250	315	+35	0	0	−35
315	400	+40	0	0	−40
400	500	+45	0	0	−45

1) 17 mm is included in this dimensional division.
Note: Interchangeable cylindrical roller bearings are bearings having the same number in the group. The bearing function is not impaired even if an outer ring is combined with an inner ring with rollers or an inner ring is combined with an outer ring with rollers.

6. Allowable speed of cylindrical roller bearing ULTAGE series

As the rotational speed of the bearing increases, the temperature of the bearing also increases because of the friction heat produced inside the bearing. Operation at excessive temperatures will significantly deteriorate the lubricant performance, causing abnormal temperature rises and seizure. Factors affecting the allowable speed of bearings are as follows.

(1) Bearing type
(2) Bearing size
(3) Lubrication (grease lubrication, circulating lubrication, oil lubrication, etc.)
(4) Bearing internal clearance (bearing internal clearance during operation)
(5) Bearing load
(6) Shaft and housing accuracy

The allowable speed specified in the bearing dimension table is the reference speed limit which allows for satisfactory heat dissipation and lubrication conditions before adversely affecting the bearing. The allowable speed of ULTAGE series cylindrical roller bearings specified in the catalog is defined as follows.

[Oil lubrication]
The allowable speed for oil lubrication is the speed at which the outer ring temperature reaches 80°C with room temperature spindle oil (lubrication oil viscosity: VG32) supplied at 1 liter/min under an operating load of 5% of the basic static load rating C_{0r}.

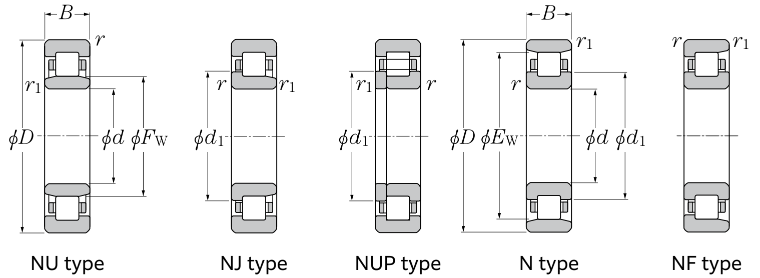
[Grease lubrication]
The allowable speed for grease lubrication is the speed at which the outer ring temperature reaches 80°C with lithium-based grease (consistency: NLGI3) filled 20%-30% of the free space under an operating load of 5% of the basic static load rating C_{0r}.

In either of the lubrication methods, the bearing temperature rise differs if the usage condition (operating load, rotational speed pattern, lubricating condition, etc.) is different; therefore, the bearings must be selected with sufficient allowable speed as specified in the catalog.

If 80% of the allowable speed specified in the dimension table is exceeded or the bearing is used under vibration or impact conditions, please consult **NTN** Engineering.

See section "9. Allowable speed" for the definition of the allowable speed of the cylindrical roller bearings that are not part of the ULTAGE series.

Cylindrical Roller Bearings

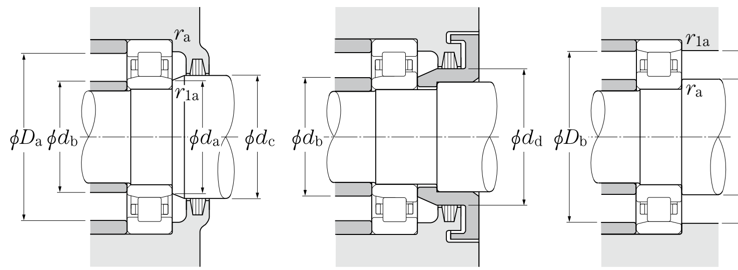


d 20 ～ 45mm

d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	NU type	NJ type	NUP type	N type
Boundary dimensions mm					Basic load rating kN		Fatigue load limit kN	Allowable speed 2) min⁻¹		Bearing number 3) 4) 5)			
20	47	14	1	0.6	32.5	24.7	3.00	15 000	21 600	**∗NU204EA**	**NJ**	**NUP**	**N**
	47	18	1	0.6	38.5	31.0	3.75	14 000	19 200	**∗NU2204EA**	**NJ**	**NUP**	**N**
	52	15	1.1	0.6	37.5	26.9	3.25	13 000	18 000	**∗NU304EA**	**NJ**	**NUP**	**N**
	52	21	1.1	0.6	49.5	39.0	4.75	12 000	16 800	**∗NU2304EA**	**NJ**	**NUP**	**N**
25	47	12	0.6	0.3	16.7	14.1	1.72	16 000	19 000	**NU1005**	**NJ**	**NUP**	**N**
	52	15	1	0.6	34.5	27.7	3.40	13 000	18 000	**∗NU205EA**	**NJ**	**NUP**	**N**
	52	18	1	0.6	41.5	34.5	4.25	11 000	15 600	**∗NU2205EA**	**NJ**	**NUP**	**N**
	62	17	1.1	1.1	49.0	37.5	4.55	11 000	15 600	**∗NU305EA**	**NJ**	**NUP**	**N**
	62	24	1.1	1.1	67.5	56.0	6.85	9 700	13 200	**∗NU2305EA**	**NJ**	**NUP**	**N**
	80	21	1.5	1.5	51.5	40.0	4.85	8 500	10 000	**NU405**	**NJ**	**NUP**	**N**
30	55	13	1	0.6	21.8	19.6	2.39	14 000	16 000	**NU1006**	**NJ**	**NUP**	**N**
	62	16	1	0.6	46.0	37.5	4.55	11 000	15 600	**∗NU206EA**	**NJ**	**NUP**	**N**
	62	20	1	0.6	58.0	50.0	6.10	9 700	13 200	**∗NU2206EA**	**NJ**	**NUP**	**N**
	72	19	1.1	1.1	63.0	50.0	6.15	9 300	13 200	**∗NU306EA**	**NJ**	**NUP**	**N**
	72	27	1.1	1.1	88.0	77.5	9.45	8 300	11 600	**∗NU2306EA**	**NJ**	**NUP**	**N**
	90	23	1.5	1.5	69.5	55.0	6.70	7 300	8 500	**NU406**	**NJ**	**NUP**	**N**
35	62	14	1	0.6	25.1	23.2	2.82	12 000	15 000	**NU1007**	**NJ**	**NUP**	**N**
	72	17	1.1	0.6	59.5	50.0	6.10	9 500	13 200	**∗NU207EA**	**NJ**	**NUP**	**N**
	72	23	1.1	0.6	73.0	65.5	7.95	8 500	12 000	**∗NU2207EA**	**NJ**	**NUP**	**N**
	80	21	1.5	1.1	83.5	71.0	8.65	8 100	11 500	**∗NU307EA**	**NJ**	**NUP**	**N**
	80	31	1.5	1.1	117	109	13.3	7 200	10 200	**∗NU2307EA**	**NJ**	**NUP**	**N**
	100	25	1.5	1.5	83.5	69.0	8.40	6 400	7 500	**NU407**	**NJ**	**NUP**	**N**
40	68	15	1	0.6	30.5	29.0	3.55	11 000	13 000	**NU1008**	**NJ**	**NUP**	**N**
	80	18	1.1	1.1	48.5	43.0	5.25	9 400	11 000	**∗∗NU208**	**NJ**	**NUP**	**N**
	80	18	1.1	1.1	66.0	55.5	6.75	8 500	12 000	**∗NU208EA**	**NJ**	**NUP**	**N**
	80	23	1.1	1.1	64.5	62.0	7.55	8 500	10 000	**∗∗NU2208**	**NJ**	**NUP**	**N**
	80	23	1.1	1.1	85.5	77.5	9.45	7 600	10 700	**∗NU2208EA**	**NJ**	**NUP**	**N**
	90	23	1.5	1.5	65.0	57.0	6.95	8 000	9 400	**∗∗NU308**	**NJ**	**NUP**	**N**
	90	23	1.5	1.5	98.5	81.5	9.95	7 200	10 200	**∗NU308EA**	**NJ**	**NUP**	**N**
	90	33	1.5	1.5	91.5	88.0	10.7	7 000	8 200	**∗∗NU2308**	**NJ**	**NUP**	**N**
	90	33	1.5	1.5	135	122	14.9	6 400	9 000	**∗NU2308EA**	**NJ**	**NUP**	**N**
	110	27	2	2	106	89.0	10.9	5 700	6 700	**NU408**	**NJ**	**NUP**	**N**
45	75	16	1	0.6	34.5	34.0	4.10	9 900	12 000	**NU1009**	**NJ**	**NUP**	**N**

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.
3) Bearing numbers marked "∗" designate ULTAGE series bearings. 4) Bearing marked "∗∗" are going to be integrated with ULTAGE Series.

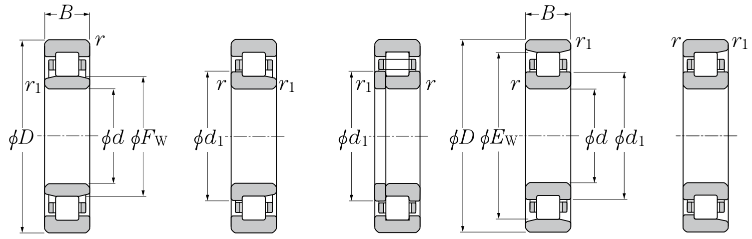
Cylindrical Roller Bearings



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

NF type	F_W	E_W	d_1	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 6)	r_{as} Max.	r_{1as} Max.	NU type	N type
	Dimension mm			Installation-related dimensions mm										Mass kg (approx.)	
NF	26.5	41.5	29.5	24	25	26	29	32	42	42	42.5	1	0.6	0.115	0.11
NF	26.5	41.5	29.5	24	25	26	29	32	42	42	42.5	1	0.6	0.146	0.144
NF	27.5	45.5	31.1	24	26.5	27	30	33	45.5	45.5	46.5	1	0.6	0.176	0.147
NF	27.5	45.5	31.1	24	26.5	27	30	33	45.5	45.5	46.5	1	0.6	0.242	0.212
—	30.5	41.5	32.7	27	29	30	32	33	43	45	42.5	0.6	0.3	0.092	0.091
NF	31.5	46.5	34.5	29	30	31	34	37	47	47	47.5	1	0.6	0.151	0.13
NF	31.5	46.5	34.5	29	30	31	34	37	47	47	47.5	1	0.6	0.186	0.163
NF	34	54	38	31.5	31.5	33	37	40	55.5	55.5	55	1	1	0.275	0.242
NF	34	54	38	31.5	31.5	33	37	40	55.5	55.5	55	1	1	0.386	0.345
NF	38.8	62.8	43.6	33	33	38	41	46	72	72	64	1.5	1.5	0.55	0.536
—	36.5	48.5	38.9	34	35	35	38	39.5	50	51	49.5	1	0.6	0.13	0.128
NF	37.5	55.5	41.1	34	35	37	40	44	57	57	56.5	1	0.6	0.226	0.205
NF	37.5	55.5	41.1	34	35	37	40	44	57	57	56.5	1	0.6	0.297	0.259
NF	40.5	62.5	44.9	36.5	36.5	40	44	48	65.5	65.5	64	1	1	0.398	0.353
NF	40.5	62.5	44.9	36.5	36.5	40	44	48	65.5	65.5	64	1	1	0.58	0.526
NF	45	73	50.5	38	38	44	47	52	82	82	74	1.5	1.5	0.751	0.732
—	42	55	44.6	39	40	41	44	45	57	58	56	1	0.6	0.179	0.176
NF	44	64	48	39	41.5	43	46	50	65.5	65.5	65.5	1	0.6	0.327	0.294
NF	44	64	48	39	41.5	43	46	50	65.5	65.5	65.5	1	0.6	0.455	0.405
NF	46.2	70.2	51	41.5	43	45	48	53	72	72	71.5	1.5	1	0.545	0.483
NF	46.2	70.2	51	41.5	43	45	48	53	72	72	71.5	1.5	1	0.78	0.737
NF	53	83	59	43	43	52	55	61	92	92	84	1.5	1.5	0.99	0.965
—	47	61	49.8	44	45	46	49	50.5	63	64	62	1	0.6	0.22	0.217
NF	50	70	54.2	46.5	46.5	49	52	56	73.5	73.5	72	1	1	0.378	0.37
NF	49.5	71.5	53.9	46.5	46.5	49	52	56	73.5	73.5	72.5	1	1	0.426	0.365
—	50	70	54.2	46.5	46.5	49	52	56	73.5	73.5	72	1	1	0.49	0.48
NF	49.5	71.5	53.9	46.5	46.5	49	52	56	73.5	73.5	72.5	1	1	0.552	0.491
NF	53.5	77.5	58.4	48	48	51	55	60	82	82	80	1.5	1.5	0.658	0.643
NF	52	80	57.6	48	48	51	55	60	82	82	81.5	1.5	1.5	0.754	0.658
—	53.5	77.5	58.4	48	48	51	55	60	82	82	80	1.5	1.5	0.951	0.932
NF	52	80	57.6	48	48	51	55	60	82	82	81.5	1.5	1.5	1.06	0.952
NF	58	92	64.8	49	49	57	60	67	101	101	93	2	2	1.3	1.27
—	52.5	67.5	55.5	49	50	52	54	56	70	71	68.5	1	0.6	0.28	0.276

5) Bearing numbers having no standard form are switched to type E or ULTAGE Series.
6) Does not apply to the sides of the outer ring rib of type NF bearings.



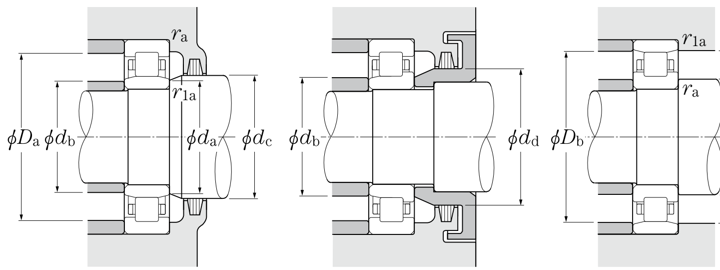
NU type NJ type NUP type N type NF type

d 45 ～ 60mm

Boundary dimensions mm					Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed [2] min⁻¹		Bearing number [3] [4]			
d	D	B	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	NU type	NJ type	NUP type	N type
45	85	19	1.1	1.1	51.0	47.0	5.70	8 400	9 900	∗∗NU209	NJ	NUP	N
	85	19	1.1	1.1	74.5	66.5	8.10	7 600	10 800	∗NU209EA	NJ	NUP	N
	85	23	1.1	1.1	68.0	68.0	8.25	7 600	9 000	∗∗NU2209	NJ	NUP	N
	85	23	1.1	1.1	90.0	84.5	10.3	6 800	9 600	∗NU2209EA	NJ	NUP	N
	100	25	1.5	1.5	82.0	71.0	8.65	7 200	8 400	∗∗NU309	NJ	NUP	N
	100	25	1.5	1.5	115	98.5	12.0	6 500	9 100	∗NU309EA	NJ	NUP	N
	100	36	1.5	1.5	110	104	12.7	6 300	7 400	∗∗NU2309	NJ	NUP	N
	100	36	1.5	1.5	162	153	18.7	5 700	8 200	∗NU2309EA	NJ	NUP	N
	120	29	2	2	119	102	12.4	5 100	6 000	NU409	NJ	NUP	N
50	80	16	1	0.6	35.5	36.0	4.40	8 900	11 000	NU1010	NJ	NUP	N
	90	20	1.1	1.1	53.5	51.0	6.20	7 600	9 000	∗∗NU210	NJ	NUP	N
	90	20	1.1	1.1	81.5	76.5	9.30	6 900	9 700	∗NU210EA	NJ	NUP	N
	90	23	1.1	1.1	71.0	73.5	9.00	6 900	8 100	∗∗NU2210	NJ	NUP	N
	90	23	1.1	1.1	98.5	97.0	11.9	6 200	8 800	∗NU2210EA	NJ	NUP	—
	110	27	2	2	96.5	86.0	10.5	6 500	7 700	∗∗NU310	NJ	NUP	N
	110	27	2	2	130	113	13.8	5 900	8 300	∗NU310EA	NJ	NUP	N
	110	40	2	2	134	131	16.0	5 700	6 700	∗∗NU2310	NJ	NUP	N
	110	40	2	2	192	187	22.7	5 200	7 300	∗NU2310EA	NJ	NUP	N
	130	31	2.1	2.1	143	124	15.1	4 700	5 500	NU410	NJ	NUP	N
55	90	18	1.1	1	42.0	44.0	5.35	8 200	9 700	NU1011	NJ	NUP	N
	100	21	1.5	1.1	64.5	62.5	7.60	6 900	8 200	∗∗NU211	NJ	NUP	N
	100	21	1.5	1.1	102	98.5	12.0	6 300	8 900	∗NU211EA	NJ	NUP	N
	100	25	1.5	1.1	83.5	87.0	10.6	6 300	7 400	∗∗NU2211	NJ	NUP	N
	100	25	1.5	1.1	120	122	14.8	5 600	7 900	∗NU2211EA	NJ	NUP	N
	120	29	2	2	123	111	13.6	5 900	7 000	∗∗NU311	NJ	NUP	N
	120	29	2	2	162	143	17.4	5 300	7 600	∗NU311EA	NJ	NUP	N
	120	43	2	2	164	162	19.8	5 200	6 100	∗∗NU2311	NJ	NUP	N
	120	43	2	2	238	233	28.4	4 700	6 700	∗NU2311EA	NJ	NUP	N
	140	33	2.1	2.1	154	138	16.9	4 300	5 000	NU411	NJ	NUP	N
60	95	18	1.1	1	44.5	48.5	5.95	7 500	8 800	NU1012	NJ	NUP	N
	110	22	1.5	1.5	76.0	75.0	9.15	6 400	7 600	∗∗NU212	NJ	NUP	N
	110	22	1.5	1.5	115	107	13.1	5 800	8 200	∗NU212EA	NJ	NUP	N
	110	28	1.5	1.5	107	116	14.1	5 800	6 800	∗∗NU2212	NJ	NUP	N
	110	28	1.5	1.5	155	157	19.1	5 200	7 300	∗NU2212EA	NJ	NUP	N

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.
3) Bearing numbers marked "∗" designate ULTAGE series bearings. 4) Bearing marked "∗∗" are going to be integrated with ULTAGE Series.

Cylindrical Roller Bearings NTN

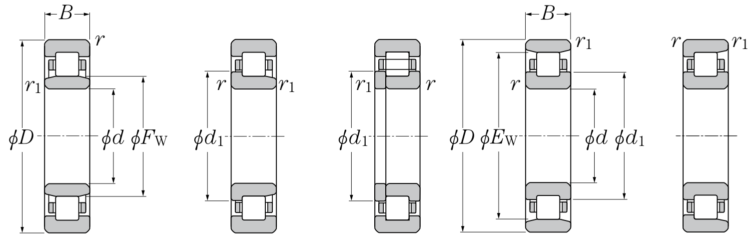


Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

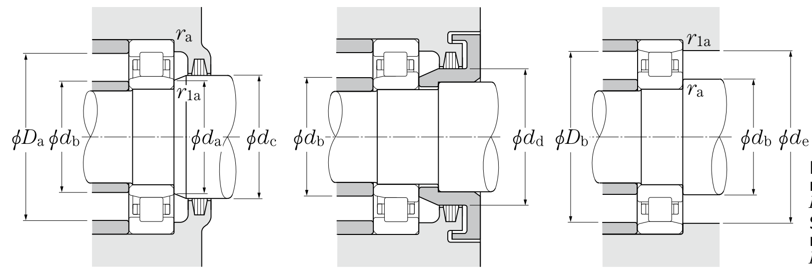
Dimension mm				Installation-related dimensions mm										Mass kg (approx.)	
NF type	F_w	E_w	d_1	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. [5]	r_{as} Max.	r_{1as} Max.	NU type	N type
NF	55	75	59	51.5	51.5	54	57	61	78.5	78.5	77	1	1	0.432	0.423
NF	54.5	76.5	58.9	51.5	51.5	54	57	61	78.5	78.5	77.5	1	1	0.495	0.423
—	55	75	59	51.5	51.5	54	57	61	78.5	78.5	77	1	1	0.53	0.52
NF	54.5	76.5	58.9	51.5	51.5	54	57	61	78.5	78.5	77.5	1	1	0.6	0.533
NF	58.5	86.5	64	53	53	57	60	66	92	92	89	1.5	1.5	0.877	0.857
NF	58.5	88.5	64.5	53	53	57	60	66	92	92	90.5	1.5	1.5	0.996	0.865
—	58.5	86.5	64	53	53	57	60	66	92	92	89	1.5	1.5	1.27	1.24
NF	58.5	88.5	64.5	53	53	57	60	66	92	92	90.5	1.5	1.5	1.41	1.3
NF	64.5	100.5	71.8	54	54	63	66	74	111	111	102	2	2	1.62	1.58
—	57.5	72.5	60.5	54	55	57	59	61	75	76	73.5	1	0.6	0.295	0.291
NF	60.4	80.4	64.6	56.5	56.5	58	62	67	83.5	83.5	83	1	1	0.47	0.46
NF	59.5	81.5	63.9	56.5	56.5	58	62	67	83.5	83.5	82.5	1	1	0.503	0.47
—	60.4	80.4	64.6	56.5	56.5	58	62	67	83.5	83.5	83	1	1	0.571	0.56
NF	59.5	81.5	63.9	56.5	56.5	58	62	67	83.5	83.5	82.5	1	1	0.587	—
NF	65	95	71	59	59	63	67	73	101	101	98	2	2	1.14	1.11
NF	65	97	71.4	59	59	63	67	73	101	101	99	2	2	1.3	1.12
—	65	95	71	59	59	63	67	73	101	101	98	2	2	1.7	1.67
NF	65	97	71.4	59	59	63	67	73	101	101	99	2	2	1.9	1.75
NF	70.8	110.8	78.8	61	61	69	73	81	119	119	112	2	2	2.02	1.97
—	64.5	80.5	67.7	60	61.5	63	66	68.5	83.5	85	81.5	1	1	0.442	0.435
NF	66.5	88.5	70.8	61.5	63	65	68	73	92	93.5	91	1.5	1	0.638	0.626
NF	66	90	70.8	61.5	63	65	68	73	92	92	91	1.5	1	0.675	0.635
—	66.5	88.5	70.8	61.5	63	65	68	73	92	93.5	91	1.5	1	0.773	0.758
NF	66	90	70.8	61.5	63	65	68	73	92	92	91	1.5	1	0.807	—
NF	70.5	104.5	77.2	64	64	69	72	80	111	111	107	2	2	1.45	1.42
NF	70.5	106.5	77.7	64	64	69	72	80	111	111	108.5	2	2	1.65	1.43
—	70.5	104.5	77.2	64	64	69	72	80	111	111	107	2	2	2.17	2.13
NF	70.5	106.5	77.7	64	64	69	72	80	111	111	108.5	2	2	2.37	2.23
NF	77.2	117.2	85.2	66	66	76	79	87	129	129	119	2	2	2.48	2.42
—	69.5	85.5	72.7	65	66.5	68	71	73.5	88.5	90	86.5	1	1	0.474	0.467
NF	73.5	97.5	78.4	68	68	71	75	80	102	102	100	1.5	1.5	0.818	0.802
NF	72	100	77.6	68	68	71	75	80	102	102	101	1.5	1.5	0.923	0.798
—	73.5	97.5	78.4	68	68	71	75	80	102	102	100	1.5	1.5	1.06	1.04
NF	72	100	77.6	68	68	71	75	80	102	102	101	1.5	1.5	1.21	1.08

5) Does not apply to the sides of the outer ring rib of type NF bearings.

Cylindrical Roller Bearings NTN



NU type NJ type NUP type N type NF type



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

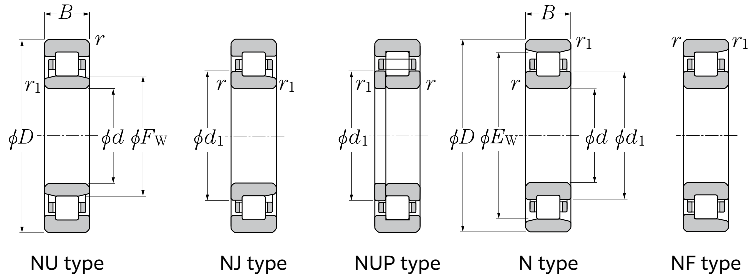
d 60 ~ 75mm

	Boundary dimensions (mm)				Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed 2) (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 3) 4) NU type	NJ type	NUP type	N type
d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u						
60	130	31	2.1	2.1	137	126	15.4	5 500	6 500	∗∗NU312	NJ	NUP	N
	130	31	2.1	2.1	177	157	19.1	4 900	7 000	∗NU312EA	NJ	NUP	N
	130	46	2.1	2.1	187	188	22.9	4 800	5 700	∗∗NU2312	NJ	NUP	N
	130	46	2.1	2.1	263	262	32.0	4 400	6 200	∗NU2312EA	NJ	NUP	N
	150	35	2.1	2.1	185	168	20.2	3 900	4 600	NU412	NJ	NUP	N
65	100	18	1.1	1	45.5	51.0	6.30	7 000	8 200	NU1013	NJ	NUP	N
	120	23	1.5	1.5	93.0	94.5	11.5	5 900	7 000	∗∗NU213	NJ	NUP	N
	120	23	1.5	1.5	127	119	14.5	5 400	7 600	∗NU213EA	NJ	NUP	N
	120	31	1.5	1.5	133	149	18.2	5 400	6 300	∗∗NU2213	NJ	NUP	N
	120	31	1.5	1.5	176	181	22.1	4 800	6 700	∗NU2213EA	NJ	NUP	N
	140	33	2.1	2.1	150	139	16.8	5 100	6 000	∗∗NU313	NJ	NUP	N
	140	33	2.1	2.1	213	191	23.1	4 600	6 500	∗NU313EA	NJ	NUP	N
	140	48	2.1	2.1	208	212	25.7	4 400	5 200	∗∗NU2313	NJ	NUP	N
	140	48	2.1	2.1	293	287	34.5	4 100	5 800	∗NU2313EA	NJ	NUP	N
	160	37	2.1	2.1	202	186	21.9	3 600	4 300	NU413	NJ	NUP	N
70	110	20	1.1	1	64.5	70.5	8.60	6 500	7 600	NU1014	NJ	NUP	N
	125	24	1.5	1.5	92.5	95.0	11.6	5 500	6 500	∗∗NU214	NJ	NUP	N
	125	24	1.5	1.5	140	137	16.7	5 000	7 100	∗NU214EA	NJ	NUP	N
	125	31	1.5	1.5	132	151	18.4	5 000	5 900	∗∗NU2214	NJ	NUP	N
	125	31	1.5	1.5	184	194	23.7	4 500	6 200	∗NU2214EA	NJ	NUP	N
	150	35	2.1	2.1	175	168	20.0	4 700	5 500	∗∗NU314	NJ	NUP	N
	150	35	2.1	2.1	242	222	26.2	4 200	6 000	∗NU314EA	NJ	NUP	N
	150	51	2.1	2.1	247	262	31.0	4 100	4 800	∗∗NU2314	NJ	NUP	N
	150	51	2.1	2.1	325	325	38.0	3 800	5 300	∗NU2314EA	NJ	NUP	N
	180	42	3	3	253	236	26.8	3 400	4 000	NU414	NJ	NUP	N
75	115	20	1.1	1	66.5	74.5	9.10	6 100	7 100	NU1015	NJ	NUP	N
	130	25	1.5	1.5	107	111	13.4	5 100	6 000	∗∗NU215	NJ	NUP	N
	130	25	1.5	1.5	154	156	18.9	4 700	6 600	∗NU215EA	NJ	NUP	N
	130	31	1.5	1.5	144	162	19.6	4 700	5 500	∗∗NU2215	NJ	NUP	N
	130	31	1.5	1.5	191	207	25.0	4 200	5 900	∗NU2215EA	NJ	NUP	N
	160	37	2.1	2.1	211	205	23.8	4 400	5 200	∗∗NU315	NJ	NUP	N
	160	37	2.1	2.1	284	263	30.5	4 000	5 600	∗NU315EA	NJ	NUP	N
	160	55	2.1	2.1	286	300	35.0	3 800	4 500	∗∗NU2315	NJ	NUP	N
	160	55	2.1	2.1	390	395	45.5	3 500	4 900	∗NU2315EA	NJ	NUP	N
	190	45	3	3	291	274	30.5	3 200	3 700	NU415	NJ	NUP	N

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.
3) Bearing numbers marked "∗" designate ULTAGE series bearings. 4) Bearing marked "∗∗" are going to be integrated with ULTAGE Series.

	Dimension (mm)			Installation-related dimensions (mm)										Mass (kg) (approx.)	
NF type	F_w	E_w	d_1	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 5)	r_{as} Max.	r_{1as} Max.	NU type	N type
NF	77	113	84.2	71	71	75	79	86	119	119	116	2	2	1.8	1.76
NF	77	115	84.6	71	71	75	79	86	119	119	117	2	2	2.05	1.77
—	77	113	84.2	71	71	75	79	86	119	119	116	2	2	2.71	2.66
NF	77	115	84.6	71	71	75	79	86	119	119	117	2	2	2.96	2.73
NF	83	127	91.8	71	71	82	85	94	139	139	128	2	2	3	2.93
—	74.5	90.5	77.7	70	71.5	73	76	78.5	93.5	95	91.5	1	1	0.485	0.477
NF	79.6	105.6	84.8	73	73	77	81	87	112	112	108	1.5	1.5	1.02	1
NF	78.5	108.5	84.5	73	73	77	81	87	112	112	110	1.5	1.5	1.21	1.01
—	79.6	105.6	84.8	73	73	77	81	87	112	112	108	1.5	1.5	1.4	1.37
NF	78.5	108.5	84.5	73	73	77	81	87	112	112	110	1.5	1.5	1.6	1.44
NF	83.5	121.5	91	76	76	81	85	93	129	129	125	2	2	2.23	2.18
NF	82.5	124.5	91	76	76	81	85	93	129	129	127	2	2	2.54	2.2
—	83.5	121.5	91	76	76	81	85	93	129	129	125	2	2	3.27	3.2
NF	82.5	124.5	91	76	76	81	85	93	129	129	127	2	2	3.48	3.25
NF	89.3	135.3	98.5	76	76	88	91	100	149	149	137	2	2	3.6	3.5
—	80	100	84	75	76.5	78	82	85	103.5	105	101	1	1	0.699	0.689
NF	84.5	110.5	89.6	78	78	82	86	92	117	117	114	1.5	1.5	1.12	1.1
NF	83.5	113.5	89.5	78	78	82	86	92	117	117	115	1.5	1.5	1.3	1.13
—	84.5	110.5	89.6	78	78	82	86	92	117	117	114	1.5	1.5	1.47	1.44
NF	83.5	113.5	89.5	78	78	82	86	92	117	117	115	1.5	1.5	1.7	1.52
NF	90	130	98	81	81	87	92	100	139	139	134	2	2	2.71	2.65
NF	89	133	98	81	81	87	92	100	139	139	136	2	2	3.1	2.75
—	90	130	98	81	81	87	92	100	139	139	134	2	2	3.98	3.9
NF	89	133	98	81	81	87	92	100	139	139	136	2	2	4.25	3.95
NF	100	152	110.5	83	83	99	102	112	167	167	153	2.5	2.5	5.24	5.1
—	85	105	89	80	81.5	83	87	90	108.5	110	106	1	1	0.738	0.727
NF	88.5	116.5	94	83	83	87	90	96	122	122	120	1.5	1.5	1.23	1.21
NF	88.5	118.5	94.5	83	83	87	90	96	122	122	120	1.5	1.5	1.41	1.28
—	88.5	116.5	94	83	83	87	90	96	122	122	120	1.5	1.5	1.55	1.52
NF	88.5	118.5	94.5	83	83	87	90	96	122	122	120	1.5	1.5	1.79	1.61
NF	95.5	139.5	104.2	86	86	93	97	106	149	149	143	2	2	3.28	3.21
NF	95	143	104.6	86	86	93	97	106	149	149	146	2	2	3.74	3.28
—	95.5	139.5	104.2	86	86	93	97	106	149	149	143	2	2	4.87	4.77
NF	95	143	104.6	86	86	93	97	106	149	149	—	2	2	5.25	4.85
NF	104.5	160.5	116	88	88	103	107	118	177	177	162	2.5	2.5	6.22	6.06

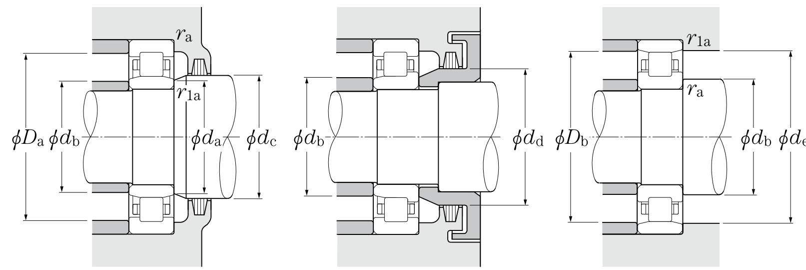
5) Does not apply to the sides of the outer ring rib of type NF bearings.



d 80 ～ 95mm

d	*D*	*B*	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed[2] Grease lubrication (min⁻¹)	Oil lubrication (min⁻¹)	Bearing number[3][4] NU type	NJ type	NUP type	N type
80	125	22	1.1	1	80.0	90.5	11.0	5 700	6 700	**NU1016**	**NJ**	**NUP**	**N**
	140	26	2	2	118	122	14.5	4 800	5 700	∗∗**NU216**	**NJ**	**NUP**	**N**
	140	26	2	2	165	167	19.7	4 400	6 100	∗**NU216EA**	**NJ**	**NUP**	**N**
	140	33	2	2	163	186	22.0	4 400	5 100	∗∗**NU2216**	**NJ**	**NUP**	**N**
	140	33	2	2	220	243	28.7	3 900	5 500	∗**NU2216EA**	**NJ**	**NUP**	**N**
	170	39	2.1	2.1	211	207	23.7	4 100	4 800	**NU316**	**NJ**	**NUP**	**N**
	170	39	2.1	2.1	284	282	32.0	3 700	4 400	**NU316E**	**NJ**	**NUP**	**N**
	170	58	2.1	2.1	305	330	38.0	3 600	4 200	**NU2316**	**NJ**	**NUP**	**N**
	170	58	2.1	2.1	395	430	49.0	3 300	3 900	**NU2316E**	**NJ**	**NUP**	**N**
	200	48	3	3	330	315	34.5	3 000	3 500	**NU416**	**NJ**	**NUP**	**N**
85	130	22	1.1	1	82.5	95.5	11.4	5 400	6 300	**NU1017**	**NJ**	**NUP**	**N**
	150	28	2	2	134	140	16.3	4 500	5 300	∗∗**NU217**	**NJ**	**NUP**	**N**
	150	28	2	2	198	199	23.0	4 100	5 800	∗**NU217EA**	**NJ**	**NUP**	**N**
	150	36	2	2	188	218	25.3	4 100	4 800	∗∗**NU2217**	**NJ**	**NUP**	**N**
	150	36	2	2	257	279	32.5	3 700	5 200	∗**NU2217EA**	**NJ**	**NUP**	**N**
	180	41	3	3	235	228	25.6	3 900	4 600	**NU317**	**NJ**	**NUP**	**N**
	180	41	3	3	325	330	37.0	3 500	4 100	**NU317E**	**NJ**	**NUP**	—
	180	60	3	3	350	380	43.0	3 400	4 000	**NU2317**	**NJ**	**NUP**	**N**
	180	60	3	3	435	485	54.0	3 100	3 700	**NU2317E**	**NJ**	**NUP**	—
90	140	24	1.5	1.1	98.0	114	13.4	5 100	5 900	**NU1018**	**NJ**	**NUP**	**N**
	160	30	2	2	169	178	20.3	4 300	5 000	∗∗**NU218**	**NJ**	**NUP**	**N**
	160	30	2	2	215	217	24.7	3 900	5 500	∗**NU218EA**	**NJ**	**NUP**	**N**
	160	40	2	2	219	248	28.3	3 900	4 600	∗∗**NU2218**	**NJ**	**NUP**	**N**
	160	40	2	2	286	315	35.5	3 500	4 900	∗**NU2218EA**	**NJ**	**NUP**	**N**
	190	43	3	3	266	265	29.3	3 700	4 300	**NU318**	**NJ**	**NUP**	**N**
	190	43	3	3	350	355	39.0	3 300	3 900	**NU318E**	**NJ**	**NUP**	—
	190	64	3	3	360	395	43.5	3 200	3 800	**NU2318**	**NJ**	**NUP**	**N**
	190	64	3	3	485	535	58.5	2 900	3 400	**NU2318E**	**NJ**	**NUP**	—
95	145	24	1.5	1.1	101	120	13.9	4 800	5 600	**NU1019**	**NJ**	**NUP**	**N**
	170	32	2.1	2.1	184	195	21.8	4 000	4 700	∗∗**NU219**	**NJ**	**NUP**	**N**
	170	32	2.1	2.1	260	265	29.6	3 600	5 200	∗**NU219EA**	**NJ**	**NUP**	**N**
	170	43	2.1	2.1	256	298	33.5	3 600	4 300	**NU2219**	**NJ**	**NUP**	**N**
	170	43	2.1	2.1	315	370	41.5	3 300	3 800	**NU2219E**	**NJ**	**NUP**	**N**
	200	45	3	3	287	289	31.5	3 400	4 000	**NU319**	**NJ**	**NUP**	**N**
	200	45	3	3	370	385	42.0	3 100	3 600	**NU319E**	**NJ**	**NUP**	—

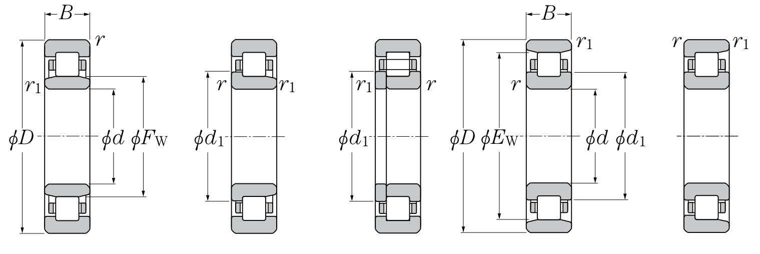
1) Smallest allowable dimension for chamfer dimension *r* or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.
3) Bearing numbers marked "∗" designate ULTAGE series bearings. 4) Bearing marked "∗∗" are going to be integrated with ULTAGE Series.



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

Dimension (mm) NF type	F_w	E_w	d_1	Installation-related dimensions (mm) d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min.[5]	r_{as} Max.	r_{1as} Max.	Mass (kg) (approx.) NU type	N type
—	91.5	113.5	95.9	85	86.5	90	94	97	118.5	120	114.5	1	1	0.98	0.965
NF	95.3	125.3	101.2	89	89	94	97	104	131	131	128	2	2	1.5	1.47
NF	95.3	127.3	101.7	89	89	94	97	104	131	131	128.5	2	2	1.67	1.56
—	95.3	125.3	101.2	89	89	94	97	104	131	131	128	2	2	1.93	1.89
NF	95.3	127.3	101.7	89	89	94	97	104	131	131	128.5	2	2	2.12	2.02
NF	103	147	111.8	91	91	99	105	114	159	159	151	2	2	3.86	3.77
NF	101	151	111	91	91	99	105	114	159	159	154	2	2	4.22	4.12
—	103	147	111.8	91	91	99	105	114	159	159	151	2	2	5.79	5.67
NF	101	151	111	91	91	99	105	114	159	159	154	2	2	6.25	5.78
NF	110	170	122	93	93	109	112	124	187	187	172	2.5	2.5	7.32	7.14
—	96.5	118.5	100.9	90	91.5	95	99	102	123.5	125	119.5	1	1	1.03	1.01
NF	101.8	133.8	108.2	94	94	99	104	110	141	141	137	2	2	1.87	1.83
NF	100.5	136.5	107.7	94	94	99	104	110	141	141	138	2	2	2.11	1.93
—	101.8	133.8	108.2	94	94	99	104	110	141	141	137	2	2	2.44	2.39
NF	100.5	136.5	107.7	94	94	99	104	110	141	141	138	2	2	2.68	2.52
NF	108	156	117.5	98	98	106	110	119	167	167	160	2.5	2.5	4.54	4.44
—	108	—	118.4	98	—	106	110	119	167	—	—	2.5	2.5	4.81	—
—	108	156	117.5	98	98	106	110	119	167	167	160	2.5	2.5	6.7	6.57
—	108	—	118.4	98	—	106	110	119	167	—	—	2.5	2.5	7.16	—
—	103	127	107.8	96.5	98	101	106	109	132	133.5	129	1.5	1	1.33	1.31
NF	107	143	114.2	99	99	105	109	116	151	151	146	2	2	2.3	2.25
NF	107	145	114.6	99	99	105	109	116	151	151	147	2	2	2.44	2.37
—	107	143	114.2	99	99	105	109	116	151	151	146	2	2	3.1	3.04
NF	107	145	114.6	99	99	105	109	116	151	151	147	2	2	3.33	3.2
NF	115	165	125	103	103	111	117	127	177	177	169	2.5	2.5	5.3	5.18
—	113.5	—	124.7	103	—	111	117	127	177	—	—	2.5	2.5	5.72	—
—	115	165	125	103	103	111	117	127	177	177	169	2.5	2.5	7.95	7.79
—	113.5	—	124.7	103	—	111	117	127	177	—	—	2.5	2.5	8.56	—
—	108	132	112.8	101.5	103	106	111	114	137	138.5	134	1.5	1	1.4	1.38
NF	113.5	151.5	121	106	106	111	116	123	159	159	155	2	2	2.78	2.72
NF	112.5	154.5	121	106	106	111	116	123	159	159	156.5	2	2	3.02	2.85
—	113.5	151.5	121	106	106	111	116	123	159	159	155	2	2	3.79	3.71
NF	112.5	154.5	121	106	106	111	116	123	159	159	156.5	2	2	4.14	3.84
NF	121.5	173.5	132	108	108	119	124	134	187	187	178	2.5	2.5	6.13	5.99
—	121.5	—	132.7	108	—	119	124	134	187	—	—	2.5	2.5	6.62	—

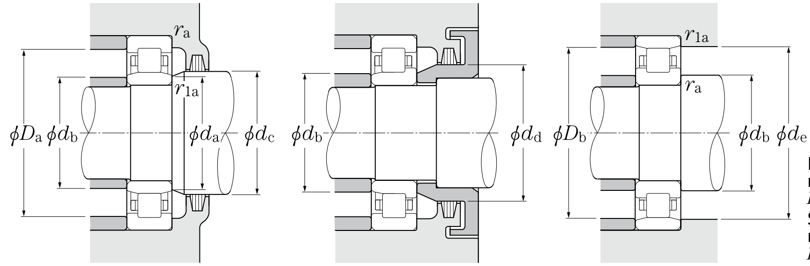
5) Does not apply to the sides of the outer ring rib of type **NF** bearings.



d 95 ～ 130mm

d	D	B	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed [2] Grease lubrication (min⁻¹)	Allowable speed [2] Oil lubrication (min⁻¹)	Bearing number NU type	NJ type	NUP type	N type
95	200	67	3	3	410	460	50.0	3 000	3 500	**NU2319**	**NJ**	**NUP**	**N**
	200	67	3	3	510	585	63.0	2 700	3 200	**NU2319E**	**NJ**	**NUP**	—
100	150	24	1.5	1.1	103	126	14.4	4 600	5 400	**NU1020**	**NJ**	**NUP**	**N**
	180	34	2.1	2.1	203	217	23.9	3 800	4 500	**NU220**	**NJ**	**NUP**	**N**
	180	34	2.1	2.1	277	305	33.5	3 500	4 100	**NU220E**	**NJ**	**NUP**	—
	180	46	2.1	2.1	286	340	37.5	3 500	4 100	**NU2220**	**NJ**	**NUP**	**N**
	180	46	2.1	2.1	370	445	49.0	3 100	3 600	**NU2220E**	**NJ**	**NUP**	—
	215	47	3	3	330	335	36.0	3 300	3 800	**NU320**	**NJ**	**NUP**	**N**
	215	47	3	3	420	425	45.0	2 900	3 500	**NU320E**	**NJ**	**NUP**	—
	215	73	3	3	455	505	54.0	2 900	3 400	**NU2320**	**NJ**	**NUP**	**N**
	215	73	3	3	630	715	76.0	2 600	3 100	**NU2320E**	**NJ**	**NUP**	—
105	160	26	2	1.1	117	142	16.0	4 300	5 100	**NU1021**	**NJ**	**NUP**	**N**
	190	36	2.1	2.1	223	241	26.1	3 600	4 300	**NU221**	**NJ**	**NUP**	**N**
	225	49	3	3	355	360	37.5	3 100	3 700	**NU321**	**NJ**	**NUP**	**N**
110	170	28	2	1.1	146	174	19.2	4 100	4 800	**NU1022**	**NJ**	**NUP**	**N**
	200	38	2.1	2.1	266	290	31.0	3 400	4 000	**NU222**	**NJ**	**NUP**	**N**
	200	38	2.1	2.1	325	365	39.0	3 100	3 700	**NU222E**	**NJ**	**NUP**	—
	200	53	2.1	2.1	350	415	44.0	3 100	3 700	**NU2222**	**NJ**	**NUP**	**N**
	200	53	2.1	2.1	425	515	55.0	2 800	3 300	**NU2222E**	**NJ**	**NUP**	—
	240	50	3	3	395	400	41.5	3 000	3 500	**NU322**	**NJ**	**NUP**	**N**
	240	50	3	3	500	525	54.0	2 700	3 100	**NU322E**	**NJ**	**NUP**	—
	240	80	3	3	670	790	81.5	2 600	3 100	**NU2322**	**NJ**	**NUP**	**N**
	240	80	3	3	750	880	90.5	2 400	2 800	**NU2322E**	**NJ**	**NUP**	—
120	180	28	2	1.1	154	191	20.6	3 800	4 400	**NU1024**	**NJ**	**NUP**	**N**
	215	40	2.1	2.1	288	320	33.5	3 200	3 700	**NU224**	**NJ**	**NUP**	**N**
	215	40	2.1	2.1	370	420	44.0	2 900	3 400	**NU224E**	**NJ**	**NUP**	—
	215	58	2.1	2.1	385	460	48.0	2 900	3 400	**NU2224**	**NJ**	**NUP**	**N**
	215	58	2.1	2.1	500	620	64.5	2 600	3 000	**NU2224E**	**NJ**	**NUP**	—
	260	55	3	3	500	510	51.0	2 700	3 200	**NU324**	**NJ**	**NUP**	**N**
	260	55	3	3	585	610	61.0	2 400	2 800	**NU324E**	**NJ**	**NUP**	—
	260	86	3	3	785	920	92.5	2 400	2 800	**NU2324**	**NJ**	**NUP**	**N**
	260	86	3	3	880	1 030	103	2 200	2 500	**NU2324E**	**NJ**	**NUP**	—
130	200	33	2	1.1	191	238	24.9	3 400	4 000	**NU1026**	**NJ**	**NUP**	**N**

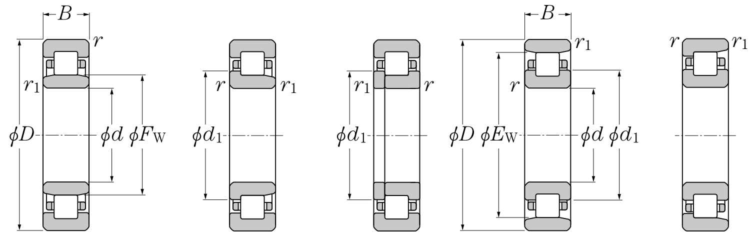
1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

Dimension (mm) NF type	F_w	E_w	d_1	Installation-related dimensions (mm) d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. [3]	r_{as} Max.	r_{1as} Max.	Mass (kg) NU type (approx.)	N type (approx.)
—	121.5	173.5	132	108	108	119	124	134	187	187	178	2.5	2.5	9.2	9.02
—	121.5	—	132.7	108	—	119	124	134	187	—	—	2.5	2.5	9.8	—
—	113	137	117.8	106.5	108	111	116	119	142	143.5	139	1.5	1	1.45	1.43
NF	120	160	128	111	111	117	122	130	169	169	164	2	2	3.33	3.26
—	119	—	128	111	—	117	122	130	169	—	—	2	2	3.66	—
—	120	160	128	111	111	117	122	130	169	169	164	2	2	4.57	4.48
—	119	—	128	111	—	117	122	130	169	—	—	2	2	5.01	—
NF	129.5	185.5	140.5	113	113	125	132	143	202	202	190	2.5	2.5	7.49	7.32
—	127.5	—	140.3	113	—	125	132	143	202	—	—	2.5	2.5	8.57	—
—	129.5	185.5	140.5	113	113	125	132	143	202	202	190	2.5	2.5	11.7	11.5
—	127.5	—	140.3	113	—	125	132	143	202	—	—	2.5	2.5	12.8	—
—	119.5	145.5	124.7	111.5	114	118	122	126	151	153.5	147.5	2	1	1.84	1.81
NF	126.8	168.8	135	116	116	124	129	137	179	179	173	2	2	3.95	3.87
NF	135	195	147	118	118	132	137	149	212	212	199	2.5	2.5	8.53	8.33
—	125	155	131	116.5	119	124	128	132	161	163.5	157	2	1	2.33	2.3
NF	132.5	178.5	141.5	121	121	130	135	144	189	189	182	2	2	4.63	4.54
—	132.5	—	142.1	121	—	130	135	144	189	—	—	2	2	4.27	—
—	132.5	178.5	141.5	121	121	130	135	144	189	189	182	2	2	6.56	6.43
—	132.5	—	142.1	121	—	130	135	144	189	—	—	2	2	7.4	—
NF	143	207	155.5	123	123	140	145	158	227	227	211	2.5	2.5	10	9.77
—	143	—	156.6	123	—	140	145	158	227	—	—	2.5	2.5	11.1	11.4
—	143	207	155.5	123	123	140	145	158	227	227	211	2.5	2.5	17.1	16.8
—	143	—	156.6	123	—	140	145	158	227	—	—	2.5	2.5	19.4	—
—	135	165	141	126.5	129	134	138	142	171	173.5	167	2	1	2.44	2.4
NF	143.5	191.5	153	131	131	141	146	156	204	204	196	2	2	5.57	5.46
—	143.5	—	153.9	131	—	141	146	156	204	—	—	2	2	5.97	—
—	143.5	191.5	153	131	131	141	146	156	204	204	196	2	2	8.19	8.03
—	143.5	—	153.9	131	—	141	146	156	204	—	—	2	2	9.18	—
NF	154	226	168.5	133	133	151	156	171	247	247	230	2.5	2.5	12.8	12.5
—	154	—	169.2	133	—	151	156	171	247	—	—	2.5	2.5	13.9	—
—	154	226	168.5	133	133	151	156	171	247	247	230	2.5	2.5	21.5	21.1
—	154	—	169.2	133	—	151	156	171	247	—	—	2.5	2.5	26.1	—
—	148	182	154.8	136.5	139	146	151	156	191	193.5	184	2	1	3.69	3.63

3) Does not apply to the sides of the outer ring rib of type **NF** bearings.

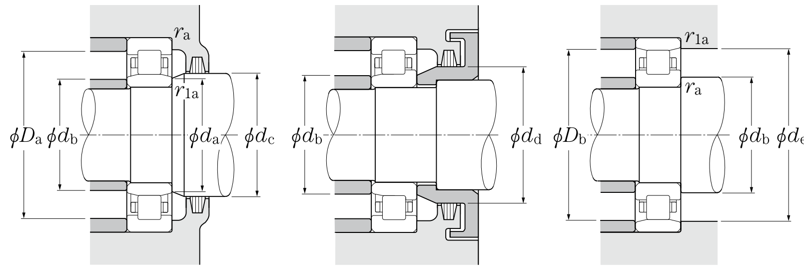


NU type NJ type NUP type N type NF type

d 130 ～ 160mm

Boundary dimensions (mm)					Basic load rating (kN)		Fatigue load limit (kN)	Allowable speed 2) (min⁻¹)		Bearing number			
					dynamic	static		Grease lubrication	Oil lubrication				
d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u			NU type	NJ type	NUP type	N type
130	230	40	3	3	300	340	35.0	2 900	3 400	NU226	NJ	NUP	N
	230	40	3	3	405	455	46.0	2 600	3 100	NU226E	NJ	NUP	—
	230	64	3	3	420	530	54.0	2 600	3 100	NU2226	NJ	NUP	N
	230	64	3	3	590	735	75.0	2 300	2 700	NU2226E	NJ	NUP	—
	280	58	4	4	620	665	65.5	2 500	2 900	NU326	NJ	NUP	N
	280	58	4	4	685	735	72.0	2 200	2 600	NU326E	NJ	NUP	—
	280	93	4	4	930	1 130	111	2 200	2 600	NU2326	NJ	NUP	N
	280	93	4	4	1 020	1 230	121	2 000	2 300	NU2326E	NJ	NUP	—
140	210	33	2	1.1	195	250	25.7	3 200	3 800	NU1028	NJ	NUP	N
	250	42	3	3	345	400	39.5	2 700	3 100	NU228	NJ	NUP	N
	250	42	3	3	435	515	51.0	2 400	2 800	NU228E	NJ	NUP	—
	250	68	3	3	495	635	63.5	2 400	2 800	NU2228	NJ	NUP	N
	250	68	3	3	635	835	83.0	2 100	2 500	NU2228E	NJ	NUP	—
	300	62	4	4	685	745	72.0	2 300	2 700	NU328	NJ	NUP	N
	300	62	4	4	735	795	76.5	2 100	2 400	NU328E	NJ	NUP	—
	300	102	4	4	1 020	1 250	120	2 000	2 300	NU2328	NJ	NUP	N
	300	102	4	4	1 130	1 380	133	1 800	2 100	NU2328E	NJ	NUP	—
150	225	35	2.1	1.5	224	294	29.6	3 000	3 500	NU1030	NJ	NUP	N
	270	45	3	3	380	435	42.5	2 500	2 900	NU230	NJ	NUP	N
	270	45	3	3	495	595	58.0	2 200	2 600	NU230E	NJ	NUP	—
	270	73	3	3	555	710	69.5	2 200	2 600	NU2230	NJ	NUP	N
	270	73	3	3	735	980	95.5	2 000	2 400	NU2230E	NJ	NUP	—
	320	65	4	4	735	805	76.0	2 100	2 500	NU330	NJ	NUP	N
	320	65	4	4	840	920	86.5	1 900	2 300	NU330E	NJ	NUP	—
	320	108	4	4	1 130	1 400	132	1 900	2 200	NU2330	NJ	NUP	N
	320	108	4	4	1 290	1 600	150	1 700	2 000	NU2330E	NJ	NUP	—
160	240	38	2.1	1.5	263	340	34.0	2 800	3 300	NU1032	NJ	NUP	N
	290	48	3	3	475	570	54.5	2 300	2 700	NU232	NJ	NUP	N
	290	48	3	3	555	665	63.5	2 100	2 400	NU232E	NJ	NUP	—
	290	80	3	3	700	940	90.0	2 100	2 400	NU2232	NJ	NUP	N
	290	80	3	3	895	1 190	114	1 900	2 200	NU2232E	NJ	NUP	—
	340	68	4	4	775	875	81.0	2 000	2 300	NU332	NJ	NUP	N
	340	68	4	4	950	1 050	97.5	1 800	2 100	NU332E	NJ	NUP	—
	340	114	4	4	1 190	1 520	141	1 700	2 000	NU2332	NJ	NUP	N
	340	114	4	4	1 460	1 820	168	1 600	1 900	NU2332E	NJ	NUP	—

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.

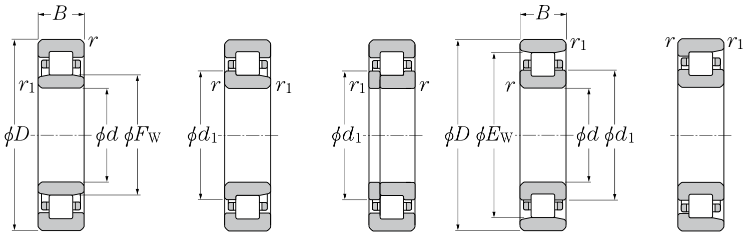


Dynamic equivalent radial load
$Pr=Fr$
Static equivalent radial load
$P_{0r}=Fr$

Dimension (mm)				Installation-related dimensions (mm)										Mass (kg) (approx.)	
NF type	F_w	E_w	d_1	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 3)	r_{as} Max.	r_{1as} Max.	NU type	N type
NF	156	204	165.5	143	143	151	158	168	217	217	208	2.5	2.5	6.3	6.17
—	153.5	—	164.7	143	—	151	158	168	217	—	—	2.5	2.5	6.9	—
—	156	204	165.5	143	143	151	158	168	217	217	208	2.5	2.5	10.2	10
—	153.5	—	164.7	143	—	151	158	168	217	—	—	2.5	2.5	11.8	—
NF	167	243	182	146	146	164	169	184	264	264	247	3	3	17.4	17
—	167	—	183	146	—	164	169	184	264	—	—	3	3	19.4	—
—	167	243	182	146	146	164	169	184	264	264	247	3	3	26.9	26.4
—	167	—	183	146	—	164	169	184	264	—	—	3	3	30.9	—
—	158	192	164.8	146.5	149	156	161	166	201	203.5	194	2	1	4.05	3.98
NF	169	221	179.5	153	153	166	171	182	237	237	225	2.5	2.5	7.88	7.72
—	169	—	180.2	153	—	166	171	182	237	—	—	2.5	2.5	8.73	—
—	169	221	179.5	153	153	166	171	182	237	237	225	2.5	2.5	12.9	12.6
—	169	—	180.2	153	—	166	171	182	237	—	—	2.5	2.5	15.8	—
NF	180	260	196	156	156	176	182	198	284	284	265	3	3	21.2	20.7
—	180	—	196.8	156	—	176	182	198	284	—	—	3	3	23.2	—
—	180	260	196	156	156	176	182	198	284	284	265	3	3	33.8	33.1
—	180	—	196.8	156	—	176	182	198	284	—	—	3	3	38.7	—
—	169.5	205.5	176.7	158	161	167	173	178	214	217	207.5	2	1.5	4.77	4.7
NF	182	238	193	163	163	179	184	196	257	257	242	2.5	2.5	9.92	9.72
—	182	—	194	163	—	179	184	196	257	—	—	2.5	2.5	11	—
—	182	238	193	163	163	179	184	196	257	257	242	2.5	2.5	16.3	16
—	182	—	194	163	—	179	184	196	257	—	—	2.5	2.5	19.7	—
NF	193	277	210	166	166	190	195	213	304	304	282	3	3	25.3	24.7
—	193	—	211	166	—	190	195	213	304	—	—	3	3	28.4	—
—	193	277	210	166	166	190	195	213	304	304	282	3	3	40.6	39.8
—	193	—	211	166	—	190	195	213	304	—	—	3	3	47.2	—
—	180	220	188	168	171	178	184	189	229	232	222	2	1.5	5.9	5.81
NF	195	255	207	173	173	192	197	210	277	277	259	2.5	2.5	13.7	13.4
—	195	—	207.8	173	—	192	197	210	277	—	—	2.5	2.5	15.6	—
—	195	255	207	173	173	192	197	210	277	277	259	2.5	2.5	22	21.6
—	193	—	206.6	173	—	192	197	210	277	—	—	2.5	2.5	25.1	—
NF	208	292	225	176	176	200	211	228	324	324	297	3	3	31.3	30.6
—	204	—	223.2	176	—	200	211	228	324	—	—	3	3	34	—
—	208	292	225	176	176	200	211	228	324	324	297	3	3	50.5	49.5
—	204	—	223.2	176	—	200	211	228	324	—	—	3	3	56	—

3) Does not apply to the sides of the outer ring rib of type NF bearings.

Cylindrical Roller Bearings



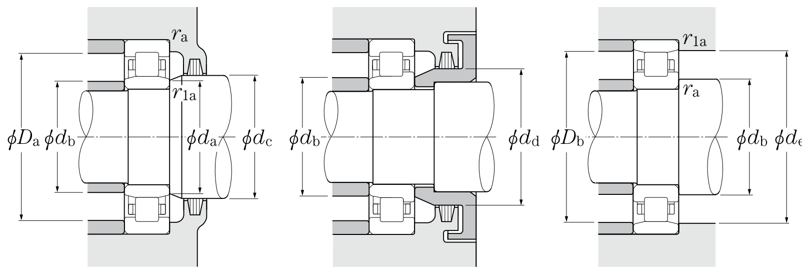
NU type NJ type NUP type N type NF type

d 170 ～ 220mm

d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed 2) Grease lubrication (min⁻¹)	Allowable speed 2) Oil lubrication (min⁻¹)	NU type	NJ type	NUP type	N type
170	260	42	2.1	2.1	310	400	38.5	2 600	3 000	NU1034	NJ	NUP	N
	310	52	4	4	530	635	59.5	2 200	2 500	NU234	NJ	NUP	N
	310	52	4	4	670	800	75.0	2 000	2 300	NU234E	NJ	NUP	—
	310	86	4	4	795	1 080	101	2 000	2 300	NU2234	NJ	NUP	N
	310	86	4	4	1 070	1 410	132	1 800	2 100	NU2234E	NJ	NUP	—
	360	72	4	4	885	1 010	92.0	1 800	2 000	NU334	NJ	NUP	N
	360	120	4	4	1 360	1 750	159	1 600	1 900	NU2334	NJ	NUP	N
180	280	46	2.1	2.1	380	485	46.5	2 400	2 900	NU1036	NJ	NUP	N
	320	52	4	4	550	675	62.5	2 000	2 400	NU236	NJ	NUP	N
	320	52	4	4	695	850	78.5	1 800	2 200	NU236E	NJ	NUP	—
	320	86	4	4	825	1 140	106	1 800	2 200	NU2236	NJ	NUP	N
	320	86	4	4	1 120	1 510	139	1 600	1 900	NU2236E	NJ	NUP	—
	380	75	4	4	1 000	1 150	103	1 700	2 000	NU336	NJ	NUP	N
	380	126	4	4	1 530	1 990	179	1 500	1 800	NU2336	NJ	NUP	N
190	290	46	2.1	2.1	390	510	48.0	2 300	2 700	NU1038	NJ	NUP	N
	340	55	4	4	615	770	70.0	1 900	2 200	NU238	NJ	NUP	N
	340	55	4	4	770	955	86.5	1 700	2 000	NU238E	NJ	NUP	—
	340	92	4	4	920	1 290	117	1 700	2 000	NU2238	NJ	NUP	N
	340	92	4	4	1 220	1 670	152	1 500	1 800	NU2238E	NJ	NUP	—
	400	78	5	5	1 080	1 260	111	1 600	1 900	NU338	NJ	NUP	N
	400	132	5	5	1 680	2 220	196	1 400	1 700	NU2338	NJ	NUP	N
200	310	51	2.1	2.1	430	580	53.5	2 200	2 600	NU1040	NJ	NUP	N
	360	58	4	4	690	865	77.5	1 800	2 100	NU240	NJ	NUP	N
	360	58	4	4	850	1 060	95.0	1 600	1 900	NU240E	NJ	NUP	—
	360	98	4	4	1 020	1 440	129	1 600	1 900	NU2240	NJ	NUP	N
	360	98	4	4	1 350	1 870	167	1 500	1 700	NU2240E	NJ	NUP	—
	420	80	5	5	1 080	1 270	111	1 500	1 800	NU340	NJ	NUP	N
	420	138	5	5	1 680	2 240	195	1 400	1 600	NU2340	NJ	NUP	N
220	340	56	3	3	555	750	67.0	2 000	2 300	NU1044	NJ	NUP	N
	400	65	4	4	845	1 080	94	1 600	1 900	NU244	NJ	NUP	N
	400	108	4	4	1 260	1 810	157	1 500	1 700	NU2244	NJ	NUP	N
	460	88	5	5	1 320	1 570	133	1 400	1 600	NU344	NJ	NUP	N
	460	145	5	5	1 970	2 620	222	1 200	1 400	NU2344	NJ	NUP	N

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.

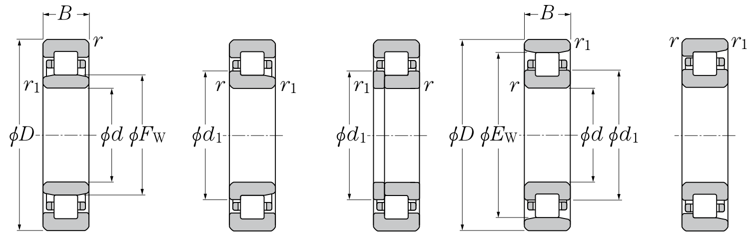
Cylindrical Roller Bearings



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

NF type	F_w (mm)	E_w (mm)	d_1 (mm)	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 3)	r_{as} Max.	r_{1as} Max.	Mass NU type (kg, approx.)	Mass N type (kg, approx.)
—	193	237	201.8	181	181	190	197	203	249	249	239	2	2	7.88	7.76
NF	208	272	220.5	186	186	204	211	223	294	294	277	3	3	17	16.7
—	207	—	221.4	186	—	204	211	223	294	—	—	3	3	19.6	—
—	208	272	220.5	186	186	204	211	223	294	294	277	3	3	27.2	26.7
—	205	—	220.2	186	—	204	211	223	294	—	—	3	3	31	—
NF	220	310	238	186	186	216	223	241	344	344	315	3	3	37	36.1
—	220	310	238	186	186	216	223	241	344	344	315	3	3	59.5	58.3
—	205	255	215	191	191	203	209	216	269	269	257	2	2	10.3	10.1
NF	218	282	230.5	196	196	214	221	233	304	304	287	3	3	17.7	17.3
—	217	—	231.4	196	—	214	221	233	304	—	—	3	3	20.4	—
—	218	282	230.5	196	196	214	221	233	304	304	287	3	3	28.4	27.8
—	215	—	230.2	196	—	214	221	233	304	—	—	3	3	31.9	—
NF	232	328	252	196	196	227	235	255	364	364	333	3	3	44.2	43.2
—	232	328	252	196	196	227	235	255	364	364	333	3	3	69.5	68.1
—	215	265	225	201	201	213	219	226	279	279	267	2	2	10.7	10.5
NF	231	299	244.5	206	206	227	234	247	324	324	304	3	3	21.3	20.8
—	230	—	245.2	206	—	227	234	247	324	—	—	3	3	24.2	—
—	231	299	244.5	206	206	227	234	247	324	324	304	3	3	34.4	33.7
—	228	—	244	206	—	227	234	247	324	—	—	3	3	39.5	—
NF	245	345	265	210	210	240	248	268	380	380	351	4	4	49.4	48.3
—	245	345	265	210	210	240	248	268	380	380	351	4	4	80.5	78.9
—	229	281	239.4	211	211	226	233	241	299	299	283	2	2	13.9	13.7
NF	244	316	258	216	216	240	247	261	344	344	321	3	3	25.3	24.8
—	243	—	259	216	—	240	247	261	344	—	—	3	3	28.1	—
—	244	316	258	216	216	240	247	261	344	344	321	3	3	41.3	40.5
—	241	—	257.8	216	—	240	247	261	344	—	—	3	3	47.8	—
NF	260	360	280	220	220	254	263	283	400	400	366	4	4	55.8	54.5
—	260	360	280	220	220	254	263	283	400	400	366	4	4	92.6	90.7
—	250	310	262	233	233	248	254	264	327	327	313	2.5	2.5	18.2	17.9
NF	270	350	286	236	236	266	273	289	384	384	355	3	3	37.7	37
—	270	350	286	236	236	266	273	289	384	384	355	3	3	59	57.8
NF	284	396	307	240	240	279	287	307	440	440	402	4	4	73.4	71.7
—	284	396	307	240	240	279	287	307	440	440	402	4	4	116	114

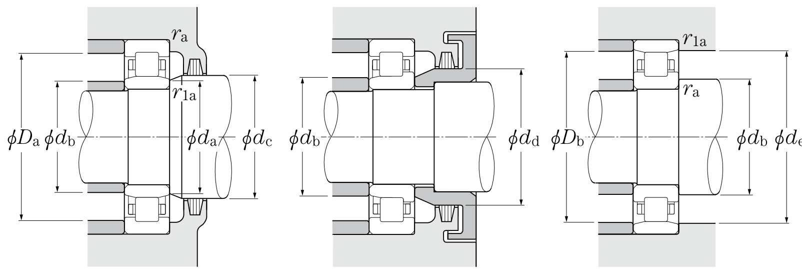
3) Does not apply to the sides of the outer ring rib of type **NF** bearings.



d 240 ～ 440mm

Boundary dimensions (mm)					Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed 2) (min-1)		Bearing number			
d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	NU type	NJ type	NUP type	N type
240	360	56	3	3	585	820	72.0	1 800	2 100	**NU1048**	**NJ**	**NUP**	**N**
	440	72	4	4	1 040	1 340	113	1 500	1 700	**NU248**	**NJ**	**NUP**	**N**
	440	120	4	4	1 590	2 320	196	1 300	1 600	**NU2248**	**NJ**	**NUP**	**N**
	500	95	5	5	1 590	1 950	160	1 300	1 500	**NU348**	**NJ**	**NUP**	**N**
	500	155	5	5	2 330	3 200	262	1 100	1 300	**NU2348**	**NJ**	**NUP**	**N**
260	400	65	4	4	715	1 000	85.0	1 600	1 900	**NU1052**	**NJ**	**NUP**	**N**
	480	80	5	5	1 270	1 660	137	1 300	1 600	**NU252**	**NJ**	**NUP**	**N**
	480	130	5	5	1 980	2 930	241	1 200	1 400	**NU2252**	**NJ**	**NUP**	**N**
	540	102	6	6	1 790	2 230	180	1 200	1 400	**NU352**	**NJ**	**NUP**	**N**
	540	165	6	6	2 600	3 600	289	1 000	1 200	**NU2352**	**NJ**	**NUP**	**N**
280	420	65	4	4	730	1 050	88.0	1 500	1 800	**NU1056**	**NJ**	**NUP**	**N**
	500	80	5	5	1 320	1 760	143	1 200	1 400	**NU256**	**NJ**	**NUP**	**N**
	500	130	5	5	2 050	3 100	252	1 100	1 300	**NU2256**	**NJ**	**NUP**	**N**
	580	108	6	6	2 010	2 540	200	1 100	1 200	**NU356**	**NJ**	**NUP**	**N**
	580	175	6	6	3 000	4 250	335	920	1 100	**NU2356**	**NJ**	**NUP**	**N**
300	460	74	4	4	950	1 340	109	1 400	1 600	**NU1060**	**NJ**	**NUP**	**N**
	540	85	5	5	1 560	2 070	164	1 100	1 300	**NU260**	**NJ**	**NUP**	**N**
	540	140	5	5	2 420	3 650	290	1 000	1 200	**NU2260**	**NJ**	**NUP**	**N**
320	480	74	4	4	970	1 410	113	1 300	1 500	**NU1064**	**NJ**	**NUP**	**N**
	580	92	5	5	1 780	2 390	186	1 000	1 200	**NU264**	**NJ**	**NUP**	**N**
	580	150	5	5	2 830	4 350	340	950	1 100	**NU2264**	**NJ**	**NUP**	**N**
340	520	82	5	5	1 160	1 670	132	1 200	1 400	**NU1068**	**NJ**	**NUP**	**N**
360	540	82	5	5	1 190	1 750	136	1 100	1 300	**NU1072**	**NJ**	**NUP**	**N**
380	560	82	5	5	1 220	1 840	141	1 100	1 200	**NU1076**	**NJ**	**NUP**	**N**
400	600	90	5	5	1 460	2 190	164	990	1 200	**NU1080**	**NJ**	**NUP**	**N**
420	620	90	5	5	1 500	2 290	170	950	1 100	**NU1084**	**NJ**	**NUP**	**N**
440	650	94	6	6	1 590	2 430	178	900	1 100	**NU1088**	**NJ**	**NUP**	**N**

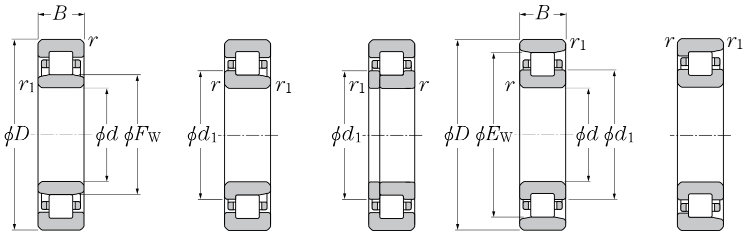
1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.



Dynamic equivalent radial load
$Pr=Fr$
Static equivalent radial load
$P_{0r}=Fr$

	Dimension (mm)			Installation-related dimensions (mm)										Mass (kg) (approx.)	
NF type	F_w	E_w	d_1	d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 3)	r_{as} Max.	r_{1as} Max.	NU type	N type
—	270	330	282	253	253	268	275	284	347	347	333	2.5	2.5	19.6	19.3
NF	295	385	313	256	256	293	298	316	424	424	390	3	3	50.2	49.2
—	295	385	313	256	256	293	298	316	424	424	390	3	3	80	78.4
NF	310	430	335	260	260	305	313	333	480	480	436	4	4	93.4	91.3
—	310	430	335	260	260	305	313	333	480	480	436	4	4	147	144
—	296	364	309.6	276	276	292	300	312	384	384	367	3	3	29.1	28.7
NF	320	420	340	280	280	318	323	343	460	460	426	4	4	66.9	65.6
—	320	420	340	280	280	318	323	343	460	460	426	4	4	104	102
NF	336	464	362	284	284	331	339	359	516	516	471	5	5	117	114
—	336	464	362	284	284	331	339	359	516	516	471	5	5	182	178
—	316	384	329.6	296	296	312	320	332	404	404	387	3	3	30.9	30.4
NF	340	440	360	300	300	336	343	365	480	480	446	4	4	70.8	69.4
—	340	440	360	300	300	336	343	365	480	480	446	4	4	109	107
NF	362	498	390	304	304	356	366	386	556	556	505	5	5	142	139
—	362	498	390	304	304	356	366	386	556	556	505	5	5	222	218
—	340	420	356	316	316	336	344	358	444	444	423	3	3	43.6	42.9
NF	364	476	387	320	320	361	368	392	520	520	482	4	4	88.2	86.4
—	364	476	387	320	320	361	368	392	520	520	482	4	4	138	135
—	360	440	376	336	336	356	364	378	464	464	443	3	3	46	45.3
NF	390	510	415	340	340	386	393	419	560	560	516	4	4	111	109
—	390	510	415	340	340	386	393	419	560	560	516	4	4	172	168
—	385	475	403	360	360	381	390	405	500	500	479	4	4	61.8	60.8
—	405	495	423	380	380	401	410	425	520	520	499	4	4	64.7	63.7
—	425	515	443	400	400	421	430	445	540	540	519	4	4	67.5	66.5
—	450	550	470	420	420	446	455	473	580	580	554	4	4	87.6	86.3
—	470	570	490	440	440	466	475	493	600	600	574	4	4	91	89.6
—	493	597	513.8	464	464	488	499	517	626	626	602	5	5	105	103

3) Does not apply to the sides of the outer ring rib of type **NF** bearings.



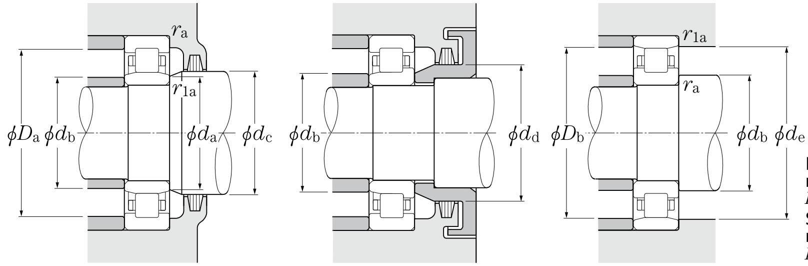
NU type NJ type NUP type N type NF type

d 460 ～ 500mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable speed 2) (min-1) Grease lubrication	Oil lubrication	Bearing number NU type	NJ type	NUP type	N type
460	680	100	6	6	1 710	2 630	191	850	1 000	**NU1092**	**NJ**	**NUP**	**N**
480	700	100	6	6	1 750	2 750	197	810	960	**NU1096**	**NJ**	**NUP**	**N**
500	720	100	6	6	1 790	2 870	203	770	910	**NU10/500**	**NJ**	**NUP**	**N**

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) This value is for machined cages; when pressed cages are used, 80% of this value is acceptable.

Cylindrical Roller Bearings NTN

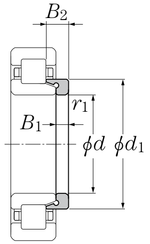


Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

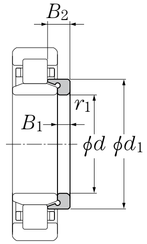
Bearing number NF type	Dimension (mm) F_w	E_w	d_1	Installation-related dimensions (mm) d_a Min.	d_e Min.	d_b Max.	d_c Min.	d_d Min.	D_a Max.	D_b Max.	D_b Min. 3)	r_{as} Max.	r_{1as} Max.	Mass (kg) NU type (approx.)	N type (approx.)
—	516	624	537.6	484	484	511	522	541	656	656	629	5	5	122	120
—	536	644	557.6	504	504	531	542	561	676	676	649	5	5	126	124
—	556	664	577.6	524	524	551	562	581	696	696	669	5	5	130	128

3) Does not apply to the sides of the outer ring rib of type **NF** bearings.

L type collar ring



NH=NJ+HJ

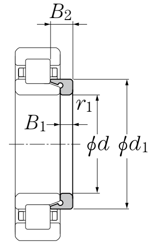


NUJ=NU+HJ

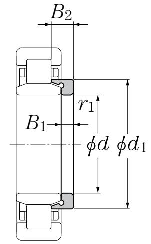
d 20 ～ 60mm

Dimension mm					L type collar ring number	Mass kg
d	d_1	B_1	B_2	$r_{1s\,min}$ 1)		(approx.)
20	29.9	3	6.75	0.6	**HJ204**	0.012
	29.5	3	5.5	0.6	**HJ204E**	0.009
	29.9	3	7.5	0.6	**HJ2204**	0.013
	29.5	3	6.5	0.6	**HJ2204E**	0.01
	31.8	4	7.5	0.6	**HJ304**	0.017
	31.1	4	6.5	0.6	**HJ304E**	0.014
	31.8	4	8.5	0.6	**HJ2304**	0.018
	31.1	4	7.5	0.6	**HJ2304E**	0.015
25	34.8	3	7.25	0.6	**HJ205**	0.015
	34.5	3	6	0.6	**HJ205E**	0.012
	34.8	3	7.5	0.6	**HJ2205**	0.015
	34.5	3	6.5	0.6	**HJ2205E**	0.013
	39	4	8	1.1	**HJ305**	0.025
	38	4	7	1.1	**HJ305E**	0.021
	39	4	9	1.1	**HJ2305**	0.027
	38	4	8	1.1	**HJ2305E**	0.024
	43.6	6	10.5	1.5	**HJ405**	0.057
30	41.7	4	8.25	0.6	**HJ206**	0.025
	41.1	4	7	0.6	**HJ206E**	0.017
	41.7	4	8.5	0.6	**HJ2206**	0.025
	41.1	4	7.5	0.6	**HJ2206E**	0.02
	45.9	5	9.5	1.1	**HJ306**	0.039
	44.9	5	8.5	1.1	**HJ306E**	0.035
	45.9	5	11.5	1.1	**HJ2306**	0.043
	44.9	5	9.5	1.1	**HJ2306E**	0.035
	50.5	7	11.5	1.5	**HJ406**	0.08
35	47.6	4	8	0.6	**HJ207**	0.03
	48	4	7	0.6	**HJ207E**	0.027
	47.6	4	8.5	0.6	**HJ2207**	0.031
	48	4	8.5	0.6	**HJ2207E**	0.031
	50.8	6	11	1.1	**HJ307**	0.056
	51	6	9.5	1.1	**HJ307E**	0.048
	50.8	6	14	1.1	**HJ2307**	0.064
	51	6	11	1.1	**HJ2307E**	0.055
	59	8	13	1.5	**HJ407**	0.12
40	54.2	5	9	1.1	**HJ208**	0.046
	53.9	5	8.5	1.1	**HJ208E**	0.042
	54.2	5	9.5	1.1	**HJ2208**	0.047
	53.9	5	9	1.1	**HJ2208E**	0.045
	58.4	7	12.5	1.5	**HJ308**	0.083
	57.6	7	11	1.5	**HJ308E**	0.07
	58.4	7	14.5	1.5	**HJ2308**	0.09
	57.6	7	12.5	1.5	**HJ2308E**	0.08
	64.8	8	13	2	**HJ408**	0.14
45	59	5	9.5	1.1	**∗HJ209**	0.053
	58.9	5	8.5	1.1	**HJ209E**	0.047
	58.9	5	9	1.1	**HJ2209E**	0.05
	64	7	12.5	1.5	**HJ309**	0.099
	64.5	7	11.5	1.5	**HJ309E**	0.093
	64	7	15	1.5	**HJ2309**	0.109
	64.5	7	13	1.5	**HJ2309E**	0.103
	71.8	8	13.5	2	**HJ409**	0.175
50	64.6	5	10	1.1	**HJ210**	0.063
	63.9	5	9	1.1	**∗HJ210E**	0.055
	64.6	5	9.5	1.1	**HJ2210**	0.061
	71	8	14	2	**HJ310**	0.142
	71.4	8	13	2	**HJ310E**	0.134
	71	8	17	2	**HJ2310**	0.157
	71.4	8	14.5	2	**HJ2310E**	0.15
	78.8	9	14.5	2.1	**HJ410**	0.23
55	70.8	6	11	1.1	**∗HJ211**	0.084
	70.8	6	9.5	1.1	**HJ211E**	0.072
	70.8	6	10	1.1	**HJ2211E**	0.076
	77.2	9	15	2	**HJ311**	0.182
	77.7	9	14	2	**HJ311E**	0.168
	77.2	9	18.5	2	**HJ2311**	0.203
	77.7	9	15.5	2	**HJ2311E**	0.185
	85.2	10	16.5	2.1	**HJ411**	0.29
60	78.4	6	11	1.5	**∗HJ212**	0.108
	77.6	6	10	1.5	**∗HJ212E**	0.094

1) Smallest allowable dimension for chamfer dimension r. Note: 1 This L type collar ring is used with NU type cylindrical roller bearings; in duplex arrangements with NJ or NU type bearing numbers, they become NH type and NUJ type respectively. Refer to pages B-98 to B-101 for bearing dimensions, allowable rotations, and mass. 2. "∗" indicates L type collar rings that can also be used with dimension series 22 bearings.



NH=NJ+HJ



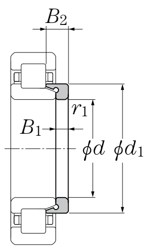
NUJ=NU+HJ

d 60 ～ 105mm

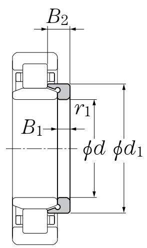
Dimension mm					L type collar ring number	Mass kg
d	d_1	B_1	B_2	$r_{1s\,min}$ 1)		(approx.)
60	84.2	9	15.5	2.1	**HJ312**	0.22
	84.6	9	14.5	2.1	**HJ312E**	0.205
	84.2	9	19	2.1	**HJ2312**	0.245
	84.6	9	16	2.1	**HJ2312E**	0.23
	91.8	10	16.5	2.1	**HJ412**	0.34
65	84.8	6	11	1.5	**HJ213**	0.123
	84.5	6	10	1.5	**HJ213E**	0.111
	84.8	6	11.5	1.5	**HJ2213**	0.126
	84.5	6	10.5	1.5	**HJ2213E**	0.118
	91	10	17	2.1	**HJ313**	0.28
	91	10	15.5	2.1	**HJ313E**	0.25
	91	10	20	2.1	**HJ2313**	0.304
	91	10	18	2.1	**HJ2313E**	0.29
	98.5	11	18	2.1	**HJ413**	0.42
70	89.6	7	12.5	1.5	**∗HJ214**	0.15
	89.5	7	11	1.5	**HJ214E**	0.13
	89.5	7	11.5	1.5	**HJ2214E**	0.138
	98	10	17.5	2.1	**HJ314**	0.33
	98	10	15.5	2.1	**HJ314E**	0.293
	98	10	20.5	2.1	**HJ2314**	0.358
	98	10	18.5	2.1	**HJ2314E**	0.35
	110.5	12	20	3	**HJ414**	0.605
75	94	7	12.5	1.5	**∗HJ215**	0.156
	94.5	7	11	1.5	**HJ215E**	0.141
	94.5	7	11.5	1.5	**HJ2215E**	0.164
	104.2	11	18.5	2.1	**HJ315**	0.4
	104.6	11	16.5	2.1	**HJ315E**	0.35
	104.2	11	21.5	2.1	**HJ2315**	0.432
	104.6	11	19.5	2.1	**HJ2315E**	0.41
	116	13	21.5	3	**HJ415**	0.71
80	101.2	8	13.5	2	**∗HJ216**	0.207
	101.7	8	12.5	2	**∗HJ216E**	0.193
	111.8	11	19.5	2.1	**HJ316**	0.47
	111	11	17	2.1	**HJ316E**	0.405
	111.8	11	23	2.1	**HJ2316**	0.511
80	111	11	20	2.1	**HJ2316E**	0.45
	122	13	22	3	**HJ416**	0.78
85	108.2	8	14	2	**∗HJ217**	0.25
	107.7	8	12.5	2	**HJ217E**	0.21
	107.7	8	13	2	**HJ2217E**	0.216
	117.5	12	20.5	3	**HJ317**	0.56
	118.4	12	18.5	3	**HJ317E**	0.505
	117.5	12	24	3	**HJ2317**	0.606
	118.4	12	22	3	**HJ2317E**	0.55
90	114.2	9	15	2	**HJ218**	0.305
	114.6	9	14	2	**HJ218E**	0.272
	114.2	9	16	2	**HJ2218**	0.315
	114.6	9	15	2	**HJ2218E**	0.308
	125	12	21	3	**HJ318**	0.63
	124.7	12	18.5	3	**HJ318E**	0.548
	125	12	26	3	**HJ2318**	0.704
	124.7	12	22	3	**HJ2318E**	0.69
95	121	9	15.5	2.1	**HJ219**	0.352
	121	9	14	2.1	**HJ219E**	0.304
	121	9	16.5	2.1	**HJ2219**	0.363
	121	9	15.5	2.1	**HJ2219E**	0.335
	132	13	22.5	3	**HJ319**	0.76
	132.7	13	20.5	3	**HJ319E**	0.7
	132	13	26.5	3	**HJ2319**	0.826
	132.7	13	24.5	3	**HJ2319E**	0.8
100	128	10	17	2.1	**HJ220**	0.444
	128	10	15	2.1	**HJ220E**	0.38
	128	10	18	2.1	**HJ2220**	0.456
	128	10	16	2.1	**HJ2220E**	0.385
	140.5	13	22.5	3	**HJ320**	0.895
	140.3	13	20.5	3	**HJ320E**	0.8
	140.5	13	27.5	3	**HJ2320**	0.986
	140.3	13	23.5	3	**HJ2320E**	0.92
105	135	10	17.5	2.1	**HJ221**	0.505

1) Smallest allowable dimension for chamfer dimension r. Note: 1 This L type collar ring is used with NU type cylindrical roller bearings; in duplex arrangements with NJ or NU type bearing numbers, they become NH type and NUJ type respectively. Refer to pages B-102 to B-107 for bearing dimensions, allowable rotations, and mass. 2. "∗" indicates L type collar rings that can also be used with dimension series 22 bearings.

L type collar ring



NH=NJ+HJ

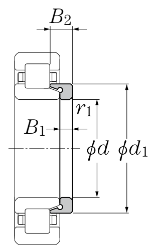


NUJ=NU+HJ

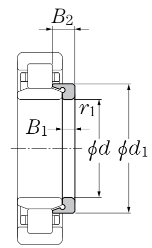
d 105 ～ 200mm

Dimension mm					L type collar ring number	Mass kg
d	d_1	B_1	B_2	$r_{1s\,min}$ 1)		(approx.)
105	147	13	22.5	3	**HJ321**	0.97
110	141.5	11	18.5	2.1	**HJ222**	0.615
	142.1	11	17	2.1	**HJ222E**	0.553
	141.5	11	20.5	2.1	**HJ2222**	0.645
	142.1	11	19.5	2.1	**HJ2222E**	0.605
	155.5	14	23	3	**HJ322**	1.17
	156.6	14	22	3	**HJ322E**	1.09
	155.5	14	28	3	**HJ2322**	1.28
	156.6	14	26.5	3	**HJ2322E**	1.25
120	153	11	19	2.1	**HJ224**	0.715
	153.9	11	17	2.1	**HJ224E**	0.634
	153	11	22	2.1	**HJ2224**	0.767
	153.9	11	20	2.1	**HJ2224E**	0.705
	168.5	14	23.5	3	**HJ324**	1.4
	169.2	14	22.5	3	**HJ324E**	1.28
	168.5	14	28	3	**HJ2324**	1.53
	169.2	14	26	3	**HJ2324E**	1.42
130	165.5	11	19	3	**HJ226**	0.84
	164.7	11	17	3	**HJ226E**	0.684
	165.5	11	25	3	**HJ2226**	0.953
	164.7	11	21	3	**HJ2226E**	0.831
	182	14	24	4	**HJ326**	1.62
	183	14	23	4	**HJ326E**	1.53
	182	14	29.5	4	**HJ2326**	1.8
	183	14	28	4	**HJ2326E**	1.75
140	179.5	11	19	3	**HJ228**	1
	180.2	11	18	3	**HJ228E**	0.929
	179.5	11	25	3	**HJ2228**	1.14
	180.2	11	23	3	**HJ2228E**	1.11
	196	15	26	4	**HJ328**	1.93
	196.8	15	25	4	**HJ328E**	1.91
	196	15	33.5	4	**HJ2328**	2.21
	196.8	15	31	4	**HJ2328E**	2.3
150	193	12	20.5	3	**HJ230**	1.24
	194	12	19.5	3	**HJ230E**	1.18
	193	12	26.5	3	**HJ2230**	1.39
	194	12	24.5	3	**HJ2230E**	1.42
	210	15	26.5	4	**HJ330**	2.37
	211	15	25	4	**HJ330E**	2.25
	210	15	34	4	**HJ2330**	2.69
	211	15	31.5	4	**HJ2330E**	2.6
160	207	12	21	3	**HJ232**	1.48
	207.8	12	20	3	**HJ232E**	1.34
	207	12	28	3	**HJ2232**	1.69
	206.6	12	24.5	3	**HJ2232E**	1.61
	225	15	28	4	**HJ332**	2.75
	223.2	15	25	4	**HJ332E**	2.4
	225	15	37	4	**HJ2332**	3.16
	223.2	15	32	4	**HJ2332E**	2.85
170	220.5	12	22	4	**HJ234**	1.7
	221.4	12	20	4	**HJ234E**	1.51
	220.5	12	29	4	**HJ2234**	1.93
	220.2	12	24	4	**HJ2234E**	1.82
	238	16	29.5	4	**HJ334**	3.25
	238	16	38.5	4	**HJ2334**	3.71
180	230.5	12	22	4	**HJ236**	1.8
	231.4	12	20	4	**HJ236E**	1.7
	230.5	12	29	4	**HJ2236**	2.04
	230.2	12	24	4	**HJ2236E**	1.91
	252	17	30.5	4	**HJ336**	3.85
	252	17	40	4	**HJ2336**	4.42
190	244.5	13	23.5	4	**HJ238**	2.2
	245.2	13	21.5	4	**HJ238E**	1.94
	244.5	13	31.5	4	**HJ2238**	2.52
	244	13	26.5	4	**HJ2238E**	2.38
	265	18	32	5	**HJ338**	4.45
	265	18	41.5	5	**HJ2338**	5.05
200	258	14	25	4	**HJ240**	2.6

1) Smallest allowable dimension for chamfer dimension *r*.
Note: 1 This L type collar ring is used with **NU** type cylindrical roller bearings; in duplex arrangements with **NJ** or **NU** type bearing numbers, they become **NH** type and **NUJ** type respectively. Refer to pages **B-106 to B-111** for bearing dimensions, allowable rotations, and mass.



NH=NJ+HJ

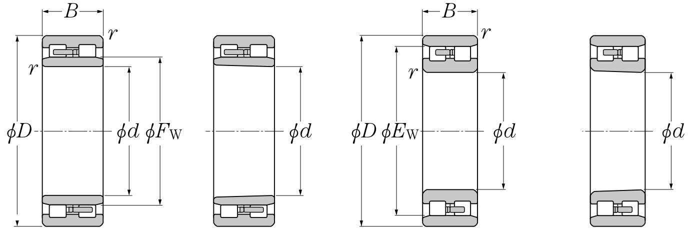


NUJ=NU+HJ

d 200 ～ 320mm

Dimension mm					L type collar ring number	Mass kg
d	d_1	B_1	B_2	$r_{1s\,min}$ 1)		(approx.)
200	259	14	23	4	**HJ240E**	2.35
	258	14	34	4	**HJ2240**	2.99
	257.8	14	28	4	**HJ2240E**	2.86
	280	18	33	5	**HJ340**	5
	280	18	44.5	5	**HJ2340**	5.76
220	286	15	27.5	4	**HJ244**	3.55
	307	20	36	5	**HJ344**	7.05
240	313	16	29.5	4	**HJ248**	4.65
	335	22	39.5	5	**HJ348**	8.2
260	340	18	33	5	**HJ252**	6.2
	362	24	43	6	**HJ352**	11.4
280	360	18	33	5	**HJ256**	7.39
	390	26	46	6	**HJ356**	13.9
300	387	20	34.5	5	**HJ260**	9.14
320	415	21	37	5	**HJ264**	11.3

1) Smallest allowable dimension for chamfer dimension *r*.
Note: 1 This L type collar ring is used with **NU** type cylindrical roller bearings; in duplex arrangements with **NJ** or **NU** type bearing numbers, they become **NH** type and **NUJ** type respectively. Refer to pages **B-110 to B-113** for bearing dimensions, allowable rotations, and mass.



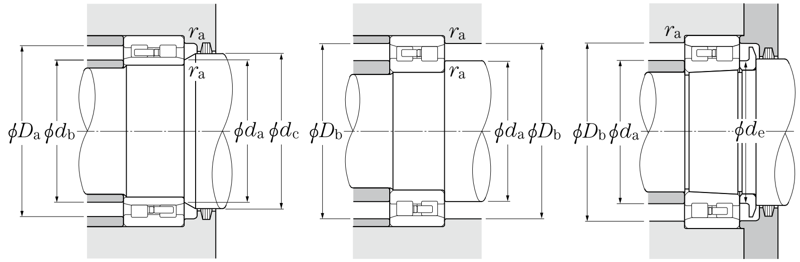
NNU type
Cylindrical bore   Tapered bore

NN type
Cylindrical bore   Tapered bore

d 25 ～ 110mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min-1		Bearing number 2) NNU type	
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore
25	47	16	0.6	28.6	30.0	3.65	14 000	17 000	—	—
30	55	19	1	34.0	37.0	4.55	12 000	15 000	—	—
35	62	20	1	42.0	47.5	5.80	11 000	13 000	—	—
40	68	21	1	48.0	55.5	6.75	9 700	11 000	—	—
45	75	23	1	57.5	68.5	8.35	8 800	10 000	—	—
50	80	23	1	59.0	72.5	8.85	8 000	9 400	—	—
55	90	26	1.1	77.0	96.5	11.8	7 300	8 600	—	—
60	95	26	1.1	78.5	102	12.4	6 700	7 900	—	—
65	100	26	1.1	83.0	111	13.6	6 200	7 300	—	—
70	110	30	1.1	105	143	17.4	5 800	6 800	—	—
75	115	30	1.1	107	149	18.2	5 400	6 300	—	—
80	125	34	1.1	128	179	21.6	5 100	5 900	—	—
85	130	34	1.1	135	194	23.1	4 800	5 600	—	—
90	140	37	1.5	158	228	26.6	4 500	5 300	—	—
95	145	37	1.5	162	238	27.4	4 300	5 000	—	—
100	140	40	1.1	145	260	30.0	4 300	5 100	NNU4920	NNU4920K
	150	37	1.5	170	256	29.2	4 000	4 800	—	—
105	145	40	1.1	147	268	30.5	4 100	4 800	NNU4921	NNU4921K
	160	41	2	220	320	36.0	3 800	4 500	—	—
110	150	40	1.1	152	284	32.0	3 900	4 600	NNU4922	NNU4922K
	170	45	2	254	375	41.5	3 600	4 300	—	—

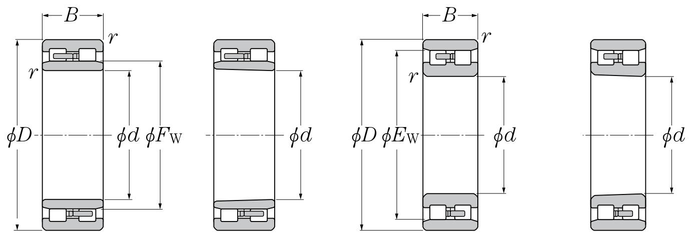
1) Smallest allowable dimension for chamfer dimension r.
2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12.



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

Bearing number 2) NN type Cylindrical bore	Tapered bore	Dimension mm F_w	E_w	Installation-related dimensions mm d_a Min.	d_e Min.	d_b Max.	d_c Min.	D_a Max.	D_b Max.	D_b Min.	r_{as} Max.	Mass (approx.) kg NNU type Cylindrical bore	NNU type Tapered bore	NN type Cylindrical bore	NN type Tapered bore
NN3005	NN3005K	—	41.3	29	30	—	—	—	43	42	0.6	—	—	0.124	0.121
NN3006	NN3006K	—	48.5	35	36.5	—	—	—	50	49	1	—	—	0.199	0.193
NN3007	NN3007K	—	55	40	41.5	—	—	—	57	56	1	—	—	0.242	0.235
NN3008	NN3008K	—	61	45	47	—	—	—	63	62	1	—	—	0.312	0.303
NN3009	NN3009K	—	67.5	50	52	—	—	—	70	69	1	—	—	0.405	0.393
NN3010	NN3010K	—	72.5	55	57	—	—	—	75	74	1	—	—	0.433	0.419
NN3011	NN3011K	—	81	61.5	63.5	—	—	—	83.5	82	1	—	—	0.651	0.631
NN3012	NN3012K	—	86.1	66.5	68.5	—	—	—	88.5	87	1	—	—	0.704	0.683
NN3013	NN3013K	—	91	71.5	73.5	—	—	—	93.5	92	1	—	—	0.758	0.735
NN3014	NN3014K	—	100	76.5	79	—	—	—	103.5	101	1	—	—	1.04	1.01
NN3015	NN3015K	—	105	81.5	84	—	—	—	108.5	106	1	—	—	1.14	1.11
NN3016	NN3016K	—	113	86.5	89.5	—	—	—	118.5	114	1	—	—	1.52	1.47
NN3017	NN3017K	—	118	91.5	94.5	—	—	—	123.5	119	1	—	—	1.61	1.56
NN3018	NN3018K	—	127	98	101	—	—	—	132	129	1.5	—	—	2.07	2.01
NN3019	NN3019K	—	132	103	106	—	—	—	137	134	1.5	—	—	2.17	2.1
NN4920	NN4920K	113	129	106.5	110	111	115	133.5	133.5	131	1	1.83	1.75	1.75	1.67
NN3020	NN3020K	—	137	108	111	—	—	—	142	139	1.5	—	—	2.26	2.19
NN4921	NN4921K	118	134	111.5	115	116	120	138.5	138.5	136	1	1.91	1.82	1.82	1.73
NN3021	NN3021K	—	146	114	117	—	—	—	151	148	2	—	—	2.89	2.8
NN4922	NN4922K	123	139	116.5	120	121	125	143.5	143.5	141	1	1.99	1.9	1.9	1.81
NN3022	NN3022K	—	155	119	123	—	—	—	161	157	2	—	—	3.69	3.56

Double Row Cylindrical Roller Bearings



NNU type
Cylindrical bore   Tapered bore

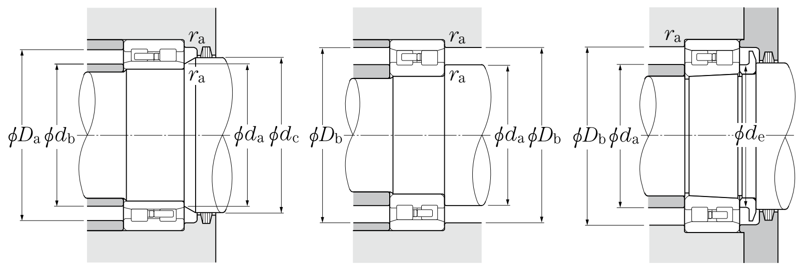
NN type
Cylindrical bore   Tapered bore

d 120 ～ 280mm

Boundary dimensions mm				Basic load rating dynamic / static kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing number 2) NNU type	
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore
120	165	45	1.1	203	360	39.5	3 600	4 200	**NNU4924**	**NNU4924K**
	180	46	2	258	390	42.5	3 300	3 900	—	—
130	180	50	1.5	244	440	47.0	3 300	3 900	**NNU4926**	**NNU4926K**
	200	52	2	315	475	50.0	3 100	3 600	—	—
140	190	50	1.5	251	470	49.0	3 000	3 600	**NNU4928**	**NNU4928K**
	210	53	2	330	515	53.0	2 800	3 300	—	—
150	210	60	2	380	690	70.5	2 800	3 300	**NNU4930**	**NNU4930K**
	225	56	2.1	370	585	59.0	2 600	3 100	—	—
160	220	60	2	395	740	74.0	2 600	3 100	**NNU4932**	**NNU4932K**
	240	60	2.1	415	660	65.5	2 500	2 900	—	—
170	230	60	2	400	765	75.5	2 500	2 900	**NNU4934**	**NNU4934K**
	260	67	2.1	490	775	75.0	2 300	2 700	—	—
180	250	69	2	510	965	93.0	2 300	2 700	**NNU4936**	**NNU4936K**
	280	74	2.1	630	995	94.5	2 200	2 600	—	—
190	260	69	2	525	1 030	98.0	2 200	2 600	**NNU4938**	**NNU4938K**
	290	75	2.1	640	1 040	97.0	2 000	2 400	—	—
200	280	80	2.1	615	1 180	110	2 100	2 400	**NNU4940**	**NNU4940K**
	310	82	2.1	725	1 170	107	1 900	2 300	—	—
220	300	80	2.1	650	1 300	118	1 900	2 200	**NNU4944**	**NNU4944K**
	340	90	3	905	1 480	132	1 700	2 100	—	—
240	320	80	2.1	680	1 410	126	1 700	2 000	**NNU4948**	**NNU4948K**
	360	92	3	945	1 600	140	1 600	1 900	—	—
260	360	100	2.1	1 000	2 070	179	1 600	1 800	**NNU4952**	**NNU4952K**
	400	104	4	1 180	1 990	170	1 500	1 700	—	—
280	380	100	2.1	1 030	2 200	187	1 400	1 700	**NNU4956**	**NNU4956K**
	420	106	4	1 200	2 080	174	1 300	1 600	—	—

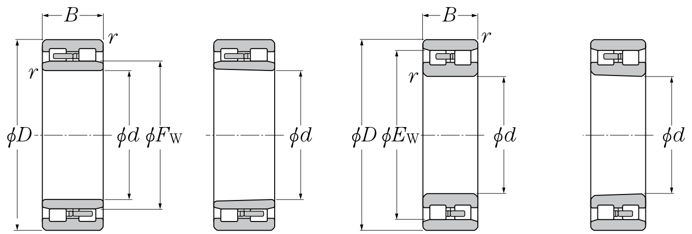
1) Smallest allowable dimension for chamfer dimension *r*.
2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12.

Double Row Cylindrical Roller Bearings



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

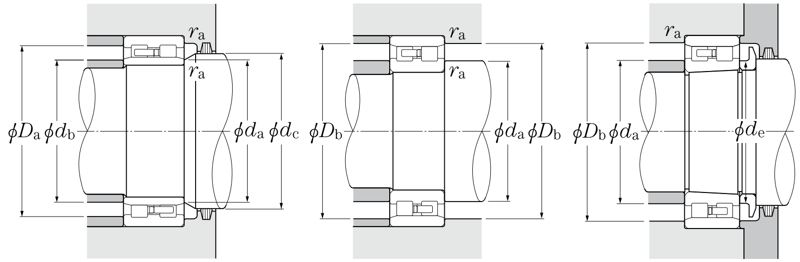
Bearing number 2) NN type		Dimension mm		Installation-related dimensions mm								Mass (approx.) kg NNU type		NN type	
Cylindrical bore	Tapered bore	F_w	E_w	d_a Min.	d_e Min.	d_b Max.	d_c Min.	D_a Max.	D_b Max.	D_b Min.	r_{as} Max.	Cylindrical bore	Tapered bore	Cylindrical bore	Tapered bore
NN4924	**NN4924K**	134.5	154.5	126.5	130	133	137	158.5	158.5	156.5	1	2.75	2.63	2.63	2.51
NN3024	**NN3024K**	—	165	129	133	—	—	—	171	167	2	—	—	3.98	3.83
NN4926	**NN4926K**	146	168	138	142	144	148	172	172	170	1.5	3.69	3.52	3.52	3.35
NN3026	**NN3026K**	—	182	139	143	—	—	—	191	183	2	—	—	5.92	5.71
NN4928	**NN4928K**	156	178	148	152	154	158	182	182	180	1.5	3.94	3.76	3.76	3.58
NN3028	**NN3028K**	—	192	149	153	—	—	—	201	194	2	—	—	6.44	6.21
NN4930	**NN4930K**	168.5	196.5	159	164	166	171	201	201	198.5	2	6.18	5.9	5.9	5.62
NN3030	**NN3030K**	—	206	161	166	—	—	—	214	208	2	—	—	7.81	7.53
NN4932	**NN4932K**	178.5	206.5	169	174	176	182	211	211	208.5	2	6.53	6.23	6.24	5.94
NN3032	**NN3032K**	—	219	171	176	—	—	—	229	221	2	—	—	8.92	8.59
NN4934	**NN4934K**	188.5	216.5	179	184	186	192	221	221	218.5	2	6.87	6.55	6.56	6.24
NN3034	**NN3034K**	—	236	181	187	—	—	—	249	238	2	—	—	12.6	12.2
NN4936	**NN4936K**	202	234	189	195	199	205	241	241	236	2	9.9	9.46	9.45	9.01
NN3036	**NN3036K**	—	255	191	197	—	—	—	269	257	2	—	—	16.6	16
NN4938	**NN4938K**	212	244	199	205	209	215	251	251	246	2	10.4	9.94	9.93	9.47
NN3038	**NN3038K**	—	265	201	207	—	—	—	279	267	2	—	—	18	17.4
NN4940	**NN4940K**	225	261	211	218	222	228	269	269	264	2	14.7	14	14	13.3
NN3040	**NN3040K**	—	282	211	218	—	—	—	299	285	2	—	—	21.6	20.8
NN4944	**NN4944K**	245	281	231	238	242	248	289	289	284	2	15.9	15.2	15.2	14.5
NN3044	**NN3044K**	—	310	233	240	—	—	—	327	313	2.5	—	—	29.3	28.2
NN4948	**NN4948K**	265	301	251	258	262	269	309	309	304	2	17.2	16.4	16.4	15.6
NN3048	**NN3048K**	—	330	253	261	—	—	—	347	333	2.5	—	—	32.8	31.6
NN4952	**NN4952K**	292	336	271	279	288	296	349	349	339	2	29.6	28.3	28.3	27
NN3052	**NN3052K**	—	364	276	285	—	—	—	384	367	3	—	—	47.4	45.8
NN4956	**NN4956K**	312	356	291	299	308	316	369	369	359	2	31.6	30.2	30.2	28.8
NN3056	**NN3056K**	—	384	296	305	—	—	—	404	387	3	—	—	51.1	49.3



d 300 ～ 500mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$[1)]	Basic load rating (kN) dynamic C_r	static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number[2)] NNU type Cylindrical bore	NNU type Tapered bore
300	420	118	3	1 330	2 800	231	1 300	1 500	**NNU4960**	**NNU4960K**
	460	118	4	1 470	2 560	209	1 200	1 500	—	—
320	440	118	3	1 370	2 970	242	1 200	1 400	**NNU4964**	**NNU4964K**
	480	121	4	1 500	2 670	214	1 100	1 300	—	—
340	460	118	3	1 410	3 150	252	1 100	1 300	**NNU4968**	**NNU4968K**
	520	133	5	1 800	3 200	251	1 100	1 300	—	—
360	480	118	3	1 430	3 250	255	1 100	1 300	**NNU4972**	**NNU4972K**
	540	134	5	1 830	3 300	258	1 000	1 200	—	—
380	520	140	4	1 810	4 050	315	1 000	1 200	**NNU4976**	**NNU4976K**
	560	135	5	1 870	3 450	265	940	1 100	—	—
400	540	140	4	1 870	4 300	325	940	1 100	**NNU4980**	**NNU4980K**
	600	148	5	2 260	4 150	310	880	1 000	—	—
420	560	140	4	1 930	4 500	340	900	1 100	**NNU4984**	**NNU4984K**
	620	150	5	2 300	4 300	320	840	990	—	—
440	600	160	4	2 380	5 550	410	850	1 000	**NNU4988**	**NNU4988K**
	650	157	6	2 680	5 100	370	800	940	—	—
460	620	160	4	2 460	5 850	430	800	950	**NNU4992**	**NNU4992K**
	680	163	6	2 830	5 350	385	750	890	—	—
480	650	170	5	2 530	5 900	425	770	910	**NNU4996**	**NNU4996K**
500	670	170	5	2 670	6 400	455	730	860	**NNU49/500**	**NNU49/500K**

1) Smallest allowable dimension for chamfer dimension r.
2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12.



Dynamic equivalent radial load
$P_r = F_r$
Static equivalent radial load
$P_{0r} = F_r$

Bearing number[2)] NN type Cylindrical bore	NN type Tapered bore	Dimension (mm) F_w	E_w	Installation-related dimensions (mm) d_a Min.	d_e Min.	d_b Max.	d_c Min.	D_a Max.	D_b Max.	D_b Min.	r_{as} Max.	Mass (approx.) kg NNU type Cylindrical bore	NNU type Tapered bore	NN type Cylindrical bore	NN type Tapered bore
NN4960	**NN4960K**	339	391	313	323	335	343	407	407	394	2.5	48.6	46.4	46.4	44.2
NN3060	**NN3060K**	—	418	316	326	—	—	—	444	421	3	—	—	70.8	68.6
NN4964	**NN4964K**	359	411	333	343	355	363	427	427	414	2.5	51.4	49.1	49	46.7
NN3064	**NN3064K**	—	438	336	346	—	—	—	464	441	3	—	—	76.2	73.5
—	—	379	—	353	363	375	383	447	—	—	2.5	54.2	51.7	—	—
NN3068	**NN3068K**	—	473	360	371	—	—	—	500	477	4	—	—	102	98.5
—	—	398	—	373	383	394	402	467	—	—	2.5	57	54.4	—	—
NN3072	**NN3072K**	—	493	380	391	—	—	—	520	497	4	—	—	107	103
—	—	425	—	396	408	420	430	504	—	—	3	84.5	80.6	—	—
NN3076	**NN3076K**	—	512	400	411	—	—	—	540	516	4	—	—	113	109
—	—	445	—	416	428	440	450	524	—	—	3	88.2	84.1	—	—
NN3080	**NN3080K**	—	547	420	432	—	—	—	580	551	4	—	—	146	141
—	—	465	—	436	448	460	470	544	—	—	3	92	87.7	—	—
NN3084	**NN3084K**	—	567	440	452	—	—	—	600	571	4	—	—	154	148
—	—	492	—	456	469	487	497	584	—	—	3	127	121	—	—
NN3088	**NN3088K**	—	596	464	477	—	—	—	626	601	5	—	—	178	172
—	—	512	—	476	489	507	517	604	—	—	3	132	126	—	—
NN3092	**NN3092K**	—	622	484	498	—	—	—	656	627	5	—	—	202	195
—	—	534	—	500	514	531	541	630	—	—	4	156	149	—	—
—	—	556	—	520	534	551	561	650	—	—	4	162	155	—	—

Tapered Roller Bearings

Single row tapered roller bearing

Double row tapered roller bearing

1. Types, design features, and characteristics

Tapered roller bearings are designed so the tapered vertex of the raceway surfaces of the inner and outer rings and rollers converge at one point on the centerline of the bearing (see **Fig. 1**).

The tapered rollers are guided by the compound force of the inner and outer raceway surfaces which keep the rollers pressed up against the large rib on the inner ring.

A large variety of these bearings, including single, double, and four row arrangements, are available in both metric and inch series. Each type and associated characteristics are shown in **Table 1**. For four-row tapered roller bearings, see section "C. Special application bearings."

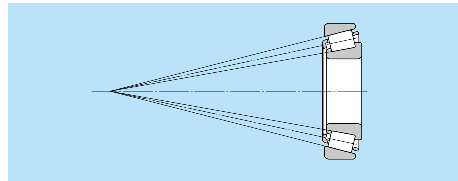
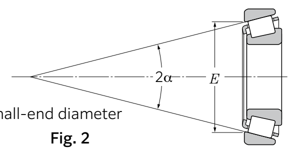


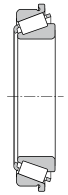
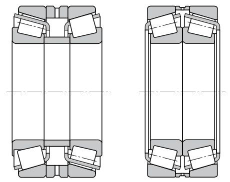
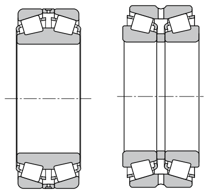
Fig. 1

Table 1 Tapered roller bearing types and characteristics

<table>
<tr><th>Type</th><th>Characteristics</th></tr>
<tr><td>Single row tapered roller bearings</td><td>
(1) There are both metric and inch series adhering to the standards shown in the following table.
Dimension series
<table>
<tr><th></th><th>Metric series</th><th>Inch series</th></tr>
<tr><td>Standard</td><td>●JIS B 1534
●JIS B 1512
●ISO 355</td><td>●ABMA
(includes metric J-series)</td></tr>
<tr><td>Basic number</td><td>Example, 30210
*T2EE040</td><td>Inner ring no. / outer ring no.
("J" appears at the beginning of the basic number in the case of J-series.)</td></tr>
</table>
*Dimension series previously not covered by 3XX are regulated under JIS B 1512; dimensions previously missing from 3XX will henceforth use the bearing number.
(2) In addition to the standard design, there are also medium contact angle and large contact angle types, denoted by the contact angle codes at the end of the part numbers (C and D, respectively).
(3) Subunits
Tapered roller bearings can be disassembled into parts: the inner ring, rollers, and cage (collectively known as the "CONE") and the outer ring (known as the "CUP"). These are the bearing's "subunits". Subunit dimensions are standardized under ISO or ABMA standards, and unified subunits are interchangeable within each dimensional standard. However, high precision grade bearings are generally not interchangeable, and these subunits must be used by assembling only subunits with identical manufacturing numbers.
Aside from any cautionary notes that may appear, the single row tapered roller bearings listed in the dimension tables have subunits standardized for both metric and inch systems (including J series). (Refer to Fig. 2)
Subunit dimensions


E : Outer ring (cup) nominal small-end diameter
α : Nominal contact angle
Fig. 2
Continued to the next page
</td></tr>
</table>

Table 1 (continued)

Type	Characteristics	
Single row tapered roller bearings	(4) These bearings are constructed to have a high capacity for radial loads, axial loads, and combined loads. The larger the contact angle, the greater the axial load capacity. When a pure radial load is applied to a tapered roller bearing, an induced load in the axial direction is also generated, so these bearings are generally used in pairs. (5) Single row tapered roller bearings are separable, so both the inner and outer rings can be used with tight fits. (6) Tapered roller bearings are also manufactured with flanges attached to the outer rings. For more details, contact **NTN** Engineering. (Refer to **Fig. 3**)	 **Fig. 3**
Duplex tapered roller bearings	(1) When two single-row tapered roller bearings are to be used in combination, the bearing clearance and preload are adjusted by the inner ring spacer or the outer ring spacer (see **Fig. 4**). (2) A product number and a combination code are indicated on inner rings, outer rings, and spacers. Parts displaying the same number and code must be used in combination. (3) See A-96 **Table 8.14** for the axial internal clearance.	 Back-to-back (DB) Face-to-face (DF) **Fig. 4**
Double row tapered roller bearings	(1) Back-to-back arrangement (using double row outer rings) and face-to-face arrangement (using double row inner rings) are both available. The assemblies have been adjusted so that each type's internal clearance values are fixed. Only parts with identical manufacturing numbers can be used and they must be assembled according to their code numbers. (Refer to **Fig. 5**) (2) See A-96 **Table 8.14** for the axial internal clearance of double-row and duplex bearings.	 Face-to-face Back-to-back **Fig. 5**

2. Standard cage type

In general, pressed cages (see **Fig. 6**) are used in tapered roller bearings. For large sized bearings, machined or pin type cages may also be used, while resin cages may also be used for smaller sized bearings.

Fig. 6 Pressed steel cage

3. Allowable misalignment

In order to avoid edge loading and potential for premature failure, the maximum allowable misalignment based on bearing series can be found below.

The allowable misalignment of combined bearings is influenced by the load center position, so please consult **NTN** Engineering.

- Single row (standard) ··············· 1/ 2 000
- Single row (ULTAGE) ··············· 1/ 600

4. Precautions

If bearing load is light during operation, or if the ratio of axial to radial load for duplex and double row bearings exceeds the value of e, slipping may develop between the rollers and raceway surface, sometimes resulting in smearing. The mass of rollers and cages particularly tends to be large for large tapered roller bearings. For additional details, please contact **NTN** Engineering.

In tapered roller bearings, the cage may protrude beyond the inner and/or outer ring side faces. Care should be taken when designing the housing and shaft to ensure contact with the cage does not occur.

5. Tapered roller bearing (ULTAGE) series

The ULTAGE tapered roller bearings have been developed for "long operating life," "improved load capacity," and "higher speed" required for various types of industrial machinery.

For details, see the **special catalog (CAT. No. 3035/E)**.

Inch Series Tapered Roller Bearings (Single Row) Index

Tapered Roller Bearings NTN

Inch Series Tapered Roller Bearings (Single Row) Index

Inch Series Tapered Roller Bearings (Single Row) Index

Series number	Bearing number CONE / CUP	Page of bearing dimension table
28000	28150 / 28315	B-165
28000	28158 / 28300	B-165
28500	28579 / 28521	B-171
28500	28580 / 28521	B-171
28500	28584 / 28521	B-173
28600	28678 / 28622	B-171
28600	28680 / 28622	B-175
28600	28682 / 28622	B-175
28900	28985 / 28921	B-177
28900	28990 / 28920	B-177
28900	28995 / 28920	B-177
29500	29580 / 29520	B-175
29500	29585 / 29520	B-177
29500	29585 / 29521	B-177
29500	29586 / 29520	B-179
29500	29590 / 29520	B-179
29600	29675 / 29620	B-179
29600	29675 / 29630	B-181
29600	29685 / 29620	B-181
29600	29688 / 29620	B-163
LM29700	LM29748 / LM29710	B-163
31500	31593 / 31520	B-163
31500	31594 / 31520	B-163
31500	31597 / 31520	B-163
33000	33225 / 33462	B-175
33000	33275 / 33462	B-179
33000	33281 / 33462	B-181
33000	33287 / 33462	B-181
33800	33885 / 33821	B-167
33800	33889 / 33821	B-171
33800	33890 / 33821	B-173
33800	33895 / 33822	B-173
34000	34274 / 34478	B-179
34000	34300 / 34478	B-181
34000	34301 / 34478	B-181
34000	34306 / 34478	B-183
36600	36690 / 36620	B-191
36900	36990 / 36920	B-191
37000	37425 / 37625	B-187
37000	37431 / 37625	B-187
39500	39575 / 39520	B-173
39500	39580 / 39520	B-175
39500	39581 / 39520	B-175
39500	39585 / 39520	B-177
39500	39590 / 39520	B-179
41000	41125 / 41286	B-159
42000	42346 / 42584	B-185
42000	42350 / 42584	B-185
42000	42368 / 42584	B-185
42000	42375 / 42584	B-187
42000	42381 / 42584	B-187
42600	42687 / 42620	B-181
42600	42690 / 42620	B-183
43000	43131 / 43312	B-161

Series number	Bearing number CONE / CUP	Page of bearing dimension table
44000	44143 / 44348	B-163
44000	44150 / 44348	B-165
44000	44158 / 44348	B-165
L44600	L44640 / L44610	B-157
L44600	L44643 / L44610	B-157
L44600	L44649 / L44610	B-157
45200	45280 / 45220	B-169
45200	45282 / 45220	B-171
45200	45284 / 45220	B-173
45200	45287 / 45220	B-173
45200	45289 / 45220	B-175
L45400	L45449 / L45410	B-159
46000	46162 / 46368	B-167
46000	46175 / 46368	B-167
46700	46780 / 46720	B-191
46700	46790 / 46720	B-191
47400	47487 / 47420	B-179
47400	47490 / 47420	B-181
47600	47678 / 47620	B-181
47600	47681 / 47620	B-183
47600	47686 / 47620	B-183
47800	47890 / 47820	B-185
47800	47896 / 47820	B-187
48200	48286 / 48220	B-189
48200	48290 / 48220	B-189
48300	48385 / 48320	B-191
48300	48393 / 48320	B-191
LM48500	LM48548 / LM48510	B-161
LM48500	LM48548A / LM48510	B-161
48600	48684 / 48620	B-191
48600	48685 / 48620	B-191
49500	49585 / 49520	B-173
52000	52375 / 52618	B-187
52000	52387 / 52618	B-187
52000	52393 / 52618	B-187
52000	52400 / 52618	B-187
53000	53162 / 53375	B-167
53000	53177 / 53375	B-167
55000C	55175C / 55437	B-169
55000C	55176C / 55437	B-169
55000C	55187C / 55437	B-171
55000C	55200C / 55443	B-173
56000	56425 / 56650	B-187
59000	59200 / 59412	B-173
64000	64433 / 64700	B-189
64000	64450 / 64700	B-189
65000	65237 / 65500	B-177
65300	65390 / 65320	B-171
66000	66200 / 66462	B-173
66000	66225 / 66462	B-175
66500	66584 / 66520	B-173
66500	66589 / 66520	B-175
LM67000	LM67048 / LM67010	B-159
67300	67388 / 67322	B-189

Series number	Bearing number CONE / CUP	Page of bearing dimension table
67300	67389 / 67322	B-189
67300	67390 / 67322	B-191
67300	67391 / 67322	B-191
67700	67790 / 67720	B-191
68000	68450 / 68712	B-189
68000	68462 / 68712	B-191
L68100	L68149 / L68111	B-163
L69300	JL69349 / JL69310	B-163
71000	71453 / 71750	B-189
72000	72188 / 72487	B-171
72000C	72200C / 72487	B-173
72000C	72212C / 72487	B-173
72000C	72218C / 72487	B-175
72000C	72225C / 72487	B-175
LM72800	LM72849 / LM72810	B-157
74000	74500 / 74850	B-189
74000	74525 / 74850	B-191
74000	74550 / 74850	B-191
78000	78225 / 78551	B-175
78000	78250 / 78551	B-177
78000C	78214C / 78551	B-173
LM78300	LM78349 / LM78310C	B-163
LM78300	LM78349A / LM78310A	B-163
M84500	M84548 / M84510	B-157
M86600	M86643 / M86610	B-157
M86600	M86647 / M86610	B-159
M86600	M86649 / M86610	B-159
M88000	M88048 / M88010	B-161
HM88500	JHM88540 / JHM88513	B-159
HM88500	HM88542 / HM88510	B-161
HM88500	HM88542 / HM88512	B-161
HM88500	HM88547 / HM88510	B-161
HM88600	HM88648 / HM88610	B-163
HM88600	HM88648 / HM88611AS	B-163
HM88600	HM88649 / HM88610	B-161
HM89200	HM89249 / HM89210	B-163
HM89400	HM89440 / HM89410	B-161
HM89400	HM89443 / HM89410	B-161
HM89400	HM89444 / HM89410	B-161
HM89400	HM89446 / HM89410	B-163
HM89400	HM89448 / HM89410	B-163
HM89400	HM89449 / HM89411	B-163
90000	J90354 / J90748	B-185
90000	90381 / 90744	B-187
95000	95475 / 95925	B-189
95000	95500 / 95905	B-189
95000	95525 / 95925	B-191
97000	97500 / 97900	B-189
99000	99550 / 99100	B-191
99000	99575 / 99100	B-191
LM102900	LM102949 / LM102910	B-169
LM104900	JLM104948 / JLM104910	B-171
LM104900	LM104947A / LM104911	B-171
LM104900	LM104949 / LM104911	B-171

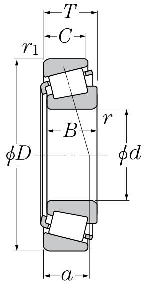
Tapered Roller Bearings NTN

Inch Series Tapered Roller Bearings (Single Row) Index

Series number	Bearing number CONE / CUP	Page of bearing dimension table
M205100	JM205149 / JM205110	B-171
M207000	JM207049 / JM207010	B-175
H211700	JH211749 / JH211710	B-179
HM212000	HM212044 / HM212011	B-177
HM212000	HM212046 / HM212011	B-177
HM212000	HM212049 / HM21210	B-179
L217800	L217849 / L217810	B-185
LL217800	LL217849 / LL217810	B-185
HM218200	HM218248 / HM218210	B-185
HH221400	HH221430 / HH221410	B-183
HH221400	HH221431 / HH221410	B-183
HH221400	HH221440 / HH221410	B-187
HH221400	HH221449 / HH221410	B-187
HH221400	HH221449A / HH221410	B-187
HH224300	HH224334 / HH224310	B-187
HH224300	HH224335 / HH224310	B-187
HH224300	HH224346 / HH224310	B-189
HH228300	HH228349 / HH228310	B-189
M231600	M231648 / M231610	B-191
LM300800	LM300849 / LM300811	B-165
H307700	JH307749 / JH307710	B-175
HM318400	JHM318448 / JHM318410	B-185
L319200	L319249 / L319210	B-187
L327200	L327249 / L327210	B-189
H414200	H414242 / H414210	B-179
H414200	H414245 / H414210	B-179
H414200	H414249 / H414210	B-181
H415600	JH415647 / JH415610	B-181
L432300	L432349 / L432310	B-191
LM501300	LM501349 / LM501310	B-165
LM501300	LM501349 / LM501314	B-165
LM503300	LM503349A / LM503310	B-169
HH506300	HH506348 / HH506310	B-171
HH506300	HH506349 / HH506310	B-171
LM506800	JLM506849 / JLM506810	B-173
LM508700	JLM508748 / JLM508710	B-175
M511900	JM511946 / JM511910	B-177
M515600	JM515649 / JM515610	B-183
HM516400	HM516442 / HM516410	B-181
HM516400	HM516448 / HM516410	B-183
HM516800	JHM516849 / JHM516810	B-185
LM522500	LM522546 / LM522510	B-187
LM522500	LM522548 / LM522510	B-189
HM522600	JHM522649 / JHM522610	B-189
HM534100	JHM534149 / JHM534110	B-191
LM603000	LM603049 / LM603011	B-169
L610500	L610549 / L610510	B-177
M612900	JM612949 / JM612910	B-179
HM617000	HM617049 / HM617010	B-185
L630300	L630349 / L630310	B-191
LL639200	LL639249 / LL639210	B-191
LM704600	JLM704649 / JLM704610	B-171
LM710900	JLM710949 / JLM710910	B-177
LM714100	JLM714149 / JLM714110	B-181

Series number	Bearing number CONE / CUP	Page of bearing dimension table
M714200	JM714249 / JM714210	B-181
H715300	H715334 / H715311	B-177
H715300	H715343 / H715311	B-179
H715300	H715345 / H715311	B-181
H715300	H715348 / H715311	B-183
M716600	JM716648 / JM716610	B-185
M718100	JM718149 / JM718110	B-185
M719100	JM719149 / JM719113	B-185
M720200	JM720249 / JM720210	B-187
L724300	JL724348 / JL724314	B-189
M736100	JM736149 / JM736110	B-191
M738200	JM738249 / JM738210	B-191
HM801300	HM801346 / HM801310	B-165
HM801300	HM801349 / HM801310	B-165
M802000	M802048 / M802011	B-167
HM803100	HM803145 / HM803110	B-167
HM803100	HM803149 / HM803110	B-167
M804000	M804048 / M804010	B-169
HM804800	HM804840 / HM804810	B-167
HM804800	HM804842 / HM804810	B-167
HM804800	HM804846 / M804810	B-169
HM804800	HM804848 / M804810	B-171
HM804800	HM804849 / M804810	B-171
LM806600	LM806649 / LM806610	B-173
HM807000	HM807040 / HM807010	B-169
HM807000	HM807044 / HM807010	B-171
HM807000	HM807046 / HM807010	B-173
HM807000	HM807048 / HM807010	B-173
HM807000	HM807049 / HM807010	B-173
HM807000	JHM807045 / JHM807012	B-171
L812100	L812148 / L812111	B-179
LM813000	JLM813049 / JLM813010	B-179
HM813800	HM813840 / HM813810	B-175
HM813800	HM813841 / HM813810	B-177
HM813800	HM813842 / HM813810	B-177
HM813800	HM813844 / HM813810	B-179
L814700	L814749 / L814710	B-181
LM814800	LM814849 / LM814810	B-183
M822000	JM822049 / JM822010	B-189
HM903200	HM903245 / HM903210	B-167
HM903200	HM903249 / HM903210	B-167
M903300	M903345 / M903310	B-167
HM907600	HM907643 / HM907614	B-173
HM911200	HM911242 / HM911210	B-173
HM911200	HM911245 / HM911210	B-177
HM911200	HM911244 / JHM911211	B-177
H913800	H913840 / H913810	B-175
H913800	H913842 / H913810	B-177
H913800	JH913848 / JH913811	B-181
H917800	H917840 / H917810	B-183
H924000	H924045 / H924010	B-189
HM926700	HM926740 / HM926710	B-189
HM926700	HM926747 / HM926710	B-189

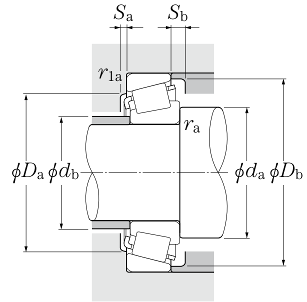
Metric series



d 15 ～ 30mm

d	D	T	B	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r (dynamic)	C_{0r} (static)	C_u	Grease lubrication	Oil lubrication	Bearing number[2]
Boundary dimensions mm							Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		
15	42	14.25	13	11	1	1	25.8	20.8	—	9 900	13 000	4T-30302
17	40	13.25	12	11	1	1	22.7	20.3	—	9 900	13 000	4T-30203
	40	17.25	16	14	1	1	30.5	28.3	—	9 900	13 000	4T-32203
	40	17.25	16	14	1	1	29.1	28.2	—	9 900	13 000	○ 4T-32203R
	47	15.25	14	12	1	1	32.0	26.3	—	9 000	12 000	4T-30303
20	42	15	15	12	0.6	0.6	27.6	27.9	—	9 500	13 000	4T-32004X
	47	15.25	14	12	1	1	31.0	28.7	—	8 800	12 000	4T-30204
	47	19.25	18	15	1	1	40.5	39.5	—	8 800	12 000	4T-32204
	52	16.25	16	13	1.5	1.5	39.0	34.0	—	8 000	11 000	4T-30304A
	52	16.25	16	12	1.5	1.5	34.5	31.0	—	7 600	10 000	4T-30304CA
	52	22.25	21	18	1.5	1.5	51.5	48.5	—	8 000	11 000	4T-32304
22	44	15	15	11.5	0.6	0.6	30.0	31.5	—	8 900	12 000	4T-320/22X
25	47	15	15	11.5	0.6	0.6	31.0	33.5	—	7 900	11 000	4T-32005X
	47	17	17	14	0.6	0.6	36.0	40.5	—	8 000	11 000	4T-33005
	52	16.25	15	13	1	1	35.0	34.0	—	7 300	9 800	4T-30205
	52	19.25	18	16	1	1	46.5	47.0	—	7 300	9 800	4T-32205
	52	19.25	18	15	1	1	42.0	43.0	—	7 300	9 800	○ 4T-32205R
	52	19.25	18	15	1	1	42.5	46.5	—	7 100	9 400	4T-32205C
	52	19.25	18	15	1	1	38.0	42.0	—	7 100	9 400	○ 4T-32205CR
	52	22	22	18	1	1	52.5	57.5	—	7 300	9 800	4T-33205
	62	18.25	17	15	1.5	1.5	54.0	47.5	—	6 700	8 900	4T-30305
	62	18.25	17	14	1.5	1.5	46.0	41.5	—	6 400	8 500	4T-30305C
	62	18.25	17	13	1.5	1.5	45.0	43.5	—	5 900	7 800	4T-30305D
	62	25.25	24	20	1.5	1.5	68.0	64.5	—	6 700	8 900	4T-32305
28	52	16	16	12	1	1	37.0	40.5	—	7 300	9 700	4T-320/28X
	58	24	24	19	1	1	64.5	69.5	—	6 700	8 900	4T-332/28
30	55	17	17	13	1	1	41.5	46.0	—	6 900	9 200	4T-32006X
	55	20	20	16	1	1	47.0	54.0	—	6 900	9 200	4T-33006
	62	17.25	16	14	1	1	48.5	48.0	—	6 300	8 400	4T-30206
	62	21.25	20	17	1	1	60.5	64.0	—	6 300	8 400	4T-32206
	62	21.25	20	17	1	1	55.5	60.0	—	6 100	8 100	4T-32206C
	62	25	25	19.5	1	1	72.0	77.0	—	6 300	8 400	4T-33206
	72	20.75	19	16	1.5	1.5	66.5	61.0	—	5 700	7 600	4T-30306

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings with a ○ mark do not incorporate the subunit dimensions.



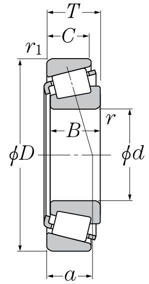
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

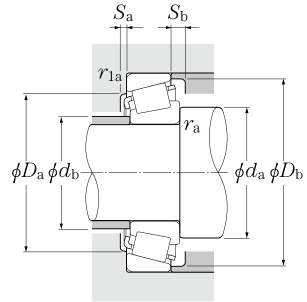
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	Mass kg (approx.)
	Installation-related dimensions mm									Load center mm	Constant	Axial load factors		
2FB	20.5	22	36.5	34.5	38	2	3	1	1	9.5	0.29	2.11	1.16	0.096
2DB	22.5	23	34.5	32.5	37.5	2	2	1	1	9.5	0.35	1.74	0.96	0.08
2DD	22.5	22.5	34.5	32	37.5	2	3	1	1	11.5	0.31	1.92	1.06	0.102
	22.5	22	34.5	31	37.5	2	3	1	1	11	0.35	1.74	0.96	0.105
2FB	22.5	24.5	41.5	38.5	42.5	3	3.5	1	1	10.5	0.29	2.11	1.16	0.132
3CC	24.5	25	37.5	33.5	39.5	3	3	0.6	0.6	10.5	0.37	1.6	0.88	0.097
2DB	25.5	27	41.5	38.5	44	2	3	1	1	11.5	0.35	1.74	0.96	0.124
2DD	25.5	26	41.5	37	43	2	4	1	1	12.5	0.33	1.81	1.00	0.161
2FB	28.5	28	43.5	42.5	47.5	3	3	1.5	1.5	10.5	0.30	2.00	1.10	0.172
	28.5	27.5	43.5	39.5	48	3	4	1.5	1.5	13.5	0.55	1.10	0.60	0.17
2FD	28.5	27	43.5	41	47.5	3	4	1.5	1.5	14	0.30	2.00	1.10	0.242
3CC	26.5	27	39.5	35.5	41.5	3	3.5	0.6	0.6	11	0.40	1.51	0.83	0.105
4CC	29.5	29.5	42.5	38.5	44.5	3	3.5	0.6	0.6	12	0.43	1.39	0.77	0.113
2CE	29.5	30	42.5	39	44.5	3	3	0.6	0.6	11	0.29	2.07	1.14	0.13
3CC	30.5	31	46.5	42	48.5	2	3	1	1	12.5	0.37	1.60	0.88	0.155
2CD	30.5	31	46.5	42.5	49.5	2	4	1	1	14	0.36	1.67	0.92	0.187
	30.5	30.5	46.5	41.5	49	2	4	1	1	13.5	0.37	1.60	0.88	0.185
5CD	30.5	30	46.5	38.5	50	2	4	1	1	16	0.58	1.03	0.57	0.192
	30.5	30.5	46.5	39.5	49.5	2	4	1	1	16	0.55	1.10	0.60	0.189
2DE	30.5	30.5	46.5	41	49.5	4	4	1	1	14	0.35	1.71	0.94	0.219
2FB	33.5	34	53.5	52	57.5	3	3	1.5	1.5	13	0.30	2.00	1.10	0.268
	33.5	34	53.5	48	58	3	4	1.5	1.5	16	0.55	1.10	0.60	0.264
7FB	33.5	33.5	53.5	45	59	3	5	1.5	1.5	20	0.83	0.73	0.40	0.266
2FD	33.5	33	53.5	50	57.5	3	5	1.5	1.5	16	0.30	2.00	1.10	0.377
4CC	33.5	33	46.5	43	49.5	3	4	1	1	12.5	0.43	1.39	0.77	0.146
2DE	33.5	33.5	52.5	47	55	5	5	1	1	15.5	0.34	1.77	0.97	0.293
4CC	35.5	35.5	49.5	45.5	52.5	3	4	1	1	13.5	0.43	1.39	0.77	0.172
2CE	35.5	35.5	49.5	46.5	52	3	4	1	1	13	0.29	2.06	1.13	0.201
3DB	35.5	37.5	56.5	51	58	2	3	1	1	13.5	0.37	1.60	0.88	0.236
3DC	35.5	36.5	56.5	50	58	2.5	4	1	1	15.5	0.37	1.60	0.88	0.299
5DC	35.5	36	56.5	48	59.5	2	5	1	1	18.5	0.56	1.07	0.59	0.297
2DE	35.5	36	56.5	50.5	59	5	5.5	1	1	16	0.34	1.76	0.97	0.348
2FB	38.5	40	63.5	60	65.5	3	4.5	1.5	1.5	15	0.31	1.90	1.05	0.404

Metric series



Tapered Roller Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

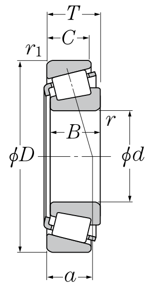
d 30 ～ 45mm

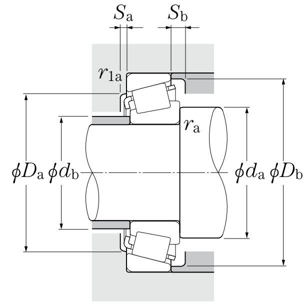
Boundary dimensions (mm)							Basic load rating dynamic (kN)	Basic load rating static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing number [2]
d	D	T	B	C	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	
30	72	20.75	19	15	1.5	1.5	65.0	58.5	—	5 500	7 300	4T-30306CA
	72	20.75	19	14	1.5	1.5	53.5	51.5	—	5 000	6 700	4T-30306D
	72	28.75	27	23	1.5	1.5	89.5	90.0	—	5 700	7 600	4T-32306
	72	28.75	27	23	1.5	1.5	88.0	94.0	—	5 500	7 300	4T-32306C
	72	28.75	27	23	1.5	1.5	77.5	88.5	—	5 500	7 300	○ 4T-32306CR
32	58	17	17	13	1	1	41.0	46.5	—	6 600	8 700	4T-320/32X
	65	26	26	20.5	1	1	78.5	85.0	—	6 000	8 000	4T-332/32
	75	29.75	28	23	1.5	1.5	93.5	102	—	5 200	6 900	4T-323/32C
35	55	14	14	11.5	0.6	0.6	30.5	37.5	4.60	6 800	9 000	32907XU
	62	18	18	14	1	1	46.0	52.5	—	6 100	8 100	4T-32007X
	62	21	21	17	1	1	56.0	66.5	—	6 100	8 100	4T-33007
	72	18.25	17	15	1.5	1.5	61.5	61.5	—	5 500	7 400	4T-30207
	72	24.25	23	19	1.5	1.5	80.5	87.0	—	5 500	7 400	4T-32207
	72	24.25	23	19	1.5	1.5	75.5	85.5	—	5 300	7 100	4T-32207C
	72	24.25	23	18	1.5	1.5	68.5	78.5	—	5 300	7 100	○ 4T-32207CR
	72	28	28	22	1.5	1.5	97.0	109	—	5 500	7 400	4T-33207
	80	22.75	21	18	2	1.5	83.0	77.0	—	5 000	6 600	4T-30307
	80	22.75	21	17	2	1.5	73.5	68.5	—	4 800	6 400	4T-30307C
	80	22.75	21	15	2	1.5	70.5	70.0	—	4 400	5 800	4T-30307D
	80	32.75	31	25	2	1.5	112	115	—	5 000	6 600	4T-32307
	80	32.75	31	25	2	1.5	103	117	—	4 800	6 400	4T-32307C
40	62	15	15	12	0.6	0.6	36.0	48.0	5.85	5 900	7 800	32908XU
	68	19	19	14.5	1	1	55.5	65.5	—	5 300	7 100	4T-32008X
	68	22	22	18	1	1	66.0	82.5	—	5 300	7 100	4T-33008
	75	26	26	20.5	1.5	1.5	88.0	103	—	5 200	6 900	4T-33108
	80	19.75	18	16	1.5	1.5	68.0	67.0	—	4 900	6 600	4T-30208
	80	24.75	23	19	1.5	1.5	88.0	93.5	—	4 900	6 600	4T-32208
	80	32	32	25	1.5	1.5	115	132	—	4 900	6 600	4T-33208
	85	33	32.5	28	2.5	2	131	144	—	4 600	6 200	4T-T2EE040
	90	25.25	23	20	2	1.5	101	102	—	4 400	5 900	4T-30308
	90	25.25	23	19	2	1.5	92.0	87.0	—	4 200	5 600	4T-30308C
	90	25.25	23	17	2	1.5	85.5	85.5	—	3 900	5 200	4T-30308D
	90	35.25	33	27	2	1.5	136	150	18.3	4 400	5 900	32308U
	90	35.25	33	27	2	1.5	122	140	—	4 200	5 600	4T-32308C
45	68	15	15	12	0.6	0.6	37.5	51.5	6.3	5 300	7 000	32909XU

Bearing number	ISO Dimension series	Installation-related dimensions (mm) d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
4T-30306CA		38.5	39.5	63.5	58	67	3	5.5	1.5	1.5	17.5	0.47	1.27	0.70	0.399
4T-30306D	7FB	38.5	39.5	63.5	53.5	68	3	6.5	1.5	1.5	23.5	0.83	0.73	0.40	0.394
4T-32306	2FD	38.5	39	63.5	57.5	66.5	3	5.5	1.5	1.5	18.5	0.31	1.90	1.05	0.577
4T-32306C	5FD	38.5	38	63.5	52	69	2	5.5	1.5	1.5	23	0.55	1.10	0.60	0.591
○ 4T-32306CR		38.5	38	63.5	49.5	67.5	2	5.5	1.5	1.5	23	0.61	0.99	0.54	0.594
4T-320/32X	4CC	37.5	37.5	52.5	47.5	55.5	3	4	1	1	14.5	0.45	1.32	0.73	0.188
4T-332/32	2DE	37.5	38	59.5	53	62	5	5.5	1	1	17	0.35	1.73	0.95	0.394
4T-323/32C	5FD	40.5	40	66.5	55	71.5	3	6.5	1.5	1.5	23	0.55	1.10	0.60	0.652
32907XU	2BD	39.5	40	50.5	48	52.5	2.5	2.5	0.6	0.6	10.5	0.29	2.06	1.13	0.121
4T-32007X	4CC	40.5	40.5	56.5	51.5	59.5	4	4	1	1	15.5	0.45	1.32	0.73	0.223
4T-33007	2CE	40.5	40.5	56.5	52	59	3	4	1	1	14	0.31	1.97	1.08	0.263
4T-30207	3DB	43.5	43.5	63.5	60.5	67.5	3	3	1.5	1.5	15	0.37	1.60	0.88	0.341
4T-32207	3DC	43.5	42.5	63.5	58.5	67.5	3	5	1.5	1.5	17.5	0.37	1.60	0.88	0.455
4T-32207C	5DC	43.5	41.5	63.5	54.5	68.5	3	6	1.5	1.5	21.5	0.58	1.03	0.57	0.461
○ 4T-32207CR		43.5	42.5	63.5	55.5	68	3	6	1.5	1.5	20.5	0.55	1.10	0.60	0.462
4T-33207	2DE	43.5	42	63.5	58	68.5	5	6	1.5	1.5	18.5	0.35	1.70	0.93	0.539
4T-30307	2FB	45	45.5	71.5	67.5	75	3	4.5	2	1.5	17	0.31	1.90	1.05	0.535
4T-30307C		45	44	71.5	63.5	75.5	3	5.5	2	1.5	20.5	0.55	1.10	0.60	0.517
4T-30307D	7FB	45	44.5	71.5	60.5	77	3	7.5	2	1.5	26	0.83	0.73	0.40	0.527
4T-32307	2FE	45	43.5	71.5	65	75	3	7.5	2	1.5	20.5	0.31	1.90	1.05	0.782
4T-32307C	5FE	45	43.5	71.5	59	76	3	7.5	2	1.5	25	0.55	1.10	0.60	0.804
32908XU	2BC	44.5	45.5	57.5	54	58.5	3	3	0.6	0.6	11.5	0.29	2.07	1.14	0.161
4T-32008X	3CD	45.5	45.5	62.5	58	65	4	4.5	1	1	15	0.38	1.58	0.87	0.272
4T-33008	2BE	45.5	46	62.5	58.5	65	2.5	4	1	1	15	0.28	2.12	1.17	0.32
4T-33108	2CE	48.5	47	66.5	62.5	71.5	4	5.5	1.5	1.5	18	0.36	1.69	0.93	0.498
4T-30208	3DB	48.5	48.5	71.5	67.5	74.5	3	3.5	1.5	1.5	16.5	0.37	1.60	0.88	0.431
4T-32208	3DC	48.5	48.5	71.5	66.5	75	3	5.5	1.5	1.5	19	0.37	1.60	0.88	0.547
4T-33208	2DE	48.5	47	71.5	64.5	76.5	5	7	1.5	1.5	21	0.36	1.68	0.92	0.738
4T-T2EE040	2EE	52	47.5	75	68	81	5	5	2	2	22.5	0.34	1.74	0.96	0.905
4T-30308	2FB	50	52.5	81.5	74.5	83.5	3	5	2	1.5	19.5	0.35	1.74	0.96	0.765
4T-30308C		50	50	81.5	72	85.5	3.5	6	2	1.5	23	0.55	1.10	0.60	0.726
4T-30308D	7FB	50	51	81.5	68.5	86	3	8	2	1.5	29.5	0.83	0.73	0.40	0.727
32308U	2FD	50	49.5	81.5	71	83.5	3	8	2	1.5	23	0.35	1.74	0.96	1.08
4T-32308C	5FD	50	49	81.5	65.5	84.5	3	8	2	1.5	27.5	0.55	1.10	0.60	1.1
32909XU	2BC	49.5	51	63.5	59.5	64.5	3	3	0.6	0.6	12	0.32	1.88	1.04	0.187

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings with a ○ mark do not incorporate the subunit dimensions.

Metric series





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

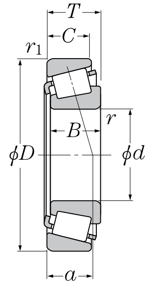
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

d 45 ～ 55mm

Boundary dimensions (mm) d	D	T	B	C	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	Basic load rating dynamic (kN) C_r	static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number [2]	ISO Dimension series	Installation-related dimensions (mm) d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
45	75	20	20	15.5	1	1	64.0	76.5	—	4 800	6 400	4T-32009X	3CC	50.5	51	69.5	64	72.5	4	4.5	1	1	16.5	0.39	1.53	0.84	0.341
	75	24	24	19	1	1	73.5	93.5	—	4 800	6 400	4T-33009	2CE	50.5	51.5	69.5	64	71.5	4	5	1	1	16	0.29	2.04	1.12	0.405
	80	26	26	20.5	1.5	1.5	94.0	115	—	4 700	6 200	4T-33109	3CE	53.5	51.5	71.5	67.5	76.5	4	5.5	1.5	1.5	19.5	0.38	1.57	0.86	0.544
	85	20.75	19	16	1.5	1.5	75.0	78.5	—	4 400	5 900	4T-30209	3DB	53.5	53.5	76.5	72	80	3	4.5	1.5	1.5	18	0.40	1.48	0.81	0.493
	85	24.75	23	19	1.5	1.5	91.0	100	—	4 400	5 900	4T-32209	3DC	53.5	53.5	76.5	71	81	3	5.5	1.5	1.5	20	0.40	1.48	0.81	0.604
	85	32	32	25	1.5	1.5	119	141	—	4 400	5 900	4T-33209	3DE	53.5	52	76.5	69	82	5	7	1.5	1.5	22	0.39	1.56	0.86	0.795
	95	29	26.5	20	2.5	2.5	99.5	108	—	4 100	5 500	4T-T7FC045	7FC	57	53	83	69	91	3	9	2	2	33	0.87	0.69	0.38	0.907
	100	27.25	25	22	2	1.5	123	126	—	4 000	5 300	4T-30309	2FB	55	58.5	91.5	84	93.5	3	5	2	1.5	21	0.35	1.74	0.96	1.01
	100	27.25	25	18	2	1.5	106	109	—	3 500	4 600	4T-30309D	7FB	55	56.5	91.5	76	96.5	3	9	2	1.5	32.5	0.83	0.73	0.40	0.966
	100	38.25	36	30	2	1.5	170	191	23.3	4 000	5 300	32309U	2FD	55	56.5	91.5	80.5	93.5	3	8	2	1.5	25.5	0.35	1.74	0.96	1.45
	100	38.25	36	30	2.5	0.6	145	175	21.4	3 800	5 100	32309CU	5FD	55	55.5	91.5	73.5	95	4	9	2.5	0.6	30	0.55	1.10	0.60	1.47
50	72	15	15	12	0.6	0.6	39.5	57.0	6.95	4 700	6 300	32910XU	2BC	54.5	55	67.5	63.5	69	3	3	0.6	0.6	13.5	0.34	1.76	0.97	0.192
	72	15	14	12	0.6	0.6	35.0	50.5	6.15	4 700	6 300	○32910		54.5	56.5	67.5	63.5	69.5	3	3	0.6	0.6	14.5	0.36	1.67	0.92	0.193
	80	20	20	15.5	1	1	69.5	88.0	—	4 400	5 800	4T-32010X	3CC	55.5	55.5	74.5	68.5	77.5	4	4.5	1	1	17.5	0.42	1.42	0.78	0.373
	80	24	24	19	1	1	77.5	103	—	4 400	5 800	4T-33010	2CE	55.5	56	74.5	69	76.5	4	5	1	1	17.5	0.32	1.90	1.04	0.44
	85	26	26	20	1.5	1.5	96.0	121	—	4 200	5 600	4T-33110	3CE	58.5	56.5	76.5	71	81.5	4	6	1.5	1.5	20.5	0.41	1.46	0.80	0.583
	90	21.75	20	17	1.5	1.5	85.5	93.0	—	4 000	5 300	4T-30210	3DB	58.5	58	81.5	76.5	85.5	3	4.5	1.5	1.5	19.5	0.42	1.43	0.79	0.56
	90	24.75	23	19	1.5	1.5	97.0	109	—	4 000	5 300	4T-32210	3DC	58.5	57.5	81.5	76	86	3	5.5	1.5	1.5	21	0.42	1.43	0.79	0.639
	90	32	32	24.5	1.5	1.5	127	158	—	4 000	5 300	4T-33210	3DE	58.5	56.5	81.5	73.5	87	5	7.5	1.5	1.5	23.5	0.41	1.45	0.80	0.862
	100	36	35	30	2.5	2.5	167	190	—	3 800	5 100	4T-T2ED050	2ED	62	58	88	82	94.5	6	6	2	2	25.5	0.34	1.75	0.96	1.3
	105	32	29	22	3	3	119	132	—	3 400	4 500	4T-T7FC050	7FC	64	59	91	82	94.5	4	10	2.5	2.5	36.5	0.87	0.69	0.38	1.22
	110	29.25	27	23	2.5	2	147	152	—	3 600	4 800	4T-30310	2FB	62	64.5	100	92.5	103	3	6	2	2	23	0.35	1.74	0.96	1.31
	110	29.25	27	19	2.5	2	126	130	—	3 200	4 200	4T-30310D	7FB	62	61.5	100	83.5	104.5	3	10	2	2	35	0.83	0.73	0.40	1.25
	110	42.25	40	33	2.5	2	204	232	28.3	3 600	4 800	32310U	2FD	62	61.5	100	88	102.5	3	9	2	2	28.5	0.35	1.74	0.96	1.92
	110	42.25	40	33	2.5	2.5	178	220	—	3 500	4 600	4T-32310C	5FD	62	61.5	100	80.5	104	3	9	2	2.5	33.5	0.55	1.1	0.60	1.97
55	80	17	17	14	1	1	49.5	73.5	8.95	4 300	5 700	32911XU	2BC	60.5	61	74.5	70.5	76.5	3	3	1	1	14.5	0.31	1.94	1.07	0.274
	90	23	23	17.5	1.5	1.5	89.0	118	—	4 000	5 400	4T-32011X	3CC	63.5	63	81.5	77.5	87	4	5.5	1.5	1.5	20	0.41	1.48	0.81	0.56
	90	27	27	21	1.5	1.5	102	138	—	4 000	5 400	4T-33011	2CE	63.5	63	81.5	78	86	5	6	1.5	1.5	19.5	0.31	1.92	1.06	0.654
	95	30	30	23	1.5	1.5	123	155	—	3 900	5 200	4T-33111	3CE	63.5	62.5	86.5	80	91	5	7	1.5	1.5	22	0.37	1.60	0.88	0.858
	100	22.75	21	18	2	1.5	103	111	—	3 600	4 900	4T-30211	3DB	65	64	91.5	86	95.5	4	4.5	2	1.5	21	0.40	1.48	0.81	0.725
	100	26.75	25	21	2	1.5	120	134	—	3 600	4 900	4T-32211	3DC	65	63	91.5	85	96	4	5.5	2	1.5	22.5	0.40	1.48	0.81	0.873
	100	35	35	27	2	1.5	153	188	—	3 600	4 900	4T-33211	3DE	65	62.5	91.5	82	96.5	6	8	2	1.5	25.5	0.40	1.50	0.83	1.17
	115	34	31	23.5	3	3	137	156	—	3 300	4 400	4T-T7FC055	7FC	69	65.5	101	83.5	110	4	10.5	2.5	2.5	43.5	0.87	0.69	0.38	1.57
	120	31.5	29	25	2.5	2	172	179	—	3 300	4 400	4T-30311	2FB	67	70.5	110	101	112	4	6.5	2	2	24.5	0.35	1.74	0.96	1.65
	120	31.5	29	21	2.5	2	146	154	—	2 900	3 800	4T-30311D	7FB	67	67	110	91.5	113.5	4	10.5	2	2	38	0.83	0.73	0.40	1.58
	120	45.5	43	35	2.5	2	238	275	33.5	3 300	4 400	32311U	2FD	67	67.5	110	96.5	111.5	4	10.5	2	2	30.5	0.35	1.74	0.96	2.44
	120	45.5	43	35	2.5	2.5	204	252	30.5	3 100	4 200	32311CU	5FD	67	67	110	88.5	113.5	4	10	2	2.5	36.5	0.55	1.10	0.60	2.47

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings with a ○ mark do not incorporate the subunit dimensions.

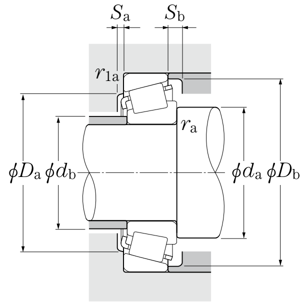
Metric series



d 60 ～ 75mm

d	D	T	B	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Bearing number [2]
Boundary dimensions (mm)							Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		
60	85	17	17	14	1	1	56.5	83.0	10.1	4 000	5 300	○32912XA
	95	23	23	17.5	1.5	1.5	91.0	123	—	3 700	4 900	4T-32012X
	95	27	27	21	1.5	1.5	104	145	—	3 700	4 900	4T-33012
	100	30	30	23	1.5	1.5	126	164	—	3 600	4 700	4T-33112
	110	23.75	22	19	2	1.5	116	125	—	3 400	4 500	4T-30212
	110	29.75	28	24	2	1.5	144	164	20.1	3 400	4 500	32212U
	110	38	38	29	2	1.5	179	223	27.1	3 400	4 500	33212U
	115	40	39	33	2.5	2.5	209	249	—	3 200	4 300	4T-T2EE060
	125	37	33.5	26	3	3	161	186	—	2 800	3 700	4T-T7FC060
	130	33.5	31	26	3	2.5	199	210	25.6	3 000	4 000	30312U
	130	33.5	31	22	3	2.5	167	176	—	2 700	3 600	4T-30312D
	130	48.5	46	37	3	2.5	271	315	38.5	3 000	4 000	32312U
	130	48.5	46	37	3	2.5	237	296	—	2 900	3 900	4T-32312C
65	90	17	17	14	1	1	53.5	85.0	10.4	3 700	4 900	32913XU
	100	23	23	17.5	1.5	1.5	92.0	128	—	3 400	4 600	4T-32013X
	100	27	27	21	1.5	1.5	108	156	—	3 400	4 600	4T-33013
	110	34	34	26.5	1.5	1.5	160	211	—	3 300	4 400	4T-33113
	120	24.75	23	20	2	1.5	136	148	—	3 100	4 200	4T-30213
	120	32.75	31	27	2	1.5	176	206	25.1	3 100	4 200	32213U
	120	41	41	32	2	1.5	216	265	32.5	3 100	4 200	33213U
	140	36	33	28	3	2.5	225	238	28.7	2 800	3 700	30313U
	140	36	33	23	3	2.5	192	204	—	2 500	3 300	4T-30313D
	140	51	48	39	3	2.5	305	350	42.5	2 800	3 700	32313U
70	100	20	20	16	1	1	76.0	110	13.4	3 400	4 600	32914XU
	110	25	25	19	1.5	1.5	116	160	—	3 200	4 200	4T-32014X
	110	31	31	25.5	1.5	1.5	140	204	—	3 200	4 200	4T-33014
	120	37	37	29	2.5	0.6	190	251	30.5	3 100	4 100	33114U
	125	26.25	24	21	2	1.5	146	162	—	2 900	3 900	4T-30214
	125	33.25	31	27	2	1.5	184	220	26.8	2 900	3 900	32214U
	125	41	41	32	2	1.5	223	282	34.5	2 900	3 900	33214U
	140	39	35.5	27	3	3	191	231	—	2 400	3 200	4T-T7FC070
	150	38	35	30	3	2.5	255	272	32.0	2 600	3 500	30314U
	150	38	35	25	3	2.5	214	229	—	2 300	3 000	4T-30314D
	150	54	51	42	3	2.5	345	405	48.0	2 600	3 500	32314U
	150	54	51	42	3	2.5	300	380	45.0	2 500	3 300	32314CU
75	105	20	20	16	1	1	77.0	114	13.9	3 200	4 300	32915XU

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings with a ○ mark do not incorporate the subunit dimensions.



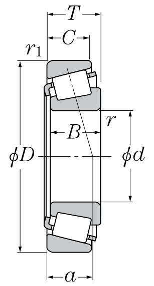
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	Mass kg (approx.)
	Installation-related dimensions (mm)									Load center (mm)	Constant	Axial load factors		
	65.5	66	79.5	76.5	82.5	3	3	1	1	15.5	0.33	1.80	0.99	0.281
4CC	68.5	67.5	86.5	81.5	91.5	4	5.5	1.5	1.5	21	0.43	1.39	0.77	0.596
2CE	68.5	67	86.5	82	90	5	6	1.5	1.5	20.5	0.33	1.83	1.01	0.693
3CE	68.5	67	91.5	84.5	96.5	5	7	1.5	1.5	23.5	0.40	1.51	0.83	0.913
3EB	70	69.5	101.5	94	103.5	4	4.5	2	1.5	22	0.40	1.48	0.81	0.929
3EC	70	68.5	101.5	92	105	4	5.5	2	1.5	25	0.40	1.48	0.81	1.18
3EE	70	68.5	101.5	90	105.5	6	9	2	1.5	27.5	0.40	1.48	0.82	1.53
2EE	72	69.5	103	95	109	6	7	2	2	28.5	0.33	1.80	0.99	1.86
7FC	74	71.5	111	92	120	4	11	2.5	2.5	42	0.82	0.73	0.40	2
2FB	74	77	118	109.5	121.5	4	7.5	2.5	2	26.5	0.35	1.74	0.96	2.05
7FB	74	73	118	99	124	4	11.5	2.5	2	40.5	0.83	0.73	0.40	1.95
2FD	74	73.5	118	106	121.5	4	11.5	2.5	2	32	0.35	1.74	0.96	3.01
5FD	74	73	118	96.5	122	5	11	2.5	2	39	0.55	1.10	0.60	3.07
2BC	70.5	70.5	84.5	80	86	3	3	1	1	16.5	0.35	1.70	0.93	0.315
4CC	73.5	72.5	91.5	86	97	4	5.5	1.5	1.5	22.5	0.46	1.31	0.72	0.631
2CE	73.5	72	91.5	87	95.5	5	6	1.5	1.5	21.5	0.35	1.72	0.95	0.742
3DE	73.5	73	101.5	92.5	106.5	6	7.5	1.5	1.5	26	0.39	1.55	0.85	1.27
3EB	75	77	111.5	103	114.5	4	4.5	2	1.5	23.5	0.40	1.48	0.81	1.18
3EC	75	75.5	111.5	101.5	115.5	4	5.5	2	1.5	27	0.40	1.48	0.81	1.57
3EE	75	74	111.5	99	115.5	7	9	2	1.5	29.5	0.39	1.54	0.85	2
2GB	79	83	128	119	131.5	4	8	2.5	2	28.5	0.35	1.74	0.96	2.54
7GB	79	79	128	107.5	133	4	13	2.5	2	44	0.83	0.73	0.40	2.41
2GD	79	79.5	128	115	131.5	4	12	2.5	2	34.5	0.35	1.74	0.96	3.63
2BC	75.5	76.5	94.5	90	96.5	4	4	1	1	18	0.32	1.90	1.05	0.475
4CC	78.5	78	101.5	94.5	105.5	5	6	1.5	1.5	24	0.43	1.38	0.76	0.863
2CE	78.5	79	101.5	96.5	105.5	5	5.5	1.5	1.5	22.5	0.28	2.11	1.16	1.07
3DE	80	79	111.5	101.5	115.5	6	8	2.5	0.6	28	0.38	1.58	0.87	1.68
3EB	80	81	116.5	107.5	119	4	5	2	1.5	25.5	0.42	1.43	0.79	1.3
3EC	80	79.5	116.5	105.5	120.5	4	6	2	1.5	28.5	0.42	1.43	0.79	1.68
3EE	80	78.5	116.5	104	121.5	7	9	2	1.5	31	0.41	1.47	0.81	2.12
7FC	84	81.5	126	104.5	135	5	12	2.5	2.5	47.5	0.87	0.69	0.38	2.62
2GB	84	88.5	138	128	141	4	8	2.5	2	30	0.35	1.74	0.96	3.05
7GB	84	84.5	138	115.5	142.5	4	13	2.5	2	47	0.83	0.73	0.40	2.92
2GD	84	85	138	122.5	141	4	12	2.5	2	36.5	0.35	1.74	0.96	4.44
5GD	84	85	138	112.5	143	5	12	2.5	2	44	0.55	1.10	0.60	4.53
2BC	80.5	81	99.5	94	101	4	4	1	1	19	0.33	1.80	0.99	0.508

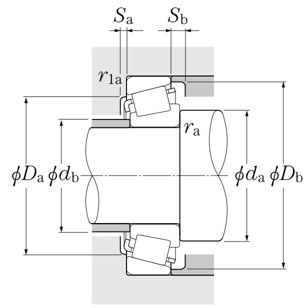
Metric series



d 75～90mm

d	D	T	B	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r (dynamic, kN)	C_{0r} (static, kN)	C_u (Fatigue load limit, kN)	Grease lubrication (Allowable speed, min⁻¹)	Oil lubrication (Allowable speed, min⁻¹)	Bearing number
75	115	25	25	19	1.5	1.5	118	167	20.3	3 000	4 000	32015XU
	115	31	31	25.5	1.5	1.5	123	186	22.7	3 000	4 000	33015U
	130	27.25	25	22	2	1.5	154	175	—	2 700	3 600	4T-30215
	130	33.25	31	27	2	1.5	186	224	27.1	2 700	3 600	32215U
	130	41	41	31	2	1.5	231	298	36.0	2 700	3 600	33215U
	160	40	37	31	3	2.5	283	305	35.0	2 400	3 200	30315U
	160	40	37	26	3	2.5	238	256	29.8	2 100	2 800	30315DU
	160	58	55	45	3	2.5	395	470	54.5	2 400	3 200	32315U
	160	58	55	45	3	2.5	365	480	56.0	2 300	3 100	32315CU
80	110	20	20	16	1	1	79.5	121	14.8	3 000	4 000	32916XU
	125	29	29	22	1.5	1.5	154	216	26.1	2 800	3 700	32016XU
	125	36	36	29.5	1.5	1.5	192	284	34.5	2 800	3 700	33016U
	130	37	37	29	2.5	0.6	199	276	33.0	2 700	3 600	33116U
	140	28.25	26	22	2.5	2	177	200	23.7	2 500	3 400	30216U
	140	35.25	33	28	2.5	2	221	265	31.5	2 500	3 400	32216U
	140	46	46	35	2.5	2	278	365	43.5	2 500	3 400	33216U
	160	45	41	31	3	2	238	297	—	2 400	3 200	4T-T7FC080
	170	42.5	39	33	3	2.5	325	350	39.5	2 300	3 000	30316U
	170	42.5	39	27	3	2.5	262	283	32.5	2 000	2 700	30316DU
	170	61.5	58	48	3	2.5	440	525	60.0	2 300	3 000	32316U
	170	61.5	58	48	3	2.5	390	505	58.0	2 200	2 900	32316CU
85	120	23	23	18	1.5	1.5	104	157	19.1	2 800	3 800	32917XU
	130	29	29	22	1.5	1.5	157	224	26.7	2 600	3 500	32017XU
	130	36	36	29.5	1.5	1.5	195	296	35.5	2 600	3 500	33017U
	140	41	41	32	2.5	2.5	234	330	39.0	2 500	3 400	33117U
	150	30.5	28	24	2.5	2	203	232	27.0	2 400	3 200	30217U
	150	38.5	36	30	2.5	2	249	300	35.0	2 400	3 200	32217U
	150	49	49	37	2.5	2	315	420	49.0	2 400	3 200	33217U
	180	44.5	41	34	4	3	335	365	40.5	2 100	2 900	30317U
	180	44.5	41	28	4	3	274	293	33.0	1 900	2 500	30317DU
	180	63.5	60	49	4	3	445	525	59.0	2 100	2 900	32317U
	180	63.5	60	49	4	3	435	575	64.5	2 100	2 700	32317CU
90	125	23	23	18	1.5	1.5	108	168	20.0	2 700	3 600	32918XU
	140	32	32	24	2	1.5	187	270	31.5	2 500	3 300	32018XU
	140	39	39	32.5	2	1.5	238	360	42.0	2 500	3 300	33018U
	150	45	45	35	2.5	2.5	280	400	46.0	2 400	3 200	33118U

1) Smallest allowable dimension for chamfer dimension r or r_1.



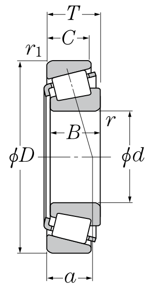
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number	ISO Dimension series	d_a Min. (mm)	d_b Max. (mm)	D_a Max. (mm)	D_a Min. (mm)	D_b Min. (mm)	S_a Min. (mm)	S_b Min. (mm)	r_{as} Max. (mm)	r_{1as} Max. (mm)	Load center a (mm)	Constant e	Axial load factors Y_2	Axial load factors Y_0	Mass kg (approx.)
32015XU	4CC	83.5	83	106.5	99.5	111	5	6	1.5	1.5	25.5	0.46	1.31	0.72	0.912
33015U	2CE	83.5	85	106.5	101	110.5	6	5.5	1.5	1.5	23	0.30	2.01	1.11	1.11
4T-30215	4DB	85	85.5	121.5	112.5	124.5	4	5	2	1.5	27	0.44	1.38	0.76	1.4
32215U	4DC	85	84.5	121.5	111	126	4	6	2	1.5	30	0.44	1.38	0.76	1.74
33215U	3EE	85	83	121.5	107.5	125	7	10	2	1.5	32	0.43	1.40	0.77	2.23
30315U	2GB	89	95	148	137	150.5	4	9	2.5	2	32	0.35	1.74	0.96	3.61
30315DU	7GB	89	91	148	124	152.5	6	14	2.5	2	50	0.83	0.73	0.40	3.46
32315U	2GD	89	91	148	131	150.5	4	13	2.5	2	39	0.35	1.74	0.96	5.4
32315CU	5GD	89	90	148	119.5	152	6	15	2.5	2	47	0.55	1.10	0.60	5.65
32916XU	2BC	85.5	86	104.5	99	106.5	4	4	1	1	20	0.35	1.71	0.94	0.54
32016XU	3CC	88.5	89	116.5	108.5	120.5	6	7	1.5	1.5	27	0.42	1.42	0.78	1.28
33016U	2CE	88.5	88.5	116.5	108.5	119.5	6	6.5	1.5	1.5	25	0.28	2.16	1.19	1.61
33116U	3DE	90	88.5	121.5	110.5	126	6	15	2.5	2	30.5	0.42	1.44	0.79	1.87
30216U	3EB	92	91	130	121	133	4	6	2	2	27.5	0.42	1.43	0.79	1.71
32216U	3EC	92	90	130	119.5	134.5	4	7	2	2	31	0.42	1.43	0.79	2.17
33216U	3EE	92	89	130	116	135.5	7	11	2	2	35	0.43	1.41	0.78	2.94
4T-T7FC080	7FC	94	94	146	119	153.5	6	15	2	2.5	55	0.87	0.69	0.38	3.92
30316U	2GB	94	101.5	158	145	160	4	9.5	2.5	2	34	0.35	1.74	0.96	4.41
30316DU	7GB	94	97	158	131	160.5	6	15.5	2.5	2	53.5	0.83	0.73	0.40	4.17
32316U	2GD	94	97	158	138.5	161.5	4	13.5	2.5	2	41.5	0.35	1.74	0.96	6.48
32316CU	5GD	94	96	158	127.5	162	4	13.5	2.5	2	50.5	0.55	1.10	0.60	6.61
32917XU	2BC	93.5	92	111.5	107.5	115.5	4	5	1.5	1.5	21	0.33	1.83	1.01	0.773
32017XU	4CC	93.5	93.5	121.5	113	126	6	7	1.5	1.5	28.5	0.44	1.36	0.75	1.34
33017U	2CE	93.5	94	121.5	114	125.5	6	6.5	1.5	1.5	26	0.29	2.06	1.13	1.69
33117U	3DE	97	95	130	118	135.5	7	9	2	2	33	0.41	1.48	0.81	2.44
30217U	3EB	97	96.5	140	128.5	141.5	5	6.5	2	2	30	0.42	1.43	0.79	2.13
32217U	3EC	97	96	140	127	143.5	5	8.5	2	2	33.5	0.42	1.43	0.79	2.75
33217U	3EE	97	95	140	124	144.5	7	12	2	2	37.5	0.42	1.43	0.79	3.61
30317U	2GB	103	106.5	166	153.5	168	5	10.5	3	2.5	35.5	0.35	1.74	0.96	5.01
30317DU	7GB	103	102.5	166	140.5	170	6	16.5	3	2.5	56	0.83	0.73	0.40	4.74
32317U	2GD	103	103.5	166	147	169	5	14.5	3	2.5	43	0.35	1.74	0.96	7.22
32317CU	5GD	103	102	166	135.5	170	7	13	2	2.5	53	0.55	1.10	0.60	7.71
32918XU	2BC	98.5	97	116.5	112.5	120.5	4	5	1.5	1.5	22	0.34	1.75	0.96	0.815
32018XU	3CC	100	100	131.5	121	134.5	6	8	2	1.5	30	0.42	1.42	0.78	1.78
33018U	2CE	100	100.5	131.5	123.5	135	7	6.5	2	1.5	28	0.27	2.23	1.23	2.22
33118U	3DE	102	101	140	127.5	145.5	7	10	2	2	35.5	0.40	1.51	0.83	3.1

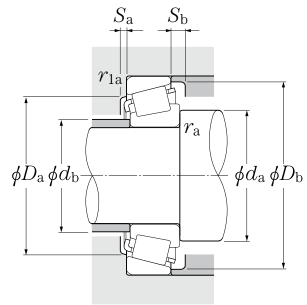
Metric series



d 90 ～ 110mm

d	D	T	B	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Bearing number 2)
Boundary dimensions (mm)							Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		
90	160	32.5	30	26	2.5	2	230	267	30.5	2 200	3 000	**30218U**
	160	42.5	40	34	2.5	2	291	360	41.0	2 200	3 000	**32218U**
	160	55	55	42	2.5	2.5	360	490	56.0	2 300	3 000	**33218U**
	190	46.5	43	36	4	3	375	405	44.5	2 000	2 700	**30318U**
	190	46.5	43	30	4	3	300	320	35.5	1 800	2 400	**30318DU**
	190	67.5	64	53	4	3	500	595	65.5	2 000	2 700	**32318U**
95	130	23	23	18	1.5	1.5	112	178	21.0	2 500	3 400	**32919XU**
	145	32	32	24	2	1.5	190	280	32.5	2 300	3 100	**32019XU**
	145	39	39	32.5	2	1.5	243	375	43.0	2 300	3 100	**33019U**
	170	34.5	32	27	3	2.5	250	290	32.5	2 100	2 800	**30219U**
	170	45.5	43	37	3	2.5	330	415	47.0	2 100	2 800	**32219U**
	200	49.5	45	38	4	3	405	445	48.5	1 900	2 500	**30319U**
	200	49.5	45	32	4	3	330	355	38.5	1 700	2 200	**30319DU**
	200	71.5	67	55	4	3	560	670	73.0	1 900	2 500	**32319U**
100	140	25	25	20	1.5	1.5	134	206	23.8	2 400	3 200	**32920XU**
	140	25	24	20	1.5	1.5	108	162	18.6	2 400	3 200	○**32920**
	145	24	22.5	17.5	3	3	119	153	—	1 800	2 400	**4T-T4CB100**
	150	32	32	24	2	1.5	188	281	32.0	2 200	3 000	**32020XU**
	150	39	39	32.5	2	1.5	248	390	44.5	2 200	3 000	**33020U**
	180	37	34	29	3	2.5	286	335	37.0	2 000	2 700	**30220U**
	180	49	46	39	3	2.5	365	465	51.0	2 000	2 700	**32220U**
	180	63	63	48	3	2.5	465	650	71.5	2 000	2 700	**33220U**
	215	51.5	47	39	4	3	455	500	53.0	1 800	2 400	**30320U**
	215	56.5	51	35	4	3	395	435	46.0	1 800	2 400	**31320XU**
	215	77.5	73	60	4	3	635	770	82.0	1 800	2 400	**32320U**
105	145	25	25	20	1.5	1.5	139	219	25.0	2 300	3 000	○**32921XA**
	160	35	35	26	2.5	2	223	335	37.5	2 100	2 800	**32021XU**
	160	43	43	34	2.5	2	272	420	47.0	2 100	2 800	**33021U**
	190	39	36	30	3	2.5	320	380	41.0	1 900	2 500	**30221U**
	190	53	50	43	3	2.5	420	540	59.0	1 900	2 500	**32221U**
	225	53.5	49	41	4	3	485	535	56.0	1 700	2 300	**30321U**
	225	58	53	36	4	3	420	470	49.0	1 700	2 300	**31321XU**
	225	81.5	77	63	4	3	680	825	87.0	1 700	2 300	**32321U**
110	150	25	25	20	1.5	1.5	141	226	25.5	2 200	2 900	○**32922XA**
	170	38	38	29	2.5	2	261	390	43.0	2 000	2 700	**32022XU**

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings with a ○ mark do not incorporate the subunit dimensions.



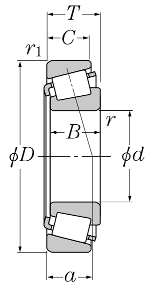
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	Mass (approx.)
	Installation-related dimensions (mm)									Load center (mm)	Constant	Axial load factors		kg
3FB	102	103	150	137	151	5	6.5	2	2	32	0.42	1.43	0.79	2.66
3FC	102	101.5	150	134.5	153.5	5	8.5	2	2	36	0.42	1.43	0.79	3.49
3FE	102	101.5	150	131.5	154.5	9	13	2	2.5	41	0.42	1.43	0.78	4.62
2GB	108	112.5	176	162	177.5	5	10.5	3	2.5	37.5	0.35	1.74	0.96	5.83
7GB	108	108.5	176	148.5	180.5	6	16.5	3	2.5	59	0.83	0.73	0.40	5.58
2GD	108	108.5	176	154.5	179	5	14.5	3	2.5	45.5	0.35	1.74	0.96	8.66
2BC	103.5	102	121.5	117	125.5	4	5	1.5	1.5	23.5	0.36	1.68	0.92	0.851
4CC	105	105	136.5	126	140	6	8	2	1.5	31.5	0.44	1.36	0.75	1.85
2CE	105	104.5	136.5	127.5	139.5	7	6.5	2	1.5	28.5	0.28	2.16	1.19	2.3
3FB	109	109.5	158	146.5	160.5	5	7.5	2.5	2	34	0.42	1.43	0.79	3.12
3FC	109	107.5	158	142.5	163	5	8.5	2.5	2	39	0.42	1.43	0.79	4.29
2GB	113	118	186	168	185.5	5	11.5	3	2.5	40	0.35	1.74	0.96	6.69
7GB	113	113.5	186	154.5	189	6	17.5	3	2.5	62.5	0.83	0.73	0.40	6.35
2GD	113	114.5	186	163.5	187.5	5	16.5	3	2.5	49	0.35	1.74	0.96	10.1
2CC	108.5	109	131.5	127.5	135.5	4	5	1.5	1.5	24.5	0.33	1.82	1.00	1.12
	108.5	110	131.5	127	135	4	5	1.5	1.5	25	0.35	1.73	0.95	1.08
4CB	114	108.5	131	130	140.5	4	6.5	2.5	2.5	30	0.47	1.27	0.70	1.14
4CC	110	109.5	141.5	130.5	145	6	8	2	1.5	32.5	0.46	1.31	0.72	1.91
2CE	110	108.5	141.5	132.5	144.5	7	6.5	2	1.5	29.5	0.29	2.09	1.15	2.4
3FB	114	115.5	168	154.5	169.5	5	8	2.5	2	36	0.42	1.43	0.79	3.76
3FC	114	113.5	168	151	172	5	10	2.5	2	41.5	0.42	1.43	0.79	5.11
3FE	114	113	168	147	173	10	15	2.5	2	45.5	0.40	1.48	0.82	6.76
2GB	118	126	201	181.5	199.5	5	12.5	3	2.5	41.5	0.35	1.74	0.96	8.3
7GB	118	122.5	201	165.5	203	7	21.5	3	2.5	69	0.83	0.73	0.40	8.7
2GD	118	122.5	201	174.5	201.5	5	17.5	3	2.5	53	0.35	1.74	0.96	12.8
	113.5	113.5	136.5	131.5	140.5	5	5	1.5	1.5	25	0.34	1.76	0.97	1.2
4DC	117	115.5	150	138.5	153.5	6	9	2	2	34.5	0.44	1.35	0.74	2.44
2DE	117	116	150	141.5	153.5	7	9	2	2	31	0.28	2.12	1.17	3
3FB	119	121.5	178	163	178.5	6	9	2.5	2	38	0.42	1.43	0.79	4.45
3FC	119	119	178	158.5	181.5	6	10	2.5	2	44	0.42	1.43	0.79	6.23
2GB	123	132	211	190	208.5	6	12.5	3	2.5	43.5	0.35	1.74	0.96	9.37
7GB	123	128.5	211	173.5	213.5	7	22	3	2.5	71.5	0.83	0.73	0.40	9.65
2GD	123	129	211	182.5	210.5	6	18.5	3	2.5	55	0.35	1.74	0.96	14.7
	118.5	118.5	141.5	136.5	146	5	5	1.5	1.5	26.5	0.36	1.69	0.93	1.24
4DC	122	122	160	147.5	164	7	9	2	2	36.5	0.43	1.39	0.77	3.07

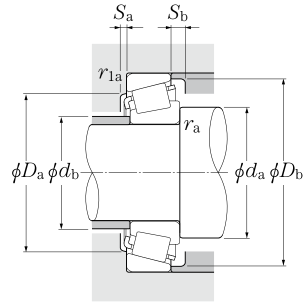
Metric series



d 110 ～ 140mm

d	D	T	B	C	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Bearing number [2][3]
Boundary dimensions (mm)							Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		
110	170	47	47	37	2.5	2	320	500	55.5	2 000	2 700	33022U
	180	56	56	43	2.5	2.5	400	610	66.5	1 900	2 600	33122UE1
	200	41	38	32	3	2.5	360	435	46.5	1 800	2 400	30222U
	200	56	53	46	3	2.5	465	605	65.0	1 800	2 400	32222U
	240	54.5	50	42	4	3	530	585	60.0	1 600	2 200	30322U
	240	63	57	38	4	3	480	535	55.0	1 600	2 200	31322XU
	240	84.5	80	65	4	3	785	970	99.5	1 600	2 200	32322U
120	165	29	29	23	1.5	1.5	180	294	32.0	2 000	2 600	32924XU
	165	29	27	23	1.5	1.5	131	205	22.5	2 000	2 600	○32924
	170	27	25	19.5	3	2	171	235	—	1 900	2 600	4T-T4CB120
	180	38	38	29	2.5	2	272	420	45.5	1 800	2 500	32024XU
	180	48	48	38	2.5	2.5	325	520	56.5	1 800	2 500	33024U
	200	62	62	48	2.5	2.5	510	760	80.5	1 800	2 300	33124U
	215	43.5	40	34	3	2.5	385	470	49.0	1 700	2 200	30224U
	215	61.5	58	50	3	2.5	510	680	71.5	1 700	2 200	32224U
	260	59.5	55	46	4	3	620	695	69.5	1 500	2 000	30324U
	260	68	62	42	4	3	570	655	66.0	1 500	2 000	31324XU
	260	90.5	86	69	4	3	905	1 130	114	1 500	2 000	32324U
130	180	32	32	25	2	1.5	215	350	37.5	1 800	2 400	32926XU
	180	32	30	26	2	2	157	252	26.9	1 800	2 400	○32926
	200	45	45	34	2.5	2	350	545	57.0	1 700	2 200	32026XU
	200	55	55	43	2.5	2.5	415	660	69.5	1 700	2 300	33026U
	230	43.75	40	34	4	3	415	505	51.5	1 500	2 000	30226U
	230	67.75	64	54	4	3	585	815	83.5	1 500	2 000	32226U
	280	63.75	58	49	5	4	830	830	81.0	1 400	2 000	∗ 30326UUTG
	280	72	66	44	5	4	670	780	77.0	1 400	1 800	31326XU
	280	98.75	93	78	4	4	1 140	1 240	122	1 400	2 000	∗ 32326UTG
140	190	32	32	25	2	1.5	221	375	39.0	1 700	2 200	32928XU
	195	29	27	21	3	3	208	299	—	1 700	2 200	4T-T4CB140
	210	45	45	34	2.5	2	365	580	60.0	1 600	2 100	32028XU
	210	56	56	44	2.5	2	435	715	74.0	1 600	2 100	33028U
	250	45.75	42	36	4	3	465	570	57.0	1 400	1 900	30228U
	250	71.75	68	58	4	3	675	920	92.0	1 400	1 900	32228U
	300	67.75	62	53	5	4	945	950	91.5	1 300	1 800	∗ 30328UUTG
	300	77	70	47	5	4	760	905	87.0	1 300	1 700	31328XU
	300	107.75	102	85	4	4	1 270	1 370	132	1 300	1 800	∗ 32328UTG

1) Smallest allowable dimension for chamfer dimension r or r_1. 2) Bearings with a ○ mark do not incorporate the subunit dimensions.
3) Bearing numbers marked "∗" designate ULTAGE series bearings.



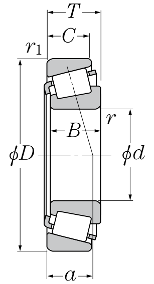
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	Mass kg (approx.)
	Installation-related dimensions (mm)									Load center (mm)	Constant	Axial load factors		Mass
2DE	122	121	160	148	162	7	10	2	2	33.5	0.29	2.09	1.15	3.84
3FE	122	121.5	170	150.5	174	9	13	2	2.5	44	0.42	1.43	0.79	5.52
3FB	124	128	188	170.5	188.5	6	9	2.5	2	40	0.42	1.43	0.79	5.19
3FC	124	125.5	188	167	192	6	10	2.5	2	47	0.42	1.43	0.79	7.44
2GB	128	141	226	203	222	6	12.5	3	2.5	45.5	0.35	1.74	0.96	11.1
7GB	128	137	226	184	225.5	7	25	3	2.5	76	0.83	0.73	0.40	11.9
2GD	128	136.5	226	195	224	6	19.5	3	2.5	57.5	0.35	1.74	0.96	17.6
2CC	128.5	129.5	156.5	150	160	6	6	1.5	1.5	29.5	0.35	1.72	0.95	1.76
	128.5	129.5	156.5	147.5	159.5	6	6	1.5	1.5	31	0.37	1.60	0.88	1.65
4CB	134	128.5	156	153	165	7	7.5	2.5	2.5	35	0.47	1.27	0.70	1.69
4DC	132	131	170	156	174.5	7	9	2	2	39	0.46	1.31	0.72	3.29
2DE	132	130	170	157	172	6	10	2	2.5	36	0.31	1.97	1.08	4.14
3FE	132	132.5	190	168	193	9	14	2	2.5	48	0.40	1.51	0.83	7.67
4FB	134	139.5	203	184.5	203	6	9.5	2.5	2	44	0.44	1.38	0.76	6.32
4FD	134	135.5	203	178	206	6	11.5	2.5	2	51.5	0.44	1.38	0.76	9.08
2GB	138	153	246	218	239	6	13.5	3	2.5	49	0.35	1.74	0.96	14.1
7GB	138	147	246	200	245	9	26	3	2.5	82.5	0.83	0.73	0.40	15.2
2GD	138	146.5	246	210	240.5	6	21.5	3	2.5	61.5	0.35	1.74	0.96	22.1
2CC	140	140.5	171.5	163	174	6	7	2	1.5	31.5	0.34	1.77	0.97	2.41
	140	141.5	170	161.5	174	6	6	2	2	34	0.37	1.60	0.88	2.24
4EC	142	144	190	173.5	193.5	8	11	2	2	43.5	0.43	1.38	0.76	5
2FE	142	143	190	173.5	193	8	12	2	2.5	42.5	0.34	1.76	0.97	6.09
4FB	148	151	216	199.5	218	7	9.5	3	2.5	45.5	0.44	1.38	0.76	7.05
4FD	148	147	216	190	220.5	7	13.5	3	2.5	57	0.44	1.38	0.76	11.3
2GB	152	165.5	262	235	257.5	8	14.5	4	3	53.5	0.35	1.74	0.96	17.4
7GB	152	154	262	214.5	263	9	28	4	3	87.5	0.83	0.73	0.40	19
	148	159	262	230	264	2.4	20	3	3	67.5	0.35	1.73	0.95	27.4
2CC	150	150	181.5	172.5	184	6	6	2	1.5	34	0.36	1.67	0.92	2.5
4CB	154	149	181	176	190	5	8	2.5	2.5	40.5	0.50	1.19	0.66	2.35
4DC	152	153	200	182.5	203	8	11	2	2	46	0.46	1.31	0.72	5.32
2DE	152	152	200	182.5	203	7	12	2	2	45.5	0.36	1.67	0.92	6.59
4FB	158	163	236	214	235	7	9.5	3	2.5	48.5	0.44	1.38	0.76	8.73
4FD	158	158.5	236	207	239.5	9	13.5	3	2.5	61	0.44	1.38	0.76	14.2
2GB	162	175.5	282	252	275.5	9	14.5	4	3	56.5	0.35	1.74	0.96	21.1
7GB	162	162.5	282	232	282.5	9	30	4	3	94	0.83	0.73	0.40	22.9
	158	168.5	282	244	281	1.5	20	3	3	74.5	0.35	1.73	0.95	33.5

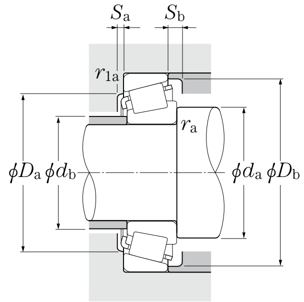
Metric series



d 150 ～ 200mm

d	D	T	B	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Bearing number[2) 3)]
Boundary dimensions (mm)							Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min^{-1})		
150	210	38	38	30	2.5	2	297	490	50.0	1 600	2 100	32930XU
	225	48	48	36	3	2.5	410	655	66.0	1 400	1 900	32030XU
	270	49	45	38	4	3	500	605	59.0	1 300	1 700	30230U
	270	77	73	60	4	3	775	1 070	105	1 300	1 700	32230U
	320	72	65	55	5	4	1 060	1 070	101	1 200	1 700	* 30330UUTG
	320	82	75	50	5	4	860	1 030	97.5	1 200	1 600	31330XU
	320	114	108	90	4	4	1 490	1 750	166	1 200	1 700	* 32330UTG
160	220	38	38	30	2.5	2	305	520	52.5	1 500	1 900	32932XU
	240	51	51	38	3	2.5	485	790	78.5	1 400	1 800	32032XU
	290	52	48	40	4	3	675	720	68.5	1 200	1 700	* 30232UUTG
	290	84	80	67	4	3	1 140	1 420	136	1 200	1 700	* 32232UUTG
	340	75	68	58	5	4	1 170	1 200	110	1 100	1 600	* 30332UUTG
	340	121	114	95	4	4	1 580	1 840	170	1 100	1 600	* 32332UTG
170	230	38	38	30	2.5	2	315	560	55.0	1 400	1 800	32934XU
	260	57	57	43	3	2.5	555	895	86.5	1 300	1 700	32034XU
	310	57	52	43	5	4	780	845	79.5	1 100	1 600	* 30234UUTG
	310	91	86	71	5	4	1 280	1 600	150	1 100	1 600	* 32234UUTG
	360	80	72	62	5	4	1 290	1 320	120	1 000	1 500	* 30334UUTG
	360	127	120	100	4	4	1 680	1 940	177	1 000	1 500	* 32334UTG
180	250	45	45	34	2.5	2	390	700	68.0	1 300	1 700	32936XU
	280	64	64	48	3	2.5	825	1 170	111	1 200	1 700	* 32036XUUTG
	320	57	52	43	5	4	805	890	82.5	1 100	1 500	* 30236UUTG
	320	91	86	71	5	4	1 320	1 690	157	1 100	1 500	* 32236UUTG
	380	83	75	64	4	4	1 170	1 190	107	960	1 400	* 30336UTG
	380	134	126	106	4	4	1 850	2 150	192	960	1 400	* 32336UTG
190	260	45	45	34	2.5	2	390	710	68.0	1 200	1 600	32938XU
	260	45	42	36	2.5	2.5	310	525	50.5	1 200	1 600	○32938
	290	64	64	48	3	2.5	840	1 210	113	1 100	1 600	* 32038XUUTG
	340	60	55	46	5	4	920	1 000	91.5	1 000	1 400	* 30238UUTG
	340	97	92	75	5	4	1 480	1 850	169	1 000	1 400	* 32238UUTG
	400	86	78	65	5	5	1 200	1 200	106	900	1 300	* 30338UUTG
	400	140	132	109	5	5	2 040	2 390	211	900	1 300	* 32338UTG
200	280	51	51	39	3	2.5	620	895	84.0	1 100	1 600	* 32940XUUTG
	310	70	70	53	3	2.5	1 030	1 470	135	1 100	1 500	* 32040XUUTG

1) Smallest allowable dimension for chamfer dimension r or r_1. 2) Bearings with a ○ mark do not incorporate the subunit dimensions.
3) Bearing numbers marked "*" designate ULTAGE series bearings.



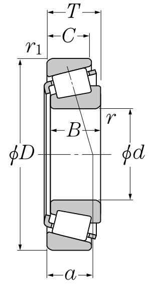
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	Mass kg (approx.)
	Installation-related dimensions (mm)									Load center (mm)	Constant	Axial load factors		
2DC	162	162	200	189.5	202	7	8	2	2	36.5	0.33	1.83	1.01	3.93
4EC	164	164	213	195	217.5	8	12	2.5	2	49.5	0.46	1.31	0.72	6.45
4GB	168	175	256	230	251.5	7	11	3	2.5	51.5	0.44	1.38	0.76	11
4GD	168	169	256	222	256	8	17	3	2.5	64.5	0.44	1.38	0.76	18
2GB	172	188.5	302	270	294	8	17	4	3	61	0.35	1.74	0.96	25.4
7GB	172	173.5	302	248	302	9	32	4	3	100.5	0.83	0.73	0.40	27.7
	168	182.5	302	254	298	4.3	24	3	3	80	0.37	1.60	0.88	42.1
2DC	172	172	210	199	213	7	8	2	2	38.5	0.35	1.73	0.95	4.14
4EC	174	174.5	228	208	231.5	8	13	2.5	2	52.5	0.46	1.31	0.72	7.86
4GB	178	188.5	276	248	271	8	12	3	2.5	55.5	0.44	1.38	0.76	13.4
4GD	178	181	276	238	277	10	17	3	2.5	70	0.44	1.38	0.76	23.9
2GB	182	200.5	322	286.5	312.5	10	17	4	3	64	0.35	1.74	0.96	29.8
	178	196.5	322	272	318.5	2.3	26	3	3	85	0.37	1.60	0.88	48.9
3DC	182	181	220	208	223.5	7	8	2	2	42.5	0.38	1.56	0.86	4.4
4EC	184	187	248	224.5	250	10	14	2.5	2	56	0.44	1.35	0.74	10.6
4GB	192	202	292	265.5	290.5	8	14	4	3	60.5	0.44	1.38	0.76	16.9
4GD	192	194	292	255	297	10	20	4	3	75	0.44	1.38	0.76	29.2
2GB	192	212.5	342	305	332.5	10	18	4	3	68	0.35	1.74	0.96	35.2
	188	208	342	287	336	1.5	27	3	3	89.5	0.37	1.60	0.88	56.5
4DC	192	192	240	219.5	241.5	8	11	2	2	54	0.48	1.25	0.69	6.55
3FD	194	199	268	243	269	10	16	2.5	2	59.5	0.42	1.42	0.78	14.5
4GB	202	210.5	302	274	299.5	9	14	4	3	63	0.45	1.33	0.73	17.8
4GD	202	202	302	263	305.5	10	20	4	3	77.5	0.45	1.33	0.73	30.4
	198	227.5	362	314	345	1.5	19	3	3	72.5	0.37	1.60	0.88	38.9
	198	219	362	305	357	2.4	28	3	3	95	0.37	1.60	0.88	67.7
4DC	202	201.5	250	230	251	8	11	2	2	55	0.48	1.26	0.69	6.82
	202	205	248	233	250.5	8	9	2	2	48.5	0.37	1.60	0.88	6.27
4FD	204	206.5	278	252	281	10	16	2.5	2	62.5	0.44	1.36	0.75	15
4GB	212	223	322	293	320.5	9	14	4	3	64	0.44	1.38	0.76	21.5
4GD	212	214	322	283	325.5	11	22	4	3	87.5	0.44	1.38	0.76	36.1
	212	241	378	335	366.5	2.3	21	4	4	74.5	0.37	1.60	0.88	43.6
	212	233	378	320	373.5	1.5	31	4	4	100	0.37	1.60	0.88	77
3EC	214	213.5	268	251.5	272	9	12	2.5	2	53.5	0.39	1.52	0.84	9.28
4FD	214	218.5	298	269	298.5	11	17	2.5	2	66.5	0.43	1.39	0.77	19.2

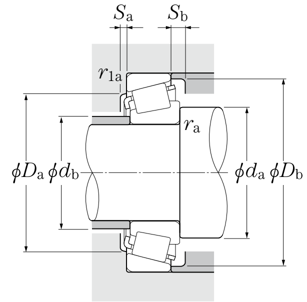
Metric series



d 200 ~ 320mm

Boundary dimensions (mm) d	D	T	B	C	$r_{s\,min}$ [1]	$r_{1s\,min}$ [1]	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min^{-1}) Grease lubrication	Oil lubrication	Bearing number [2] [3]
200	360	64	58	48	5	4	1 010	1 110	99.0	950	1 300	* **30240UUTG**
	360	104	98	82	5	4	1 690	2 130	191	950	1 300	* **32240UUTG**
	420	89	80	67	5	5	1 340	1 370	119	850	1 200	* **30340UTG**
	420	146	138	115	5	5	2 240	2 650	230	850	1 200	* **32340UTG**
220	300	51	51	39	3	2.5	615	950	87.0	1 000	1 500	* **32944XUUTG**
	300	51	48	41	2.5	2.5	385	670	61.0	1 000	1 400	○ **32944E1**
	340	76	76	57	4	3	1 180	1 690	152	960	1 400	* **32044XUUTG**
	400	72	65	54	4	4	1 050	1 220	106	840	1 200	* **30244UTG**
	400	114	108	90	4	4	1 780	2 410	209	840	1 200	* **32244UTG**
	460	97	88	73	5	5	1 620	1 690	142	770	1 100	* **30344UTG**
	460	154	145	122	5	5	2 590	3 050	259	770	1 100	* **32344UTG**
240	320	51	51	39	3	2.5	625	1 000	90.0	940	1 300	* **32948XUUTG**
	360	76	76	57	4	3	1 190	1 760	154	870	1 200	* **32048XUUTG**
	440	79	72	60	4	4	1 250	1 480	125	760	1 100	* **30248UTG**
	440	127	120	100	4	4	2 180	2 750	232	760	1 100	* **32248UTG**
	500	105	95	80	5	5	1 900	2 000	165	690	990	* **30348UTG**
260	360	63.5	63.5	48	3	2.5	905	1 430	124	860	1 200	* **32952XUUTG**
	400	87	87	65	5	4	1 540	2 270	193	800	1 100	* **32052XUUTG**
	480	89	80	67	5	5	1 500	1 810	149	690	990	* **30252UTG**
	480	137	130	106	5	5	2 410	3 350	275	690	990	* **32252UTG**
280	380	63.5	63.5	48	3	2.5	930	1 520	129	790	1 100	* **32956XUUTG**
	420	87	87	65	5	4	1 570	2 350	197	740	1 000	* **32056XUUTG**
	500	89	80	67	5	5	1 590	1 910	155	630	900	* **30256UTG**
	500	137	130	106	5	5	2 530	3 500	283	630	900	* **32256UTG**
300	420	76	76	57	4	3	1 290	2 090	173	720	1 000	* **32960XUUTG**
	460	100	100	74	5	4	1 920	2 830	232	680	960	* **32060XUUTG**
	540	96	85	71	5	5	1 820	2 220	176	580	830	* **30260UTG**
	540	149	140	115	5	5	2 950	4 100	325	580	830	* **32260UTG**
320	440	76	76	57	4	3	1 300	2 150	176	670	960	* **32964XUUTG**
	440	76	72	63	3	3	955	1 880	153	670	900	○ **32964E1**
	480	100	100	74	5	4	1 940	2 940	237	630	900	* **32064XUUTG**
	580	104	92	75	5	5	2 130	2 580	201	540	770	* **30264UTG**
	580	159	150	125	5	5	3 350	4 650	360	540	770	* **32264UTG**

1) Smallest allowable dimension for chamfer dimension r or r_1. 2) Bearings with a ○ mark do not incorporate the subunit dimensions.
3) Bearing numbers marked "*" designate ULTAGE series bearings.



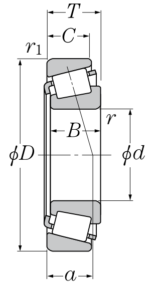
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	Installation-related dimensions (mm) d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
4GB	222	235	342	311	338	10	16	4	3	70	0.44	1.38	0.76	25.2
3GD	222	224.5	342	299	342.5	11	22	4	3	85	0.41	1.48	0.81	43.8
	222	251	398	350	382.5	5.3	22	4	4	77	0.37	1.60	0.88	51.5
	222	242	398	335	391.5	3.2	31	4	4	105	0.37	1.60	0.88	89.6
3EC	234	233.5	288	269.5	291	10	12	2.5	2	59.5	0.43	1.41	0.78	9.98
	232	238	288	270	291	10	10	2	2	57	0.39	1.55	0.85	9.47
4FD	238	239.5	326	293.5	326	12	19	3	2.5	72.5	0.43	1.39	0.77	24.9
	238	262.5	382	334	368	3.4	18	3	3	82	0.49	1.23	0.68	34.8
	238	249	382	323	380.5	4.4	24	3	3	102	0.49	1.23	0.68	59.8
	242	270	438	383	418.5	4.2	24	4	4	86.5	0.37	1.60	0.88	66.6
	242	262.5	438	371	431	1.5	32	4	4	112	0.37	1.60	0.88	110
4EC	254	252.5	308	289	312.5	10	12	2.5	2	65.5	0.46	1.31	0.72	10.9
4FD	258	258.5	346	311.5	347	12	19	3	2.5	78	0.46	1.31	0.72	26.5
	258	284.5	422	368	406	3.9	19	3	3	91	0.49	1.23	0.68	47.7
	258	270.5	422	365	421.5	4.1	27	3	3	107	0.43	1.39	0.77	78.9
	262	294.5	478	417	456	8.1	25	4	4	94	0.37	1.60	0.88	88.3
3EC	274	278	348	323	348.5	11	15	2.5	2	69.5	0.41	1.48	0.81	18.7
4FC	282	283.5	382	346	383	14	22	4	3	85.5	0.43	1.38	0.76	39
	282	307	458	396	438.5	4.2	22	4	4	99.5	0.49	1.23	0.68	63.4
	282	297	458	385	453	2.9	31	4	4	121.5	0.49	1.23	0.68	100
4EC	294	297	368	341.5	369.5	11	15	2.5	2	75	0.43	1.39	0.76	19.9
4FC	302	301	402	363	403	14	22	4	3	90.5	0.46	1.31	0.72	40.5
	302	324.5	478	422	464.5	5.9	22	4	4	102	0.49	1.23	0.68	66.5
	302	312	478	405	473	6.4	31	4	4	123.5	0.49	1.23	0.68	110
3FD	318	322	406	377.5	406.5	13	19	3	2.5	80	0.39	1.52	0.84	31.4
4GD	322	324.5	442	398.5	441.5	15	26	4	3	98	0.43	1.38	0.76	57.2
	322	349.5	518	453	498	4.9	25	4	4	111	0.49	1.23	0.68	83.5
	322	339	518	438	511.5	2.6	34	4	4	135.5	0.49	1.23	0.68	140
3FD	338	341	426	395.5	427	13	19	3	2.5	85	0.42	1.44	0.79	32.8
	334	345.5	426	392	424.5	13	13	3	2.5	85	0.39	1.55	0.85	33.2
4GD	342	344.5	462	418.5	463	15	26	4	3	104	0.46	1.31	0.72	60.2
	342	372	558	485	531.5	4.7	29	4	4	118.5	0.47	1.27	0.70	100
	342	363	558	473	551	3.9	34	4	4	142	0.47	1.27	0.70	170

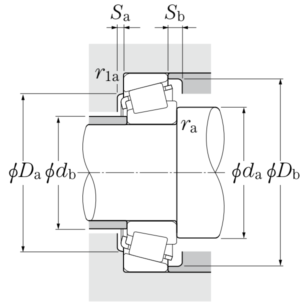
Metric series



d 340 ～ 440mm

Boundary dimensions (mm) d	D	T	B	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating dynamic (kN) C_r	static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 2) 3)
340	460	76	76	57	4	3	1 340	2 270	183	630	900	∗ 32968XUUTG
	460	76	72	63	3	3	1 010	1 980	159	630	900	○ 32968E1
	520	112	106	90	5	5	2 120	3 150	249	590	840	∗ 32068UTG
360	480	76	76	57	4	3	1 350	2 330	185	590	840	∗ 32972XUUTG
	540	112	106	90	5	5	2 230	3 300	258	550	780	∗ 32072UTG
380	520	87	82	72	4	4	1 460	2 500	194	550	790	∗ 32976UTG
	560	112	106	90	5	5	2 460	3 800	292	520	740	∗ 32076UTG
400	540	87	82	71	4	4	1 530	2 710	207	520	740	∗ 32980UTG
	600	125	118	100	5	5	2 790	4 250	320	490	700	∗ 32080UTG
420	560	87	82	71	4	4	1 570	2 840	215	490	700	∗ 32984UTG
	620	125	118	100	6	5	2 920	4 550	340	460	660	∗ 32084UTG
440	600	100	95	82	4	4	2 060	3 450	258	470	670	∗ 32988UTG
	650	130	122	104	6	6	3 250	5 000	365	440	620	∗ 32088UTG

1) Smallest allowable dimension for chamfer dimension r or r_1. 2) Bearings with a ○ mark do not incorporate the subunit dimensions.
3) Bearing numbers marked "∗" designate ULTAGE series bearings.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

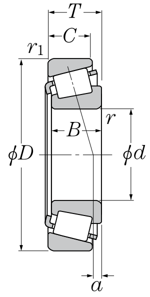
$P_{0r} = 0.5F_r + Y_0F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

For values of e, Y_2 and Y_0 see the table below.

ISO Dimension series	Installation-related dimensions (mm) d_a Min.	d_b Max.	D_a Max.	D_a Min.	D_b Min.	S_a Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
4FD	358	360	446	414	447.5	13	19	3	2.5	90.5	0.44	1.37	0.75	34.5
	354	364	446	413	445.5	13	13	3	2.5	87	0.39	1.55	0.85	34
	362	368.5	498	452	496	3.5	22	4	4	103.5	0.37	1.60	0.88	78.5
4FD	378	379.5	466	431.5	467.5	13	19	3	2.5	96.5	0.46	1.31	0.72	36.3
	382	388	518	476	520	5.5	22	4	4	106	0.37	1.60	0.88	83
	398	404.5	502	464.5	503	4	15	3	3	101	0.40	1.49	0.82	51.3
	402	406.5	538	495	539	6.5	22	4	4	109.5	0.37	1.60	0.88	89.1
	418	422.5	522	482	521.5	4	16	3	3	106	0.42	1.43	0.79	54
	422	428.5	578	526	575	5	25	4	4	119	0.37	1.60	0.88	110
	438	442	542	501.5	543	3.5	16	3	3	111.5	0.44	1.37	0.76	56.2
	448	449.5	598	549	598	6.5	25	4	4	120	0.37	1.60	0.88	120
	458	465.5	582	543	580.5	3.5	18	3	3	106	0.35	1.70	0.93	76
	468	469.5	622	576.5	627.5	5	26	3	5	127	0.37	1.60	0.88	140

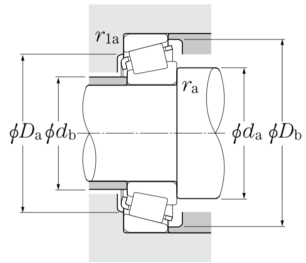
Inch series



d 12.700 ～ 22.225mm

Boundary dimensions mm					Basic load rating kN		Allowable speed min⁻¹	
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication
12.700	34.988	10.998	10.988	8.730	13.7	11.6	12 000	16 000
14.989	34.988	10.998	10.988	8.730	13.7	11.6	12 000	16 000
15.875	41.275	14.288	14.681	11.112	22.6	18.7	10 000	13 000
	42.862	14.288	14.288	9.525	19.5	17.5	8 700	12 000
	42.862	16.670	16.670	13.495	29.6	26.0	9 800	13 000
	47.000	14.381	14.381	11.112	26.6	24.2	8 600	11 000
	49.225	19.845	21.539	14.288	42.5	39.0	8 500	11 000
16.993	47.000	14.381	14.381	11.112	26.6	24.2	8 600	11 000
17.462	39.878	13.843	14.605	10.668	26.4	24.2	10 000	13 000
19.050	39.992	12.014	11.153	9.525	14.2	12.8	10 000	13 000
	45.237	15.494	16.637	12.065	31.5	28.6	8 900	12 000
	47.000	14.381	14.381	11.112	26.6	24.2	8 600	11 000
	49.225	18.034	19.050	14.288	42.5	39.0	8 500	11 000
	49.225	19.845	21.539	14.288	42.5	39.0	8 500	11 000
	49.225	21.209	19.050	17.462	42.5	39.0	8 500	11 000
	53.975	22.225	21.839	15.875	44.5	39.0	8 000	11 000
	56.896	19.368	19.837	15.875	47.5	46.5	7 200	9 600
19.987	47.000	14.381	14.381	11.112	26.6	24.2	8 600	11 000
20.000	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
20.625	49.225	19.845	21.539	14.288	42.5	39.0	8 500	11 000
20.638	49.225	19.845	19.845	15.875	41.5	39.0	8 200	11 000
21.430	50.005	17.526	18.288	13.970	42.0	39.0	8 000	11 000
21.986	45.974	15.494	16.637	12.065	33.0	34.0	8 400	11 000
22.225	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
	50.005	17.526	18.288	13.970	42.0	39.0	8 000	11 000
	52.388	19.368	20.168	14.288	45.0	43.0	7 600	10 000
	53.975	19.368	20.168	14.288	45.0	43.0	7 600	10 000

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{0r} = 0.5F_r + Y_0F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

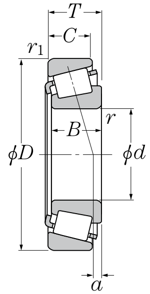
For values of e, Y_2 and Y_0 see the table below.

Bearing number [1]	Installation-related dimensions mm						Load center mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-A4050/A4138	18.5	17	29	32	1.3	1.3	2.5	0.45	1.32	0.73	0.053
4T-A4059†/A4138	19.5	19	29	32	0.8	1.3	2.5	0.45	1.32	0.73	0.049
4T-03062/03162	21.5	20	34	37.5	1.3	2	5.4	0.31	1.93	1.06	0.093
4T-11590/11520	24.5	22.5	34.5	39.5	1.5	1.5	1.2	0.70	0.85	0.47	0.103
4T-17580/17520	23	21	36.5	39	1.5	1.5	5.8	0.33	1.81	1.00	0.123
4T-05062/05185	23.5	21	40.5	42.5	1.5	1.3	4.2	0.36	1.68	0.92	0.131
4T-09062/09195	22	21.5	42	44.5	0.8	1.3	9.4	0.27	2.26	1.24	0.203
4T-05066/05185	24.5	22	40.5	42.5	1.5	1.3	4.2	0.36	1.68	0.92	0.13
4T-LM11749/LM11710	24	22	34	37	1.3	1.3	5.3	0.29	2.10	1.15	0.084
4T-A6075/A6157	24	23	34	37	1	1.3	1.5	0.53	1.14	0.63	0.065
4T-LM11949/LM11910	25	23.5	39.5	41.5	1.3	1.3	5.6	0.30	2.00	1.10	0.123
4T-05075/05185	25	23.5	40.5	42.5	1.3	1.3	4.2	0.36	1.68	0.92	0.121
4T-09067/09195	25.5	24	42	44.5	1.3	1.3	7.6	0.27	2.26	1.24	0.179
4T-09078/09195	25.5	24	42	44.5	1.3	1.3	9.4	0.27	2.26	1.24	0.19
4T-09067/09196	25.5	24	41.5	44.5	1.3	1.5	7.6	0.27	2.26	1.24	0.198
4T-21075/21212††	31.5	26	43	50	1.5	2.3	5.6	0.59	1.02	0.56	0.248
4T-1775/1729	27	25	49	51	1.5	1.3	6.5	0.31	1.95	1.07	0.268
4T-05079†/05185	26.5	24	40.5	42.5	1.5	1.3	4.2	0.36	1.68	0.92	0.118
4T-07079/07196	27.5	26	44.5	47	1.5	1	3.0	0.40	1.49	0.82	0.138
4T-09081/09195	27.5	25.4	42	44.5	1.5	1.3	9.4	0.27	2.26	1.24	0.18
4T-12580/12520	28.5	26	42.5	45.5	1.5	1.5	7.1	0.32	1.86	1.02	0.183
4T-M12649/M12610	29.5	27.5	44	46	1.3	1.3	6.4	0.28	2.16	1.19	0.169
4T-LM12749†/LM12711††	27.5	26	40	42.5	1.3	1.3	5.4	0.31	1.96	1.08	0.123
4T-07087/07196	28.5	27	44.5	47	1.3	1	3.0	0.40	1.49	0.82	0.128
4T-M12648/M12610	28.5	26.5	44	46	1.3	1.3	6.4	0.28	2.16	1.19	0.165
4T-1380/1328	29.5	27	45	48.5	1.5	1.5	7.4	0.29	2.05	1.13	0.196
4T-1380/1329††	29.5	27	46	49	1.5	1.5	7.4	0.29	2.05	1.13	0.22

1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.

Tapered Roller Bearings

Inch series

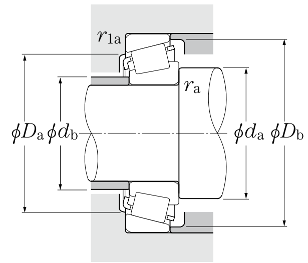


d 22.225 ~ 28.575mm

Boundary dimensions (mm)					Basic load rating (kN)		Allowable speed (min^{-1})	
					dynamic	static	Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
22.225	56.896	19.368	19.837	15.875	47.5	46.5	7 200	9 600
	57.150	22.225	22.225	17.462	52.5	49.5	7 100	9 500
22.606	47.000	15.500	15.500	12.000	30.5	32.5	8 200	11 000
23.812	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
	50.292	14.224	14.732	10.668	32.0	34.0	7 400	9 900
	56.896	19.368	19.837	15.875	47.5	46.5	7 200	9 600
24.981	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
25.000	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
25.159	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
25.400	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
	50.005	13.495	14.260	9.525	28.8	27.9	7 500	10 000
	50.292	14.224	14.732	10.668	32.0	34.0	7 400	9 900
	51.994	15.011	14.260	12.700	28.8	27.9	7 500	10 000
	56.896	19.368	19.837	15.875	47.5	46.5	7 200	9 600
	57.150	19.431	19.431	14.732	47.0	48.5	6 900	9 200
	61.912	19.050	20.638	14.288	52.0	54.0	6 100	8 200
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200
	64.292	21.433	21.433	16.670	57.5	64.5	6 100	8 100
	65.088	22.225	21.463	15.875	52.0	50.5	5 700	7 600
	66.421	23.812	25.433	19.050	71.5	72.5	6 200	8 200
26.157	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200
26.162	66.421	23.812	25.433	19.050	71.5	72.5	6 200	8 200
26.988	50.292	14.224	14.732	10.668	32.0	34.0	7 400	9 900
	60.325	19.842	17.462	15.875	44.0	45.5	6 700	8 900
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200
	66.421	23.812	25.433	19.050	71.5	72.5	6 200	8 200
28.575	56.896	19.845	19.355	15.875	45.0	44.5	6 700	8 900
	57.150	17.462	17.462	13.495	44.0	45.5	6 700	8 900

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.

Tapered Roller Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{0r} = 0.5F_r + Y_0F_a$

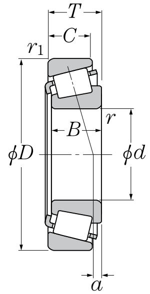
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

For values of e, Y_2 and Y_0 see the table below.

Bearing number [1]	Installation-related dimensions (mm)						Load center (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-1755/1729	29	27.5	49	51	1.3	1.3	6.5	0.31	1.95	1.07	0.252
4T-1280/1220	29.5	29	49	52	0.8	1.5	7.1	0.35	1.73	0.95	0.287
4T-LM72849/LM72810	30	28	40.5	44	1.5	1	3.0	0.47	1.27	0.70	0.125
4T-07093/07196	30.5	28.5	44.5	47	1.5	1	3	0.40	1.49	0.82	0.121
4T-L44640/L44610	30.5	28.5	44.5	47	1.5	1.3	3.4	0.37	1.60	0.88	0.133
4T-1779/1729	29.5	28.5	49	51	0.8	1.3	6.5	0.31	1.95	1.07	0.244
4T-07098/07196	31	29	44.5	47	1.5	1	3.0	0.40	1.49	0.82	0.121
4T-07097/07196	31	29	44.5	47	1.5	1	3.0	0.40	1.49	0.82	0.116
4T-07096/07196	31.5	29.5	44.5	47	1.5	1	3.0	0.40	1.49	0.82	0.12
4T-07100/07196	30.5	29.5	44.5	47	1	1	3.0	0.40	1.49	0.82	0.114
4T-07100S/07196	31.5	29.5	44.5	47	1.5	1	3.0	0.40	1.49	0.82	0.114
4T-L44643/L44610	32	30	44.5	47	1.3	1.3	3.4	0.37	1.60	0.88	0.13
4T-07100/07204	30.5	29.5	45	48	1	1.3	3.0	0.40	1.49	0.82	0.141
4T-1780/1729	30.5	30	49	51	0.8	1.3	6.5	0.31	1.95	1.07	0.234
4T-M84548/M84510	38.5	33	48.5	54	1.5	1.5	3.4	0.55	1.10	0.60	0.244
4T-15101/15243	32.5	31.5	54	58	0.8	2	6.0	0.35	1.71	0.94	0.301
4T-15100/15245	38	31.5	55	58	3.5	1.3	6.0	0.35	1.71	0.94	0.301
4T-15102/15245	34	31.5	55	58	1.5	1.3	6.0	0.35	1.71	0.94	0.303
4T-M86643/M86610	38	36.5	54	60	1.5	1.5	3.3	0.55	1.10	0.60	0.372
4T-23100/23256	39	34.5	53	63	1.5	1.5	2.0	0.73	0.82	0.45	0.363
4T-2687/2631	33.5	31.5	58	60	1.3	1.3	9.3	0.25	2.36	1.30	0.444
4T-15103/15245	33	32.5	55	58	0.8	1.3	6.0	0.35	1.71	0.94	0.3
4T-2682/2631	34.5	32	58	60	1.5	1.3	9.3	0.25	2.36	1.30	0.436
4T-L44649†/L44610	37.5	31	44.5	47	3.5	1.3	3.4	0.37	1.60	0.88	0.12
4T-15580†/15523	38.5	32	51	54	3.5	1.5	5.0	0.35	1.73	0.95	0.261
4T-15106†/15245	33.5	33	55	58	0.8	1.3	6.0	0.35	1.71	0.94	0.291
4T-2688†/2631	35	33	58	60	1.5	1.3	9.3	0.25	2.36	1.30	0.429
4T-1985/1930	34	33.5	51	54	0.8	0.8	5.9	0.33	1.82	1.00	0.217
4T-15590/15520	39.5	33.5	51	53	3.5	1.5	5.0	0.35	1.73	0.95	0.197

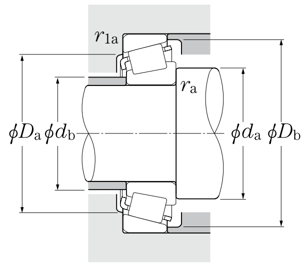
1) As for the maximum value for inner ring bore diameters of bearings whose bearing numbers are marked with "†" (inner ring), the precision class is an integer for class 4 and class 2 bearings only.

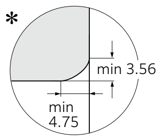
Inch series
J series



d 28.575 ～ 31.750mm

Tapered Roller Bearings NTN



*


Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

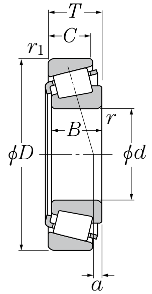
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e,
Y_2 and Y_0 see the table below.

Boundary dimensions (mm) d	D	T	B	C	Basic load rating dynamic (kN) C_r	static C_{0r}	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 1) 2)	Installation-related dimensions (mm) d_a	d_b	D_a	D_b	r_{as} 3) Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass kg (approx.)
28.575	58.738	19.050	19.355	15.080	45.0	44.5	6 700	8 900	4T-1985/1932	34	33.5	52	54	0.8	1.3	5.9	0.33	1.82	1.00	0.231
	60.325	19.842	17.462	15.875	44.0	45.5	6 700	8 900	4T-15590/15523	39.5	33.5	51	54	3.5	1.5	5.0	0.35	1.73	0.95	0.25
	60.325	19.845	19.355	15.875	45.0	44.5	6 700	8 900	4T-1985/1931	34	33.5	52	55	0.8	1.3	5.9	0.33	1.82	1.00	0.256
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15112/15245	40	34	55	58	3.5	1.3	6.0	0.35	1.71	0.94	0.279
	64.292	21.433	21.433	16.670	57.5	64.5	6 100	8 100	4T-M86647/M86610	40	31	54	60	1.5	1.5	3.3	0.55	1.10	0.60	0.348
	66.421	23.812	25.433	19.050	71.5	72.5	6 200	8 200	4T-2689/2631	37.5	36	58	60	1.3	1.3	9.3	0.25	2.36	1.30	0.363
	68.262	22.225	22.225	17.462	63.0	67.0	5 800	7 700	4T-02474/02420	36.5	36	59	63	0.8	1.5	5.2	0.42	1.44	0.79	0.41
	68.262	22.225	23.812	17.462	64.0	65.5	5 700	7 700	4T-2474/2420	36	35	60	63	0.8	1.5	6.5	0.34	1.77	0.97	0.38
	69.850	23.812	25.357	19.050	76.5	81.5	5 700	7 600	4T-2578/2523	39	35	61	64	2.3	1.3	9.1	0.27	2.19	1.21	0.484
	72.626	24.608	24.257	17.462	64.5	55.5	5 800	7 700	4T-41125/41286	48	36.5	61	68	4.8	1.5	3.7	0.60	1.00	0.55	0.475
	73.025	22.225	22.225	17.462	62.5	68.0	5 300	7 000	4T-02872/02820	37.5	37	62	68	0.8	3.3	3.9	0.45	1.32	0.73	0.481
29.000	50.292	14.224	14.732	10.668	31.0	35.5	7 200	9 600	4T-L45449/L45410	40	33.5	44.5	48	3.5	1.3	3.5	0.37	1.62	0.89	0.113
29.367	66.421	23.812	25.433	19.050	71.5	72.5	6 200	8 200	4T-2690/2631	41	35	58	60	3.5	1.3	9.3	0.25	2.36	1.30	0.407
29.987	62.000	16.002	16.566	14.288	43.0	42.0	6 300	8 400	4T-17118†/17244	38.5	36	54	57	1.5	1.5	3.3	0.38	1.57	0.86	0.229
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15117†/15245	36.5	35	55	58	1.3	1.3	6.0	0.35	1.71	0.94	0.27
30.000	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400	4T-14117A/14276	44	41	60	63	3.5	1.3	4.1	0.38	1.57	0.86	0.37
	72.000	29.370	27.783	23.020	80.0	97.0	5 400	7 100	#4T-JHM88540/JHM88513	44.5	42.5	58	69	1.3	3.3	6.0	0.55	1.10	0.60	0.62
30.112	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15116/15245	36	35.5	55	58	0.8	1.3	6.0	0.35	1.71	0.94	0.27
30.162	62.000	16.002	16.566	14.288	43.0	42.0	6 300	8 400	4T-17119/17244	37	34.5	54	57	1.5	1.5	3.3	0.38	1.57	0.86	0.228
	64.292	21.433	21.433	16.670	57.5	64.5	6 100	8 100	4T-M86649/M86610	44	38	54	60	1.5	1.5	3.3	0.55	1.10	0.60	0.336
	69.850	23.812	25.357	19.050	76.5	81.5	5 700	7 600	4T-2558/2523	40	36.5	61	64	2.3	1.3	9.1	0.27	2.19	1.21	0.467
	72.626	30.162	29.997	23.812	93.5	98.0	5 500	7 300	4T-3187/3120	39	38.5	61	67	0.8	3.3	9.9	0.33	1.80	0.99	0.621
30.213	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15118/15245	43	36.5	55	58	3.5	1.3	6.0	0.35	1.71	0.94	0.266
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15119/15245	37.5	35.5	55	58	1.5	1.3	6.0	0.35	1.71	0.94	0.269
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15120/15245	36	35.5	55	58	0.8	1.3	6.0	0.35	1.71	0.94	0.269
30.226	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400	4T-14116/14274	38.5	38	59	63	0.8	3.3	4.1	0.38	1.57	0.86	0.369
	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400	4T-14116/14276	38.5	38	60	63	0.8	1.3	4.1	0.38	1.57	0.86	0.371
31.750	59.131	15.875	16.764	11.811	38.5	41.0	6 300	8 400	4T-LM67048/LM67010	42.5	36	52	56	*	1.3	2.8	0.41	1.46	0.80	0.183
	62.000	18.161	19.050	14.288	52.0	54.0	6 100	8 200	4T-15123/15245	44	38	55	58	*	1.3	5.1	0.35	1.71	0.94	0.249
	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200	4T-15125/15245	42.5	36.5	55	58	3.5	1.3	6.0	0.35	1.71	0.94	0.254

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner ring bore diameters of bearings whose bearing numbers are marked with "†" (inner ring), the precision class is an integer for class 4 and class 2 bearings only.

2) Bearing numbers marked "#" designate J-series bearings. The tolerance of these bearings is listed in Table 6.8 on page A-66 to A-67.
3) Chamfer dimensions of the bearings marked "∗" are shown in the above drawings.

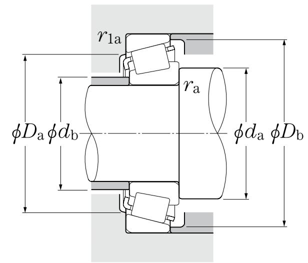
Inch series
J series

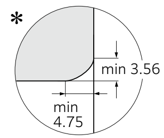


d 31.750 ～ 34.925mm

Boundary dimensions					Basic load rating		Allowable speed	
mm					dynamic kN	static	min⁻¹ Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
31.750	62.000	19.050	20.638	14.288	52.0	54.0	6 100	8 200
	66.421	25.400	25.357	20.638	76.5	81.5	5 700	7 600
	68.262	22.225	22.225	17.462	63.0	67.0	5 800	7 700
	68.262	22.225	22.225	17.462	63.0	67.0	5 800	7 700
	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400
	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400
	69.850	23.812	25.357	19.050	76.5	81.5	5 700	7 600
	69.850	23.812	25.357	19.050	76.5	81.5	5 700	7 600
	72.626	30.162	29.997	23.812	93.5	98.0	5 500	7 300
	72.626	30.162	29.997	23.812	93.5	98.0	5 500	7 300
	73.025	22.225	22.225	17.462	62.5	68.0	5 300	7 000
	73.025	22.225	23.812	17.462	69.5	75.5	5 200	7 000
	73.025	29.370	27.783	23.020	80.0	97.0	5 400	7 100
	73.812	29.370	27.783	23.020	80.0	97.0	5 400	7 100
	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800
	79.375	29.370	29.771	23.812	103	114	4 900	6 600
33.338	68.262	22.225	22.225	17.462	62.5	71.0	5 700	7 500
	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400
	69.850	23.812	25.357	19.050	76.5	81.5	5 700	7 600
	72.626	30.162	29.997	23.812	93.5	98.0	5 500	7 300
	73.025	29.370	27.783	23.020	80.0	97.0	5 400	7 100
	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800
	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800
	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800
	79.375	25.400	24.074	17.462	72.5	67.0	5 200	6 900
34.925	65.088	18.034	18.288	13.970	51.5	56.0	5 700	7 600
	65.088	18.034	18.288	13.970	51.5	56.0	5 700	7 600
	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400
	72.233	25.400	25.400	19.842	72.0	84.5	5 400	7 200
	72.238	20.638	20.638	15.875	53.0	58.5	5 300	7 000
	73.025	22.225	22.225	17.462	62.5	68.0	5 300	7 000
	73.025	22.225	22.225	17.462	62.5	68.0	5 300	7 000
	73.025	22.225	23.812	17.462	69.5	75.5	5 200	7 000
	73.025	23.812	24.608	19.050	78.5	85.0	5 300	7 100
	73.025	23.812	24.608	19.050	78.5	85.0	5 300	7 100
	73.025	23.812	25.654	19.050	81.0	90.5	5 100	6 800
	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

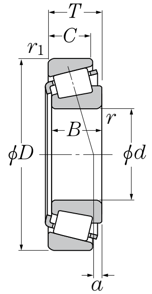
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

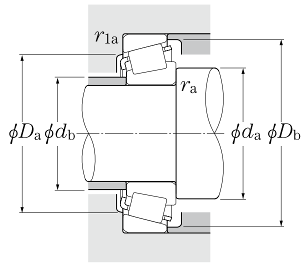
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e,
Y_2 and Y_0 see the table below.

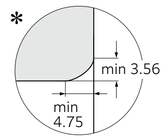
Bearing number [1]	Installation-related dimensions						Load center	Constant	Axial load factors		Mass
	mm						mm				kg
	d_a	d_b	D_a	D_b	r_{as} [1] Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-15126/15245	38.5	38	55	58	0.8	1.3	6.0	0.35	1.71	0.94	0.257
4T-2580/2520	38.5	37.5	56.9	62.5	0.8	3.3	9.1	0.27	2.19	1.21	0.41
4T-02475/02420	44.5	38.5	59	63	3.5	1.5	5.2	0.42	1.44	0.79	0.382
4T-02476/02420	39	38.5	59	63	0.8	1.5	5.2	0.42	1.44	0.79	0.384
4T-14124/14276	39.5	39	60	63	0.8	1.3	4.1	0.38	1.57	0.86	0.36
4T-14125A/14276	45	39	60	63	3.5	1.3	4.1	0.38	1.57	0.86	0.357
4T-2580/2523	38.5	37.5	61	64	0.8	1.3	9.1	0.27	2.19	1.21	0.455
4T-2582/2523	44	37.5	61	64	3.5	1.3	9.1	0.27	2.19	1.21	0.452
4T-3188/3120	40	39.5	61	67	0.8	3.3	9.9	0.33	1.80	0.99	0.606
4T-3193/3120	45.5	39.5	61	67	3.5	3.3	9.9	0.33	1.80	0.99	0.605
4T-02875/02820	45.5	39.5	62	68	3.5	3.3	3.9	0.45	1.32	0.73	0.453
4T-2879/2820	39.5	38.5	63	68	0.8	3.3	5.5	0.37	1.63	0.90	0.466
4T-HM88542/HM88510	45.5	42.6	59	70	1.3	3.3	6.0	0.55	1.10	0.60	0.622
4T-HM88542/HM88512	45.5	42.6	60	70	1.3	3.3	6.0	0.55	1.10	0.60	0.638
4T-HM89440/HM89410	45.5	44.3	62	73	0.8	3.3	5.8	0.55	1.10	0.60	0.686
4T-3476/3420	43	41	67	74	1.3	3.3	8.7	0.37	1.64	0.90	0.772
4T-M88048/M88010	42.5	41.2	58	65	0.8	1.5	2.9	0.55	1.10	0.60	0.379
4T-14130/14276	46.5	40	60	63	3.5	1.3	4.1	0.38	1.57	0.86	0.345
4T-2585/2523	45	39	61	64	3.5	1.3	9.1	0.27	2.19	1.21	0.436
4T-3196/3120	47	40.5	61	67	3.5	3.3	9.9	0.33	1.80	0.99	0.584
4T-HM88547/HM88510	45.5	42.6	59	70	0.8	3.3	6.0	0.55	1.10	0.60	0.603
4T-2785/2720	46	40	66	70	3.5	3.3	7.8	0.30	1.98	1.09	0.548
4T-HM89443/HM89410	46.5	44.3	62	73	0.8	3.3	5.8	0.55	1.10	0.60	0.667
4T-HM89444/HM89410	53	44.3	62	73	3.8	3.3	5.8	0.55	1.10	0.60	0.665
4T-43131/43312	51	42.1	67	74	3.5	1.5	1.4	0.67	0.90	0.49	0.568
4T-LM48548/LM48510	48	41.5	58	61	*	1.3	3.7	0.38	1.59	0.88	0.25
4T-LM48548A/LM48510	40.5	42.2	58	61	0.8	1.3	3.7	0.38	1.59	0.88	0.252
4T-14137A/14276	43.5	41.5	60	63	1.5	1.3	4.1	0.38	1.57	0.86	0.334
4T-HM88649/HM88610	48.5	42.5	60	69	2.3	2.3	4.6	0.55	1.10	0.60	0.489
4T-16137/16284	47	40.5	63	67	3.5	1.3	4.2	0.40	1.49	0.82	0.37
4T-02877/02820	48.5	42	62	68	3.5	3.3	3.9	0.45	1.32	0.73	0.423
4T-02878/02820	42.5	42	62	68	0.8	3.3	3.9	0.45	1.32	0.73	0.426
4T-2878/2820	42	41	63	68	0.8	3.3	5.5	0.37	1.63	0.90	0.435
4T-25877/25820	43	40.5	64	68	1.5	2.3	8.1	0.29	2.07	1.14	0.47
4T-25877/25821	43	40.5	65	68	1.5	0.8	8.1	0.29	2.07	1.14	0.473
4T-2793/2735X	42	41	66	69	0.8	0.8	7.8	0.30	1.98	1.09	0.444
4T-2793/2720	42	41	66	70	0.8	3.3	7.8	0.30	1.98	1.09	0.534

1) Chamfer dimensions of the bearings marked "*" are shown in the above drawings.

Inch series
J series







Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e,
Y_2 and Y_0 see the table below.

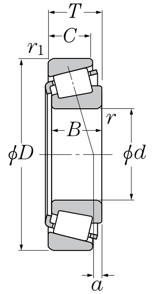
d 34.925 ～ 38.100mm

Boundary dimensions (mm)					Basic load rating (kN) dynamic	static	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 1) 2)	Installation-related dimensions (mm)						Load center 4) (mm)	Constant	Axial load factors		Mass (kg)
d	D	T	B	C	C_r	C_{0r}				d_a	d_b	D_a	D_b	r_{as} 3) Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
34.925	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800	4T-2796/2729	47.5	41	68	70	3.5	0.8	7.8	0.30	1.98	1.09	0.536
	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800	4T-HM89446/HM89410	56	44.3	62	73	3.5	3.3	5.8	0.55	1.10	0.60	0.646
	76.200	29.370	28.575	23.812	89.5	97.0	5 100	6 800	4T-31593/31520	50	43.5	64	72	3.5	3.3	7.8	0.40	1.49	0.82	0.626
	76.200	29.370	28.575	23.812	89.5	97.0	5 100	6 800	4T-31594/31520	46	43.5	64	72	1.5	3.3	7.8	0.40	1.49	0.82	0.628
	79.375	29.370	29.771	23.812	103	114	4 900	6 600	4T-3478/3420	50	43.5	67	74	3.5	3.3	8.7	0.37	1.64	0.90	0.731
	80.167	29.370	30.391	23.812	105	112	4 800	6 400	4T-3379/3320	48	41.5	70	75	3.5	3.3	11.2	0.27	2.20	1.21	0.736
	85.725	30.162	30.162	23.812	116	132	4 500	6 000	4T-3872/3820	53	46	73	81	3.5	3.3	8.1	0.40	1.49	0.82	0.902
34.976	69.012	19.845	19.583	15.875	53.5	58.0	5 600	7 400	4T-14139/14276	43.5	41.5	60	63	1.3	1.3	4.1	0.38	1.57	0.86	0.33
34.988	59.974	15.875	16.764	11.938	39.0	47.5	6 100	8 100	4T-L68149†/L68111††	45.5	39	53	56	*	1.3	2.5	0.42	1.44	0.79	0.179
	61.973	16.700	17.000	13.600	41.0	48.0	5 900	7 900	4T-LM78349A†/LM78310A††	42	39.5	54	59	1.5	1.5	2.4	0.44	1.35	0.74	0.206
	61.973	18.000	17.000	15.000	41.0	48.0	5 900	7 900	4T-LM78349†/LM78310C††	46	40	56	59	*	1.5	2.4	0.44	1.35	0.74	0.218
35.000	70.000	24.000	23.500	19.000	69.0	78.0	5 500	7 300	#4T-JS3549A/JS3510	47	42	60	66.5	2	1.5	3.6	0.55	1.10	0.60	0.42
	79.375	23.812	25.400	19.050	85.0	97.5	4 800	6 400	4T-26883/26822	42.5	42	71	74	0.8	0.8	7.4	0.32	1.88	1.04	0.61
	80.000	21.000	22.403	17.826	75.5	75.0	4 700	6 300	4T-339/332	42.5	41.5	73	75	0.8	1.3	6.6	0.27	2.20	1.21	0.534
35.717	72.233	25.400	25.400	19.842	72.0	84.5	5 400	7 200	4T-HM88648/HM88610	54	42.5	60	69	3.5	2.3	4.6	0.55	1.10	0.60	0.477
	72.626	25.400	25.400	19.842	72.0	84.5	5 400	7 200	4T-HM88648/HM88611AS	54	42.5	59	69	3.5	3.3	3.0	0.55	1.10	0.60	0.482
36.487	73.025	23.812	24.608	19.050	78.5	85.0	5 300	7 100	4T-25880/25821	44	42	65	68	1.5	0.8	8.1	0.29	2.07	1.14	0.456
	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800	4T-2780/2720	44.5	42.5	66	70	1.5	3.3	7.8	0.30	1.98	1.09	0.516
36.512	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800	4T-HM89448/HM89410	48.5	44.3	62	73	0.8	3.3	5.8	0.55	1.10	0.60	0.628
	76.200	29.370	28.575	23.020	86.5	105	5 100	6 800	4T-HM89449/HM89411	57	44.3	65	73	3.5	0.8	5.8	0.55	1.10	0.60	0.63
	76.200	29.370	28.575	23.812	89.5	97.0	5 100	6 800	4T-31597/31520	51	44.5	64	72	3.5	3.3	7.8	0.40	1.49	0.82	0.606
	79.375	29.370	28.829	22.664	95.5	104	5 000	6 600	4T-HM89249/HM89210	55	44	66	75	3.5	3.3	5.8	0.55	1.10	0.60	0.689
	79.375	29.370	29.771	23.812	103	114	4 900	6 600	4T-3479/3420	45.5	44.5	67	74	0.8	3.3	8.7	0.37	1.64	0.90	0.707
	88.500	25.400	23.698	17.462	78.5	78.0	4 000	5 300	4T-44143/44348	54	50	75	84	2.3	1.5	-2.9	0.78	0.77	0.42	0.73
38.000	63.000	17.000	17.000	13.500	43.0	52.5	5 700	7 600	#4T-JL69349/JL69310	46.5	42.5	56	60	*	1.3	2.3	0.42	1.44	0.79	0.2
38.100	63.500	12.700	11.908	9.525	28.7	33.5	5 500	7 300	4T-13889/13830	45	42.5	59	60	1.5	0.8	0.8	0.35	1.73	0.95	0.148
	65.088	18.034	18.288	13.970	48.0	57.0	5 500	7 400	4T-LM29748/LM29710	49	42.5	58.9	62	*	1.3	4.3	0.33	1.80	0.99	0.227
	69.012	19.050	19.050	15.083	53.0	59.5	5 300	7 100	4T-13685/13621	49.5	43	61	65	3.5	2.3	3.0	0.40	1.49	0.82	0.294
	69.012	19.050	19.050	15.083	53.0	59.5	5 300	7 100	4T-13687/13621	46.5	43	61	65	2	2.3	3.0	0.40	1.49	0.82	0.296
	71.438	15.875	16.520	11.908	48.0	51.0	5 400	7 200	4T-19150/19281	45	43	63	66	1.5	1.5	1.4	0.44	1.35	0.74	0.241
	72.000	19.000	20.638	14.237	53.0	58.5	5 300	7 000	4T-16150/16282	49.5	43	63	67	3.5	1.5	4.2	0.40	1.49	0.82	0.331

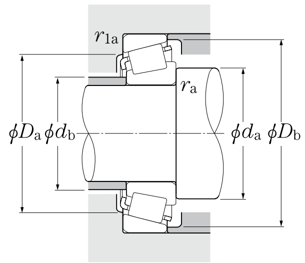
Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.

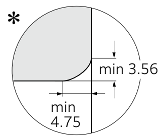
2) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66 to A-67**.
3) Chamfer dimensions of the bearings marked "*" are shown in the above drawings.
4) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

Inch series



d 38.100 ～ 41.275mm





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e,
Y_2 and Y_0 see the table below.

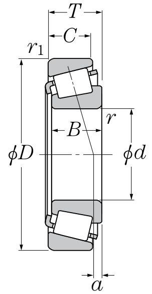
Boundary dimensions mm					Basic load rating kN		Allowable speed min-1		Bearing number 1)	Installation-related dimensions mm						Load center 3) mm	Constant	Axial load factors		Mass kg
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication		d_a	d_b	D_a	D_b	r_{as} 2) Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
38.100	76.200	20.638	20.940	15.507	61.5	63.0	5 000	6 700	4T-28150/28300	45.5	43.5	68	71	1.5	1.3	4.8	0.40	1.49	0.82	0.406
	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800	4T-2776/2720	52	43.5	66	70	4.3	0.8	7.8	0.30	1.98	1.09	0.495
	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800	4T-2788/2720	50	43.5	66	70	3.5	3.3	7.8	0.30	1.98	1.09	0.494
	79.375	23.812	25.400	19.050	85.0	97.5	4 800	6 400	4T-26878/26822	45	44.5	71	74	0.8	0.8	7.4	0.32	1.88	1.04	0.575
	79.375	29.370	29.771	23.812	103	114	4 900	6 600	4T-3490/3420	52	45.5	67	74	3.5	3.3	8.7	0.37	1.64	0.90	0.688
	80.000	21.006	20.940	15.875	61.5	63.0	5 000	6 700	4T-28150/28315	45.5	43.5	69	73	1.5	1.5	4.8	0.40	1.49	0.82	0.467
	80.035	24.608	23.698	18.512	74.5	82.5	4 800	6 400	4T-27880/27820	48	47	68	75	0.8	1.5	2.5	0.56	1.07	0.59	0.567
	82.550	29.370	28.575	23.020	96.5	117	4 700	6 200	4T-HM801346/HM801310	51	49.1	68	78	0.8	3.3	4.7	0.55	1.10	0.60	0.767
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000	4T-25572/25520	46	46	74	77	0.8	0.8	6.2	0.33	1.79	0.99	0.646
	85.725	30.162	30.162	23.812	116	132	4 500	6 000	4T-3875/3820	49.5	48.5	73	81	0.8	3.3	8.1	0.40	1.49	0.82	0.861
	87.312	30.162	30.886	23.812	104	117	4 400	5 900	4T-3580/3525	48	45.5	75	81	1.5	3.3	10.0	0.31	1.96	1.08	0.881
	88.500	25.400	23.698	17.462	78.5	78.0	4 000	5 300	4T-44150/44348	55	50.8	75	84	2.3	1.5	-2.9	0.78	0.77	0.42	0.714
	88.500	26.988	29.083	22.225	106	107	4 600	6 100	4T-418/414	51	44.5	77	80	3.5	1.5	9.1	0.26	2.28	1.25	0.843
39.688	76.200	23.812	25.654	19.050	81.0	90.5	5 100	6 800	4T-2789/2720	52	45	66	70	3.5	3.3	7.8	0.30	1.98	1.09	0.475
	77.534	29.370	30.391	23.812	105	112	4 800	6 400	4T-3382/3321	52	45.5	68	75	3.5	3.3	11.2	0.27	2.20	1.21	0.669
	79.375	23.812	25.400	19.050	85.0	97.5	4 800	6 400	4T-26880/26822	48	45.5	71	74	1.5	0.8	7.4	0.32	1.88	1.04	0.556
	80.035	29.370	30.391	23.812	105	112	4 800	6 400	4T-3382/3339	52	45.5	71	74.8	3.5	1.5	11.2	0.27	2.20	1.21	0.666
	80.167	29.370	30.391	23.812	105	112	4 800	6 400	4T-3386/3320	46.5	45.5	70	75	0.8	3.3	11.2	0.27	2.20	1.21	0.672
	88.500	25.400	23.698	17.462	78.5	78.0	4 000	5 300	4T-44158/44348	58	50.8	75	84	3.5	1.5	-2.9	0.78	0.77	0.42	0.691
40.000	76.200	20.638	20.940	15.507	61.5	63.0	5 000	6 700	4T-28158/28300	47.5	45	68	71	1.5	1.3	4.8	0.40	1.49	0.82	0.387
	80.000	21.000	22.403	17.826	75.5	75.0	4 700	6 300	4T-344/332	52	45.5	73	75	3.5	1.3	6.6	0.27	2.20	1.21	0.479
	85.000	20.638	21.692	17.462	77.5	79.5	4 400	5 800	4T-350A/354A	47.5	46.5	77	80	0.8	1.3	5.1	0.31	1.96	1.08	0.566
	88.500	26.988	29.083	22.225	106	107	4 600	6 100	4T-420/414	52	46	77	80	3.5	1.5	9.1	0.26	2.28	1.25	0.817
	107.950	36.512	36.957	28.575	157	177	3 600	4 800	4T-543/532X	57	50	94	100	3.5	3.3	12.3	0.30	2.02	1.11	1.77
40.483	82.550	29.370	28.575	23.020	96.5	117	4 700	6 200	4T-HM801349/HM801310	58	49.1	68	78	3.5	3.3	4.7	0.55	1.10	0.60	0.734
40.988	67.975	17.500	18.000	13.500	51.0	62.5	5 300	7 000	4T-LM300849†/LM300811††	52	45.5	61	65	*	1.5	3.6	0.35	1.72	0.95	0.232
41.275	73.025	16.667	17.462	12.700	51.0	55.5	5 000	6 600	4T-18590/18520	53	46	66	69	3.5	1.5	2.9	0.35	1.71	0.94	0.283
	73.431	19.558	19.812	14.732	62.0	69.5	5 000	6 600	4T-LM501349/LM501310	54	48	67	70	3.5	0.8	3.3	0.40	1.50	0.83	0.334
	73.431	21.430	19.812	16.604	62.0	69.5	5 000	6 600	4T-LM501349/LM501314	54	48	65	70	3.5	0.8	3.3	0.40	1.50	0.83	0.354
	76.200	18.009	17.384	14.288	47.0	51.5	4 900	6 500	4T-11162/11300	49	46.5	67	71	1.5	1.5	0.7	0.49	1.23	0.68	0.337
	76.200	22.225	23.020	17.462	72.0	80.5	4 900	6 500	4T-24780/24720	54	47	68	72	3.5	0.8	4.5	0.39	1.53	0.84	0.435
	76.200	25.400	25.400	20.638	85.0	97.5	4 800	6 400	4T-26882/26823	54	47	69	73	3.5	1.5	7.4	0.32	1.88	1.04	0.49
	79.378	23.812	25.400	19.050	85.0	97.5	4 800	6 400	4T-26885/26822	48	47	71	74	0.8	0.8	7.4	0.32	1.88	1.04	0.535
	80.000	18.009	17.384	14.288	47.0	51.5	4 900	6 500	4T-11162/11315	49	46.5	69	73	1.5	1.5	0.7	0.49	1.23	0.68	0.389

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.

2) Chamfer dimensions of the bearings marked "*" are shown in the above drawings.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

NTN

Inch series

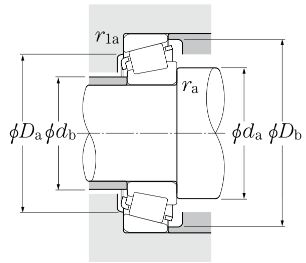


d 41.275 ～ 44.450mm

Boundary dimensions (mm)					Basic load rating (kN)		Allowable speed (min^{-1})	
					dynamic	static	Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
41.275	80.000	21.000	22.403	17.826	75.5	75.0	4 700	6 300
	79.378	23.812	25.400	19.050	85.0	97.5	4 800	6 400
	82.550	26.543	25.654	20.193	89.0	104	4 600	6 100
	85.725	30.162	30.162	23.812	116	132	4 500	6 000
	87.312	30.162	30.886	23.812	104	117	4 400	5 900
	88.900	30.162	29.370	23.020	104	125	4 300	5 800
	90.488	39.688	40.386	33.338	151	175	4 300	5 800
	92.075	26.195	23.812	16.670	80.5	81.5	3 800	5 000
	93.662	31.750	31.750	26.195	115	131	4 100	5 500
	95.250	30.162	29.370	23.020	120	147	4 000	5 300
	95.250	30.958	28.300	20.638	91.5	92.0	3 700	5 000
	95.250	30.958	28.575	22.225	107	116	3 700	4 900
42.070	90.488	39.688	40.386	33.338	151	175	4 300	5 800
42.862	82.550	26.195	26.988	20.638	83.5	97.0	4 600	6 100
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	87.312	30.162	30.886	23.812	104	117	4 400	5 900
42.875	79.375	23.812	25.400	19.050	85.0	97.5	4 800	6 400
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
44.450	76.992	17.462	17.145	11.908	48.5	54.0	4 700	6 300
	79.375	17.462	17.462	13.495	50.5	56.0	4 600	6 200
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	84.138	30.162	30.886	23.812	104	117	4 400	5 900
	85.000	20.638	21.692	17.462	77.5	79.5	4 400	5 800
	87.312	30.162	30.886	23.812	104	117	4 400	5 900
	88.900	30.162	29.370	23.020	104	125	4 300	5 800
	93.264	30.162	30.302	23.812	113	134	4 000	5 300
	93.662	31.750	31.750	26.195	115	131	4 100	5 500
	95.250	27.783	28.575	22.225	119	139	3 900	5 200
	95.250	27.783	29.900	22.225	120	129	4 200	5 600
	95.250	30.162	29.370	23.020	120	147	4 000	5 300
	95.250	30.958	28.300	20.638	91.5	92.0	3 700	5 000
	95.250	30.958	28.575	22.225	107	116	3 700	4 900
	101.600	34.925	36.068	26.988	150	165	3 800	5 000
	104.775	30.162	29.317	24.605	127	148	3 500	4 700

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.

NTN



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{0r} = 0.5F_r + Y_0F_a$

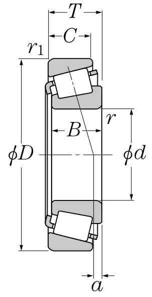
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

For values of e, Y_2 and Y_0 see the table below.

Bearing number	Installation-related dimensions (mm)						Load center[1] (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-336/332	47	46	73	75	0.8	1.3	6.6	0.27	2.20	1.21	0.468
4T-26882/26824	54	47	70	74	3.5	0.8	7.4	0.32	1.88	1.04	0.532
4T-M802048/M802011	57	50.6	70	79	3.5	3.3	3.2	0.55	1.10	0.60	0.641
4T-3880/3820	52	50	73	81	0.8	3.3	8.1	0.40	1.49	0.82	0.814
4T-3576/3525	49	48	75	81	0.8	3.3	10.0	0.31	1.96	1.08	0.83
4T-HM803145/HM803110	54	53	74	85	0.8	3.3	4.6	0.55	1.10	0.60	0.902
4T-4388/4335	60	52	77	85	3.5	3.3	15.0	0.28	2.11	1.16	1.26
4T-M903345/M903310	65	54	78	88	3.5	1.5	-3.6	0.83	0.72	0.40	0.758
4T-46162/46368	52	51	79	87	0.8	3.3	7.1	0.40	1.49	0.82	1.09
4T-HM804840/HM804810	61	54	81	91	3.5	3.3	3.7	0.55	1.10	0.60	1.08
4T-53162/53375	57	52.7	81	89	1.5	0.8	0.5	0.74	0.81	0.45	0.974
4T-HM903245/HM903210	63	54	81	91	3.5	0.8	-0.4	0.74	0.81	0.45	1.05
4T-4395/4335	60	52	77	85	3.5	3.3	15.0	0.28	2.11	1.16	1.24
4T-22780/22720	56	50	71	77	3.5	3.3	6.4	0.40	1.49	0.82	0.618
4T-25578/25520	53	49.5	74	77	2.3	0.8	6.2	0.33	1.79	0.99	0.584
4T-3579/3525	56	49.5	75	81	3.5	3.3	10.0	0.31	1.96	1.08	0.807
4T-26884/26822	55	48.5	71	74	3.5	0.8	7.4	0.32	1.88	1.04	0.511
4T-25577/25520	55	49	74	77	3.5	0.8	6.2	0.33	1.79	0.99	0.582
4T-12175/12303	52	49.5	68	73	1.5	1.5	-0.2	0.51	1.19	0.65	0.308
4T-18685/18620	54	49.5	71	74	2.8	1.5	2.2	0.37	1.60	0.88	0.347
4T-25580/25520	57	50	74	77	3.5	0.8	6.2	0.33	1.79	0.99	0.56
4T-25582/25520	60	50	74	77	5	0.8	6.2	0.33	1.79	0.99	0.564
4T-3578/3520	57	51	74	79.5	3.5	3.3	10.0	0.31	1.96	1.08	0.701
4T-355/354A	54	50	77	80	2.3	1.3	5.1	0.31	1.96	1.08	0.511
4T-3578/3525	57	51	75	81	3.5	3.3	10.0	0.31	1.96	1.08	0.78
4T-HM803149/HM803110	62	53.4	74	85	3.5	3.3	4.6	0.55	1.10	0.60	0.85
4T-3782/3720	58	52	82	87.9	3.5	3.3	8.3	0.34	1.77	0.97	0.959
4T-46175/46368	55	54	79	87	0.8	3.3	7.1	0.40	1.49	0.82	1.04
4T-33885/33821	53	53	85	90	0.8	2.3	8.0	0.33	1.82	1.00	0.986
4T-438/432	57	51	83	87	3.5	2.3	9.2	0.28	2.11	1.16	0.957
4T-HM804842/HM804810	57	57	81	91	0.8	3.3	3.7	0.55	1.10	0.60	1.04
4T-53177/53375	63	52.7	81	89	3.5	0.8	0.5	0.74	0.81	0.45	0.93
4T-HM903249/HM903210	65	54	81	91	3.5	0.8	-0.4	0.74	0.81	0.45	0.999
4T-527/522	59	53	89	95	3.5	3.3	12.9	0.29	2.10	1.16	1.36
4T-460/453X	60	54	92	98	3.5	3.3	7.1	0.34	1.79	0.98	1.29

1) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

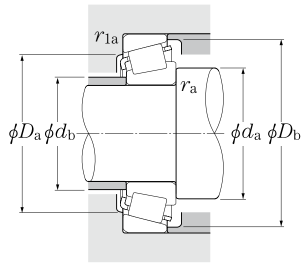
Inch series

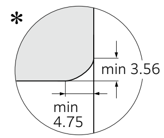


d 44.450 ～ 47.625mm

Boundary dimensions mm					Basic load rating kN		Allowable speed min^{-1}	
					dynamic	static	Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
44.450	104.775	30.162	30.958	23.812	144	169	3 500	4 700
	104.775	36.512	36.512	28.575	153	189	3 600	4 800
	111.125	30.162	26.909	20.638	115	136	3 200	4 200
	111.125	30.162	26.909	20.638	115	136	3 200	4 200
	127.000	50.800	52.388	41.275	277	320	3 200	4 300
44.983	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	93.264	30.162	30.302	23.812	113	134	4 000	5 300
45.000	85.000	20.638	21.692	17.462	77.5	79.5	4 400	5 800
	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500
45.237	87.312	30.162	30.886	23.812	104	117	4 400	5 900
45.242	73.431	19.558	19.812	15.748	60.0	76.0	4 800	6 400
	77.788	19.842	19.842	15.080	63.5	73.5	4 600	6 200
45.618	82.550	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	83.058	23.876	25.400	19.114	84.5	98.0	4 500	6 000
	85.000	23.812	25.400	19.050	84.5	98.0	4 500	6 000
45.987	74.976	18.000	18.000	14.000	56.5	71.0	4 700	6 300
46.038	79.375	17.462	17.462	13.495	50.5	56.0	4 600	6 200
	82.931	23.812	25.400	19.050	84.5	98.0	4 500	6 000
	85.000	20.638	21.692	17.462	77.5	79.5	4 400	5 800
	85.000	25.400	25.608	20.638	87.5	104	4 400	5 800
	90.119	23.000	21.692	21.808	77.5	79.5	4 400	5 800
	93.264	30.162	30.302	23.812	113	134	4 000	5 300
	95.250	27.783	29.900	22.225	120	129	4 200	5 600
47.625	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500
	88.900	25.400	25.400	19.050	91.0	101	4 200	5 600
	93.264	30.162	30.302	23.812	113	134	4 000	5 300
	95.250	30.162	29.370	23.020	120	147	4 000	5 300
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	101.600	34.925	36.068	26.988	150	165	3 800	5 000
	104.775	30.162	29.317	24.605	127	148	3 500	4 700

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

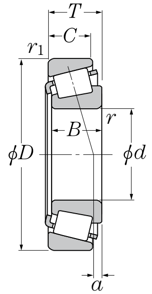
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e,
Y_2 and Y_0 see the table below.

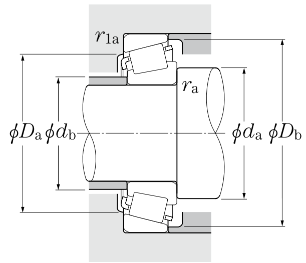
Bearing number 1)	Installation-related dimensions mm						Load center 3) mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} 2) Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-45280/45220	55	54	93	99	0.8	3.3	7.9	0.33	1.80	0.99	1.33
4T-HM807040/HM807010	66	59	89	100	3.5	3.3	7.4	0.49	1.23	0.68	1.62
4T-55175C/55437	70	64	92	105	3.5	3.3	-7.4	0.88	0.68	0.37	1.45
4T-55176C/55437	71	65	92	105	0.8	3.3	-7.4	0.88	0.68	0.37	1.09
4T-6277/6220	67	60	108	117	3.5	3.3	19.5	0.30	2.01	1.11	3.59
4T-25584/25520	53	51	74	77	1.5	0.8	6.2	0.33	1.79	0.99	0.556
4T-3776/3720	59	53	82	87.9	3.5	3.3	8.3	0.34	1.77	0.97	0.95
4T-358/354A	53	50	77	80	1.5	1.3	5.1	0.31	1.96	1.08	0.505
4T-367/362A	55	51	81	84	2	1.3	4.0	0.32	1.88	1.03	0.6
4T-3586/3525	58	52	75	81	3.5	3.3	10.0	0.31	1.96	1.08	0.767
4T-LM102949/LM102910	56	50	68	70	3.5	0.8	4.7	0.31	1.97	1.08	0.309
4T-LM603049/LM603011	58	52	71	74	3.5	0.8	2.2	0.43	1.41	0.77	0.371
4T-25590/25519	58	51	73	77	3.5	2	6.2	0.33	1.79	0.99	0.534
4T-25590/25520	58	51	74	77	3.5	0.8	6.2	0.33	1.79	0.99	0.544
4T-25590/25522	58	51	73	77	3.5	2	6.2	0.33	1.79	0.99	0.545
4T-25590/25526	58	51	74	78	3.5	2.3	6.2	0.33	1.79	0.99	0.581
4T-LM503349A†/LM503310††	57	51	67	71	*	1.5	1.9	0.40	1.49	0.82	0.298
4T-18690/18620	56	51	71	74	2.8	1.5	2.2	0.37	1.60	0.88	0.331
4T-25592/25520	58	52	74	77	3.5	0.8	6.2	0.33	1.79	0.99	0.538
4T-359A/354A	57	51	77	80	3.5	1.3	5.1	0.31	1.96	1.08	0.489
4T-2984/2924	58	52	76	80	3.5	1.3	6.4	0.35	1.73	0.95	0.616
4T-359S/352	55	51	78	82	2.3	2.3	5.1	0.31	1.96	1.08	0.654
4T-3777/3720	60	53	82	87.9	3.5	3.3	8.3	0.34	1.77	0.97	0.934
4T-436/432	59	52	83	87	3.5	2.3	9.2	0.28	2.11	1.16	0.93
4T-369A/362A	60	53	81	84	3.5	1.3	4.0	0.32	1.88	1.03	0.564
4T-M804048/M804010	59	56	77	85	0.8	3.3	1.7	0.55	1.10	0.60	0.664
4T-3778/3720	67	55	82	87.9	6.4	3.3	8.3	0.34	1.77	0.97	0.896
4T-HM804846/HM804810	66	57	81	91	3.5	3.3	3.7	0.55	1.10	0.60	0.979
4T-386A/382A	56	55	89	92	0.8	0.8	3.1	0.35	1.69	0.93	0.719
4T-528/522	62	55	89	95	3.5	3.3	12.9	0.29	2.10	1.16	1.3
4T-463/453X	65	56	92	98	4.8	3.3	7.1	0.34	1.79	0.98	1.24

2) Chamfer dimensions of the bearings marked "*" are shown in the above drawings.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

Inch series
J series



● Tapered Roller Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

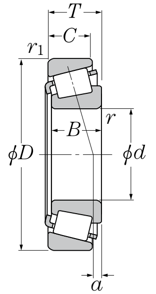
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

d 47.625 ～ 50.800mm

Boundary dimensions (mm) d	D	T	B	C	Basic load rating (kN) dynamic C_r	static C_{0r}	Allowable speed (min^{-1}) Grease lubrication	Oil lubrication	Bearing number [1) 2)]	Installation-related dimensions (mm) d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	Load center[3)] (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
47.625	104.775	30.162	30.958	23.812	144	169	3 500	4 700	4T-45282/45220	63	57	93	99	3.5	3.3	7.9	0.33	1.80	0.99	1.33
	111.125	30.162	26.909	20.638	115	136	3 200	4 200	4T-55187C/55437	69	62	92	105	3.5	3.3	-7.4	0.88	0.68	0.37	1.4
	123.825	36.512	32.791	25.400	171	188	2 900	3 900	4T-72188C/72487	69	67	102	116	0.8	3.3	-1.5	0.74	0.81	0.45	2.16
48.412	95.250	30.162	29.370	23.020	120	147	4 000	5 300	4T-HM804848/HM804810	63	57	81	91	2.3	3.3	3.7	0.55	1.10	0.60	0.967
	95.250	30.162	29.370	23.020	120	147	4 000	5 300	4T-HM804849/HM804810	66	57	81	91	3.5	3.3	3.7	0.55	1.10	0.60	0.965
49.212	93.264	30.162	30.302	23.812	113	134	4 000	5 300	4T-3781/3720	62	56	82	87.9	3.5	3.3	8.3	0.34	1.77	0.97	0.876
	103.188	43.658	44.475	36.512	193	232	3 800	5 000	4T-5395/5335	66	60	89	97	3.5	3.3	16.1	0.30	2.02	1.11	1.75
	104.775	36.512	36.512	28.575	153	189	3 600	4 800	4T-HM807044/HM807010	69	63	89	100	3.5	3.3	7.4	0.49	1.23	0.68	1.52
	114.300	44.450	44.450	34.925	206	225	3 600	4 800	4T-65390/65320	70	60	97	107	3.5	3.3	12.5	0.43	1.39	0.77	2.23
	114.300	44.450	44.450	36.068	226	261	3 500	4 700	4T-HH506348/HH506310	71	61	97	107	3.5	3.3	13.3	0.40	1.49	0.82	2.33
49.987	82.550	21.590	22.225	16.510	77.5	94.0	4 300	5 700	4T-LM104947A†/LM104911	55	55	75	78	0.5	1.3	5.8	0.31	1.97	1.08	0.434
	92.075	24.608	25.400	19.845	93.0	116	4 000	5 300	4T-28579†/28521	60	56	83	87	2.3	0.8	4.6	0.38	1.59	0.87	0.718
	114.300	44.450	44.450	36.068	226	261	3 500	4 700	4T-HH506349†/HH506310	72	61	97	107	3.5	3.3	13.3	0.40	1.49	0.82	2.31
50.000	82.000	21.500	21.500	17.000	77.5	94.0	4 300	5 700	#4T-JLM104948/JLM104910	61	55	76	78	3	0.5	5.4	0.31	1.97	1.08	0.42
	84.000	22.000	22.000	17.500	77.5	94.5	4 300	5 700	#4T-JLM704649/JLM704610	64	56	76	80	3.5	1.5	2.3	0.44	1.37	0.75	0.466
	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500	4T-365/362A	58	55	81	84	2	1.3	4.0	0.32	1.88	1.03	0.534
	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500	4T-366/362A	59	55	81	84	2.3	1.3	4.0	0.32	1.88	1.03	0.53
	90.000	28.000	28.000	23.000	118	141	4 100	5 400	#4T-JM205149/JM205110	63	57	80	85	3	2.5	7.4	0.33	1.82	1.00	0.755
	105.000	37.000	36.000	29.000	153	189	3 600	4 800	#4T-JHM807045/JHM807012	69	63	90	100	3	2.5	7.5	0.49	1.23	0.68	1.52
	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300	4T-396/394A	61	60	101	105	0.8	1.3	0.7	0.40	1.49	0.82	1.07
50.800	82.550	21.590	22.225	16.510	77.5	94.0	4 300	5 700	4T-LM104949/LM104911	63	56	75	78	3.5	1.3	5.8	0.31	1.97	1.08	0.418
	85.000	17.462	17.462	13.495	55.0	65.0	4 200	5 600	4T-18790/18720	62	56	77	80	3.5	1.5	0.8	0.41	1.48	0.81	0.375
	88.900	17.462	17.462	13.495	55.0	65.0	4 200	5 600	4T-18790/18724	62	56	78	82	3.5	1.5	0.8	0.41	1.48	0.81	0.431
	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500	4T-368/362A	58	56	81	84	1.5	1.3	4.0	0.32	1.88	1.03	0.524
	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500	4T-370A/362A	65	56	81	84	5	1.3	4.0	0.32	1.88	1.03	0.516
	90.000	20.000	22.225	15.875	85.0	90.5	4 100	5 500	4T-368A/362	62	56	81	84	3.5	2	4.0	0.32	1.88	1.03	0.53
	92.075	24.608	25.400	19.845	93.0	116	4 000	5 300	4T-28580/28521	63	57	83	87	3.5	0.8	4.6	0.38	1.59	0.87	0.703
	93.264	30.162	30.302	23.812	113	134	4 000	5 300	4T-3775/3720	58	58	82	87.9	0.8	3.3	8.3	0.34	1.77	0.97	0.85
	93.264	30.162	30.302	23.812	113	134	4 000	5 300	4T-3780/3720	64	58	82	87.9	3.5	3.3	8.3	0.34	1.77	0.97	0.846
	95.250	27.783	28.575	22.225	119	139	3 900	5 200	4T-33889/33821	64	58	85	90	3.5	2.3	8.0	0.33	1.82	1.00	0.878
	95.250	30.162	30.302	23.812	113	134	4 000	5 300	4T-3780/3726	64	58	83.1	88.9	3.5	3.3	8.3	0.34	1.77	0.97	0.899
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000	4T-385A/382A	61	60	89	92	2.3	0.8	3.1	0.35	1.69	0.93	0.675
	97.630	24.608	24.608	19.446	98.0	128	3 700	4 900	4T-28678/28622	65	58	88	92	3.5	0.8	3.3	0.40	1.49	0.82	0.854
	98.425	30.162	30.302	23.812	113	134	4 000	5 300	4T-3780/3732	64	58	84.1	89.9	3.5	3.3	8.3	0.34	1.77	0.97	0.99

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner ring bore diameters of bearings whose bearing numbers are marked with "†" (inner ring), the precision class is an integer for class 4 and class 2 bearings only.
2) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
3) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

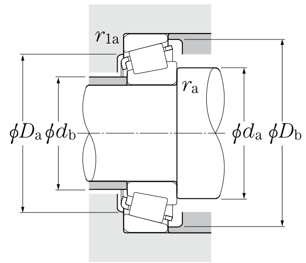
Inch series
J series



d 50.800 ～ 55.000mm

	Boundary dimensions				Basic load rating		Allowable speed	
	mm				dynamic kN	static	min-1	
							Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
50.800	101.600	31.750	31.750	25.400	122	136	3 700	5 000
	101.600	34.925	36.068	26.988	150	165	3 800	5 000
	104.775	30.162	29.317	24.605	127	148	3 500	4 700
	104.775	30.162	30.958	23.812	144	169	3 500	4 700
	104.775	36.512	36.512	28.575	153	189	3 600	4 800
	104.775	36.512	36.512	28.575	158	178	3 700	4 900
	107.950	36.512	36.957	28.575	157	177	3 600	4 800
	111.125	30.162	28.575	20.638	115	136	3 200	4 200
	112.712	30.162	26.909	20.638	115	136	3 200	4 200
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	112.712	30.162	30.162	23.812	153	195	3 200	4 200
	117.475	33.338	31.750	23.812	144	153	3 300	4 400
	120.650	41.275	41.275	31.750	190	213	3 300	4 400
	123.825	36.512	32.791	25.400	171	188	2 900	3 900
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
51.592	88.900	20.638	22.225	16.513	85.0	90.5	4 100	5 500
52.388	92.075	24.608	25.400	19.845	93.0	116	4 000	5 300
	93.264	30.162	30.302	23.812	113	134	4 000	5 300
	95.250	27.783	28.575	22.225	119	139	3 900	5 200
53.975	88.900	19.050	19.050	13.492	67.5	82.5	4 000	5 300
	95.250	27.783	28.575	22.225	119	139	3 900	5 200
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	104.775	30.162	30.958	23.812	144	169	3 500	4 700
	104.775	36.512	36.512	28.575	153	189	3 600	4 800
	107.950	36.512	36.957	28.575	157	177	3 600	4 800
	120.650	41.275	41.275	31.750	190	213	3 300	4 400
	122.238	33.338	31.750	23.812	149	163	3 100	4 200
	122.238	43.658	43.764	36.512	215	283	3 100	4 100
	123.825	36.512	32.791	25.400	171	188	2 900	3 900
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	130.175	36.512	33.338	23.812	173	186	2 700	3 600
	140.030	36.512	33.236	23.520	190	212	2 600	3 400
54.488	104.775	36.512	36.512	28.575	153	189	3 600	4 800
55.000	90.000	23.000	23.000	18.500	86.0	109	3 900	5 300

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

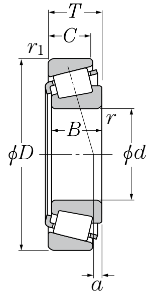
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1)	Installation-related dimensions						Load center2)	Constant	Axial load factors		Mass
	mm						mm				kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-49585/49520	66	59	88	96	3.5	3.3	7.1	0.40	1.50	0.82	1.13
4T-529/522	61	60	89	95	0.8	3.3	12.9	0.29	2.10	1.16	1.23
4T-455/453X	60	59	92	98	0.8	3.3	7.1	0.34	1.79	0.98	1.19
4T-45284/45220	71	59	93	99	6.4	3.3	7.9	0.33	1.80	0.99	1.24
4T-HM807046/HM807010	70	63.1	89	100	3.5	3.3	7.4	0.49	1.23	0.68	1.48
4T-59200/59412	68	61	92	99	3.5	3.3	9.6	0.40	1.49	0.82	1.44
4T-537/532X	65	59	94	100	3.5	3.3	12.3	0.30	2.02	1.11	1.55
4T-HM907643/HM907614	74	65.3	91	105	3.5	3.3	-7.2	0.88	0.68	0.37	1.36
4T-55200C/55443	71	64.4	92	106	3.5	3.3	-7.4	0.88	0.68	0.37	1.34
4T-3975/3920	68	61	99	106	3.5	3.3	4.5	0.40	1.49	0.82	1.53
4T-39575/39520	68	61	101	107	3.5	3.3	6.6	0.34	1.77	0.97	1.54
4T-66200/66462	71	65	100	111	3.5	3.3	0.4	0.63	0.96	0.53	1.68
4T-619/612	67	61	105	110	3.5	3.3	14.4	0.31	1.91	1.05	2.3
4T-72200C/72487	77	67	102	116	3.5	3.3	-1.5	0.74	0.81	0.45	2.1
4T-555/552A	66	62	109	116	2.3	3.3	9.4	0.35	1.73	0.95	2.34
4T-368S/362A	59	56	81	84	2	1.3	4.0	0.32	1.88	1.03	0.512
4T-28584/28521	65	58	83	87	3.5	0.8	4.6	0.38	1.59	0.87	0.703
4T-3767/3720	63	59	82	87.9	2.3	3.3	8.3	0.34	1.77	0.97	0.817
4T-33890/33821	61	59	85	90	1.5	2.3	8.0	0.33	1.82	1.00	0.851
4T-LM806649/LM806610	65	61	80	85	2.3	2	-2.2	0.55	1.10	0.60	0.437
4T-33895/33822	63	60	86	90	1.5	0.8	8.0	0.33	1.82	1.00	0.823
4T-389A/382A	61	60	89	92	0.8	0.8	3.1	0.35	1.69	0.93	0.632
4T-45287/45220	62	62	93	99	0.8	3.3	7.9	0.33	1.80	0.99	1.17
4T-HM807049/HM807010	73	63.1	89	100	3.5	3.3	7.4	0.49	1.23	0.68	1.41
4T-539/532X	68	61	94	100	3.5	3.3	12.3	0.30	2.02	1.11	1.47
4T-621/612	70	63	105	110	3.5	3.3	14.4	0.31	1.91	1.05	2.22
4T-66584/66520	75	68	105	116	3.5	3.3	-1.8	0.67	0.90	0.50	1.81
4T-5578/5535	73	67	106	116	3.5	3.3	13.3	0.36	1.67	0.92	2.64
4T-72212C/72487	79	67	102	116	3.5	3.3	-1.5	0.74	0.81	0.45	2.03
4T-557S/552A	73	67	109	116	3.5	3.3	9.4	0.35	1.73	0.95	2.25
4T-HM911242/HM911210	79	74	109	123.6	3.5	3.3	-5.2	0.82	0.73	0.40	2.28
4T-78214C/78551	79	77.5	117	132	0.8	2.3	-8.5	0.87	0.69	0.38	2.77
4T-HM807048/HM807010	73	63	89	100	3.5	3.3	7.4	0.49	1.23	0.68	1.4
#4T-JLM506849/JLM506810	63	61	82	86	1.5	0.5	2.8	0.40	1.49	0.82	0.556

1) Bearing numbers marked "#" designate J-series bearings. The tolerance of these bearings is listed in Table 6.8 on page A-66 to A-67.
2) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

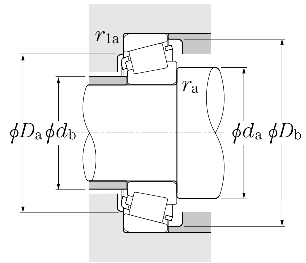
Inch series
J series



d 55.000 ～ 60.000mm

Boundary dimensions (mm)					Basic load rating (kN)		Allowable speed (min⁻¹)	
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication
55.000	95.000	29.000	29.000	23.500	119	144	3 800	5 100
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	110.000	39.000	39.000	32.000	192	219	3 500	4 600
55.562	97.630	24.608	24.608	19.446	98.0	128	3 700	4 900
	123.825	36.512	32.791	25.400	171	188	2 900	3 900
	127.000	36.512	36.512	26.988	181	228	2 900	3 800
55.575	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
57.150	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
	97.630	24.608	24.608	19.446	98.0	128	3 700	4 900
	104.775	30.162	29.317	24.605	127	148	3 500	4 700
	104.775	30.162	29.317	24.605	127	148	3 500	4 700
	104.775	30.162	30.958	23.812	144	169	3 500	4 700
	107.950	27.783	29.317	22.225	127	148	3 500	4 700
	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	110.000	27.795	29.317	27.000	127	148	3 500	4 700
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	112.712	30.162	30.162	23.812	153	195	3 200	4 200
	112.712	30.162	30.162	23.812	153	195	3 200	4 200
	117.475	30.162	30.162	23.812	129	175	3 000	4 000
	117.475	33.338	31.750	23.812	144	153	3 300	4 400
	120.650	41.275	41.275	31.750	190	213	3 300	4 400
	123.825	36.512	32.791	25.400	171	188	2 900	3 900
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	140.030	36.512	33.236	23.520	190	212	2 600	3 400
57.531	96.838	21.000	21.946	15.875	86.5	96.5	3 700	5 000
59.972	122.238	33.338	31.750	23.812	149	163	3 100	4 200
59.987	146.050	41.275	39.688	25.400	220	234	2 400	3 200
60.000	95.000	24.000	24.000	19.000	92.5	122	3 700	4 900
	107.950	25.400	25.400	19.050	101	140	3 200	4 300

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner ring bore diameters of bearings whose bearing numbers are marked with "†" (inner ring), the precision class is an integer for class 4 and class 2 bearings only.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

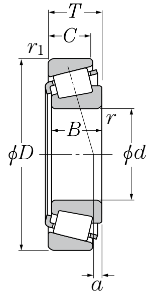
Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1) 2)	Installation-related dimensions (mm)						Load center[3] (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
#4T-JM207049/JM207010	64	62	85	91	1.5	2.5	7.6	0.33	1.79	0.99	0.823
4T-385/382A	65	61	89	92	2.3	0.8	3.1	0.35	1.69	0.93	0.615
#4T-JH307749/JH307710	71	64	97	104	3	2.5	11.7	0.35	1.73	0.95	1.7
4T-28680/28622	68	62	88	92	3.5	0.8	3.3	0.40	1.49	0.82	0.776
4T-72218C/72487	80	67	102	116	3.5	3.3	-1.5	0.74	0.81	0.45	2
4T-HM813840/HM813810	78	72	111	121	3.5	3.3	3.7	0.50	1.20	0.66	2.34
4T-389/382A	65	61	89	92	2.3	0.8	3.1	0.35	1.69	0.93	0.606
4T-387/382A	67	63	89	92	2.3	0.8	3.1	0.35	1.69	0.93	0.582
4T-387A/382A	70	63	89	92	3.5	0.8	3.1	0.35	1.69	0.93	0.58
4T-387AS/382A	73	63	89	92	5	0.8	3.1	0.35	1.69	0.93	0.575
4T-387S/382A	64	63	89	92	0.8	0.8	3.1	0.35	1.69	0.93	0.584
4T-28682/28622	70	63	88	92	3.5	0.8	3.3	0.40	1.49	0.82	0.749
4T-462/453X	67	63	92	98	2.3	3.3	7.1	0.34	1.79	0.98	1.06
4T-469/453X	72	68	92	98	3.5	3.3	7.1	0.34	1.79	0.98	1.06
4T-45289/45220	65	65	93	99	0.8	3.3	7.9	0.33	1.80	0.99	1.1
4T-469/453A	72	68	97	100	3.5	0.8	7.1	0.34	1.79	0.98	1.11
4T-390/394A	70	66	101	105	2.3	1.3	0.7	0.40	1.49	0.82	0.961
4T-469/454	72	68	96	100	3.5	2	7.1	0.34	1.79	0.98	1.24
4T-3979/3920	72	66	99	106	3.5	3.3	4.5	0.40	1.49	0.82	1.41
4T-39580/39520	74	68	101	107	3.5	3.3	6.6	0.34	1.77	0.97	1.41
4T-39581/39520	81	66	101	107	8	3.3	6.6	0.34	1.77	0.97	1.4
4T-33225/33462	74	68	104	112	3.5	3.3	2.6	0.44	1.38	0.76	1.58
4T-66225/66462	76	68.9	100	111	3.5	3.3	0.4	0.63	0.96	0.53	1.54
4T-623/612	72	66	105	110	3.5	3.3	14.4	0.31	1.91	1.05	2.13
4T-72225C/72487	81	67	102	116	3.5	3.3	-1.5	0.74	0.81	0.45	1.96
4T-555S/552A	76	70	109	116	3.5	3.3	9.4	0.35	1.73	0.95	2.17
4T-78225/78551	83	77	117	132	3.5	2.3	-8.5	0.87	0.69	0.38	2.69
4T-388A/382A	70	63	89	92	3.5	0.8	3.1	0.35	1.69	0.93	0.574
4T-66589/66520	74	73	105	116	0.8	3.3	-1.8	0.67	0.90	0.50	1.66
4T-H913840†/H913810	97	82	124	138	3.5	3.3	-4.3	0.78	0.77	0.42	3.22
#4T-JLM508748/JLM508710	75	66	85	91	5	2.5	3.0	0.40	1.49	0.82	0.609
4T-29580/29520	75	68	96	103	3.5	3.3	0.6	0.46	1.31	0.72	0.992

2) Bearing numbers marked "#" designate J-series bearings. The tolerance of these bearings is listed in Table 6.8 on page A-66 to A-67.
3) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

Tapered Roller Bearings

Inch series
J series

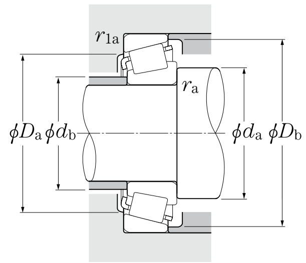


d 60.000 ～ 65.000mm

Boundary dimensions (mm) d	D	T	B	C	Basic load rating (kN) dynamic C_r	static C_{0r}	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication
60.000	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	130.000	34.100	30.924	22.650	173	186	2 700	3 600
60.325	100.000	25.400	25.400	19.845	100	134	3 500	4 700
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	122.238	38.100	38.354	29.718	208	244	3 100	4 100
	122.238	43.658	43.764	36.512	215	283	3 100	4 100
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	127.000	36.512	36.512	26.988	181	228	2 900	3 800
	127.000	44.450	44.450	34.925	226	263	3 100	4 200
	130.175	36.512	33.338	23.812	173	186	2 700	3 600
61.912	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	136.525	46.038	46.038	36.512	248	355	2 600	3 500
	146.050	41.275	39.688	25.400	220	234	2 400	3 200
61.976	101.600	24.608	24.608	19.845	100	134	3 500	4 700
62.738	101.600	25.400	25.400	19.845	100	134	3 500	4 700
63.500	94.458	19.050	19.050	15.083	67.0	103	3 600	4 800
	107.950	25.400	25.400	19.050	101	140	3 200	4 300
	107.950	25.400	25.400	19.050	101	140	3 200	4 300
	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	110.000	25.400	25.400	19.050	101	140	3 200	4 300
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	112.712	30.162	30.162	23.812	153	195	3 200	4 200
	120.000	29.794	29.007	24.237	142	177	3 000	4 000
	120.000	29.794	29.007	24.237	142	177	3 000	4 000
	122.238	38.100	38.354	29.718	208	244	3 100	4 100
	122.238	43.658	43.764	36.512	215	283	3 100	4 100
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	127.000	36.512	36.170	28.575	181	229	2 900	3 800
	127.000	36.512	36.512	26.988	181	228	2 900	3 800
	136.525	41.275	41.275	31.750	215	262	2 800	3 800
	140.030	36.512	33.236	23.520	190	212	2 600	3 400
65.000	105.000	24.000	23.000	18.500	94.5	117	3 300	4 500
	110.000	28.000	28.000	22.500	132	174	3 200	4 300

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.

Tapered Roller Bearings



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

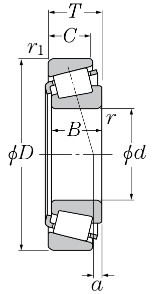
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1)	Installation-related dimensions (mm) d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	Load center 2) (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
4T-397/394A	69	68	101	105	0.8	1.3	0.7	0.40	1.49	0.82	0.918
#4T-JHM911244/JHM911211	84	74	109	123	3.5	3.3	-7.6	0.82	0.73	0.40	2.01
4T-28985/28921	73	67	89	96	3.5	3.3	2.5	0.43	1.41	0.78	0.769
4T-3980/3920	75	68	99	106	3.5	3.3	4.5	0.40	1.49	0.82	1.34
4T-HM212044/HM212011	85	70	108	116	8	3.3	11.1	0.34	1.78	0.98	2.02
4T-5583/5535	78	72	106	116	3.5	3.3	13.3	0.36	1.67	0.92	2.45
4T-558/552A	76	72	109	116	2.3	3.3	9.4	0.35	1.73	0.95	2.09
4T-HM813841/HM813810	83	77	111	121	3.5	3.3	3.7	0.50	1.20	0.66	2.21
4T-65237/65500	87	71	107	119	3.5	3.3	9.3	0.49	1.23	0.68	2.59
4T-HM911245/HM911210	93	74	109	123.6	5	3.3	-5.2	0.82	0.73	0.40	2.12
4T-392/394A	70	69	101	105	0.8	1.3	0.7	0.40	1.49	0.82	0.88
4T-H715334/H715311	87	81	118	132	3.5	3.3	8.7	0.47	1.27	0.70	3.47
4T-H913842/H913810	90	82.4	124	138	3.5	3.3	-4.3	0.78	0.77	0.42	3.17
4T-28990/28920	72	68	90	97	2	3.3	1.7	0.43	1.41	0.78	0.766
4T-28995/28920	75	69	90	97	3.5	3.3	2.5	0.43	1.41	0.78	0.762
4T-L610549/L610510	71	69	86	91	1.5	1.5	-0.6	0.42	1.41	0.78	0.453
4T-29585/29520	77	71	96	103	3.5	3.3	0.6	0.46	1.31	0.72	0.924
4T-29586/29520	73	71	96	103	1.5	3.3	0.6	0.46	1.31	0.72	0.93
4T-390A/394A	73	70	101	105	1.5	1.3	0.7	0.40	1.49	0.82	0.858
4T-29585/29521	77	71	99	104	3.5	1.3	0.6	0.46	1.31	0.72	0.982
4T-3982/3920	77	71	99	106	3.5	3.3	4.5	0.40	1.49	0.82	1.27
4T-39585/39520	77	71	101	107	3.5	3.3	6.6	0.34	1.77	0.97	1.27
4T-477/472	73	72	107	114	0.8	2	3.9	0.38	1.56	0.86	1.6
4T-483/472	78	72	107	114	3.5	2	3.9	0.38	1.56	0.86	1.43
4T-HM212046/HM212011	80	73	108	116	3.5	3.3	11.1	0.34	1.78	0.98	1.95
4T-5584/5535	81	75	106	116	3.5	3.3	13.3	0.36	1.67	0.92	2.34
4T-559/552A	81	75	109	116	3.5	3.3	9.4	0.35	1.73	0.95	2.01
4T-565/563	80	73	112	120	3.5	3.3	8.3	0.36	1.65	0.91	2.11
4T-HM813842/HM813810	84	78	111	121	3.5	3.3	3.7	0.50	1.20	0.66	2.13
4T-639/632	81	74	118	125	3.5	3.3	11.4	0.36	1.66	0.91	2.85
4T-78250/78551	85	79	117	132	2.3	2.3	-8.5	0.87	0.69	0.38	2.54
#4T-JLM710949/JLM710910	77	71	96	100.5	3	1	0.3	0.45	1.32	0.73	0.744
#4T-JM511946/JM511910	78	72	99	105	3	2.5	3.4	0.40	1.49	0.82	1.09

1) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
2) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

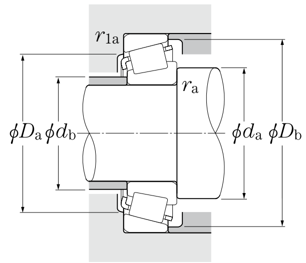
Inch series
J series



d 65.000 ～ 70.000mm

Boundary dimensions mm					Basic load rating dynamic kN	static kN	Allowable speed min-1 Grease lubrication	Allowable speed min-1 Oil lubrication
d	D	T	B	C	C_r	C_{0r}	Grease lubrication	Oil lubrication
65.000	120.000	39.000	38.500	32.000	205	248	3 100	4 100
65.088	135.755	53.975	56.007	44.450	310	380	2 900	3 800
66.675	103.213	17.602	17.602	11.989	66.5	78.0	3 300	4 400
	107.950	25.400	25.400	19.050	101	140	3 200	4 300
	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	112.712	30.162	30.048	23.812	132	174	3 200	4 300
	112.712	30.162	30.162	23.812	153	195	3 200	4 200
	122.238	38.100	38.354	29.718	208	244	3 100	4 100
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	127.000	36.512	36.512	26.988	181	228	2 900	3 800
	130.175	41.275	41.275	31.750	215	262	2 800	3 800
	135.755	53.975	56.007	44.450	310	380	2 900	3 800
	136.525	41.275	41.275	31.750	215	262	2 800	3 800
	136.525	41.275	41.275	31.750	251	293	2 700	3 700
68.262	110.000	22.000	21.996	18.824	99.5	120	3 200	4 300
	120.000	29.794	29.007	24.237	142	177	3 000	4 000
	123.825	38.100	36.678	30.162	175	216	3 000	4 100
	136.525	41.275	41.275	31.750	251	293	2 700	3 700
	136.525	46.038	46.038	36.512	248	355	2 600	3 500
69.850	112.712	25.400	25.400	19.050	106	151	3 100	4 100
	117.475	30.162	30.162	23.812	129	175	3 000	4 000
	120.000	29.794	29.007	24.237	142	177	3 000	4 000
	120.000	32.545	32.545	26.195	163	214	3 000	4 000
	120.650	25.400	25.400	19.050	106	151	3 100	4 100
	127.000	36.512	36.170	28.575	181	229	2 900	3 800
	136.525	41.275	41.275	31.750	215	262	2 800	3 800
	146.050	41.275	41.275	31.750	228	295	2 500	3 300
	150.089	44.450	46.672	36.512	289	360	2 400	3 200
	168.275	53.975	56.363	41.275	375	460	2 200	3 000
69.952	121.442	24.608	23.012	17.462	101	127	2 900	3 800
70.000	110.000	26.000	25.000	20.500	108	150	3 200	4 200
	115.000	29.000	29.000	23.000	138	171	3 100	4 100

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load

$P_{0r} = 0.5F_r + Y_0F_a$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

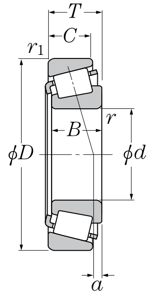
For values of e, Y_2 and Y_0 see the table below.

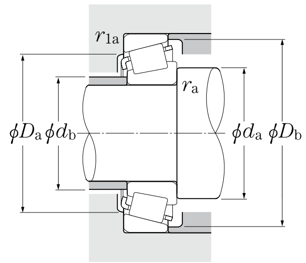
Bearing number [1]	Installation-related dimensions mm						Load center[2] mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
#4T-JH211749/JH211710	80	74	107	114	3	2.5	10.9	0.34	1.78	0.98	1.9
4T-6379/6320	84	77	117	126	3.5	3.3	18.8	0.32	1.85	1.02	3.71
4T-L812148/L812111	75	72	96	99	1.5	0.8	-3.7	0.49	1.23	0.68	0.48
4T-29590/29520	80	73	96	103	3.5	3.3	0.6	0.46	1.31	0.72	0.86
4T-395A/394A	73	73	101	105	0.8	1.3	0.7	0.40	1.49	0.82	0.803
4T-3984/3925	80	74	101	106	3.5	0.8	4.5	0.40	1.49	0.82	1.19
4T-3994/3920	86	75	99	106	5.5	3.3	4.5	0.40	1.49	0.82	1.18
4T-39590/39520	82	75	101	107	3.5	3.3	6.6	0.34	1.77	0.97	1.28
4T-HM212049/HM212010	82	75.5	110	116	3.5	1.5	11.1	0.34	1.78	0.98	1.84
4T-560/552A	84	77	109	116	3.5	3.3	9.4	0.35	1.73	0.95	1.9
4T-HM813844/HM813810	88	82	111	121	3.5	3.3	3.7	0.50	1.20	0.66	2.03
4T-641/633	83	77	116	124	3.5	3.3	11.4	0.36	1.66	0.91	2.41
4T-6386/6320	87	77	117	126	4.3	3.3	18.8	0.32	1.85	1.02	3.64
4T-641/632	83	77	118	125	3.5	3.3	11.4	0.36	1.66	0.91	2.75
4T-H414242/H414210	85	81	121	129	3.5	3.3	11.0	0.36	1.67	0.92	2.75
4T-399A/394A	78	74	101	105	2.3	1.3	0.7	0.40	1.49	0.82	0.772
4T-480/472	82	75	107	114	3.5	2	3.9	0.38	1.56	0.86	1.13
4T-560S/552A	83	76	109	116	3.5	3.3	9.4	0.35	1.73	0.95	1.87
4T-H414245/H414210	86	82	121	129	3.5	3.3	11.0	0.36	1.67	0.92	2.7
4T-H715343/H715311	92	86	118	132	3.5	3.3	8.7	0.47	1.27	0.70	3.23
4T-29675/29620	80	77	101	109	1.5	3.3	-0.9	0.49	1.23	0.68	0.95
4T-33275/33462	85	79	104	112	3.5	3.3	2.6	0.44	1.38	0.76	1.28
4T-482/472	83	77	107	114	3.5	2	3.9	0.38	1.56	0.86	1.33
4T-47487/47420	84	78	107	114	3.5	3.3	6.1	0.36	1.67	0.92	1.63
4T-29675/29630	80	77	104	113	1.5	3.3	-0.9	0.49	1.23	0.68	1.17
4T-566/563	85	78	112	120	3.5	3.3	8.3	0.36	1.65	0.91	1.91
4T-643/632	86	80	118	125	3.5	3.3	11.4	0.36	1.66	0.91	2.63
4T-655/653	88	82	131	139	3.5	3.3	8.0	0.41	1.47	0.81	3.28
4T-745A/742	88	82	134	142	3.5	3.3	12.0	0.33	1.84	1.01	3.93
4T-835/832	91	84	149	155	3.5	3.3	18.5	0.30	2.00	1.10	6.14
4T-34274/34478	81	78	110	116	2	2	-1.2	0.45	1.33	0.73	1.11
#4T-JLM813049/JLM813010	78	77	98	105	1	2.5	-0.3	0.49	1.23	0.68	0.888
#4T-JM612949/JM612910	83	77	103	110	3	2.5	2.5	0.43	1.39	0.77	1.12

1) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
2) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

Tapered Roller Bearings

Inch series
J series





Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

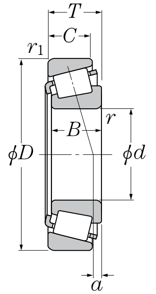
d 70.000 ～ 76.200mm

Boundary dimensions (mm) d	D	T	B	C	Basic load rating (kN) dynamic C_r	static C_{0r}	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing number 1)	Installation-related dimensions (mm) d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	Load center 2) (mm) a	Constant e	Axial load factors Y_2	Y_0	Mass (kg) (approx.)
70.000	120.000	29.794	29.007	24.237	142	177	3 000	4 000	4T-484/472	80	77	107	114	2	2	3.9	0.38	1.56	0.86	1.33
	150.000	41.275	39.688	25.400	220	234	2 400	3 200	#4T-JH913848/JH913811	92	82.3	126	146	2	3.3	-4.3	0.78	0.77	0.42	3.09
71.438	117.475	30.162	30.162	23.812	129	175	3 000	4 000	4T-33281/33462	87	80	104	112	3.5	3.3	2.6	0.44	1.38	0.76	1.24
	120.000	32.545	32.545	26.195	163	214	3 000	4 000	4T-47490/47420	86	79	107	114	3.5	3.3	6.1	0.36	1.67	0.92	1.42
	127.000	36.512	36.170	28.575	181	229	2 900	3 800	4T-567A/563	86	80	112	120	3.5	3.3	8.3	0.36	1.65	0.91	1.87
	136.525	41.275	41.275	31.750	215	262	2 800	3 800	4T-644/632	87	81	118	125	3.5	3.3	11.4	0.36	1.66	0.91	2.58
	136.525	41.275	41.275	31.750	251	293	2 700	3 700	4T-H414249/H414210	89	83.3	121	129	3.5	3.3	11.0	0.36	1.67	0.92	2.58
	136.525	46.038	46.038	36.512	248	355	2 600	3 500	4T-H715345/H715311	94	88	118	132	3.5	3.3	8.7	0.47	1.27	0.70	3.11
73.025	112.712	25.400	25.400	19.050	106	151	3 100	4 100	4T-29685/29620	86	80	101	109	3.5	3.3	-0.9	0.49	1.23	0.68	0.874
	117.475	30.162	30.162	23.812	129	175	3 000	4 000	4T-33287/33462	88	81	104	112	3.5	3.3	2.6	0.44	1.38	0.76	1.19
	127.000	36.512	36.170	28.575	181	229	2 900	3 800	4T-567/563	88	81	112	120	3.5	3.3	8.3	0.36	1.65	0.91	1.82
	139.992	36.512	36.098	28.575	197	265	2 600	3 400	4T-576/572	90	83	125	133	3.5	3.3	5.5	0.40	1.49	0.82	2.52
	149.225	53.975	54.229	44.450	320	410	2 500	3 400	4T-6460/6420	93	87	129	140	3.5	3.3	14.8	0.36	1.66	0.91	4.43
	150.089	44.450	46.672	36.512	289	360	2 400	3 200	4T-744/742	91	85	134	142	3.5	3.3	12.0	0.33	1.84	1.01	3.8
73.817	112.712	25.400	25.400	19.050	106	151	3 100	4 100	4T-29688/29620	83	80	101	109	1.5	3.3	-0.9	0.49	1.23	0.68	0.862
	127.000	36.512	36.170	28.575	181	229	2 900	3 800	4T-568/563	83	82	112	120	0.8	3.3	8.3	0.36	1.65	0.91	1.8
74.612	139.992	36.512	36.098	28.575	197	265	2 600	3 400	4T-577/572	91	85	125	133	3.5	3.3	5.5	0.40	1.49	0.82	2.47
75.000	115.000	25.000	25.000	19.000	105	143	3 000	4 000	#4T-JLM714149/JLM714110	88	82	104	110.5	3	2.5	-0.3	0.46	1.31	0.72	0.88
	120.000	31.000	29.500	25.000	145	197	2 900	3 900	#4T-JM714249/JM714210	88	82.9	108	115	3	2.5	1.9	0.44	1.35	0.74	1.29
	145.000	51.000	51.000	42.000	320	410	2 500	3 400	#4T-JH415647/JH415610	94	89	129	139	3	2.5	14.1	0.36	1.66	0.91	3.82
76.200	109.538	19.050	19.050	15.083	70.0	115	3 100	4 100	4T-L814749/L814710	84	82	100	105	1.5	1.5	-5.0	0.50	1.20	0.66	0.579
	121.442	24.608	23.012	17.462	101	127	2 900	3 800	4T-34300/34478	86	83	110	116	2	2	-1.2	0.45	1.33	0.73	0.978
	121.442	24.608	23.012	17.462	101	127	2 900	3 800	4T-34301/34478	89	83	110	116	3.5	2	-1.2	0.45	1.33	0.73	0.976
	127.000	30.162	31.000	22.225	150	194	2 800	3 700	4T-42687/42620	90	84	114	121	3.5	3.3	2.8	0.42	1.43	0.79	1.46
	133.350	33.338	33.338	26.195	170	235	2 600	3 500	4T-47678/47620	97	85	119	128	6.4	3.3	3.9	0.40	1.48	0.82	1.92
	133.350	39.688	39.688	32.545	196	305	2 600	3 500	4T-HM516442/HM516410	93	87	118	128	3.5	3.3	7.5	0.40	1.49	0.82	2.43
	135.733	44.450	46.100	34.925	235	330	2 700	3 500	4T-5760/5735	94	88	119	130	3.5	3.3	11.0	0.41	1.48	0.81	2.75
	136.525	30.162	29.769	22.225	143	189	2 600	3 500	4T-495A/493	92	86	122	130	3.5	3.3	0.7	0.44	1.35	0.74	1.83
	139.992	36.512	36.098	28.575	197	265	2 600	3 400	4T-575/572	92	86	125	133	3.5	3.3	5.5	0.40	1.49	0.82	2.42
	139.992	36.512	36.098	28.575	197	265	2 600	3 400	4T-575S/572	99	86	125	133	6.8	3.3	5.5	0.40	1.49	0.82	2.4
	146.050	41.275	41.275	31.750	228	295	2 500	3 300	4T-659/653	93	87	131	139	3.5	3.3	8.0	0.41	1.47	0.81	3.04
	149.225	53.975	54.229	44.450	320	410	2 500	3 400	4T-6461A/6420	108	89	129	140	9.7	3.3	14.8	0.36	1.66	0.91	4.24
	150.089	44.450	46.672	36.512	289	360	2 400	3 200	4T-748S/742	93	87	134	142	3.5	3.3	12.0	0.33	1.84	1.01	3.65

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.

1) Bearing numbers marked "#" designate J-series bearings. The tolerance of these bearings is listed in Table 6.8 on page A-66 to A-67.
2) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

Inch series
J series

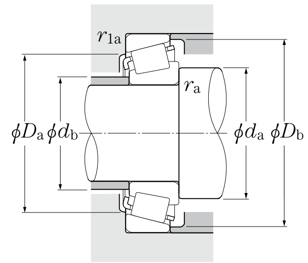


d 76.200 ～ 83.345mm

Boundary dimensions mm					Basic load rating kN		Allowable speed min^{-1}	
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication
76.200	149.225	53.975	54.229	44.450	320	410	2 500	3 400
	161.925	53.975	55.100	42.862	340	460	2 300	3 000
	180.975	53.975	53.183	35.720	360	415	1 900	2 600
	190.500	57.150	57.531	46.038	490	610	1 900	2 600
77.788	117.475	25.400	25.400	19.050	110	162	2 900	3 900
	121.442	24.608	23.012	17.462	101	127	2 900	3 800
	127.000	30.162	31.000	22.225	150	194	2 800	3 700
	136.525	30.162	29.769	22.225	143	189	2 600	3 500
	136.525	46.038	46.038	36.512	248	355	2 600	3 500
79.375	146.050	41.275	41.275	31.750	228	295	2 500	3 300
	161.925	47.625	48.260	38.100	299	385	2 300	3 100
	190.500	57.150	57.531	46.038	490	610	1 900	2 600
80.000	130.000	35.000	34.000	28.500	184	249	2 700	3 600
80.962	133.350	33.338	33.338	26.195	170	235	2 600	3 500
	136.525	30.162	29.769	22.225	143	189	2 600	3 500
	139.992	36.512	36.098	28.575	197	265	2 600	3 400
	150.089	44.450	46.672	36.512	289	360	2 400	3 200
82.550	125.412	25.400	25.400	19.845	113	163	2 700	3 600
	133.350	33.338	33.338	26.195	170	235	2 600	3 500
	133.350	39.688	39.688	32.545	196	305	2 600	3 500
	136.525	30.162	29.769	22.225	143	189	2 600	3 500
	139.992	36.512	36.098	28.575	197	265	2 600	3 400
	139.992	36.512	36.098	28.575	197	265	2 600	3 400
	146.050	41.275	41.275	31.750	228	295	2 500	3 300
	150.089	44.450	46.672	36.512	289	360	2 400	3 200
	152.400	39.688	36.322	30.162	199	279	2 300	3 100
	152.400	41.275	41.275	31.750	228	295	2 500	3 300
	161.925	47.625	48.260	38.100	299	385	2 300	3 100
	161.925	53.975	55.100	42.862	340	460	2 300	3 000
	168.275	53.975	56.363	41.275	375	460	2 200	3 000
83.345	125.412	25.400	25.400	19.845	113	163	2 700	3 600
	125.412	25.400	25.400	19.845	113	163	2 700	3 600
	125.412	25.400	25.400	19.845	113	163	2 700	3 600

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.

Tapered Roller Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

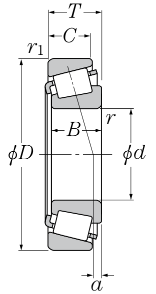
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1) 2)	Installation-related dimensions mm						Load center3) mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-6461/6420	96	89	129	140	3.5	3.3	14.8	0.36	1.66	0.91	4.26
4T-6576/6535	99	92	141	154	3.5	3.3	12.8	0.40	1.50	0.82	5.43
4T-H917840/H917810††	110	100.1	152	170	3.5	3.3	-0.5	0.73	0.82	0.45	6.57
4T-HH221430/HH221410	101	95	171	179	3.5	3.3	14.4	0.33	1.79	0.99	8.71
4T-LM814849/LM814810	91	85	105	113	3.5	3.3	-2.3	0.51	1.18	0.65	0.929
4T-34306/34478	91	84	110	116	3.5	2	-1.2	0.45	1.33	0.73	0.94
4T-42690/42620	91	85	114	121	3.5	3.3	2.8	0.42	1.43	0.79	1.24
4T-495AS/493	93	87	122	130	3.5	3.3	0.7	0.44	1.35	0.74	1.78
4T-H715348/H715311	99	88	118	132	3.5	3.3	8.7	0.47	1.27	0.70	2.84
4T-661/653	96	90	131	139	3.5	3.3	8.0	0.41	1.47	0.81	2.92
4T-756A/752	109	94	144	150	8	3.3	12.0	0.34	1.76	0.97	4.55
4T-HH221431/HH221410	103	97	171	179	3.5	3.3	14.4	0.33	1.79	0.99	8.52
#4T-JM515649/JM515610	94	88	117	125	3	2.5	4.9	0.39	1.54	0.85	1.74
4T-47681/47620	95	89	119	128	3.5	3.3	3.9	0.40	1.48	0.82	1.78
4T-496/493	95	89	122	130	3.5	3.3	0.7	0.44	1.35	0.74	1.69
4T-581/572	96	90	125	133	3.5	3.3	5.5	0.40	1.49	0.82	2.25
4T-740/742	101	91	134	142	5	3.3	12.0	0.33	1.84	1.01	3.44
4T-27687/27620	96	89	115	120	3.5	1.5	-0.6	0.42	1.44	0.79	1.05
4T-47686/47620	98	92	119	128	3.5	3.3	3.9	0.40	1.48	0.82	1.72
4T-HM516448/HM516410	106	92	118	128	6.8	3.3	7.5	0.40	1.49	0.82	2.16
4T-495/493	97	90	122	130	3.5	3.3	0.7	0.44	1.35	0.74	1.64
4T-580/572	98	91	125	133	3.5	3.3	5.5	0.40	1.49	0.82	2.19
4T-582/572	104	91	125	133	6.8	3.3	5.5	0.40	1.49	0.82	2.18
4T-663/653	99	92	131	139	3.5	3.3	8.0	0.41	1.47	0.81	2.79
4T-749A/742	99	93	134	142	3.5	3.3	12.0	0.33	1.84	1.01	3.37
4T-595/592A	100	93	135	144	3.5	3.3	2.6	0.44	1.36	0.75	3.02
4T-663/652	99	92	134	141	3.5	3.3	8.0	0.41	1.47	0.81	3.16
4T-757/752	100	94	144	150	3.5	3.3	12.0	0.34	1.76	0.97	4.42
4T-6559C/6535	104	98	141	154	3.5	3.3	12.8	0.40	1.50	0.82	5.1
4T-842/832	101	94	149	155	3.5	3.3	18.5	0.30	2.00	1.10	5.47
4T-27689/27620	90	90	115	120	0.8	1.5	-0.6	0.42	1.44	0.79	1.06
4T-27690/27620	96	89	115	120	3.5	1.5	-0.6	0.42	1.44	0.79	1.03
4T-27691/27620	102	90	115	120	6.4	1.5	-0.6	0.42	1.44	0.79	1.04

2) Bearing numbers marked "#" designate J-series bearings. The tolerance of these bearings is listed in Table 6.8 on page A-66 to A-67.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

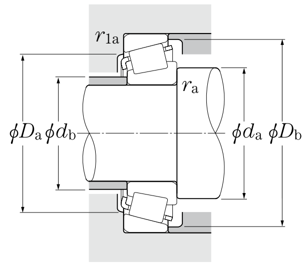
Inch series
J series



d 84.138 ～ 95.000mm

Boundary dimensions (mm)					Basic load rating (kN)		Allowable speed (min^{-1})	
					dynamic	static	Grease lubrication	Oil lubrication
d	D	T	B	C	C_r	C_{0r}		
84.138	136.525	30.162	29.769	22.225	143	189	2 600	3 500
85.000	130.000	30.000	29.000	24.000	149	214	2 600	3 500
	140.000	39.000	38.000	31.500	218	297	2 500	3 400
85.026	150.089	44.450	46.672	36.512	289	360	2 400	3 200
85.725	133.350	30.162	29.769	22.225	143	189	2 600	3 500
	142.138	42.862	42.862	34.133	240	350	2 500	3 300
	146.050	41.275	41.275	31.750	228	295	2 500	3 300
	152.400	39.688	36.322	30.162	199	279	2 300	3 100
	161.925	47.625	48.260	38.100	299	385	2 300	3 100
87.960	148.430	28.575	28.971	21.433	153	215	2 300	3 100
88.900	121.442	15.083	15.083	11.112	63.0	88.0	2 700	3 600
	123.825	20.638	20.638	16.670	89.0	141	2 700	3 500
	148.430	28.575	28.971	21.433	153	215	2 300	3 100
	152.400	39.688	36.322	30.162	199	279	2 300	3 100
	161.925	47.625	48.260	38.100	299	385	2 300	3 100
	161.925	53.975	55.100	42.862	340	460	2 300	3 000
	168.275	53.975	56.363	41.275	375	460	2 200	3 000
89.974	146.975	40.000	40.000	32.500	252	340	2 400	3 200
90.000	145.000	35.000	34.000	27.000	210	279	2 400	3 200
	155.000	44.000	44.000	35.500	299	385	2 300	3 100
	190.000	50.800	46.038	31.750	310	365	1 800	2 400
90.488	161.925	47.625	48.260	38.100	299	385	2 300	3 100
92.075	146.050	33.338	34.925	26.195	181	266	2 400	3 100
	152.400	39.688	36.322	30.162	199	279	2 300	3 100
	168.275	41.275	41.275	30.162	247	340	2 100	2 800
93.662	148.430	28.575	28.971	21.433	153	215	2 300	3 100
95.000	150.000	35.000	34.000	27.000	199	279	2 300	3 100

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

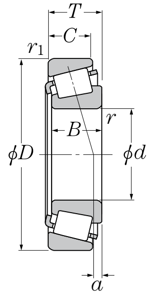
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1) 2)	Installation-related dimensions (mm)						Load center 3) (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-498/493	98	91	122	130	3.5	3.3	0.7	0.44	1.35	0.74	1.6
#4T-JM716648/JM716610	104	92	117	125	6	2.5	0.2	0.44	1.35	0.74	1.37
#4T-JHM516849/JHM516810	100	94	125	134	3	2.5	5.9	0.41	1.47	0.81	2.3
4T-749/742	101	95	134	142	3.5	3.3	12.0	0.33	1.84	1.01	3.24
4T-497/492A	99	93	120	128	3.5	3.3	0.7	0.44	1.35	0.74	1.43
4T-HM617049/HM617010	106	95.2	125	137	4.8	3.3	6.9	0.43	1.39	0.76	2.71
4T-665/653	102	95	131	139	3.5	3.3	8.0	0.41	1.47	0.81	2.65
4T-596/592A	102	96	135	144	3.5	3.3	2.6	0.44	1.36	0.75	2.9
4T-758/752	106	100	144	150	3.5	3.3	12.0	0.34	1.76	0.97	4.26
4T-42346/42584	103	98	134	142	3	3	-3.0	0.49	1.22	0.67	1.98
4T-LL217849/LL217810	97	94	115	117	1.5	1.5	-2.9	0.33	1.81	1.00	0.452
4T-L217849/L217810	97	94	116	119	1.5	1.5	-0.7	0.33	1.82	1.00	0.737
4T-42350/42584	104	98	134	142	3	3	-3.0	0.49	1.22	0.67	1.95
4T-593/592A	104	98	135	144	3.5	3.3	2.6	0.44	1.36	0.75	2.77
4T-759/752	108	101	144	150	3.5	3.3	12.0	0.34	1.76	0.97	4.1
4T-6580/6535	117	102	141	154	3.5	3.3	12.8	0.40	1.50	0.82	4.72
4T-850/832	106	100	149	155	3.5	3.3	18.5	0.30	2.00	1.10	5.09
4T-HM218248†/HM218210††	112	99	133	141	7	3.5	8.6	0.33	1.8	0.99	2.55
#4T-JM718149/JM718110	106	99	131	138.8	3	2.5	2.0	0.44	1.35	0.74	2.14
#4T-JHM318448/JHM318410	106	100	140	148	3	2.5	10.1	0.34	1.76	0.97	3.33
#4T-J90354/J90748	120	111.8	162	179.3	3.5	3.3	-12.9	0.87	0.69	0.38	6.32
4T-760/752	110	101	144	150	3.5	3.3	12.0	0.34	1.76	0.97	4.01
4T-47890/47820	107	101	131	140	3.5	3.3	0.6	0.45	1.34	0.74	2.08
4T-598A/592A	113	101	135	144	6.4	3.3	2.6	0.44	1.36	0.75	2.63
4T-681/672	110	104	149	160	3.5	3.3	3.0	0.47	1.28	0.7	3.87
4T-42368/42584	107	102	134	142	3	3	-3.0	0.49	1.22	0.67	1.8
#4T-JM719149/JM719113	109	104	135	143	3	2.5	1.7	0.44	1.36	0.75	2.19

2) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

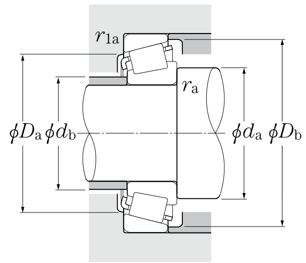
Inch series
J series



d 95.250 ～ 109.538mm

Boundary dimensions (mm)					Basic load rating (kN)		Allowable speed (min-1)	
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication
95.250	130.175	20.638	21.433	16.670	90.0	147	2 500	3 300
	146.050	33.338	34.925	26.195	181	266	2 400	3 100
	147.638	35.717	36.322	26.192	199	279	2 300	3 100
	148.430	28.575	28.971	21.433	153	215	2 300	3 100
	152.400	39.688	36.322	30.162	199	279	2 300	3 100
	157.162	36.512	36.116	26.195	208	305	2 200	2 900
	168.275	41.275	41.275	30.162	247	340	2 100	2 800
	190.500	57.150	57.531	46.038	490	610	1 900	2 600
96.838	148.430	28.575	28.971	21.433	153	215	2 300	3 100
	188.912	50.800	46.038	31.750	310	365	1 800	2 400
98.425	157.162	36.512	36.116	26.195	208	305	2 200	2 900
	168.275	41.275	41.275	30.162	247	340	2 100	2 800
99.974	212.725	66.675	66.675	53.975	635	810	1 700	2 300
100.000	155.000	36.000	35.000	28.000	213	310	2 200	2 900
100.012	157.162	36.512	36.116	26.195	208	305	2 200	2 900
101.600	157.162	36.512	36.116	26.195	208	305	2 200	2 900
	168.275	41.275	41.275	30.162	247	340	2 100	2 800
	180.975	47.625	48.006	38.100	315	430	2 000	2 700
	190.500	57.150	57.531	44.450	420	555	2 000	2 600
	190.500	57.150	57.531	46.038	490	610	1 900	2 600
	190.500	57.150	57.531	46.038	490	610	1 900	2 600
	212.725	66.675	66.675	53.975	525	695	1 800	2 300
	212.725	66.675	66.675	53.975	635	810	1 700	2 300
104.775	180.975	47.625	48.006	38.100	315	430	2 000	2 700
107.950	158.750	23.020	21.438	15.875	114	166	2 100	2 800
	159.987	34.925	34.925	26.988	186	320	2 100	2 800
	165.100	36.512	36.512	26.988	212	315	2 100	2 700
	212.725	66.675	66.675	53.975	525	695	1 800	2 300
109.538	158.750	23.020	21.438	15.875	114	166	2 100	2 800

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

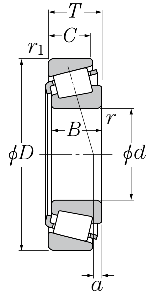
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

Bearing number 1) 2)	Installation-related dimensions (mm)						Load center 3) (mm)	Constant	Axial load factors		Mass (kg)
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-L319249/L319210	103	101	122	125	1.5	1.5	-1.0	0.35	1.72	0.95	0.786
4T-47896/47820	110	103	131	140	3.5	3.3	0.6	0.45	1.34	0.74	1.95
4T-594A/592XE	113	104	135	142	5	0.8	2.6	0.44	1.36	0.75	2.09
4T-42375/42584	108	103	134	142	3	3	-3.0	0.49	1.22	0.67	1.74
4T-594/592A	110	104	135	144	3.5	3.3	2.6	0.44	1.36	0.75	2.51
4T-52375/52618	112	105	142	152	3.5	3.3	0.6	0.47	1.26	0.69	2.76
4T-683/672	113	106	149	160	3.5	3.3	3.0	0.47	1.28	0.70	3.72
4T-HH221440/HH221410	125	110	171	179	8	3.3	14.4	0.33	1.79	0.99	7.5
4T-42381/42584	112	105	134	142	3.5	3	-3.0	0.49	1.22	0.67	1.69
4T-90381/90744	125	113	161	179	3.5	3.3	-12.9	0.87	0.69	0.38	5.46
4T-52387/52618	114	108	142	152	3.5	3.3	0.6	0.47	1.26	0.69	2.62
4T-685/672	116	109	149	160	3.5	3.3	3.0	0.47	1.28	0.70	3.57
4T-HH224334†/HH224310	124	120	192	201.7	3.5	3.3	18.9	0.33	1.84	1.01	11.5
#4T-JM720249/JM720210	115	109	140	149	3	2.5	-0.3	0.47	1.27	0.70	2.4
4T-52393/52618	116	109	142	152	3.5	3.3	0.6	0.47	1.26	0.69	2.55
4T-52400/52618	117	111	142	152	3.5	3.3	0.6	0.47	1.26	0.69	2.48
4T-687/672	118	112	149	160	3.5	3.3	3.0	0.47	1.28	0.70	3.4
4T-780/772††	119	113	161	168	3.5	3.3	8.1	0.39	1.56	0.86	5.12
4T-861/854	129	114	170	174	8	3.3	15.3	0.33	1.79	0.99	7
4T-HH221449/HH221410	131	115.9	171	179	8	3.3	14.4	0.33	1.79	0.99	7.07
4T-HH221449A/HH221410	122	115.9	171	179	3.5	3.3	14.4	0.33	1.79	0.99	7.06
4T-941/932	130	117	187	193.1	7	3.3	19.7	0.33	1.84	1.01	11.2
4T-HH224335/HH224310	132	121	192	201.7	7	3.3	18.9	0.33	1.84	1.01	11.3
4T-782/772††	122	116	161	168	3.5	3.3	8.1	0.39	1.56	0.86	4.92
4T-37425/37625	122	115	143	152	3.5	3.3	-14.0	0.61	0.99	0.54	1.37
4T-LM522546/LM522510	122	116	146	154	3.5	3.3	1.4	0.40	1.49	0.82	2.37
4T-56425/56650	123	117	149	159	3.5	3.3	-2.0	0.50	1.21	0.66	2.69
4T-936/932	137	122	187	193.1	8	3.3	19.7	0.33	1.84	1.01	10.7
4T-37431/37625	123	116	143	152	3.5	3.3	-14	0.61	0.99	0.54	1.32

2) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

Inch series
J series

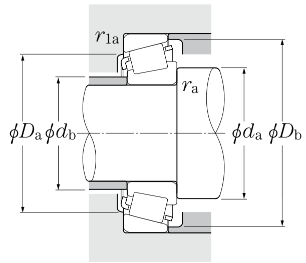


d 109.987 ～ 133.350mm

Boundary dimensions mm					Basic load rating kN		Allowable speed min⁻¹	
d	D	T	B	C	dynamic C_r	static C_{0r}	Grease lubrication	Oil lubrication
109.987	159.987	34.925	34.925	26.988	186	320	2 100	2 800
109.992	177.800	41.275	41.275	30.162	257	375	1 900	2 600
110.000	165.000	35.000	35.000	26.500	212	315	2 100	2 700
	180.000	47.000	46.000	38.000	340	480	1 900	2 600
111.125	214.312	55.562	52.388	39.688	450	560	1 500	2 000
114.300	177.800	41.275	41.275	30.162	257	375	1 900	2 600
	180.975	34.925	31.750	25.400	187	245	1 900	2 500
	212.725	66.675	66.675	53.975	525	695	1 800	2 300
	212.725	66.675	66.675	53.975	635	810	1 700	2 300
	228.600	53.975	49.428	38.100	475	620	1 400	1 900
115.087	190.500	47.625	49.212	34.925	335	475	1 800	2 500
117.475	180.975	34.925	31.750	25.400	187	245	1 900	2 500
120.000	170.000	25.400	25.400	19.050	141	210	2 000	2 600
120.650	234.950	63.500	63.500	49.212	580	825	1 500	2 000
123.825	182.562	39.688	38.100	33.338	249	435	1 800	2 400
127.000	182.562	39.688	38.100	33.338	249	435	1 800	2 400
	196.850	46.038	46.038	38.100	340	550	1 700	2 200
	215.900	47.625	47.625	34.925	355	540	1 600	2 100
	228.600	53.975	49.428	38.100	355	445	1 400	1 900
	228.600	53.975	49.428	38.100	475	620	1 400	1 900
	230.000	63.500	63.500	49.212	580	825	1 500	2 000
	254.000	77.788	82.550	61.912	820	1 070	1 400	1 900
128.588	206.375	47.625	47.625	34.925	350	520	1 700	2 200
130.175	196.850	46.038	46.038	38.100	340	550	1 700	2 200
	206.375	47.625	47.625	34.925	350	520	1 700	2 200
133.350	177.008	25.400	26.195	20.638	140	259	1 800	2 400

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.
1) As for the maximum value for inner and outer ring diameters of bearings whose bearing numbers are marked with "†" (inner ring) and "††" (outer ring), the precision class is an integer for class 4 and class 2 bearings only.

Tapered Roller Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

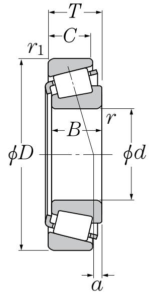
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

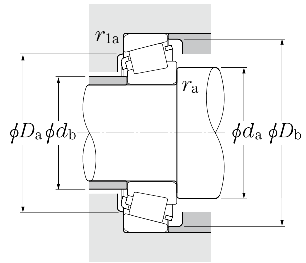
Bearing number 1) 2)	Installation-related dimensions mm						Load center 3) mm	Constant	Axial load factors		Mass kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-LM522548/LM522510	133	118	146	154	8	3.3	1.4	0.40	1.49	0.82	2.24
4T-64433/64700	128	121	160	172	3.5	3.3	-1.1	0.52	1.16	0.64	3.77
#4T-JM822049/JM822010	125	119	149	159	3	2.5	-3.0	0.50	1.21	0.66	2.52
#4T-JHM522649/JHM522610	127	122	162	172	3	2.5	6.0	0.41	1.48	0.81	4.61
4T-H924045/H924010	139	131.2	186	205	3.5	3.3	-6.8	0.67	0.89	0.49	8.47
4T-64450/64700	131	125	160	172	3.5	3.3	-1.1	0.52	1.16	0.64	3.52
4T-68450/68712††	130	123	163	172	3.5	3.3	-5.4	0.50	1.21	0.66	2.93
4T-938/932	141	128	187	193.1	7	3.3	19.7	0.33	1.84	1.01	10.1
4T-HH224346/HH224310	143	131	192	201.7	7	3.3	18.9	0.33	1.84	1.01	10.1
4T-HM926740/HM926710	146	142	200	219.3	3.5	3.3	-13.5	0.74	0.81	0.45	9.76
4T-71453/71750	133	126	171	181	3.5	3.3	6.7	0.42	1.44	0.79	5.11
4T-68462/68712††	132	125	163	172	3.5	3.3	-5.4	0.50	1.21	0.66	2.78
#4T-JL724348/JL724314	132	127	156	163	3.3	3.3	-7.9	0.46	1.31	0.72	1.67
4T-95475/95925	149	137	209	217	6.4	3.3	14.0	0.37	1.62	0.89	12.6
4T-48286/48220	139	133	168	176	3.5	3.3	5.7	0.31	1.97	1.08	3.52
4T-48290/48220	141	135	168	176	3.5	3.3	5.7	0.31	1.97	1.08	3.33
4T-67388/67322	144	138	180	189	3.5	3.3	6.3	0.34	1.74	0.96	5.1
4T-74500/74850	148	141	196	208	3.5	3.3	-2.2	0.49	1.23	0.68	7.04
4T-97500/97900	151	144	197	213	3.5	3.3	-13.4	0.74	0.81	0.45	8.43
4T-HM926747/HM926710	156	143	200	219.3	3.5	3.3	-13.5	0.74	0.81	0.45	8.83
4T-95500/95905	154	142	207	217	6.4	3.3	14.0	0.37	1.62	0.89	12.9
4T-HH228349/HH228310	164	148	223	233.6	9.7	6.4	23.4	0.32	1.87	1.03	18
4T-799/792	146	140	186	196	3.3	3.3	1.9	0.46	1.31	0.72	5.77
4T-67389/67322	147	141	180	189	3.5	3.3	6.3	0.34	1.74	0.96	4.87
4T-799A/792	148	142	186	196	3.5	3.3	1.9	0.46	1.31	0.72	5.65
4T-L327249/L327210	142	140	167	171	1.5	1.5	-3.7	0.35	1.72	0.95	1.7

2) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
3) Dimensions with "−" indicate a load center at the outside on the end of an inner ring.

Inch series
J series



Tapered Roller Bearings NTN



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

Static equivalent radial load
$P_{0r} = 0.5F_r + Y_0F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.
For values of e, Y_2 and Y_0 see the table below.

d 133.350 ～ 196.850mm

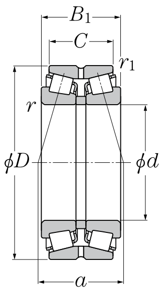
Boundary dimensions					Basic load rating		Allowable speed	
mm					dynamic kN	static	min-1	
d	D	T	B	C	C_r	C_{0r}	Grease lubrication	Oil lubrication
133.350	190.500	39.688	39.688	33.338	262	475	1 700	2 300
	196.850	46.038	46.038	38.100	340	550	1 700	2 200
	196.850	46.038	46.038	38.100	340	550	1 700	2 200
	215.900	47.625	47.625	34.925	355	540	1 600	2 100
	234.950	63.500	63.500	49.212	580	825	1 500	2 000
136.525	190.500	39.688	39.688	33.338	262	475	1 700	2 300
	228.600	57.150	57.150	44.450	495	735	1 500	2 000
139.700	215.900	47.625	47.625	34.925	355	540	1 600	2 100
	228.600	57.150	57.150	44.450	495	735	1 500	2 000
	254.000	66.675	66.675	47.625	610	910	1 400	1 800
142.875	200.025	41.275	39.688	34.130	265	490	1 600	2 100
	200.025	41.275	39.688	34.130	265	490	1 600	2 100
146.050	193.675	28.575	28.575	23.020	183	340	1 600	2 200
	254.000	66.675	66.675	47.625	610	910	1 400	1 800
152.400	192.088	25.000	24.000	19.000	144	261	1 600	2 100
	222.250	46.830	46.830	34.925	350	585	1 500	2 000
158.750	205.583	23.812	23.812	18.258	140	247	1 500	2 000
	225.425	41.275	39.688	33.338	282	555	1 400	1 900
165.100	225.425	41.275	39.688	33.338	282	555	1 400	1 900
170.000	230.000	39.000	38.000	31.000	310	520	1 400	1 800
177.800	227.012	30.162	30.162	23.020	201	415	1 300	1 800
	247.650	47.625	47.625	38.100	380	690	1 300	1 700
180.000	250.000	47.000	45.000	37.000	410	710	1 300	1 700
190.000	260.000	46.000	44.000	36.500	405	720	1 200	1 600
196.850	241.300	23.812	23.017	17.462	177	330	1 200	1 600

Bearing number [1]	Installation-related dimensions						Load center[2]	Constant	Axial load factors		Mass
	mm						mm				kg
	d_a	d_b	D_a	D_b	r_{as} Max.	r_{1as} Max.	a	e	Y_2	Y_0	(approx.)
4T-48385/48320	148	142	177	184	3.5	3.3	4.0	0.32	1.87	1.03	3.64
4T-67390/67322	150	144	180	189	3.5	3.3	6.3	0.34	1.74	0.96	4.63
4T-67391/67322	157	143	180	189	8	3.3	6.3	0.34	1.74	0.96	4.59
4T-74525/74850	152	146	196	208	3.5	3.3	-2.2	0.49	1.23	0.68	6.56
4T-95525/95925	166	148	209	217	9.7	3.3	14.0	0.37	1.62	0.89	11.3
4T-48393/48320	151	144	177	184	3.5	3.3	4.0	0.32	1.87	1.03	3.43
4T-896/892	156	150	205	216	3.5	3.3	6.0	0.42	1.43	0.78	9.12
4T-74550/74850	158	151	196	208	3.5	3.3	-2.2	0.49	1.23	0.68	6.05
4T-898/892	160	153	205	216	3.5	3.3	6.0	0.42	1.43	0.78	8.81
4T-99550/99100	170	156	227	238	7	3.3	12.1	0.41	1.47	0.81	14.3
4T-48684/48620	166	151	185	193	8	3.3	3.1	0.34	1.78	0.98	3.85
4T-48685/48620	158	151	185	193	3.5	3.3	3.1	0.34	1.78	0.98	3.89
4T-36690/36620	155	153	182	188	1.5	1.5	-5.0	0.37	1.63	0.90	2.26
4T-99575/99100	175	162	227	238	7	3.3	12.1	0.41	1.47	0.81	13.6
4T-L630349/L630310	162	158	183	187	2	2	-10.0	0.42	1.44	0.79	1.57
4T-M231648/M231610	178	163	207	213	8	1.5	5.9	0.33	1.80	0.99	5.7
4T-L432349/L432310	168	166	195	199	1.5	1.5	-9.8	0.37	1.61	0.88	1.89
4T-46780/46720	176	169	209	218	3.5	3.3	-2.6	0.38	1.57	0.86	5.19
4T-46790/46720	181	174	209	218	3.5	3.3	-2.6	0.38	1.57	0.86	4.68
#4T-JHM534149/JHM534110	184	178	217	224	3	2.5	-4.7	0.38	1.57	0.86	4.37
4T-36990/36920	188	186	214	221	1.5	1.5	-12.8	0.44	1.36	0.75	2.91
4T-67790/67720	194	188	229	240	3.5	3.3	-4.8	0.44	1.36	0.75	6.72
#4T-JM736149/JM736110	196	190.5	232	242.6	3	2.5	-9.0	0.48	1.25	0.69	6.74
#4T-JM738249/JM738210	206	200	242	252	3	2.5	-10.9	0.48	1.26	0.69	6.84
4T-LL639249/LL639210	205	203	232	236	1.5	1.5	-17.3	0.42	1.44	0.79	2.07

Note: Chamfer dimensions on the back face of the inner and outer rings of the bearing are larger than the maximum values of installation-related dimensions r_{as} and r_{1as}.

1) Bearing numbers marked "#" designate **J-series** bearings. The tolerance of these bearings is listed in **Table 6.8** on page **A-66** to **A-67**.
2) Dimensions with "–" indicate a load center at the outside on the end of an inner ring.

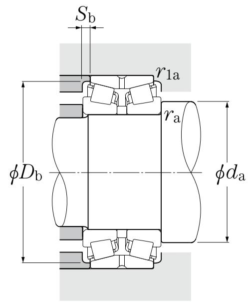
Back-to-back arrangement



d 40 ～ 70mm

Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹	
						dynamic	static		Grease	Oil
d	D	B_1	C	$r_{s\,min}$[1)]	$r_{1s\,min}$[1)]	C_r	C_{0r}	C_u	lubrication	lubrication
40	80	45	37.5	1.5	0.6	116	134	—	4 100	5 500
	80	55	43.5	1.5	0.6	151	187	—	4 100	5 500
	90	56	39.5	2	0.6	147	171	—	3 200	4 200
	90	56	45.5	2	0.6	174	204	—	3 700	4 900
45	85	47	37.5	1.5	0.6	129	157	—	3 700	4 900
	85	55	43.5	1.5	0.6	156	200	—	3 700	4 900
	100	60	41.5	2	0.6	183	218	—	2 800	3 800
	100	60	49.5	2	0.6	212	251	—	3 300	4 400
50	90	49	39.5	1.5	0.6	147	186	—	3 400	4 500
	90	55	43.5	1.5	0.6	166	218	26.6	3 400	4 500
	110	64	43.5	2.5	0.6	216	260	—	2 600	3 500
	110	64	51.5	2.5	0.6	252	305	—	3 000	4 000
	110	90	71.5	2.5	0.6	350	465	56.5	3 000	4 000
55	100	51	41.5	2	0.6	177	221	—	3 100	4 100
	100	60	48.5	2	0.6	206	269	33.0	3 100	4 100
	120	70	49	2.5	0.6	251	305	—	2 400	3 100
	120	70	57	2.5	0.6	295	360	43.5	2 700	3 700
	120	97	76	2.5	0.6	410	550	67.0	2 700	3 700
60	110	53	43.5	2	0.6	199	249	—	2 800	3 800
	110	66	54.5	2	0.6	247	330	40.0	2 800	3 800
	130	74	51	3	1	286	350	—	2 200	2 900
	130	74	59	3	1	340	420	51.0	2 500	3 400
	130	104	81	3	1	465	625	76.5	2 500	3 400
65	120	56	46.5	2	0.6	234	295	—	2 600	3 500
	120	73	61.5	2	0.6	300	410	50.0	2 600	3 500
	140	79	53	3	1	330	410	—	2 000	2 700
	140	79	63	3	1	385	475	57.5	2 300	3 100
	140	108	84	3	1	520	700	85.0	2 300	3 100
70	125	59	48.5	2	0.6	250	325	—	2 400	3 200
	125	74	61.5	2	0.6	315	440	53.5	2 400	3 200
	150	83	57	3	1	365	460	—	1 900	2 500
	150	83	67	3	1	435	545	64.0	2 200	2 900
	150	116	92	3	1	590	805	95.5	2 200	2 900

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

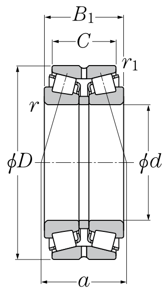
Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number	Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_1	Y_2	Y_0	(approx.)
4T-430208X	48.5	75	3.5	1.5	0.6	38.5	0.37	1.80	2.68	1.76	0.956
4T-432208X	48.5	75	5.5	1.5	0.6	43.5	0.37	1.80	2.68	1.76	1.18
4T-430308DX	50	86.5	8	2	0.6	64.5	0.83	0.82	1.22	0.80	1.59
4T-430308	50	83.5	5	2	0.6	44.5	0.35	1.96	2.91	1.91	1.7
4T-430209	53.5	80	4.5	1.5	0.6	42	0.40	1.67	2.48	1.63	1.08
4T-432209	53.5	81	5.5	1.5	0.6	46	0.40	1.67	2.48	1.63	1.27
4T-430309DX	55	96.5	9	2	0.6	70	0.83	0.82	1.22	0.80	2.11
4T-430309	55	93.5	5	2	0.6	47.5	0.35	1.96	2.91	1.91	2.17
4T-430210	58.5	85	4.5	1.5	0.6	45	0.42	1.61	2.39	1.57	1.23
432210U	58.5	86	5.5	1.5	0.6	47.5	0.42	1.61	2.39	1.57	1.4
4T-430310DX	62	104.5	10	2	0.6	75	0.83	0.82	1.22	0.80	2.7
4T-430310	62	103	6	2	0.6	51	0.35	1.96	2.91	1.91	2.81
432310U	62	102.5	9	2	0.6	62.5	0.35	1.96	2.91	1.91	3.98
4T-430211X	65	95	4.5	2	0.6	47.5	0.40	1.67	2.48	1.63	1.57
432211U	65	96	5.5	2	0.6	47.5	0.40	1.67	2.48	1.63	1.89
4T-430311DX	67	113.5	10.5	2	0.6	83	0.83	0.82	1.22	0.80	3.42
430311XU	67	112.5	6.5	2	0.6	56	0.35	1.96	2.91	1.91	3.57
432311U	67	111.5	10.5	2	0.6	66.5	0.35	1.96	2.91	1.91	5.05
4T-430212X	70	104	4.5	2	0.6	49.5	0.40	1.67	2.48	1.63	1.99
432212U	70	105	5.5	2	0.6	56	0.40	1.67	2.48	1.63	2.49
4T-430312DX	74	124	11.5	2.5	1	88.5	0.83	0.82	1.22	0.80	4.3
430312U	74	122	7.5	2.5	1	60	0.35	1.96	2.91	1.91	4.31
432312U	74	121.5	11.5	2.5	1	71	0.35	1.96	2.91	1.91	6.39
4T-430213X	75	114.5	4.5	2	0.6	54	0.40	1.67	2.48	1.63	2.56
432213U	75	115.5	5.5	2	0.6	62	0.40	1.67	2.48	1.63	3.41
4T-430313DX	79	133.5	13	2.5	1	94.5	0.83	0.82	1.22	0.80	5.26
430313XU	79	131.5	8	2.5	1	64	0.35	1.96	2.91	1.91	5.41
432313U	79	131.5	12	2.5	1	74.5	0.35	1.96	2.91	1.91	7.55
4T-430214	80	119	5	2	0.6	57.5	0.42	1.61	2.39	1.57	2.83
432214U	80	120.5	6	2	0.6	65	0.42	1.61	2.39	1.57	3.65
4T-430314DX	84	142.5	13	2.5	1	101.5	0.83	0.82	1.22	0.80	6.32
430314XU	84	141	8	2.5	1	67	0.35	1.96	2.91	1.91	6.53
432314U	84	141	12	2.5	1	80.5	0.35	1.96	2.91	1.91	9.28

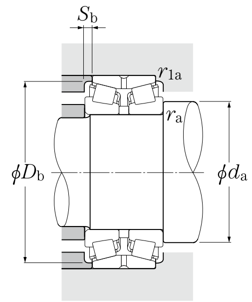
Back-to-back arrangement



d 75 ～ 105mm

d	D	B_1	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r (dynamic)	C_{0r} (static)	C_u	Grease lubrication	Oil lubrication
Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹	
75	130	62	51.5	2	0.6	264	350	—	2 300	3 000
	130	74	61.5	2	0.6	320	445	54.0	2 300	3 000
	160	87	59	3	1	410	510	59.5	1 700	2 300
	160	87	69	3	1	485	605	70.0	2 000	2 700
	160	125	99	3	1	675	935	109	2 000	2 700
80	140	64	51.5	2.5	0.6	305	400	47.5	2 100	2 800
	140	78	63.5	2.5	0.6	380	530	63.0	2 100	2 800
	170	92	61	3	1	450	565	64.5	1 600	2 200
	170	92	73	3	1	555	700	79.5	1 900	2 500
	170	131	104	3	1	755	1 050	120	1 900	2 500
85	150	70	57	2.5	0.6	345	465	54.0	2 000	2 700
	150	86	69	2.5	0.6	425	600	70.0	2 000	2 700
	180	98	65	4	1	470	585	66.0	1 500	2 100
	180	98	77	4	1	580	725	81.0	1 800	2 400
	180	137	108	4	1	765	1 050	118	1 800	2 400
90	160	74	61	2.5	0.6	395	535	61.0	1 900	2 500
	160	94	77	2.5	0.6	500	720	82.5	1 900	2 500
	190	102	69	4	1	515	645	71.0	1 500	1 900
	190	102	81	4	1	640	815	89.0	1 700	2 300
	190	144	115	4	1	855	1 190	131	1 700	2 300
95	170	78	63	3	1	430	580	65.0	1 800	2 400
	170	100	83	3	1	570	835	93.5	1 800	2 400
	200	108	85	4	1	700	890	96.5	1 600	2 100
	200	151	118	4	1	955	1 340	146	1 600	2 100
100	180	83	67	3	1	490	675	74.5	1 700	2 200
	180	107	87	3	1	630	925	102	1 700	2 200
	215	112	87	4	1	780	995	106	1 500	2 000
	215	162	127	4	1	1 090	1 540	164	1 500	2 000
105	190	88	70	3	1	545	760	82.5	1 600	2 100
	190	115	95	3	1	720	1 080	118	1 600	2 100

1) Smallest allowable dimension for chamfer dimension r or r_1.



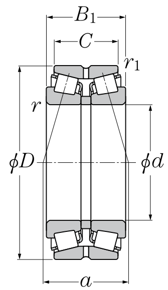
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_1	Y_2	Y_0	Mass (approx.)
	Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			kg
4T-430215	85	125	5	2	0.6	61.5	0.44	1.55	2.31	1.52	3.1
432215U	85	125.5	6	2	0.6	67	0.44	1.55	2.31	1.52	3.68
430315DU	89	152.5	14	2.5	1	107	0.83	0.82	1.22	0.80	7.31
430315XU	89	150.5	9	2.5	1	70.5	0.35	1.96	2.91	1.91	7.71
432315U	89	150.5	13	2.5	1	87.5	0.35	1.96	2.91	1.91	11.5
430216XU	92	133	6	2	0.6	63	0.42	1.61	2.39	1.57	3.76
432216XU	92	135	7	2	0.6	69.5	0.42	1.61	2.39	1.57	4.7
430316DU	94	160.5	15.5	2.5	1	113.5	0.83	0.82	1.22	0.80	8.99
430316XU	94	160	9.5	2.5	1	75.5	0.35	1.96	2.91	1.91	9.4
432316U	94	161.5	13.5	2.5	1	91	0.35	1.96	2.91	1.91	13.6
430217XU	97	141.5	6.5	2	0.6	69	0.42	1.61	2.39	1.57	4.76
432217XU	97	143.5	8.5	2	0.6	76.5	0.42	1.61	2.39	1.57	5.99
430317DU	103	170	16.5	3	1	121.5	0.83	0.82	1.22	0.80	10.4
430317XU	103	168	10.5	3	1	80	0.35	1.96	2.91	1.91	10.8
432317U	103	169	14.5	3	1	96	0.35	1.96	2.91	1.91	15.4
430218U	102	151	6.5	2	0.6	73	0.42	1.61	2.39	1.57	5.85
432218U	102	153.5	8.5	2	0.6	81	0.42	1.61	2.39	1.57	7.35
430318DU	108	180.5	16.5	3	1	127	0.83	0.82	1.22	0.80	12.2
430318U	108	177.5	10.5	3	1	84	0.35	1.96	2.91	1.91	12.5
432318U	108	179	14.5	3	1	100	0.35	1.96	2.91	1.91	18.3
430219XU	109	160.5	7.5	2.5	1	76.5	0.42	1.61	2.39	1.57	6.85
432219XU	109	163	8.5	2.5	1	86.5	0.42	1.61	2.39	1.57	9.2
430319XU	113	185.5	11.5	3	1	89	0.35	1.96	2.91	1.91	14.6
432319U	113	187.5	16.5	3	1	106	0.35	1.96	2.91	1.91	21
430220XU	114	169.5	8	2.5	1	81.5	0.42	1.61	2.39	1.57	8.27
432220XU	114	172	10	2.5	1	92	0.42	1.61	2.39	1.57	11
430320XU	118	198.5	12.5	3	1	92	0.35	1.96	2.91	1.91	17.9
432320U	118	201.5	17.5	3	1	112.5	0.35	1.96	2.91	1.91	26.8
430221XU	119	178.5	9	2.5	1	86	0.42	1.61	2.39	1.57	9.8
432221XU	119	181.5	10	2.5	1	97.5	0.42	1.61	2.39	1.57	13.3

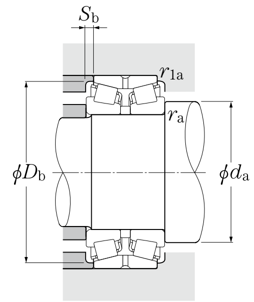
Back-to-back arrangement



d 110 ～ 150mm

d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating (kN) dynamic C_r	Basic load rating (kN) static C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Allowable speed (min⁻¹) Oil lubrication
	Boundary dimensions (mm)									
110	180	56	50	2.5	0.6	253	340	37.5	1 600	2 200
	180	70	56	2.5	0.6	330	485	53.0	1 600	2 200
	200	92	74	3	1	615	865	92.5	1 500	2 000
	200	121	101	3	1	800	1 210	130	1 500	2 000
	240	118	93	4	1	910	1 170	120	1 400	1 800
	240	181	142	4	1	1 340	1 940	199	1 400	1 800
120	180	46	41	2.5	0.6	214	298	32.0	1 500	2 100
	180	58	46	2.5	0.6	255	375	40.0	1 500	2 100
	200	62	55	2.5	0.6	291	435	46.0	1 500	2 000
	200	78	62	2.5	0.6	415	610	64.5	1 500	2 000
	215	97	78	3	1	660	940	98.5	1 400	1 900
	215	132	109	3	1	875	1 360	143	1 400	1 900
	260	128	101	4	1	1 060	1 390	139	1 200	1 700
	260	188	145	4	1	1 550	2 270	228	1 200	1 700
130	200	52	46	2.5	0.6	249	365	38.5	1 400	1 900
	200	65	52	2.5	0.6	325	490	51.5	1 400	1 900
	210	64	57	2.5	0.6	350	485	50.5	1 400	1 800
	210	80	64	2.5	0.6	455	675	70.5	1 400	1 800
	230	98	78.5	4	1	710	1 010	103	1 300	1 700
	230	145	117.5	4	1	1 010	1 630	167	1 300	1 700
	280	137	107.5	5	1.5	1 430	1 660	162	1 200	1 600
	280	205	163.5	4	1.5	1 960	2 470	243	1 200	1 600
140	210	53	47	2.5	0.6	291	415	43.0	1 300	1 800
	210	66	53	2.5	0.6	335	535	55.0	1 300	1 800
	225	68	61	3	1	410	580	59.0	1 200	1 700
	225	84	68	3	1	435	650	66.0	1 200	1 700
	250	102	82.5	4	1	800	1 140	114	1 200	1 600
	250	153	125.5	4	1	1 160	1 840	184	1 200	1 600
	300	145	115.5	5	1.5	1 620	1 900	183	1 100	1 500
	300	145	115.5	4	1.5	1 220	1 560	150	1 100	1 400
	300	223	177.5	4	1.5	2 170	2 740	264	1 100	1 500
150	225	56	50	3	1	305	430	43.5	1 200	1 600
	225	70	56	3	1	395	630	64.0	1 200	1 600
	250	80	71	3	1	540	805	79.5	1 200	1 500
	250	100	80	3	1	670	1 040	103	1 200	1 500

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

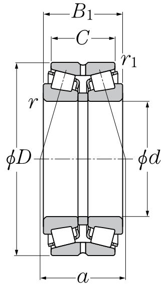
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number 2)	Abutment and fillet dimensions (mm) d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center (mm) a	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass (kg) (approx.)
413122	122	170.5	3	2	0.6	66.5	0.40	1.68	2.50	1.64	4.93
423122	122	167.5	7	2	0.6	66.5	0.33	2.03	3.02	1.98	6.38
430222XU	124	188.5	9	2.5	1	90	0.42	1.61	2.39	1.57	11.4
432222XU	124	192	10	2.5	1	102.5	0.42	1.61	2.39	1.57	15.8
430322U	128	222	12.5	3	1	99	0.35	1.96	2.91	1.91	23.9
432322U	128	224	19.5	3	1	127	0.35	1.96	2.91	1.91	37.4
413024	132	172	2.5	2	0.6	59	0.37	1.80	2.69	1.76	3.85
423024	132	171.5	6	2	0.6	66	0.37	1.80	2.69	1.76	4.35
413124	132	185.5	3.5	2	0.6	76.5	0.43	1.57	2.34	1.53	7.24
423124	132	189.5	8	2	0.6	76.5	0.37	1.80	2.69	1.76	8.69
430224XU	134	203	9.5	2.5	1	98	0.44	1.55	2.31	1.52	13.8
432224XU	134	206	11.5	2.5	1	112.5	0.44	1.55	2.31	1.52	19.2
430324XU	138	239	13.5	3	1	107	0.35	1.96	2.91	1.91	30.3
432324U	138	240.5	21.5	3	1	129.5	0.35	1.96	2.91	1.91	47
413026	142	188	3	2	0.6	66	0.37	1.80	2.69	1.76	5.55
423026	142	190.5	6.5	2	0.6	71.5	0.37	1.80	2.69	1.76	6.62
413126	142	197	3.5	2	0.6	69	0.33	2.03	3.02	1.98	7.83
423126	142	199.5	8	2	0.6	79.5	0.37	1.80	2.69	1.76	9.4
430226XU	148	218	9.5	3	1	101.5	0.44	1.55	2.31	1.52	15.3
432226XU	148	220.5	13.5	3	1	123.5	0.44	1.55	2.31	1.52	24
* 430326XUUTG	152	257.5	14.5	4	1.5	116.5	0.35	1.96	2.91	1.91	37.9
* 432326UTG	148	264	20.5	3	1.5	143	0.35	1.95	2.90	1.91	56.6
413028	152	200	3	2	0.6	68.5	0.37	1.80	2.69	1.76	5.73
423028	152	198	6.5	2	0.6	75	0.37	1.84	2.74	1.80	7.07
413128	154	212	3.5	2.5	1	73.5	0.33	2.03	3.02	1.98	9.29
423128	154	211	8	2.5	1	88	0.37	1.80	2.69	1.76	11.1
430228XU	158	235	9.5	3	1	107.5	0.44	1.55	2.31	1.52	19.2
432228XU	158	239.5	13.5	3	1	131.5	0.44	1.55	2.31	1.52	30
* 430328XUUTG	162	275.5	14.5	4	1.5	122.5	0.35	1.96	2.91	1.91	45.3
430328X	158	275.5	14.5	4	1.5	123.5	0.35	1.95	2.90	1.91	43.2
* 432328UTG	158	280.5	22.5	3	1.5	156	0.35	1.95	2.90	1.91	68.9
413030	164	213.5	3	2.5	1	73.5	0.37	1.80	2.69	1.76	6.66
423030	164	213	7	2.5	1	79.5	0.37	1.80	2.69	1.76	8.48
413130	164	232.5	4.5	2.5	1	83.5	0.33	2.03	3.02	1.98	14.6
423130	164	236	10	2.5	1	96.5	0.37	1.80	2.69	1.76	17.6

2) Bearing numbers marked "*" designate **ULTAGE series** bearings.

Double Row Tapered Roller Bearings

Back-to-back arrangement



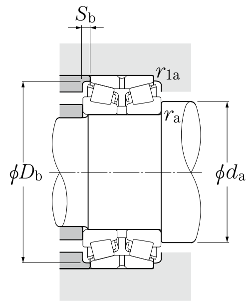
d 150 ～ 200mm

d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed Grease lubrication (min⁻¹)	Oil lubrication (min⁻¹)
150	270	109	87	4	1	855	1 210	118	1 100	1 500
	270	164	130	4	1	1 330	2 140	209	1 100	1 500
	320	154	120	5	1.5	1 810	2 140	201	990	1 400
160	240	60	53	3	1	370	535	53.0	1 100	1 500
	240	75	60	3	1	475	765	76.0	1 100	1 500
	270	86	76	3	1	760	965	93.0	1 100	1 600
	270	108	86	3	1	865	1 180	114	1 100	1 600
	290	115	91	4	1	1 150	1 440	137	1 000	1 400
	290	178	144	4	1	1 960	2 840	272	1 000	1 400
	340	160	126	5	1.5	2 010	2 390	221	920	1 300
170	260	67	60	3	1	405	620	60.0	1 100	1 400
	260	84	67	3	1	545	865	83.5	1 100	1 400
	280	88	78	3	1	705	900	86.0	1 000	1 500
	280	110	88	3	1	930	1 270	122	1 000	1 500
	310	125	97	5	1.5	1 340	1 690	159	950	1 400
	310	192	152	5	1.5	2 190	3 200	300	950	1 400
180	280	74	66	3	1	545	735	69.5	1 000	1 400
	280	93	74	3	1	745	1 050	99.5	1 000	1 400
	300	96	85	4	1.5	910	1 190	111	940	1 400
	300	120	96	4	1.5	1 130	1 530	144	940	1 400
	320	127	99	5	1.5	1 380	1 780	165	890	1 300
	320	192	152	5	1.5	2 260	3 350	315	890	1 300
190	290	75	67	3	1	555	740	69.5	940	1 400
	290	94	75	3	1	790	1 110	104	940	1 400
	320	104	92	4	1.5	1 000	1 280	118	890	1 300
	320	130	104	4	1.5	1 260	1 710	157	890	1 300
	340	133	105	5	1.5	1 570	2 010	183	840	1 200
	340	204	160	5	1.5	2 530	3 700	335	840	1 200
200	310	82	73	3	1	680	940	87.0	900	1 300
	310	103	82	3	1	920	1 320	121	900	1 300
	340	112	100	4	1.5	1 240	1 660	150	840	1 200
	340	140	112	4	1.5	1 400	1 910	173	840	1 200
	360	142	110	5	1.5	1 730	2 210	198	800	1 100
	360	218	174	5	1.5	2 900	4 250	380	800	1 100

Boundary dimensions in mm.

1) Smallest allowable dimension for chamfer dimension r or r_1.

Double Row Tapered Roller Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

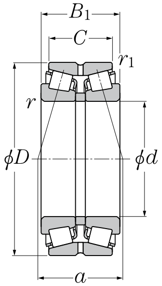
Bearing number 2)	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	Load center a (mm)	Constant e	Y_1	Y_2	Y_0	Mass kg (approx.)
430230U	168	251.5	11	3	1	114	0.44	1.55	2.31	1.52	24.1
432230XU	168	256	17	3	1	139	0.44	1.55	2.31	1.52	38
∗ 430330UUTG	172	294.5	17	4	1.5	131.5	0.35	1.96	2.91	1.91	54.6
413032	174	228.5	3.5	2.5	1	79	0.37	1.80	2.69	1.76	8.39
423032	174	228.5	7.5	2.5	1	85.5	0.37	1.80	2.69	1.76	10.7
∗ 413132UTG	174	256	5	2.5	1	98.5	0.40	1.68	2.50	1.64	18.2
∗ 423132UTG	174	252	11	2.5	1	106	0.37	1.80	2.69	1.76	22.5
∗ 430232UUTG	178	271	12	3	1	122	0.44	1.55	2.31	1.52	29.3
∗ 432232UUTG	178	277	17	3	1	149.5	0.44	1.55	2.31	1.52	49.9
∗ 430332XUUTG	182	312.5	17	4	1.5	137.5	0.35	1.96	2.91	1.91	63.8
413034	184	243.5	3.5	2.5	1	86.5	0.37	1.80	2.69	1.76	11.6
423034	184	245.5	8.5	2.5	1	93.5	0.37	1.80	2.69	1.76	14.3
∗ 413134UTG	184	262	5	2.5	1	104	0.40	1.68	2.50	1.64	19.2
∗ 423134UTG	184	262	11	2.5	1	108.5	0.37	1.80	2.69	1.76	24.2
∗ 430234UUTG	192	290.5	14	4	1.5	132.5	0.44	1.55	2.31	1.52	37.1
∗ 432234XUUTG	192	296	20	4	1.5	160	0.44	1.55	2.31	1.52	61.3
∗ 413036UTG	194	262	4	2.5	1	94	0.37	1.80	2.69	1.76	15.2
∗ 423036UTG	194	264	9.5	2.5	1	102	0.37	1.80	2.69	1.76	19
∗ 413136UTG	198	282	5.5	3	1.5	110.5	0.40	1.68	2.50	1.64	25
∗ 423136UTG	198	281	12	3	1.5	119	0.37	1.80	2.69	1.76	30.1
∗ 430236UUTG	202	300	14	4	1.5	139	0.45	1.50	2.23	1.47	39.1
∗ 432236UUTG	202	305.5	20	4	1.5	165	0.45	1.50	2.23	1.47	63.8
∗ 413038UTG	204	272.5	4	2.5	1	96	0.37	1.80	2.69	1.76	15.9
∗ 423038UTG	204	274	9.5	2.5	1	104.5	0.37	1.80	2.69	1.76	16.1
∗ 413138UTG	208	303	6	3	1.5	118.5	0.40	1.68	2.50	1.64	30.3
∗ 423138UTG	208	302	13	3	1.5	126.5	0.37	1.80	2.69	1.76	37.7
∗ 430238UUTG	212	321	14	4	1.5	141.5	0.44	1.55	2.31	1.52	47
∗ 432238UUTG	212	325.5	22	4	1.5	173.5	0.44	1.55	2.31	1.52	75.6
∗ 413040UTG	214	289.5	4.5	2.5	1	103	0.37	1.80	2.69	1.76	20.9
∗ 423040UTG	214	293	10.5	2.5	1	112	0.37	1.80	2.69	1.76	26.6
∗ 413140UTG	218	320	6	3	1.5	125.5	0.40	1.68	2.50	1.64	38.6
∗ 423140UTG	218	319	14	3	1.5	134.5	0.37	1.80	2.69	1.76	47.3
∗ 430240UUTG	222	338	16	4	1.5	154	0.44	1.55	2.31	1.52	55.8
∗ 432240UUTG	222	342.5	22	4	1.5	180	0.41	1.66	2.47	1.62	91.5

Abutment and fillet dimensions in mm.

2) Bearing numbers marked "∗" designate **ULTAGE series** bearings.

Double Row Tapered Roller Bearings

Back-to-back arrangement

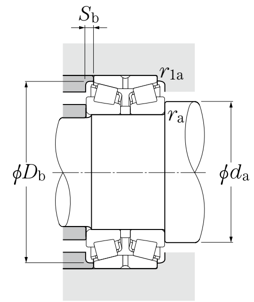


d 220 ~ 340mm

Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Allowable speed min^{-1}	
						dynamic	static		Grease lubrication	Oil lubrication
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u		
220	340	90	80	4	1.5	765	1 060	94.5	810	1 200
	340	113	90	4	1.5	1 130	1 650	148	810	1 200
	370	120	107	5	1.5	1 420	1 920	169	760	1 100
	370	150	120	5	1.5	1 570	2 260	199	760	1 100
	400	158	122	4	1.5	1 790	2 440	212	710	1 000
240	360	92	82	4	1.5	840	1 160	101	730	1 000
	360	115	92	4	1.5	1 170	1 770	155	730	1 000
	400	128	114	5	1.5	1 580	2 130	183	690	1 000
	400	160	128	5	1.5	1 790	2 600	223	690	1 000
	440	165	127	4	1.5	2 150	2 960	250	640	900
	440	266	212	4	1.5	3 750	5 500	465	640	900
260	400	104	92	5	1.5	1 070	1 540	131	670	1 000
	400	130	104	5	1.5	1 470	2 190	187	670	1 000
	440	144	128	5	1.5	1 920	2 630	220	630	910
	440	180	144	5	1.5	2 510	3 750	310	630	910
280	420	106	94	5	1.5	1 140	1 630	137	620	880
	420	133	106	5	1.5	1 540	2 340	196	620	880
	460	146	130	6	2	2 100	2 900	239	580	830
	460	183	146	6	2	2 480	3 650	300	580	830
300	460	118	105	5	1.5	1 370	1 990	163	570	810
	460	148	118	5	1.5	2 070	3 150	257	570	810
	500	160	142	6	2	2 580	3 600	290	530	770
	500	200	160	6	2	2 690	4 050	325	530	770
320	480	121	108	5	1.5	1 520	2 250	181	530	750
	480	151	121	5	1.5	2 030	3 100	247	530	750
	540	176	157	6	2	2 870	4 100	320	500	710
	540	220	176	6	2	3 200	4 900	385	500	710
340	520	133	118	6	2	1 890	2 870	226	500	700
	520	165	133	6	2	2 420	3 750	295	500	700
	580	190	169	6	2	3 450	4 900	380	460	660
	580	238	190	6	2	4 300	6 500	500	460	660

1) Smallest allowable dimension for chamfer dimension r or r_1.

Double Row Tapered Roller Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

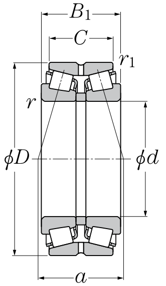
For values of e, Y_1, Y_2 and Y_0 see the table below.

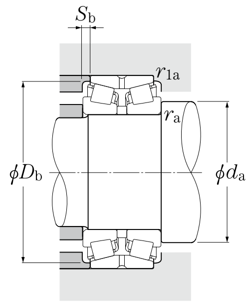
Bearing number 2)	Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_1	Y_2	Y_0	(approx.)
* 413044UTG	238	320	5	3	1.5	111.5	0.37	1.80	2.69	1.76	27.1
* 423044UTG	238	321	11.5	3	1.5	124.5	0.37	1.80	2.69	1.76	33
* 413144UTG	242	349	6.5	4	1.5	135	0.40	1.68	2.50	1.64	47.8
* 423144UTG	242	344	15	4	1.5	154	0.40	1.68	2.50	1.64	58.1
* 430244UTG	238	368	18	3	1.5	178.5	0.49	1.38	2.06	1.35	77
* 413048UTG	258	341	5	3	1.5	117.5	0.37	1.80	2.69	1.76	29.1
* 423048UTG	258	340.5	11.5	3	1.5	130.5	0.37	1.80	2.69	1.76	36.3
* 413148UTG	262	378	7	4	1.5	144.5	0.40	1.68	2.50	1.64	58.5
* 423148UTG	262	376	16	4	1.5	164	0.40	1.68	2.50	1.64	71.4
* 430248UTG	258	406	19	3	1.5	189	0.49	1.38	2.06	1.35	100
* 432248UTG	258	421.5	27	3	1.5	226	0.43	1.57	2.34	1.53	160
* 413052UTG	282	375	6	4	1.5	130.5	0.37	1.80	2.69	1.76	43.4
* 423052UTG	282	377	13	4	1.5	143	0.37	1.80	2.69	1.76	53
* 413152UTG	282	415	8	4	1.5	161	0.40	1.68	2.50	1.64	82
* 423152UTG	282	416	18	4	1.5	176.5	0.40	1.68	2.50	1.64	100
* 413056UTG	302	396.5	6	4	1.5	136.5	0.37	1.80	2.69	1.76	46
* 423056UTG	302	399.5	13.5	4	1.5	148.5	0.37	1.80	2.69	1.76	56.8
* 413156UTG	308	438	8	5	2	168	0.40	1.68	2.50	1.64	85.5
* 423156UTG	308	435.5	18.5	5	2	182.5	0.40	1.68	2.50	1.64	110
* 413060UTG	322	431	6.5	4	1.5	151	0.37	1.80	2.69	1.76	65.6
* 423060UTG	322	436.5	15	4	1.5	163	0.37	1.80	2.69	1.76	77.8
* 413160UTG	328	475	9	5	2	182	0.40	1.68	2.50	1.64	110
* 423160UTG	328	467	20	5	2	201.5	0.40	1.68	2.50	1.64	140
* 413064UTG	342	452	6.5	4	1.5	156.5	0.37	1.80	2.69	1.76	69.2
* 423064UTG	342	457.5	15	4	1.5	170	0.37	1.80	2.69	1.76	82
* 413164UTG	348	509	9.5	5	2	197.5	0.40	1.68	2.50	1.64	150
* 423164UTG	348	504.5	22	5	2	216.5	0.40	1.68	2.50	1.64	190
* 413068UTG	368	491	7.5	5	2	169.5	0.37	1.80	2.69	1.76	93.1
* 423068UTG	368	492	16	5	2	184	0.37	1.80	2.69	1.76	110
* 413168UTG	368	548	10.5	5	2	213	0.40	1.68	2.50	1.64	190
* 423168UTG	368	546	24	5	2	237	0.40	1.68	2.50	1.64	240

2) Bearing numbers marked "*" designate ULTAGE series bearings.

Double Row Tapered Roller Bearings

Back-to-back arrangement





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

d 360 ～ 500mm

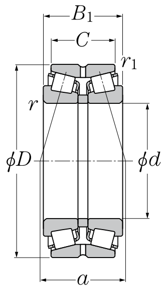
Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹	
						dynamic	static		Grease lubrication	Oil lubrication
d	D	B_1	C	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u		
360	540	134	120	6	2	1 880	2 810	218	460	660
	540	169	134	6	2	2 630	4 200	325	460	660
	600	192	171	6	2	3 500	5 050	385	430	620
	600	240	192	6	2	4 100	6 500	495	430	620
380	560	135	122	6	2	2 170	3 350	255	440	620
	560	171	135	6	2	2 670	4 350	335	440	620
	620	194	173	6	2	3 650	5 250	395	410	580
	620	243	194	6	2	4 250	6 700	505	410	580
400	600	148	132	6	2	2 390	3 700	276	410	580
	600	185	148	6	2	3 250	5 450	410	410	580
	650	200	178	6	3	3 850	5 800	430	380	540
	650	250	200	6	3	4 800	7 850	580	380	540
420	620	150	134	6	2	2 710	4 250	315	390	550
	620	188	150	6	2	3 400	5 900	435	390	550
	700	224	200	6	3	4 750	7 200	525	360	510
	700	280	224	6	3	6 150	9 700	705	360	510
440	650	157	140	6	3	3 150	5 150	375	370	520
	650	196	157	6	3	3 350	5 450	400	370	520
	720	226	201	6	3	5 150	7 800	560	340	480
	720	283	226	6	3	6 400	10 300	740	340	480
460	680	163	145	6	3	3 350	5 350	390	350	500
	680	204	163	6	3	3 950	6 750	485	350	500
	760	300	240	7.5	4	6 300	10 300	725	320	450
480	700	165	147	6	3	3 200	5 000	360	330	470
	700	206	165	6	3	3 900	6 700	480	330	470
	790	310	248	7.5	4	6 750	11 100	775	310	430
500	720	167	149	6	3	3 350	5 400	380	320	450
	720	209	167	6	3	3 950	6 900	485	320	450
	830	264	235	7.5	4	6 700	10 500	725	290	410

Bearing number 2)	Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_1	Y_2	Y_0	(approx.)
∗ 413072UTG	388	510	7	5	2	176	0.37	1.80	2.69	1.76	98.2
∗ 423072UTG	388	512	17.5	5	2	192	0.37	1.80	2.69	1.76	120
∗ 413172UTG	388	565	10.5	5	2	218.5	0.40	1.68	2.50	1.64	200
∗ 423172UTG	388	563.5	24	5	2	239.5	0.40	1.68	2.50	1.64	250
∗ 413076UTG	408	532	6.5	5	2	183	0.37	1.80	2.69	1.76	100
∗ 423076UTG	408	532	18	5	2	196.5	0.37	1.80	2.69	1.76	130
∗ 413176UTG	408	587	10.5	5	2	224.5	0.40	1.68	2.50	1.64	210
∗ 423176UTG	408	582	24.5	5	2	249	0.40	1.68	2.50	1.64	260
∗ 413080UTG	428	567	8	5	2	194	0.37	1.80	2.69	1.76	130
∗ 423080UTG	428	567	18.5	5	2	210	0.37	1.80	2.69	1.76	170
∗ 413180UTG	428	614	11	5	2.5	232	0.40	1.68	2.50	1.64	240
∗ 423180UTG	428	613.5	25	5	2.5	256.5	0.40	1.68	2.50	1.64	290
∗ 413084UTG	448	589	8	5	2	199.5	0.37	1.80	2.69	1.76	140
∗ 423084UTG	448	586	19	5	2	220	0.37	1.80	2.69	1.76	180
∗ 413184UTG	448	658.5	12	5	2.5	258	0.40	1.68	2.50	1.64	320
∗ 423184UTG	448	663	28	5	2.5	287	0.40	1.68	2.50	1.64	380
∗ 413088UTG	468	618	8.5	5	2.5	208	0.37	1.80	2.69	1.76	160
∗ 423088UTG	468	617.5	19.5	5	2.5	229.5	0.37	1.80	2.69	1.76	190
∗ 413188UTG	468	675	12.5	5	2.5	263	0.40	1.68	2.50	1.64	330
∗ 423188UTG	468	681.5	28.5	5	2.5	288.5	0.40	1.68	2.50	1.64	460
∗ 413092UTG	488	650	9	5	2.5	217.5	0.37	1.80	2.69	1.76	180
∗ 423092UTG	488	647.5	20.5	5	2.5	239.5	0.37	1.80	2.69	1.76	230
∗ 423192UTG	496	715.5	30	6	3	305	0.40	1.68	2.50	1.64	480
∗ 413096UTG	508	669	9	5	2.5	222.5	0.37	1.80	2.69	1.76	190
∗ 423096UTG	508	667.5	20.5	5	2.5	245.5	0.37	1.80	2.69	1.76	240
∗ 423196UTG	516	761.5	31	6	3	328.5	0.40	1.68	2.50	1.64	540
∗ 4130/500UTG	528	690	9	5	2.5	230	0.37	1.80	2.69	1.76	200
∗ 4230/500UTG	528	687	21	5	2.5	249.5	0.37	1.80	2.69	1.76	250
∗ 4131/500UTG	536	784	14.5	6	3	296	0.40	1.68	2.50	1.64	530

1) Smallest allowable dimension for chamfer dimension r or r_1.

2) Bearing numbers marked "∗" designate ULTAGE series bearings.

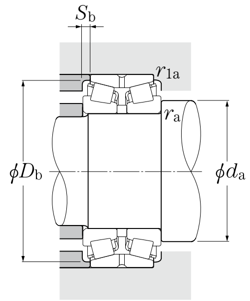
Back-to-back arrangement



d 530 ～ 710mm

Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Allowable speed min-1	
						dynamic	static		Grease lubrication	Oil lubrication
d	D	B_1	C	$r_{s\,min}$[1]	$r_{1s\,min}$[1]	C_r	C_{0r}	C_u		
530	780	185	163	6	3	3 750	5 900	410	290	420
600	870	200	176	6	3	5 000	8 550	570	250	360

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

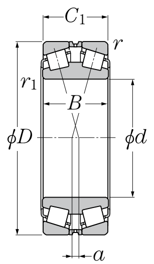
$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number[2]	Abutment and fillet dimensions mm					Load center mm	Constant	Axial load factors			Mass kg
	d_a Min.	D_b Min.	S_b Min.	r_{as} Max.	r_{1as} Max.	a	e	Y_1	Y_2	Y_0	(approx.)
∗ **4130/530UTG**	558	740	11	5	2.5	249.5	0.37	1.80	2.69	1.76	270
∗ **4130/600UTG**	628	828	12	5	2.5	277	0.37	1.80	2.69	1.76	350

2) Bearing numbers marked "∗" designate ULTAGE series bearings.

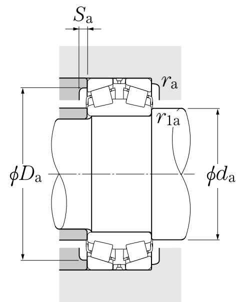
Face-to-face arrangement



d 110 ～ 280mm

d	D	B	C_1	$r_{1s\,min}$ 1)	$r_{s\,min}$ 1)	Basic load rating dynamic C_r (kN)	Basic load rating static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed Grease lubrication (min⁻¹)	Allowable speed Oil lubrication (min⁻¹)
110	180	56	56	2.5	2	330	485	53.0	1 600	2 200
120	180	46	46	2.5	2	255	375	40.0	1 500	2 100
	200	62	62	2.5	2	415	610	64.5	1 500	2 000
130	200	52	52	2.5	2	325	490	51.5	1 400	1 900
	210	64	64	2.5	2	455	675	70.5	1 400	1 800
140	210	53	53	2.5	2	335	535	55.0	1 300	1 800
	225	68	68	3	2.5	435	650	66.0	1 200	1 700
150	225	56	56	3	2.5	395	630	64.0	1 200	1 600
	250	80	80	3	2.5	670	1 040	103.0	1 200	1 500
160	240	60	60	3	2.5	475	765	76.0	1 100	1 500
	270	86	86	3	2.5	865	1 180	114	1 100	1 600
170	260	67	67	3	2.5	545	865	83.5	1 100	1 400
	280	88	88	3	2.5	930	1 270	122	1 000	1 500
180	280	74	74	3	2.5	745	1 050	99.5	1 000	1 400
	300	96	96	4	3	1 130	1 530	144	960	1 400
190	290	75	75	3	2.5	790	1 110	104	950	1 400
	320	104	104	4	3	1 260	1 710	157	900	1 300
200	310	82	82	3	2.5	920	1 320	121	900	1 300
	340	112	112	4	3	1 400	1 910	173	850	1 200
220	340	90	90	4	3	1 130	1 650	148	810	1 200
	370	120	120	5	4	1 570	2 260	199	770	1 100
240	360	92	92	4	3	1 170	1 770	155	730	1 000
	400	128	128	5	4	1 790	2 600	223	700	1 000
260	400	104	104	5	4	1 470	2 190	187	670	1 000
	440	144	144	5	4	2 510	3 750	310	640	910
280	420	106	106	5	4	1 540	2 340	196	610	880

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

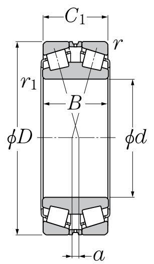
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number 2)	d_a Max. (mm)	D_a Max. (mm)	D_a Min. (mm)	S_a Min. (mm)	r_{1as} Max. (mm)	r_{as} Max. (mm)	Load center a (mm)	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
323122	126.5	170	157.5	8	2	2	1	0.33	2.03	3.02	1.98	5.54
323024	134	168	162.5	8	2	2	12	0.37	1.80	2.69	1.76	4.08
323124	141.5	190	176	8	2	2	6.5	0.37	1.80	2.69	1.76	7.82
323026	148.5	190	178.5	8	2	2	13.5	0.37	1.80	2.69	1.76	5.74
323126	147.5	200	185	8	2	2	7.5	0.37	1.80	2.69	1.76	8.38
323028	157.5	200	187.5	8	2	2	14	0.37	1.84	2.74	1.80	6.36
323128	161	213	197.5	10	2.5	2	8	0.37	1.80	2.69	1.76	9.82
323030	167.5	213	200	10	2.5	2	15.5	0.37	1.80	2.69	1.76	7.63
323130	175.5	238	219	10	2.5	2	6.5	0.37	1.80	2.69	1.76	15.7
323032	179	228	215.5	10	2.5	2	17.5	0.37	1.80	2.69	1.76	9.42
∗ **323132UTG**	187.5	258	233.5	10	2.5	2	8	0.37	1.80	2.69	1.76	20
323034E1	192	248	231	10	2.5	2	18	0.37	1.80	2.69	1.76	12.8
∗ **323134UTG**	195.5	268	244	10	2.5	2	8.5	0.37	1.80	2.69	1.76	21.8
∗ **323036UTG**	205	268	248.5	10	2.5	2	17	0.37	1.80	2.69	1.76	16.5
∗ **323136UTG**	206	286	262	12	3	2.5	8	0.37	1.80	2.69	1.76	27.2
∗ **323038UTG**	213	278	258	12	2.5	2	17.5	0.37	1.80	2.69	1.76	17.9
∗ **323138UTG**	220.5	306	279.5	12	3	2.5	8.5	0.37	1.80	2.69	1.76	33.2
∗ **323040UTG**	225.5	298	275	12	2.5	2	19	0.37	1.80	2.69	1.76	22.3
∗ **323140UTG**	233	326	294.5	12	3	2.5	8.5	0.37	1.80	2.69	1.76	41.8
∗ **323044UTG**	249	326	302.5	12	3	2.5	21.5	0.37	1.80	2.69	1.76	29.8
∗ **323144UTG**	254.5	352	317	14	4	3	14	0.40	1.68	2.50	1.64	52.2
∗ **323048UTG**	269	346	322	14	3	2.5	25.5	0.37	1.80	2.69	1.76	32.5
∗ **323148UTG**	277.5	382	347	14	4	3	17	0.40	1.68	2.50	1.64	63.4
∗ **323052UTG**	291.5	382	354.5	14	4	3	25	0.37	1.80	2.69	1.76	47.7
∗ **323152UTG**	300.5	422	381.5	16	4	3	16.5	0.40	1.68	2.50	1.64	90.5
∗ **323056UTG**	311.5	402	376	16	4	3	29.5	0.37	1.80	2.69	1.76	50.5

2) Bearing numbers marked "∗" designate ULTAGE series bearings.

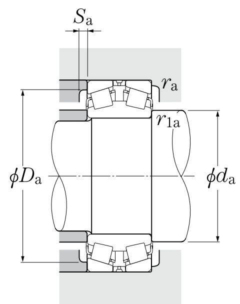
Face-to-face arrangement



d 280 ～ 710mm

d	D	B	C_1	$r_{1s\,min}$ 1)	$r_{s\,min}$ 1)	dynamic C_r	static C_{0r}	Fatigue load limit C_r	Allowable speed Grease lubrication	Allowable speed Oil lubrication
Boundary dimensions mm						Basic load rating kN		kN	min⁻¹	
280	460	146	146	6	5	2 480	3 650	300	590	830
300	460	118	118	5	4	2 070	3 150	257	570	810
	500	160	160	6	5	2 690	4 050	325	540	770
320	480	121	121	5	4	2 030	3 100	247	530	750
	540	176	176	6	5	3 200	4 900	385	500	710
340	520	133	133	6	5	2 420	3 750	295	490	700
	580	190	190	6	5	4 300	6 500	500	460	660
360	540	134	134	6	5	2 630	4 200	325	460	660
	600	192	192	6	5	4 100	6 500	495	430	620
380	560	135	135	6	5	2 310	4 350	335	440	580
	620	194	194	6	5	3 700	6 700	505	410	540
400	600	148	148	6	5	3 250	5 450	410	410	580
	650	200	200	6	6	4 800	7 850	580	380	540
420	620	150	150	6	5	3 400	5 900	435	390	550
	700	224	224	6	6	6 150	9 700	705	360	510
440	650	157	157	6	6	3 350	5 450	400	370	520
	720	226	226	6	6	6 400	10 300	740	340	480
460	680	163	163	6	6	3 950	6 750	485	350	500
	760	240	240	7.5	7.5	6 300	10 300	725	320	450
480	700	165	165	6	6	3 900	6 700	480	330	470
	790	248	248	7.5	7.5	6 750	11 100	775	300	430
500	720	167	167	6	6	3 950	6 900	485	320	450

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number 2)	d_a Max.	D_a Max.	D_a Min.	S_a Min.	r_{1as} Max.	r_{as} Max.	Load center a	Constant e	Y_1	Y_2	Y_0	Mass (approx.)
	Installation-related dimensions mm						mm		Axial load factors			kg
∗ 323156UTG	318.5	438	402	16	5	4	19.5	0.40	1.68	2.50	1.64	93.6
∗ 323060UTG	337	442	566	16	4	3	31	0.37	1.80	2.69	1.76	69.2
∗ 323160UTG	344.5	478	432	16	5	4	16.5	0.40	1.68	2.50	1.64	130
∗ 323064UTG	354	462	432	16	4	3	34	0.37	1.80	2.69	1.76	73.4
∗ 323164UTG	369.5	518	464	18	5	4	18.5	0.40	1.68	2.50	1.64	170
∗ 323068UTG	379	498	463.5	18	5	4	36	0.37	1.80	2.69	1.76	100
∗ 323168UTG	388.5	558	500	18	5	4	20.5	0.40	1.68	2.50	1.64	210
∗ 323072UTG	398	518	483.5	18	5	4	41	0.37	1.80	2.69	1.76	110
∗ 323172UTG	412.5	578	518.5	18	5	4	25.5	0.40	1.68	2.50	1.64	220
323076	418	538	504	18	5	4	42.5	0.37	1.80	2.69	1.76	110
323176	428	598	537.5	20	5	4	27	0.40	1.68	2.50	1.64	230
∗ 323080UTG	444	578	535.5	18	5	4	45	0.37	1.80	2.69	1.76	150
∗ 323180UTG	452.5	622	566	20	5	5	32.5	0.40	1.68	2.50	1.64	260
∗ 323084UTG	464.5	598	555	20	5	4	50	0.37	1.80	2.69	1.76	150
∗ 323184UTG	475	672	611	25	5	5	35	0.40	1.68	2.50	1.64	350
∗ 323088UTG	485.5	622	584	20	5	5	52.5	0.37	1.80	2.69	1.76	180
∗ 323188UTG	493.5	692	629	25	5	5	33	0.40	1.68	2.50	1.64	360
∗ 323092UTG	507.5	652	612.5	25	5	5	56.5	0.37	1.80	2.69	1.76	200
∗ 323192UTG	525	724	660	25	6	6	31	0.40	1.68	2.50	1.64	430
∗ 323096UTG	527	672	632.5	25	5	5	60.5	0.37	1.80	2.69	1.76	210
∗ 323196UTG	547.5	754	688.5	30	6	6	34.5	0.40	1.68	2.50	1.64	480
∗ 3230/500UTG	548.5	692	652	25	5	5	61.5	0.37	1.80	2.69	1.76	220

2) Bearing numbers marked "∗" designate **ULTAGE series** bearings.

Spherical Roller Bearings

1. Types, design features, and characteristics

Spherical roller bearings consist of an outer ring having a continuous spherical raceway and two rows of barrel-shaped rollers guided by an inner ring with two raceways. (Refer to **Fig. 1**) This bearing has self-aligning properties, and therefore is suited for use where misalignment between the inner and outer rings occurs from housing installation error or shaft bending.

Spherical roller bearings have a large capacity for radial loads, axial loads in either direction, and combined loads. They are also suited for applications where vibration and shock loads are encountered. When spherical roller bearings are used with a vertical shaft or under a large axial load, the load on the rollers of the row that is not subject to the axial load becomes small, and the resulting skidding on the rollers may result in wear. If the ratio of the axial load to the radial load exceeds the factor e in the dimension table ($F_a/F_r > e$), consult **NTN** Engineering.

In addition to spherical roller bearings with cylindrical bores, spherical roller bearings with tapered bores are also available. Bearings with tapered bores are specified by the suffix "K" at the end of the spherical roller bearing part number. The standard taper ratio is 1:12 for bearings with a "K" suffix; for bearings in series 240 and 241, the suffix "K30" indicates the taper ratio for a bearing is 1:30. Most tapered bore bearings incorporate the use of adapters and withdrawal sleeves for shaft mounting.

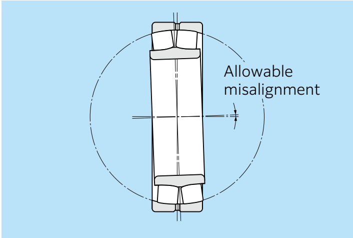
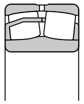
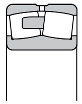
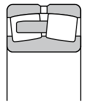
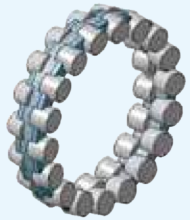
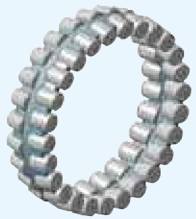
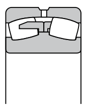
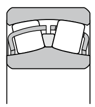
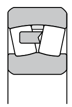


Fig. 1

Table 1 Types of spherical roller bearings

Type	ULTAGE series [1] EA type	ULTAGE series [1] EM type	ULTAGE series [1] EM type (large size)
Design			
Bearing series	Series other than 213 with outer diameter of 420 mm or smaller		Series with outer diameter of 440 to 580 mm
Rollers	Symmetrical		
Cage type	Pressed cage	Machined cage	Machined cage
Cage shape			
Max. operating temperature	200°C		
Type	**B type**	**213C type**	**213 type**
Design			
Bearing series	Other than ULTAGE series (outer diameter of 300 mm or larger)	Series 213 with bore diameter of 50 mm or smaller	Series 213 with bore diameter of 55 mm or larger
Rollers	Asymmetrical	Symmetrical	Asymmetrical
Cage type	Two-piece machined cage	Two-piece pressed cage	Machined cage
Cage shape			
Max. operating temperature	120°C (instantaneous) 100°C (continuous)		

1) ULTAGE series spherical roller bearings has been developed for "longer life," "improved loading capability," and "higher speed," which are required for various types of industrial machinery.
For details, please refer to the special catalog "**ULTAGE series spherical roller bearings [EA and EM types] (CAT. No. 3033/E).**"

2. ULTAGE series fits

Table 2 Shaft tolerance class in common use

Condition		Shaft diameter (mm) Over	Shaft diameter (mm) Incl.	Shaft tolerance class	Note
Cylindrical bore bearing (class 0)					
Inner ring rotational load or load of undetermined direction	Light load [1] or Normal load [1] or Fluctuating load	18 25 40 60 100 200	25 40 60 100 200 500	k5 m5 n5 n6 p6 r6	
	Heavy load [1] or Impact load	50 70 140	70 140 200 [2]	n5 p6 r6	Use bearings with larger internal clearances than CN clearance bearings.
Inner ring: Stationary Load	Inner ring must move easily over shaft.	Overall shaft diameter		g6	For large bearings, f6 will suffice to facilitate movement.
	Inner ring does not have to move easily over shaft.	Overall shaft diameter		h6	
Tapered bore bearing (class 0) (with adapter or withdrawal sleeve)					
Full load		Overall shaft diameter		h9/IT5 [3]	h10/IT7 [3] will suffice for power transmitting shafts.

1) Standards for light loads, normal loads, and heavy loads
- Light loads: dynamic equivalent radial load ≦ 0.05 C_r
- Normal loads: 0.05 C_r < dynamic equivalent radial load ≦ 0.10 C_r
- Heavy loads: 0.10 C_r < dynamic equivalent radial load

2) When the shaft diameter exceeds ϕ200 mm and the bearing is to be used under heavy load or impact load conditions, please consult **NTN** Engineering.
3) The shaft shape error (roundness, cylindricity, etc.) must be within the tolerance range of IT5 and IT7.
Note: 1. All values and fits listed in the above tables are for solid steel shafts.
2. Use the formula below to calculate necessary interference. The upper limit value should not exceed 1/1 000 of the shaft diameter.
- When F_r ≦ 0.3 C_{0r}, necessary interference Δd_F (μm) is $\Delta d_F = 0.08 (d \cdot F_r/B)^{1/2}$
- When $F_r > 0.3\ C_{0r}$, $\Delta d_F = 0.02 (F_r/B)$

(d: bearing bore diameter (mm), B: inner ring width (mm), F_r: radial load, (N), C_{0r}: basic static rating load (N))
When the difference between the bearing temperature and the ambient temperature during bearing operation is to be considered, consider the effective interference Δ_{dT} (μm) by the temperature difference as the necessary interference.
$\Delta_{dT} = 0.0015 \cdot d \cdot \Delta T$
(ΔT: Difference between bearing temperature and ambient temperature °C)

Table 3 Housing bore tolerance class in common use

Condition				Housing bore tolerance class	Note
Housing	Load type, etc.		Outer ring axial direction movement		
Single housing or divided housing	Static outer ring load	All types of loads	Yes	H7	G7 can be used for large bearings or bearings with a large temperature differential between the outer ring and housing.
		Light [1] or ordinary load [1]	Yes	H8	—
		Shaft and inner ring become hot.	Easily	G7	F7 can be used for large bearings or bearings with a large temperature differential between the outer ring and housing.
Single housing		Requires precise rotation under light or ordinary loads.	Basically no Yes	K6 JS6	— —
		Requires low noise operation.	Yes	H6	—
	Indeterminate load	Light or ordinary load	Yes	JS7	—
		Ordinary or heavy load [1]	Basically no	K7	—
		High impact load	No	M7	—
	Rotating outer ring load	Light or fluctuating load	No	M7	—
		Ordinary or heavy load	No	N7	—
		Heavy load or large impact load with thin wall housing	No	P7	—

1) Standards for light loads, normal loads, and heavy loads
Light loads: dynamic equivalent radial load $\leqq 0.05\ C_r$
Normal loads: $0.05\ C_r <$ dynamic equivalent radial load $\leqq 0.10\ C_r$
Heavy loads: $0.10\ C_r <$ dynamic equivalent radial load
Note: All values and fits listed in the above tables are for cast iron or steel housings.

3. Allowable speed of ULTAGE series

As the rotational speed of the bearing increases, the temperature of the bearing also increases because of the friction heat produced inside the bearing. Excessive heat will significantly deteriorate the bearing performance, causing abnormal temperature rises and seizure.

Factors affecting the allowable speed of bearings are as follows.

(1) Bearing type
(2) Bearing size
(3) Lubrication (grease lubrication, circulating lubrication, oil lubrication, etc.)
(4) Bearing internal clearance (bearing internal clearance during operation)
(5) Bearing load
(6) Shaft and housing accuracy

The allowable speed specified in the bearing dimension table is the limit for heat dissipation and satisfactory lubrication conditions before the bearing is adversely affected.

The allowable speed of ULTAGE series spherical roller bearings specified in the catalog is defined as follows.

[Oil lubrication]
The allowable speed for oil lubrication is the speed at which the outer ring temperature reaches 80°C with room temperature spindle oil (lubrication oil viscosity: VG32) supplied at 1 liter/min under an operating load of 5% of the basic static load rating C_{0r}.

[Grease lubrication]
The allowable speed for grease lubrication is the speed at which the outer ring temperature reaches 80°C with lithium-based grease (consistency: NLGI3) filled 20%-30% of the free space under an operating load of 5% of the basic static load rating C_{0r}.

In either of the lubrication methods, the bearing temperature rise differs if the usage condition (operating load, rotational speed pattern, lubricating condition, etc.) is different; therefore, the bearings must be selected with sufficient allowable speed as specified in the catalog.

If 80% of the allowable speed specified in the dimension table is exceeded or the bearing is used in vibration or impact conditions, please consult **NTN** Engineering.

See section “9. Allowable speed” for the allowable speed of the spherical roller bearings that are not part of the ULTAGE series.

4. Oil hole and groove for outer ring

Both ULTAGE series and B type spherical roller bearings are provided with oil holes and an oil groove. (See **Fig. 2** and **Table 4**)

Types 213 and C do not have oil holes and grooves. However, they can be made based on customer request. Contact **NTN** Engineering with the bearing numbers and supplementary suffix code "D1" (refer to page A-48).

If a pin to prevent outer ring rotation is necessary, contact **NTN** Engineering.

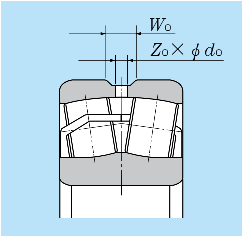


Fig. 2

Table 4 Oil inlet number

Nominal bearing outside diameter mm		Number of oil holes	
		D1	W33 (European spec)
Incl.	Below	Z_0	Z_0
–	320	4	3
320	1 010	8	3
1 010	–	12	–

For oil groove width W_0 and diameter of oil hole d_0, see the dimension table.

5. Allowable misalignment angle

Spherical roller bearings have the same self-aligning properties as other self-aligning bearings. The allowable misalignment angle varies according to dimension series and load conditions, but the general allowable misalignment angles are listed below:

- Normal load or more: ··············· 1/115
- Light load: ····························· 1/30

∗Increasing the misalignment angle beyond the allowable angle may cause the rollers to protrude from the outer ring and interfere with nearby components.

Spherical Roller Bearings NTN

6. Adapters and withdrawal sleeves

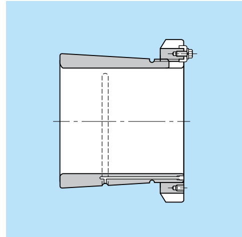


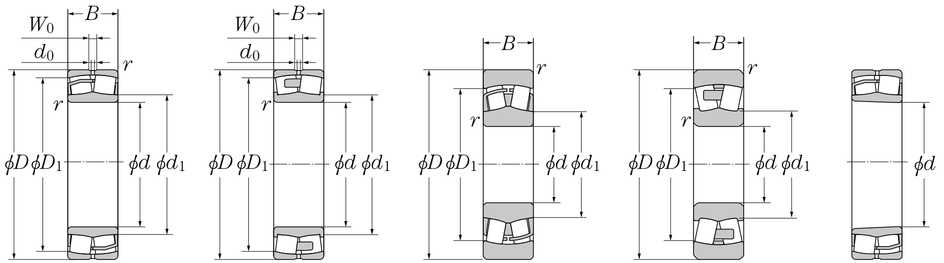
Fig. 3

Adapters are used for installation of bearings with tapered bores on cylindrical shafts. Withdrawal sleeves are also used to install and disassemble bearings with tapered bores onto and off of cylindrical shafts. In disassembling the bearing from the shaft, the nut is turned against the side face of the inner ring utilizing the bolt provided on the withdrawal sleeve, and then the sleeve is drawn away from the bearing's bore. (Precision and dimensions of adapter and withdrawal sleeve are defined in JIS B 1552 and JIS B 1556).

For bearings with a bore diameter of 200 mm or more, high pressure oil (hydraulic) type adapters and withdrawal sleeves can be made to make installation and disassembly easier. As shown in **Fig. 3** construction is designed to reduce friction by injecting high pressure oil between the surfaces of the adapter sleeve and bearing inner bore by means of a pressure fitting.

If the oil supply inlet is attached in the nut side of the adapter, the supplementary suffix "HF" is added to the bearing number; if the oil supply inlet is attached on the opposite side, the suffix "HB" is added to the bearing number. For adapter sleeves, the supplementary suffix "H" is added to the bearing's number for both cases. The hydraulic sleeve nut is equipped with holes for bolts used for mounting and dismounting and holes for hydraulic piping. The suffix SP (with screw holes) or SPB (with bolts) is added to the bearing number of the nut.

For information on the **hydraulic adapters and withdrawal sleeves**, see **the special catalog (CAT. No. 4201/E)**.

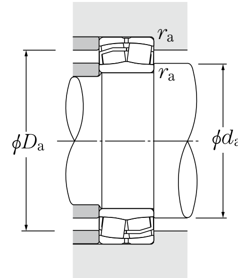


Cylindrical bore [EA type] | Cylindrical bore [EM type] | Cylindrical bore [213C type] | Cylindrical bore [213 type] | Tapered bore

d 25 ～ 60mm

d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2) 4)
Boundary dimensions mm						Basic load rating dynamic kN	static kN	Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers 1)	
25	52	18	1	3	1.5	57.3	46.1	3.23	10 400	13 000	∗22205EAW33	∗22205EAKW33
	52	18	1	3	1.5	57.3	46.1	3.23	10 400	13 000	∗22205EMW33	∗22205EMKW33
30	62	20	1	4	2	75.7	64.5	4.58	8 800	11 000	∗22206EAW33	∗22206EAKW33
	62	20	1	4	2	75.7	64.5	4.58	8 800	11 000	∗22206EMW33	∗22206EMKW33
35	72	23	1.1	5	2	100	92.0	6.11	7 500	9 400	∗22207EAW33	∗22207EAKW33
	72	23	1.1	5	2	100	92.0	6.11	7 500	9 400	∗22207EMW33	∗22207EMKW33
40	80	23	1.1	5	2.5	116	105	7.78	6 800	8 500	∗22208EAD1	∗22208EAKD1
	80	23	1.1	5	2.5	110	98.0	7.29	6 800	8 500	∗22208EMD1	∗22208EMKD1
	90	23	1.5	6	3	98.0	90.0	12.6	4 900	6 400	21308C	21308CK
	90	33	1.5	6	3	169	152	9.36	5 400	6 600	∗22308EAD1	∗22308EAKD1
	90	33	1.5	6	3	169	152	9.36	5 400	6 600	∗22308EMD1	∗22308EMKD1
45	85	23	1.1	6	2.5	121	113	8.76	6 100	7 700	∗22209EAD1	∗22209EAKD1
	85	23	1.1	6	2.5	116	106	8.24	6 100	7 700	∗22209EMD1	∗22209EMKD1
	100	25	1.5	6	3	114	106	14.1	4 400	5 700	21309C	21309CK
	100	36	1.5	6	3	206	187	11.8	4 600	5 700	∗22309EAD1	∗22309EAKD1
	100	36	1.5	6	3	206	187	11.8	4 600	5 700	∗22309EMD1	∗22309EMKD1
50	90	23	1.1	6	2.5	130	124	10.1	5 700	7 200	∗22210EAD1	∗22210EAKD1
	90	23	1.1	6	2.5	125	117	9.54	5 700	7 200	∗22210EMD1	∗22210EMKD1
	110	27	2	6	3	131	127	13.7	4 000	5 200	21310C	21310CK
	110	40	2	7	3.5	250	232	14.0	4 300	5 300	∗22310EAD1	∗22310EAKD1
	110	40	2	7	3.5	250	232	14.0	4 300	5 300	∗22310EMD1	∗22310EMKD1
55	100	25	1.5	6	3	155	148	12.6	5 300	6 700	∗22211EAD1	∗22211EAKD1
	100	25	1.5	6	3	148	140	11.9	5 300	6 700	∗22211EMD1	∗22211EMKD1
	120	29	2	6	3	161	163	16.1	3 700	4 800	21311	21311K
	120	43	2	8	3.5	296	274	17.4	3 900	4 800	∗22311EAD1	∗22311EAKD1
	120	43	2	8	3.5	296	274	17.4	3 900	4 800	∗22311EMD1	∗22311EMKD1
60	110	28	1.5	7	3	187	181	15.4	4 800	6 000	∗22212EAD1	∗22212EAKD1
	110	28	1.5	7	3	179	171	14.6	4 800	6 000	∗22212EMD1	∗22212EMKD1
	130	31	2.1	7	4	186	191	28.2	3 400	4 400	21312	21312K
	130	46	2.1	9	4	340	319	20.3	3 600	4 600	∗22312EAD1	∗22312EAKD1
	130	46	2.1	9	4	340	319	20.3	3 600	4 600	∗22312EMD1	∗22312EMKD1

1) Bearing part numbers with ∗ are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard.
2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12. 3) Smallest allowable dimension for chamfer dimension r.
4) "W33" indicates the specification for Europe and have three oil holes.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

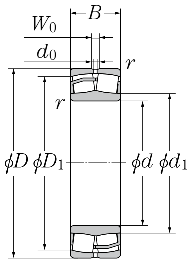
Static equivalent radial load

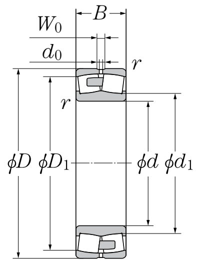
$P_{0r} = F_r + Y_0 F_a$

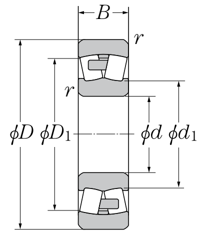
For values of e, Y_1, Y_2 and Y_0 see the table below.

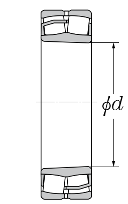
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
30	30	46	46	1	0.34	2.00	2.98	1.96	0.173	0.169
30	30	46	46	1	0.34	2.00	2.98	1.96	0.174	0.171
37	36	56	55	1	0.31	2.15	3.20	2.10	0.278	0.272
37	36	56	55	1	0.31	2.15	3.20	2.10	0.281	0.275
45	42	65	63	1.1	0.31	2.21	3.29	2.16	0.438	0.43
45	42	65	63	1.1	0.31	2.21	3.29	2.16	0.442	0.433
50	47	73	71	1.1	0.27	2.47	3.67	2.41	0.528	0.518
50	47	73	71	1.1	0.27	2.47	3.67	2.41	0.529	0.519
52	48.5	81.5	76	1.5	0.26	2.55	3.80	2.50	0.705	0.694
52	49	81	78	1.5	0.36	1.87	2.79	1.83	1.02	1
52	49	81	78	1.5	0.36	1.87	2.79	1.83	1.03	1.01
54	52	78	76	1.1	0.26	2.64	3.93	2.58	0.572	0.561
54	52	78	76	1.1	0.26	2.64	3.93	2.58	0.577	0.566
58	53.5	91.5	85	1.5	0.26	2.60	3.87	2.54	0.927	0.912
58	54	91	87	1.5	0.36	1.90	2.83	1.86	1.37	1.34
58	54	91	87	1.5	0.36	1.90	2.83	1.86	1.38	1.35
59	57	83	81	1.1	0.24	2.84	4.23	2.78	0.614	0.602
59	57	83	81	1.1	0.24	2.84	4.23	2.78	0.616	0.604
65	60	100	93	2	0.26	2.64	3.93	2.58	1.21	1.19
63	61	99	95	2	0.36	1.87	2.79	1.83	1.82	1.79
63	61	99	95	2	0.36	1.87	2.79	1.83	1.84	1.8
66	64	91	90	1.5	0.23	2.95	4.40	2.89	0.83	0.814
66	64	91	90	1.5	0.23	2.95	4.40	2.89	0.827	0.811
73	65	110	102	2	0.25	2.69	4.00	2.63	1.71	1.69
68	66	109	104	2	0.36	1.87	2.79	1.83	2.31	2.26
68	66	109	104	2	0.36	1.87	2.79	1.83	2.34	2.29
71	69	101	99	1.5	0.24	2.84	4.23	2.78	1.14	1.12
71	69	101	99	1.5	0.24	2.84	4.23	2.78	1.15	1.13
78	72	118	109	2	0.25	2.69	4.00	2.63	2.1	2.07
75	72	118	113	2.1	0.35	1.95	2.90	1.91	2.86	2.8
75	72	118	113	2.1	0.35	1.95	2.90	1.91	2.91	2.85

Note: For the bearings other than **ULTAGE Series**, outer rings with oil inlets and oil grooves can also be made based on your request. In this case, supplementary suffix "D1" is added after a bearing number. **Example: 21311D1**


Cylindrical bore
[EA type]


Cylindrical bore
[EM type]

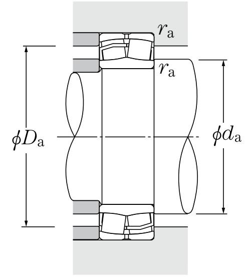

Cylindrical bore
[213 type]


Tapered bore

d 65 ～ 95mm

Boundary dimensions (mm)						Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers 1)	
d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)
65	120	31	1.5	8	3.5	226	224	18.2	4 400	5 500	*22213EAD1	*22213EAKD1
	120	31	1.5	8	3.5	217	212	17.2	4 400	5 500	*22213EMD1	*22213EMKD1
	140	33	2.1	7	4	216	228	31.0	3 100	4 000	21313	21313K
	140	48	2.1	9	4	369	343	23.4	3 300	4 100	*22313EAD1	*22313EAKD1
	140	48	2.1	9	4	369	343	23.4	3 300	4 100	*22313EMD1	*22313EMKD1
70	125	31	1.5	7	3.5	235	240	20.1	4 100	5 200	*22214EAD1	*22214EAKD1
	125	31	1.5	7	3.5	235	240	20.1	4 100	5 200	*22214EMD1	*22214EMKD1
	150	35	2.1	7	4	245	262	33.5	2 900	3 800	21314	21314K
	150	51	2.1	10	5	420	396	26.0	3 000	3 800	*22314EAD1	*22314EAKD1
	150	51	2.1	10	5	420	396	26.0	3 000	3 800	*22314EMD1	*22314EMKD1
75	130	31	1.5	7	3.5	244	249	21.1	4 000	5 000	*22215EAD1	*22215EAKD1
	130	31	1.5	7	3.5	244	249	21.1	4 000	5 000	*22215EMD1	*22215EMKD1
	160	37	2.1	7	4	266	287	27.5	2 700	3 500	21315	21315K
	160	55	2.1	10	5	491	467	29.8	2 900	3 600	*22315EAD1	*22315EAKD1
	160	55	2.1	10	5	491	467	29.8	2 900	3 600	*22315EMD1	*22315EMKD1
80	140	33	2	8	3.5	278	287	24.0	3 700	4 600	*22216EAD1	*22216EAKD1
	140	33	2	8	3.5	267	272	22.8	3 700	4 600	*22216EMD1	*22216EMKD1
	170	39	2.1	7	4	289	315	30.5	2 500	3 300	21316	21316K
	170	58	2.1	10	5	541	522	32.5	2 700	3 400	*22316EAD1	*22316EAKD1
	170	58	2.1	10	5	541	522	32.5	2 700	3 400	*22316EMD1	*22316EMKD1
85	150	36	2	8	3.5	324	330	27.1	3 400	4 300	*22217EAD1	*22217EAKD1
	150	36	2	8	3.5	324	330	27.1	3 400	4 300	*22217EMD1	*22217EMKD1
	180	41	3	7	4	320	355	45.0	2 400	3 100	21317	21317K
	180	60	3	11	5	599	604	36.4	2 600	3 200	*22317EAD1	*22317EAKD1
	180	60	3	11	5	599	604	36.4	2 600	3 200	*22317EMD1	*22317EMKD1
90	160	40	2	10	4.5	384	398	30.2	3 200	4 000	*22218EAD1	*22218EAKD1
	160	40	2	10	4.5	384	398	30.2	3 200	4 000	*22218EMD1	*22218EMKD1
	160	52.4	2	9	4	467	513	30.0	2 600	3 200	*23218EMD1	*23218EMKD1
	190	43	3	7	4	355	400	50.5	2 300	3 000	21318	21318K
	190	64	3	12	5	668	652	40.0	2 500	3 000	*22318EAD1	*22318EAKD1
	190	64	3	12	5	668	652	40.0	2 500	3 000	*22318EMD1	*22318EMKD1
95	170	43	2.1	10	4.5	416	417	33.4	3 000	3 800	*22219EAD1	*22219EAKD1
	170	43	2.1	10	4.5	416	417	33.4	3 000	3 800	*22219EMD1	*22219EMKD1

1) Bearing part numbers with * are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard.
2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12. 3) Smallest allowable dimension for chamfer dimension r.



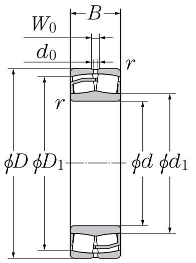
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

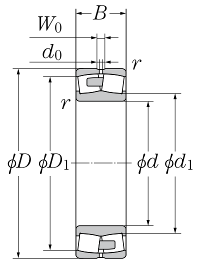
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Installation-related dimensions (mm)					Constant	Axial load factors			Mass (approx.) kg	
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
78	74	111	107	1.5	0.24	2.79	4.15	2.73	1.52	1.49
78	74	111	107	1.5	0.24	2.79	4.15	2.73	1.53	1.5
85	77	128	119	2	0.25	2.69	4.00	2.63	2.55	2.51
81	77	128	122	2.1	0.33	2.06	3.06	2.01	3.48	3.41
81	77	128	122	2.1	0.33	2.06	3.06	2.01	3.5	3.43
84	79	116	113	1.5	0.22	3.01	4.48	2.94	1.61	1.58
84	79	116	113	1.5	0.22	3.01	4.48	2.94	1.64	1.6
91	82	138	126	2	0.25	2.69	4.00	2.63	3.18	3.14
85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.25	4.16
85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.31	4.22
88	84	121	118	1.5	0.22	3.14	4.67	3.07	1.67	1.64
88	84	121	118	1.5	0.22	3.14	4.67	3.07	1.71	1.67
99	87	148	136	2	0.24	2.84	4.23	2.78	3.81	3.76
91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.18	5.07
91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.27	5.16
94	91	129	127	2	0.22	3.14	4.67	3.07	2.09	2.05
94	91	129	127	2	0.22	3.14	4.67	3.07	2.11	2.07
105	92	158	144	2	0.23	2.95	4.40	2.89	4.53	4.47
98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.12	5.99
98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.28	6.15
100	96	139	137	2	0.22	3.07	4.57	3.00	2.59	2.54
100	96	139	137	2	0.22	3.07	4.57	3.00	2.67	2.62
111	99	166	152	2.5	0.25	2.69	4.00	2.63	5.35	5.28
107	99	166	157	3	0.32	2.09	3.11	2.04	7.18	7.04
107	99	166	157	3	0.32	2.09	3.11	2.04	7.29	7.15
105	101	149	144	2	0.23	2.90	4.31	2.83	3.34	3.27
105	101	149	144	2	0.23	2.90	4.31	2.83	3.43	3.37
104	101	149	141	2	0.30	2.25	3.34	2.20	4.43	4.31
119	104	176	162	2.5	0.24	2.84	4.23	2.78	6.3	6.21
110	104	176	166	3	0.33	2.06	3.06	2.01	8.42	8.25
110	104	176	166	3	0.33	2.06	3.06	2.01	8.53	8.35
110	107	158	153	2.1	0.23	2.95	4.40	2.89	3.98	3.9
110	107	158	153	2.1	0.23	2.95	4.40	2.89	4.06	3.98

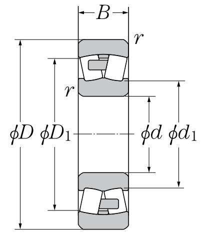
Note: For the bearings other than **ULTAGE Series**, outer rings with oil inlets and oil grooves can also be made based on your request.
In this case, supplementary suffix "D1" is added after a bearing number. **Example: 21317D1**



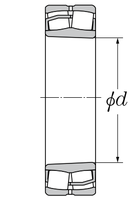
Cylindrical bore
[EA type]



Cylindrical bore
[EM type]



Cylindrical bore
[213 type]

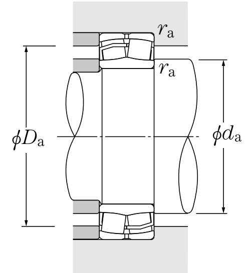


Tapered bore

d 95 ～ 130mm

Boundary dimensions mm						Basic load rating dynamic kN	static	Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers 1)	
d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)
95	200	45	3	7	4	375	420	54.0	2 100	2 700	21319	21319K
	200	67	3	12	6	732	751	43.4	2 300	2 800	*22319EAD1	*22319EAKD1
	200	67	3	12	6	732	751	43.4	2 300	2 800	*22319EMD1	*22319EMKD1
100	165	52	2	8	4	464	563	30.7	2 400	3 000	*23120EAD1	*23120EAKD1
	165	52	2	8	4	480	590	32.1	2 400	3 000	*23120EMD1	*23120EMKD1
	180	46	2.1	11	5	472	495	36.9	2 800	3 600	*22220EAD1	*22220EAKD1
	180	46	2.1	11	5	472	495	36.9	2 800	3 600	*22220EMD1	*22220EMKD1
	180	60.3	2.1	9	4.5	586	661	36.3	2 300	2 900	*23220EMD1	*23220EMKD1
	215	47	3	9	5	410	465	42.5	2 000	2 600	21320	21320K
	215	73	3	13	6	827	844	50.1	2 100	2 600	*22320EAD1	*22320EAKD1
	215	73	3	13	6	827	844	50.1	2 100	2 600	*22320EMD1	*22320EMKD1
110	170	45	2	8	3.5	417	517	32.1	2 600	3 300	*23022EAD1	*23022EAKD1
	170	45	2	8	3.5	417	517	32.1	2 600	3 300	*23022EMD1	*23022EMKD1
	180	56	2	9	4	547	669	36.2	2 200	2 800	*23122EAD1	*23122EAKD1
	180	56	2	9	4	547	669	36.2	2 200	2 800	*23122EMD1	*23122EMKD1
	180	69	2	8	4	622	769	35.7	2 200	2 700	*24122EMD1	*24122EMK30D1
	200	53	2.1	12	6	602	643	45.0	2 600	3 300	*22222EAD1	*22222EAKD1
	200	53	2.1	12	6	602	643	45.0	2 600	3 300	*22222EMD1	*22222EMKD1
	200	69.8	2.1	11	5	752	869	43.9	2 100	2 600	*23222EMD1	*23222EMKD1
	240	50	3	9	5	550	615	61.5	1 800	2 300	21322	21322K
	240	80	3	16	7	975	972	59.0	2 000	2 400	*22322EAD1	*22322EAKD1
	240	80	3	16	7	975	972	59.0	2 000	2 400	*22322EMD1	*22322EMKD1
120	180	46	2	8	3.5	446	577	35.8	2 400	3 100	*23024EAD1	*23024EAKD1
	180	46	2	8	3.5	446	577	35.8	2 400	3 100	*23024EMD1	*23024EMKD1
	180	60	2	8	3.5	526	726	34.4	2 100	2 600	*24024EMD1	*24024EMK30D1
	200	62	2	10	4.5	663	820	43.4	2 000	2 500	*23124EAD1	*23124EAKD1
	200	62	2	10	4.5	663	820	43.4	2 000	2 500	*23124EMD1	*23124EMKD1
	200	80	2	10	4.5	756	991	41.3	1 900	2 500	*24124EMD1	*24124EMK30D1
	215	58	2.1	12	6	688	753	49.9	2 400	3 000	*22224EAD1	*22224EAKD1
	215	58	2.1	12	6	688	753	49.9	2 400	3 000	*22224EMD1	*22224EMKD1
	215	76	2.1	11	5	857	998	49.8	1 900	2 400	*23224EMD1	*23224EMKD1
	260	86	3	18	8	1 170	1 280	68.4	1 800	2 200	*22324EAD1	*22324EAKD1
	260	86	3	18	8	1 170	1 280	68.4	1 800	2 200	*22324EMD1	*22324EMKD1
130	200	52	2	9	4	565	721	44.2	2 200	2 900	*23026EAD1	*23026EAKD1
	200	52	2	9	4	565	721	44.2	2 200	2 900	*23026EMD1	*23026EMKD1

1) Bearing part numbers with * are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard. 2) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings appended with "K30" have a tapered bore ratio of 1:30. 3) Smallest allowable dimension for chamfer dimension r.



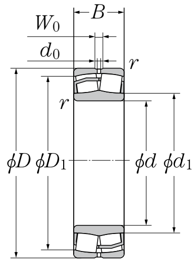
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

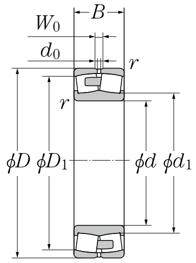
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
127	109	186	171	2.5	0.22	3.01	4.48	2.94	7.1	7
120	109	186	174	3	0.32	2.09	3.11	2.04	9.91	9.71
120	109	186	174	3	0.32	2.09	3.11	2.04	10.0	9.82
114	111	154	147	2	0.28	2.39	3.56	2.34	4.37	4.24
114	111	154	147	2	0.28	2.39	3.56	2.34	4.45	4.32
118	112	168	161	2.1	0.24	2.84	4.23	2.78	4.9	4.8
118	112	168	161	2.1	0.24	2.84	4.23	2.78	5.02	4.93
118	112	168	159	2.1	0.31	2.18	3.24	2.13	6.51	6.33
133	114	201	179	2.5	0.22	3.01	4.48	2.94	8.89	8.78
127	114	201	187	3	0.34	1.98	2.94	1.93	12.6	12.3
127	114	201	187	3	0.34	1.98	2.94	1.93	12.9	12.7
123	119	161	155	2	0.23	2.95	4.40	2.89	3.66	3.55
123	119	161	155	2	0.23	2.95	4.40	2.89	3.66	3.55
125	121	169	161	2	0.28	2.43	3.61	2.37	5.66	5.49
125	121	169	161	2	0.28	2.43	3.61	2.37	5.53	5.36
121	121	169	158	2	0.36	1.90	2.83	1.86	6.75	6.65
130	122	188	179	2.1	0.25	2.69	4.00	2.63	7.1	6.95
130	122	188	179	2.1	0.25	2.69	4.00	2.63	7.3	7.15
130	122	188	176	2.1	0.32	2.12	3.15	2.07	9.41	9.14
146	124	226	203	2.5	0.21	3.20	4.77	3.13	11.2	11.1
139	124	226	209	3	0.32	2.09	3.11	2.04	17	16.6
139	124	226	209	3	0.32	2.09	3.11	2.04	17.4	17.1
134	129	171	165	2	0.22	3.14	4.67	3.07	4.02	3.9
134	129	171	165	2	0.22	3.14	4.67	3.07	4.02	3.9
132	129	171	161	2	0.29	2.32	3.45	2.26	5.28	5.21
138	131	189	179	2	0.28	2.43	3.61	2.37	7.72	7.49
138	131	189	179	2	0.28	2.43	3.61	2.37	7.77	7.54
136	131	189	173	2	0.37	1.84	2.74	1.80	10	9.87
141	132	203	193	2.1	0.25	2.74	4.08	2.68	8.88	8.68
141	132	203	193	2.1	0.25	2.74	4.08	2.68	9.01	8.82
139	132	203	190	2.1	0.32	2.09	3.11	2.04	11.7	11.3
156	134	246	225	3	0.32	2.09	3.11	2.04	22.3	21.9
156	134	246	225	3	0.32	2.09	3.11	2.04	22.7	22.2
145	139	191	183	2	0.22	3.01	4.48	2.94	5.88	5.71
145	139	191	183	2	0.22	3.01	4.48	2.94	5.9	5.73

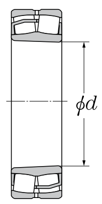
Note: For the bearings other than **ULTAGE Series**, outer rings with oil inlets and oil grooves can also be made based on your request.
In this case, supplementary suffix "D1" is added after a bearing number. **Example: 21322D1**



Cylindrical bore
[EA type]



Cylindrical bore
[EM type]

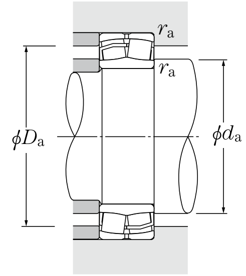


Tapered bore

d 130 ～ 160mm

Boundary dimensions mm						Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Bearing numbers 1) Cylindrical bore	Tapered bore 2)
d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u				
130	200	69	2	9	4	682	936	42.2	1 900	2 400	*24026EMD1	*24026EMK30D1
	210	64	2	10	4.5	710	906	47.1	1 900	2 400	*23126EAD1	*23126EAKD1
	210	64	2	10	4.5	710	906	47.1	1 900	2 400	*23126EMD1	*23126EMKD1
	210	80	2	10	4.5	803	1 080	45.0	1 800	2 400	*24126EMD1	*24126EMK30D1
	230	64	3	13	6	808	898	56.6	2 200	2 800	*22226EAD1	*22226EAKD1
	230	64	3	13	6	808	898	56.6	2 200	2 800	*22226EMD1	*22226EMKD1
	230	80	3	12	5	958	1 130	55.4	1 700	2 300	*23226EMD1	*23226EMKD1
	280	93	4	19	9	1 330	1 400	77.8	1 600	2 000	*22326EAD1	*22326EAKD1
	280	93	4	19	9	1 330	1 400	77.8	1 600	2 000	*22326EMD1	*22326EMKD1
140	210	53	2	9	4	597	783	47.5	2 100	2 700	*23028EAD1	*23028EAKD1
	210	53	2	9	4	597	783	47.5	2 100	2 700	*23028EMD1	*23028EMKD1
	210	69	2	9	4	709	990	46.0	1 800	2 200	*24028EMD1	*24028EMK30D1
	225	68	2.1	11	5	802	1 030	53.1	1 800	2 200	*23128EAD1	*23128EAKD1
	225	68	2.1	11	5	802	1 030	53.1	1 800	2 200	*23128EMD1	*23128EMKD1
	225	85	2.1	10	4.5	951	1 280	53.3	1 700	2 200	*24128EMD1	*24128EMK30D1
	250	68	3	14	7	912	1 010	65.8	2 000	2 500	*22228EAD1	*22228EAKD1
	250	68	3	14	7	912	1 010	65.8	2 000	2 500	*22228EMD1	*22228EMKD1
	250	88	3	13	6	1 140	1 370	64.2	1 600	2 100	*23228EMD1	*23228EMKD1
	300	102	4	19	9	1 540	1 720	88.8	1 500	1 900	*22328EAD1	*22328EAKD1
	300	102	4	19	9	1 540	1 720	88.8	1 500	1 900	*22328EMD1	*22328EMKD1
150	225	56	2.1	10	4.5	660	893	52.9	2 000	2 500	*23030EAD1	*23030EAKD1
	225	56	2.1	10	4.5	660	893	52.9	2 000	2 500	*23030EMD1	*23030EMKD1
	225	75	2.1	10	4.5	789	1 140	51.2	1 700	2 100	*24030EMD1	*24030EMK30D1
	250	80	2.1	13	6	1 060	1 350	65.1	1 600	2 000	*23130EAD1	*23130EAKD1
	250	80	2.1	13	6	1 060	1 350	65.1	1 600	2 000	*23130EMD1	*23130EMKD1
	250	100	2.1	12	6	1 180	1 590	62.8	1 600	2 000	*24130EMD1	*24130EMK30D1
	270	73	3	15	7	1 080	1 220	74.4	1 800	2 300	*22230EAD1	*22230EAKD1
	270	73	3	15	7	1 080	1 220	74.4	1 800	2 300	*22230EMD1	*22230EMKD1
	270	96	3	14	6	1 340	1 620	74.0	1 500	1 900	*23230EMD1	*23230EMKD1
	320	108	4	20	9	1 740	1 890	98.9	1 400	1 700	*22330EMD1	*22330EMKD1
160	220	45	2	9	4	455	683	45.6	1 900	2 400	*23932EMD1	*23932EMKD1
	240	60	2.1	11	5	748	1 000	59.1	1 800	2 300	*23032EAD1	*23032EAKD1
	240	60	2.1	11	5	748	1 000	59.1	1 800	2 300	*23032EMD1	*23032EMKD1
	240	80	2.1	10	5	901	1 290	56.8	1 600	2 000	*24032EMD1	*24032EMK30D1
	270	86	2.1	14	6	1 220	1 580	73.6	1 500	1 900	*23132EAD1	*23132EAKD1
	270	86	2.1	14	6	1 220	1 580	73.6	1 500	1 900	*23132EMD1	*23132EMKD1

1) Bearing part numbers with * are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard. 2) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings appended with "K30" have a tapered bore ratio of 1:30. 3) Smallest allowable dimension for chamfer dimension r.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

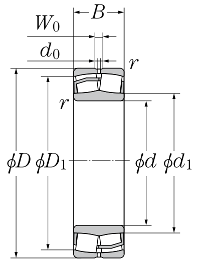
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

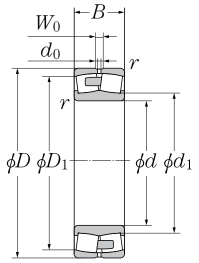
$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

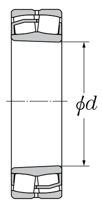
Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg Cylindrical bore	Tapered bore
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0		
143	139	191	178	2	0.31	2.20	3.27	2.15	7.82	7.71
148	141	199	189	2	0.27	2.51	3.74	2.45	8.45	8.19
148	141	199	189	2	0.27	2.51	3.74	2.45	8.51	8.25
146	141	199	183	2	0.34	1.96	2.92	1.92	10.7	10.5
151	144	216	206	3	0.25	2.69	4.00	2.63	11	10.7
151	144	216	206	3	0.25	2.69	4.00	2.63	11.1	10.9
150	144	216	203	3	0.32	2.12	3.15	2.07	13.8	13.4
164	147	263	243	4	0.33	2.06	3.06	2.01	27.2	26.6
164	147	263	243	4	0.33	2.06	3.06	2.01	28	27.5
155	149	201	193	2	0.22	3.14	4.67	3.07	6.32	6.13
155	149	201	193	2	0.22	3.14	4.67	3.07	6.37	6.18
153	149	201	188	2	0.28	2.37	3.53	2.32	8.27	8.15
159	152	213	203	2.1	0.26	2.55	3.80	2.50	10.3	9.94
159	152	213	203	2.1	0.26	2.55	3.80	2.50	10.3	10
156	152	213	198	2.1	0.34	1.98	2.94	1.93	12.9	12.8
163	154	236	224	3	0.25	2.74	4.08	2.68	13.9	13.6
163	154	236	224	3	0.25	2.74	4.08	2.68	14.2	13.9
162	154	236	220	3	0.33	2.06	3.06	2.01	18.2	17.7
181	157	283	261	4	0.33	2.03	3.02	1.98	34.4	33.7
181	157	283	261	4	0.33	2.03	3.02	1.98	35.4	34.7
167	161	214	207	2.1	0.21	3.20	4.77	3.13	7.68	7.45
167	161	214	207	2.1	0.21	3.20	4.77	3.13	7.73	7.5
165	161	214	202	2.1	0.29	2.32	3.45	2.26	10.4	10.3
171	162	238	223	2.1	0.29	2.35	3.50	2.30	15.7	15.2
171	162	238	223	2.1	0.29	2.35	3.50	2.30	15.8	15.3
168	162	238	216	2.1	0.36	1.85	2.76	1.81	19.7	19.4
177	164	256	242	3	0.25	2.74	4.08	2.68	17.6	17.3
177	164	256	242	3	0.25	2.74	4.08	2.68	18	17.7
174	164	256	237	3	0.33	2.03	3.02	1.98	23.6	22.9
188	167	303	279	4	0.34	2.00	2.98	1.96	42.2	41.3
175	169	211	205	2	0.17	3.90	5.81	3.81	5.09	4.94
177	171	229	221	2.1	0.21	3.20	4.77	3.13	9.32	9.03
177	171	229	221	2.1	0.21	3.20	4.77	3.13	9.37	9.09
175	171	229	215	2.1	0.29	2.32	3.45	2.26	12.6	12.4
185	172	258	240	2.1	0.29	2.35	3.50	2.30	20.1	19.5
185	172	258	240	2.1	0.29	2.35	3.50	2.30	20.2	19.6



Cylindrical bore
[EA type]



Cylindrical bore
[EM type]



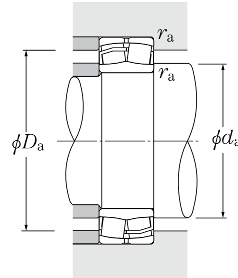
Tapered bore

d 160 ～ 190mm

d	D	B	$r_{s\,min}$[3]	W_0	d_0	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore[2]
Boundary dimensions (mm)						Basic load rating (kN)		Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers[1]	
160	270	109	2.1	14	6	1 360	1 860	70.6	1 500	1 800	*24132EMD1	*24132EMK30D1
	290	80	3	17	8	1 220	1 390	84.1	1 700	2 100	*22232EAD1	*22232EAKD1
	290	80	3	17	8	1 220	1 390	84.1	1 700	2 100	*22232EMD1	*22232EMKD1
	290	104	3	15	7	1 550	1 890	83.8	1 400	1 800	*23232EMD1	*23232EMKD1
	340	114	4	20	10	1 950	2 210	109	1 300	1 600	*22332EMD1	*22332EMKD1
170	230	45	2	9	4.5	468	723	48.8	1 800	2 300	*23934EMD1	*23934EMKD1
	260	67	2.1	12	5	914	1 240	68.8	1 700	2 200	*23034EAD1	*23034EAKD1
	260	67	2.1	12	5	914	1 240	68.8	1 700	2 200	*23034EMD1	*23034EMKD1
	260	90	2.1	11	5	1 100	1 600	66.3	1 500	1 900	*24034EMD1	*24034EMK30D1
	280	88	2.1	14	6	1 270	1 700	77.3	1 400	1 800	*23134EAD1	*23134EAKD1
	280	88	2.1	14	6	1 270	1 700	77.3	1 400	1 800	*23134EMD1	*23134EMKD1
	280	109	2.1	14	6	1 410	1 990	74.4	1 400	1 700	*24134EMD1	*24134EMK30D1
	310	86	4	18	8	1 400	1 610	94.7	1 600	2 000	*22234EMD1	*22234EMKD1
	310	110	4	16	8	1 700	2 070	94.6	1 300	1 700	*23234EMD1	*23234EMKD1
	360	120	4	20	10	2 200	2 630	121	1 200	1 500	*22334EMD1	*22334EMKD1
180	250	52	2	10	5	573	869	57.2	1 700	2 100	*23936EMD1	*23936EMKD1
	280	74	2.1	13	6	1 080	1 450	78.6	1 600	2 000	*23036EAD1	*23036EAKD1
	280	74	2.1	13	6	1 080	1 450	78.6	1 600	2 000	*23036EMD1	*23036EMKD1
	280	100	2.1	13	6	1 310	1 880	76.0	1 400	1 800	*24036EMD1	*24036EMK30D1
	300	96	3	15	7	1 490	1 960	88.7	1 300	1 700	*23136EAD1	*23136EAKD1
	300	96	3	15	7	1 490	1 960	88.7	1 300	1 700	*23136EMD1	*23136EMKD1
	300	118	3	15	7	1 660	2 290	85.5	1 300	1 600	*24136EMD1	*24136EMK30D1
	320	86	4	18	8	1 450	1 660	101	1 500	1 900	*22236EMD1	*22236EMKD1
	320	112	4	16	8	1 800	2 270	101	1 200	1 600	*23236EMD1	*23236EMKD1
	380	126	4	21	10	2 420	2 810	132	1 100	1 400	*22336EMD1	*22336EMKD1
190	260	52	2	10	5	603	935	62.8	1 600	2 000	*23938EMD1	*23938EMKD1
	290	75	2.1	13	6	1 140	1 570	83.5	1 500	1 900	*23038EAD1	*23038EAKD1
	290	75	2.1	13	6	1 140	1 570	83.5	1 500	1 900	*23038EMD1	*23038EMKD1
	290	100	2.1	13	6	1 360	2 000	80.7	1 300	1 700	*24038EMD1	*24038EMK30D1
	320	104	3	17	8	1 670	2 250	100	1 200	1 600	*23138EMD1	*23138EMKD1
	320	128	3	16	8	1 900	2 700	96.8	1 200	1 500	*24138EMD1	*24138EMK30D1
	340	92	4	20	9	1 620	1 870	112	1 400	1 800	*22238EMD1	*22238EMKD1
	340	120	4	18	8	1 990	2 480	109	1 200	1 500	*23238EMD1	*23238EMKD1
	400	132	5	21	10	2 600	3 120	145	1 000	1 300	*22338EMD1	*22338EMKD1

1) Bearing part numbers with * are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard.
2) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings appended with "K30" have a tapered bore ratio of 1:30.
3) Smallest allowable dimension for chamfer dimension r.

Spherical Roller Bearings NTN

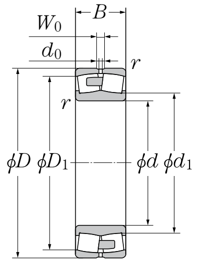


Dynamic equivalent radial load
$P_r = XF_r + YF_a$

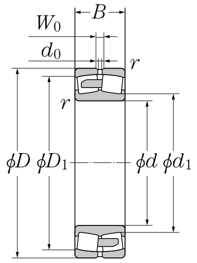
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

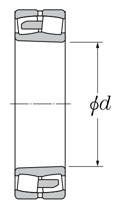
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
Installation-related dimensions (mm)					Constant	Axial load factors			Mass (approx.) kg	
181	172	258	232	2.1	0.37	1.83	2.72	1.79	25.4	25.1
190	174	276	260	3	0.25	2.69	4.00	2.63	22.3	21.8
190	174	276	260	3	0.25	2.69	4.00	2.63	22.9	22.4
187	174	276	254	3	0.33	2.03	3.02	1.98	29.6	28.8
205	177	323	296	4	0.33	2.03	3.02	1.98	50.5	49.5
185	179	221	215	2	0.16	4.11	6.12	4.02	5.39	5.23
190	181	249	238	2.1	0.22	3.07	4.57	3.00	12.7	12.3
190	181	249	238	2.1	0.22	3.07	4.57	3.00	12.8	12.4
186	181	249	231	2.1	0.30	2.23	3.32	2.18	17.2	16.9
195	182	268	250	2.1	0.28	2.39	3.56	2.34	21.5	20.9
195	182	268	250	2.1	0.28	2.39	3.56	2.34	21.6	20.9
193	182	268	243	2.1	0.35	1.91	2.85	1.87	26.7	26.3
201	187	293	277	4	0.26	2.60	3.87	2.54	28.3	27.7
199	187	293	272	4	0.33	2.03	3.02	1.98	35.8	34.8
223	187	343	313	4	0.32	2.09	3.11	2.04	60.3	59.1
199	189	241	232	2	0.17	3.90	5.81	3.81	7.79	7.56
201	191	269	255	2.1	0.23	2.95	4.40	2.89	16.8	16.3
201	191	269	255	2.1	0.23	2.95	4.40	2.89	16.9	16.4
199	191	269	248	2.1	0.31	2.15	3.20	2.10	22.8	22.4
205	194	286	267	3	0.29	2.32	3.45	2.26	27.2	26.4
205	194	286	267	3	0.29	2.32	3.45	2.26	27.4	26.5
202	194	286	259	3	0.36	1.87	2.79	1.83	33.5	33
209	197	303	287	4	0.25	2.74	4.08	2.68	29.3	28.7
210	197	303	282	4	0.33	2.06	3.06	2.01	38.2	37.1
229	197	363	329	4	0.32	2.09	3.11	2.04	70.2	68.7
209	199	251	243	2	0.17	4.05	6.04	3.96	8.2	7.96
213	201	279	266	2.1	0.22	3.01	4.48	2.94	17.8	17.3
213	201	279	266	2.1	0.22	3.01	4.48	2.94	17.9	17.4
209	201	279	258	2.1	0.30	2.23	3.32	2.18	23.8	23.4
221	204	306	284	3	0.29	2.32	3.45	2.26	34.3	33.2
216	204	306	275	3	0.37	1.84	2.74	1.80	42.1	41.5
222	207	323	305	4	0.25	2.74	4.08	2.68	35.6	34.9
220	207	323	299	4	0.33	2.03	3.02	1.98	46.1	44.7
247	210	380	346	5	0.32	2.12	3.15	2.07	81.5	79.9



Cylindrical bore
[EM type]



Cylindrical bore
[EM type (large size)]

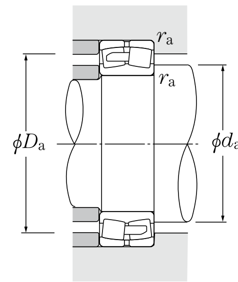


Tapered bore

d 200 ～ 280mm

d	D	B	$r_{s\,min}$ [3]	W_0	d_0	Basic load rating dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing numbers [1] Cylindrical bore	Tapered bore [2]
Boundary dimensions (mm)												
200	280	60	2.1	12	6	766	1 190	71.8	1 500	1 900	*23940EMD1	*23940EMKD1
	310	82	2.1	15	7	1 310	1 790	94.1	1 400	1 800	*23040EMD1	*23040EMKD1
	310	109	2.1	14	7	1 570	2 280	91.1	1 200	1 600	*24040EMD1	*24040EMK30D1
	340	112	3	18	8	1 890	2 510	110	1 100	1 400	*23140EMD1	*23140EMKD1
	340	140	3	17	8	2 130	2 930	105	1 100	1 400	*24140EMD1	*24140EMK30D1
	360	98	4	20	10	1 810	2 100	124	1 400	1 700	*22240EMD1	*22240EMKD1
	360	128	4	19	9	2 250	2 840	120	1 100	1 300	*23240EMD1	*23240EMKD1
	420	138	5	21	10	2 830	3 530	158	950	1 200	*22340EMD1	*22340EMKD1
220	300	60	2.1	12	6	789	1 260	79.4	1 400	1 700	*23944EMD1	*23944EMKD1
	340	90	3	15	7	1 530	2 110	109	1 300	1 600	*23044EMD1	*23044EMKD1
	340	118	3	15	7	1 850	2 720	106	1 100	1 400	*24044EMD1	*24044EMK30D1
	370	120	4	19	9	2 190	2 940	128	1 000	1 300	*23144EMD1	*23144EMKD1
	370	150	4	19	9	2 540	3 620	124	1 000	1 300	*24144EMD1	*24144EMK30D1
	400	108	4	21	11	2 210	2 690	149	1 200	1 500	*22244EMD1	*22244EMKD1
	400	144	4	20	10	2 890	3 830	147	1 000	1 200	*23244EMD1	*23244EMKD1
	460	145	5	20	12	3 010	3 560	163	850	1 090	*22344EMD1	*22344EMKD1
240	320	60	2.1	12	6	815	1 350	87.7	1 300	1 600	*23948EMD1	*23948EMKD1
	360	92	3	16	8	1 630	2 350	120	1 100	1 400	*23048EMD1	*23048EMKD1
	360	118	3	16	8	1 940	2 980	116	1 000	1 300	*24048EMD1	*24048EMK30D1
	400	128	4	20	9	2 510	3 500	147	960	1 200	*23148EMD1	*23148EMKD1
	400	160	4	19	9	2 910	4 290	142	960	1 200	*24148EMD1	*24148EMK30D1
	440	120	4	16	10	2 470	3 110	159	1 060	1 350	*22248EMD1	*22248EMKD1
	440	160	4	20	12	3 140	4 260	156	850	1 090	*23248EMD1	*23248EMKD1
	500	155	5	20	12	3 500	4 170	193	780	1 000	*22348EMD1	*22348EMKD1
260	360	75	2.1	14	7	1 130	1 940	105	1 100	1 400	*23952EMD1	*23952EMKD1
	400	104	4	18	8	2 060	2 910	144	1 000	1 300	*23052EMD1	*23052EMKD1
	400	140	4	18	8	2 520	3 820	139	960	1 200	*24052EMD1	*24052EMK30D1
	440	144	4	20	12	2 780	4 020	160	860	1 090	*23152EMD1	*23152EMKD1
	440	180	4	27	16	3 290	4 880	147	850	1 090	*24152EMD1	*24152EMK30D1
	480	130	5	20	12	2 890	3 680	183	970	1 240	*22252EMD1	*22252EMKD1
	480	174	5	27	16	3 650	5 050	180	780	1 000	*23252EMD1	*23252EMKD1
	540	165	6	27	16	4 020	4 830	221	720	920	*22352EMD1	*22352EMKD1
280	380	75	2.1	14	7	1 180	2 050	115	1 000	1 300	*23956EMD1	*23956EMKD1
	420	106	4	18	8	2 170	3 150	155	960	1 200	*23056EMD1	*23056EMKD1

1) Bearing part numbers with * are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard. Bearing models having outer diameter D dimension of 440 mm or more are the EM type (large size). 2) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings appended with "K30" have a tapered bore ratio of 1:30. 3) Smallest allowable dimension for chamfer dimension r.

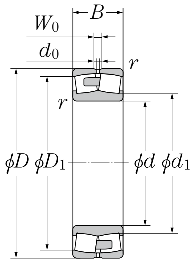


Dynamic equivalent radial load
$P_r = XF_r + YF_a$

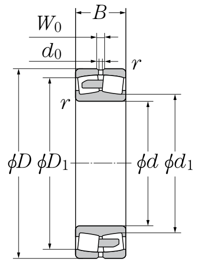
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

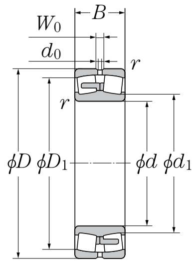
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	Constant e	Y_1	Y_2	Y_0	Mass (approx.) kg Cylindrical bore	Tapered bore
Installation-related dimensions (mm)						Axial load factors				
221	211	269	260	2.1	0.18	3.76	5.59	3.67	12	11.6
223	211	299	283	2.1	0.23	2.95	4.40	2.89	22.8	22.1
221	211	299	275	2.1	0.31	2.18	3.24	2.13	30.2	29.7
231	214	326	301	3	0.30	2.25	3.34	2.20	41.9	40.6
224	214	326	291	3	0.39	1.74	2.59	1.70	51.5	50.7
234	217	343	323	4	0.25	2.74	4.08	2.68	42.7	41.8
232	217	343	315	4	0.34	1.98	2.94	1.93	55.2	53.6
265	220	400	364	5	0.31	2.15	3.20	2.10	94.6	92.7
241	231	289	280	2.1	0.17	4.05	6.04	3.96	12.5	12.1
246	233	327	310	3	0.23	2.95	4.40	2.89	29.9	29.1
243	233	327	302	3	0.31	2.20	3.27	2.15	39.2	38.6
252	237	353	328	4	0.30	2.28	3.39	2.23	52.3	50.7
247	237	353	317	4	0.38	1.78	2.65	1.74	65.2	64.3
264	237	383	358	4	0.25	2.74	4.08	2.68	59.6	58.4
261	237	383	349	4	0.34	2.00	2.98	1.96	79.4	77.1
277	240	440	388	5	0.32	2.10	3.13	2.06	119	116
262	251	309	301	2.1	0.15	4.40	6.56	4.31	13.5	13.1
267	253	347	329	3	0.22	3.07	4.57	3.00	32	31.7
264	253	347	322	3	0.28	2.37	3.53	2.32	42.2	41.6
276	257	383	356	4	0.29	2.32	3.45	2.26	65.1	63.1
270	257	383	344	4	0.37	1.82	2.70	1.78	81	79.8
288	257	423	383	4	0.27	2.53	3.77	2.47	82.6	80.9
284	257	423	372	4	0.36	1.86	2.77	1.82	108	105
299	260	480	421	5	0.32	2.12	3.15	2.07	149	146
292	271	349	335	2.1	0.17	3.90	5.81	3.81	23.9	23.1
291	275	385	366	4	0.23	2.95	4.40	2.89	47.8	46.3
286	275	385	354	4	0.31	2.16	3.22	2.12	63.6	62.6
302	277	423	380	4	0.31	2.15	3.20	2.10	92.2	89.5
295	277	423	371	4	0.40	1.69	2.52	1.65	111	109
312	280	460	415	5	0.27	2.53	3.77	2.47	108	105
310	280	460	405	5	0.36	1.87	2.79	1.83	143	139
324	286	514	456	6	0.31	2.16	3.22	2.12	186	183
310	291	369	356	2.1	0.16	4.16	6.20	4.07	25.2	24.4
310	295	405	386	4	0.22	3.07	4.57	3.00	51.3	49.7



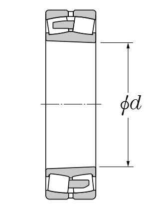
Cylindrical bore
[EM type]



Cylindrical bore
[EM type (large size)]



Cylindrical bore

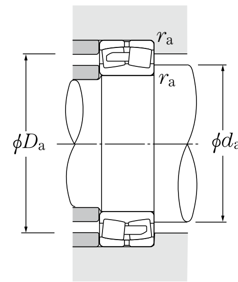


Tapered bore

d 280 ～ 360mm

Boundary dimensions (mm)						Basic load rating (kN)		Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers 1)	
						dynamic	static		Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)
d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u				
280	420	140	4	18	8	2 620	4 060	150	880	1 100	*24056EMD1	*24056EMK30D1
	460	146	5	20	12	2 980	4 400	182	810	1 030	*23156EMD1	*23156EMKD1
	460	180	5	27	16	3 550	5 450	167	810	1 030	*24156EMD1	*24156EMK30D1
	500	130	5	20	12	3 010	3 920	198	920	1 180	*22256EMD1	*22256EMKD1
	500	176	5	27	16	3 810	5 420	193	740	950	*23256EMD1	*23256EMKD1
	580	175	6	27	16	4 490	5 450	249	670	860	*22356EMD1	*22356EMKD1
300	420	90	3	14	8	1 600	2 620	145	890	1 140	*23960EMD1	*23960EMKD1
	460	118	4	16	10	2 400	3 610	176	890	1 130	*23060EMD1	*23060EMKD1
	460	160	4	20	12	3 150	5 190	166	760	970	*24060EMD1	*24060EMK30D1
	500	160	5	20	12	3 540	5 170	205	750	950	*23160EMD1	*23160EMKD1
	500	200	5	27	16	4 270	6 610	198	750	950	*24160EMD1	*24160EMK30D1
	540	140	5	20	12	3 470	4 590	232	860	1 080	*22260EMD1	*22260EMKD1
	540	192	5	27	16	4 520	6 280	228	690	880	*23260EMD1	*23260EMKD1
	620	185	7.5	27	16	4 000	5 400	490	550	720	22360B	22360BK
320	440	90	3	14	8	1 670	2 820	154	840	1 080	*23964EMD1	*23964EMKD1
	480	121	4	20	12	2 540	4 020	191	850	1 070	*23064EMD1	*23064EMKD1
	480	160	4	20	12	3 250	5 400	184	720	920	*24064EMD1	*24064EMK30D1
	540	176	5	27	16	4 020	6 020	227	700	880	*23164EMD1	*23164EMKD1
	540	218	5	33	20	5 010	7 720	225	690	880	*24164EMD1	*24164EMK30D1
	580	150	5	20	12	3 950	5 100	261	800	1 020	*22264EMD1	*22264EMKD1
	580	208	5	33	20	5 230	7 370	259	640	820	*23264EMD1	*23264EMKD1
340	460	90	3	14	8	1 710	2 980	162	800	1 020	*23968EMD1	*23968EMKD1
	520	133	5	20	12	2 990	4 690	219	790	1 000	*23068EMD1	*23068EMKD1
	520	180	5	27	16	3 910	6 510	206	670	860	*24068EMD1	*24068EMK30D1
	580	190	5	27	16	4 670	6 870	257	650	830	*23168EMD1	*23168EMKD1
	580	243	5	33	20	5 980	9 340	254	650	830	*24168EMD1	*24168EMK30D1
	620	224	6	33	20	4 950	8 000	585	490	630	23268B	23268BK
360	480	90	3	14	8	1 750	3 090	171	760	970	*23972EMD1	*23972EMKD1
	540	134	5	20	12	3 070	4 910	232	750	950	*23072EMD1	*23072EMKD1
	540	180	5	27	16	4 040	6 840	220	640	820	*24072EMD1	*24072EMK30D1
	600	192	5	27	16	4 200	7 050	530	490	630	23172B	23172BK
	600	243	5	33	20	5 100	9 150	470	490	630	24172B	24172BK30
	650	232	6	33	20	5 400	8 700	620	450	590	23272B	23272BK

1) Bearing part numbers with ∗ are **ULTAGE Series** and have outer ring oil holes and oil grooves as standard. Bearing models having outer diameter D dimension of 440 mm or more are the EM type (large size). 2) Bearings appended with "K" have a tapered bore ratio of 1:12; bearings appended with "K30" have a tapered bore ratio of 1:30. 3) Smallest allowable dimension for chamfer dimension r.



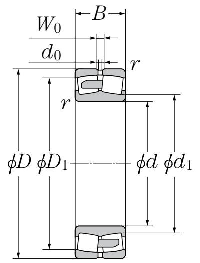
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

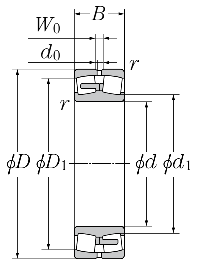
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Installation-related dimensions (mm)					Constant	Axial load factors			Mass (approx.) kg	
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
306	295	405	376	4	0.29	2.30	3.42	2.25	67.3	66.3
322	300	440	403	5	0.30	2.23	3.32	2.18	98.4	95.3
316	300	440	394	5	0.38	1.78	2.65	1.74	118	117
333	300	480	437	5	0.25	2.69	4.00	2.63	113	111
331	300	480	426	5	0.35	1.95	2.90	1.91	152	148
349	306	554	489	6	0.31	2.18	3.24	2.13	228	223
329	313	407	387	3	0.20	3.42	5.09	3.34	40.1	39.2
338	315	445	413	4	0.24	2.81	4.19	2.75	72.9	70.9
332	315	445	401	4	0.33	2.04	3.04	2.00	98.0	96.9
345	320	480	436	5	0.31	2.20	3.27	2.15	129	125
340	320	480	425	5	0.39	1.74	2.59	1.70	159	157
358	320	520	469	5	0.25	2.69	4.00	2.63	134	131
352	320	520	461	5	0.35	1.92	2.86	1.88	194	188
381	336	584	522	6	0.32	2.13	3.17	2.08	270	265
350	333	427	407	3	0.19	3.62	5.39	3.54	42.1	40.8
360	335	465	433	4	0.23	2.92	4.35	2.86	78.9	76.6
352	335	465	423	4	0.31	2.15	3.20	2.10	104	102
373	340	520	468	5	0.31	2.15	3.20	2.10	169	164
363	340	520	457	5	0.39	1.71	2.54	1.67	204	201
383	340	560	510	5	0.25	2.69	4.00	2.63	177	174
376	340	560	493	5	0.35	1.91	2.85	1.87	245	238
370	353	447	427	3	0.18	3.80	5.66	3.72	44.5	43.1
384	358	502	466	5	0.24	2.87	4.27	2.80	98.5	95.5
377	358	502	456	5	0.33	2.06	3.06	2.01	140	137
393	360	560	500	5	0.32	2.12	3.15	2.07	213	206
385	360	560	486	5	0.41	1.65	2.46	1.61	266	262
435	368	592	598	5	0.37	1.84	2.75	1.80	300	291
390	373	467	447	3	0.17	4.00	5.96	3.91	46.2	44.8
405	378	522	488	5	0.23	2.98	4.44	2.92	111	108
398	378	522	478	5	0.31	2.16	3.22	2.12	147	145
417	382	578	520	4	0.32	2.11	3.15	2.07	222	215
414	382	578	507	4	0.40	1.67	2.48	1.63	281	277
429	388	622	551	5	0.36	1.87	2.78	1.83	339	329

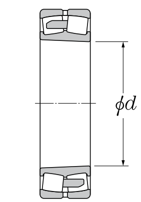
Note: Bearings other than the **ULTAGE Series** with outer diameter D dimension of 320 mm or more are also provided with outer ring oil inlets and oil grooves.



Cylindrical bore
[EM type (large size)]



Cylindrical bore

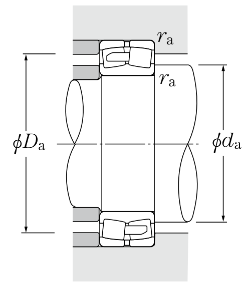


Tapered bore

d 380 ～ 480mm

Boundary dimensions (mm)						Basic load rating (kN)		Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers 1)	
						dynamic	static					
d	D	B	$r_{s\,min}$ 3)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)
380	520	106	4	16	10	2 300	3 920	205	710	910	∗23976EMD1	∗23976EMKD1
	560	135	5	20	12	3 230	5 270	247	720	910	∗23076EMD1	∗23076EMKD1
	560	180	5	27	16	4 140	7 280	240	610	780	∗24076EMD1	∗24076EMK30D1
	620	194	5	27	16	4 350	7 500	560	450	590	23176B	23176BK
	620	243	5	33	20	5 350	9 650	570	450	590	24176B	24176BK30
	680	240	6	33	20	5 800	9 650	665	430	550	23276B	23276BK
400	540	106	4	16	10	2 370	4 170	215	680	870	∗23980EMD1	∗23980EMKD1
	600	148	5	20	12	3 300	6 050	450	520	680	23080B	23080BK
	600	200	5	27	16	4 250	8 400	485	460	600	24080B	24080BK30
	650	200	6	27	16	4 650	8 050	630	430	560	23180B	23180BK
	650	250	6	33	20	5 650	10 300	585	430	560	24180B	24180BK30
	720	256	6	33	20	6 500	10 600	740	400	520	23280B	23280BK
420	560	106	4	16	10	2 390	4 320	230	650	830	∗23984EMD1	∗23984EMKD1
	620	150	5	20	12	3 450	6 400	475	490	640	23084B	23084BK
	620	200	5	27	16	4 300	8 450	470	440	570	24084B	24084BK30
	700	224	6	33	20	5 800	9 950	680	410	530	23184B	23184BK
	700	280	6	33	20	6 850	12 200	755	410	530	24184B	24184BK30
	760	272	7.5	33	20	7 300	12 000	820	380	490	23284B	23284BK
440	600	118	4	16	10	2 260	4 700	325	500	650	23988	23988K
	650	157	6	20	12	3 650	6 850	530	470	610	23088B	23088BK
	650	212	6	33	20	4 800	9 450	530	420	540	24088B	24088BK30
	720	226	6	33	20	5 800	10 100	685	390	500	23188B	23188BK
	720	280	6	33	20	7 200	13 100	715	390	500	24188B	24188BK30
	790	280	7.5	33	20	7 700	12 800	870	360	470	23288B	23288BK
460	620	118	4	16	10	2 340	4 950	325	480	620	23992	23992K
	680	163	6	27	16	4 000	7 450	560	450	580	23092B	23092BK
	680	218	6	33	20	5 100	10 200	590	390	510	24092B	24092BK30
	760	240	7.5	33	20	6 350	11 400	775	360	470	23192B	23192BK
	760	300	7.5	33	20	7 900	14 500	805	360	470	24192B	24192BK30
	830	296	7.5	33	20	8 650	14 500	925	340	440	23292B	23292BK
480	650	128	5	20	12	2 590	5 500	365	450	590	23996	23996K
	700	165	6	27	16	4 050	7 700	570	420	550	23096B	23096BK
	700	218	6	33	20	5 200	10 500	610	380	490	24096B	24096BK30

1) Bearing part numbers with ∗ are the **ULTAGE Series** EM type (large size) and have outer ring oil holes and oil grooves as standard.
2) Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
3) Smallest allowable dimension for chamfer dimension r.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

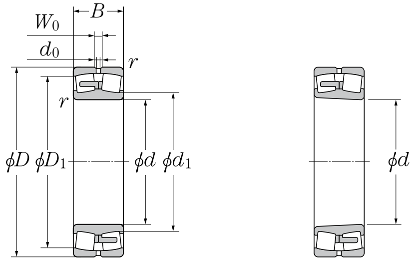
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

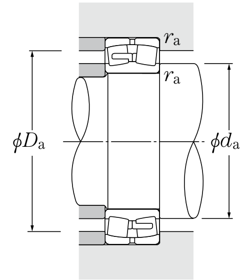
Installation-related dimensions (mm)					Constant	Axial load factors			Mass (approx.) kg	
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
412	395	505	481	4	0.18	3.66	5.46	3.58	68.0	65.9
425	398	542	509	5	0.22	3.07	4.57	3.00	117	113
420	398	542	499	5	0.30	2.25	3.34	2.20	154	151
436	402	598	540	4	0.31	2.16	3.22	2.12	235	228
431	402	598	529	4	0.39	1.73	2.58	1.69	292	287
453	408	652	575	5	0.36	1.89	2.82	1.85	380	369
433	415	525	501	4	0.18	3.80	5.66	3.72	71.4	69.2
451	422	578	542	4	0.24	2.80	4.16	2.73	149	144
446	422	578	528	4	0.32	2.09	3.11	2.04	202	200
458	428	622	567	5	0.31	2.21	3.29	2.16	264	256
453	428	622	552	5	0.38	1.77	2.63	1.73	329	324
473	428	692	612	5	0.37	1.81	2.69	1.77	457	443
454	435	545	522	4	0.17	3.95	5.88	3.86	74.9	72.6
471	442	598	562	4	0.24	2.85	4.24	2.79	157	152
465	442	598	551	4	0.32	2.13	3.17	2.08	210	207
488	448	672	611	5	0.32	2.11	3.15	2.07	354	343
477	448	672	592	5	0.40	1.69	2.51	1.65	440	433
501	456	724	643	6	0.36	1.86	2.77	1.82	544	528
483	458	582	551	3	0.18	3.66	5.46	3.58	101	98
490	468	622	585	5	0.24	2.85	4.24	2.79	181	175
486	468	622	576	5	0.32	2.11	3.15	2.07	245	241
504	468	692	627	5	0.31	2.15	3.21	2.11	370	358
498	468	692	614	5	0.39	1.75	2.61	1.71	456	449
525	476	754	671	6	0.36	1.88	2.80	1.84	600	582
503	478	602	572	3	0.17	3.95	5.88	3.86	107	104
512	488	652	613	5	0.23	2.88	4.29	2.82	206	200
509	488	652	604	5	0.31	2.15	3.21	2.11	276	272
534	496	724	660	6	0.31	2.14	3.19	2.10	443	429
523	496	724	645	6	0.39	1.71	2.55	1.67	550	541
547	496	794	703	6	0.36	1.87	2.78	1.83	704	683
527	502	628	599	4	0.18	3.85	5.73	3.76	123	119
532	508	672	633	5	0.23	2.94	4.38	2.88	217	209
530	508	672	625	5	0.30	2.22	3.30	2.17	285	280

Note: Outer ring oil inlets/oil grooves are provided.

Spherical Roller Bearings



Cylindrical bore   Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

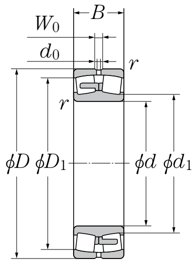
d 480 ～ 630mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 2)	W_0	d_0	Basic load rating dynamic (kN) C_r	Basic load rating static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Allowable speed (min⁻¹) Oil lubrication	Bearing numbers Cylindrical bore	Bearing numbers Tapered bore 1)
480	790	248	7.5	33	20	6 900	12 300	860	350	450	**23196B**	**23196BK**
	790	308	7.5	33	20	8 250	15 300	860	350	450	**24196B**	**24196BK30**
	870	310	7.5	33	20	9 200	15 500	1 000	320	420	**23296B**	**23296BK**
500	670	128	5	20	12	2 640	5 600	460	430	560	**239/500**	**239/500K**
	720	167	6	27	16	4 250	8 300	645	410	530	**230/500B**	**230/500BK**
	720	218	6	33	20	5 300	10 900	640	350	460	**240/500B**	**240/500BK30**
	830	264	7.5	33	20	7 700	13 700	875	330	430	**231/500B**	**231/500BK**
	830	325	7.5	42	25	9 000	16 700	870	330	430	**241/500B**	**241/500BK30**
	920	336	7.5	42	25	10 500	17 800	1 100	310	400	**232/500B**	**232/500BK**
530	710	136	5	20	12	2 940	6 450	400	400	520	**239/530**	**239/530K**
	780	185	6	27	16	4 850	9 350	710	380	490	**230/530B**	**230/530BK**
	780	250	6	33	20	6 200	12 700	700	330	430	**240/530B**	**240/530BK30**
	870	272	7.5	33	20	7 800	14 200	920	310	400	**231/530B**	**231/530BK**
	870	335	7.5	42	25	9 250	17 400	910	310	400	**241/530B**	**241/530BK30**
	980	355	9.5	42	25	11 500	19 800	1 210	280	370	**232/530B**	**232/530BK**
560	750	140	5	20	12	3 200	6 900	525	380	490	**239/560**	**239/560K**
	820	195	6	27	16	5 350	10 500	800	350	450	**230/560B**	**230/560BK**
	820	258	6	33	20	6 750	14 100	750	310	400	**240/560B**	**240/560BK30**
	920	280	7.5	33	20	8 550	15 500	1 000	280	370	**231/560B**	**231/560BK**
	920	355	7.5	42	25	11 100	20 800	1 030	280	370	**241/560B**	**241/560BK30**
	1 030	365	9.5	42	25	12 300	21 100	1 320	260	340	**232/560B**	**232/560BK**
600	800	150	5	20	12	3 600	8 000	490	350	450	**239/600**	**239/600K**
	870	200	6	27	16	5 800	12 000	835	310	420	**230/600B**	**230/600BK**
	870	272	6	33	20	7 150	15 600	750	280	370	**240/600B**	**240/600BK30**
	980	300	7.5	33	20	10 000	18 400	1 160	260	340	**231/600B**	**231/600BK**
	980	375	7.5	42	25	11 900	23 200	1 130	260	340	**241/600B**	**241/600BK30**
	1 090	388	9.5	42	25	13 600	23 700	930	250	320	**232/600B**	**232/600BK**
630	850	165	6	27	16	4 100	9 250	545	320	420	**239/630**	**239/630K**
	920	212	7.5	33	20	6 550	13 000	950	310	400	**230/630B**	**230/630BK**
	920	290	7.5	33	20	8 400	17 900	915	270	350	**240/630B**	**240/630BK30**
	1 030	315	7.5	33	20	10 700	19 900	1 190	250	320	**231/630B**	**231/630BK**
	1 030	400	7.5	42	25	12 900	25 000	1 200	250	320	**241/630B**	**241/630BK30**
	1 150	412	12	42	25	15 200	26 800	1 540	230	300	**232/630B**	**232/630BK**

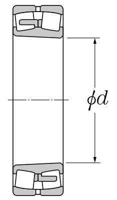
1) Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
2) Smallest allowable dimension for chamfer dimension r.

d	Installation-related dimensions (mm) d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass (approx.) kg Cylindrical bore	Mass (approx.) kg Tapered bore
480	554	516	754	687	6	0.31	2.15	3.21	2.11	492	477
	546	516	754	671	6	0.39	1.74	2.59	1.70	608	600
	574	516	834	737	6	0.36	1.87	2.78	1.83	814	790
500	547	522	648	621	4	0.17	4.02	5.98	3.93	131	127
	552	528	692	653	5	0.23	2.98	4.44	2.92	226	218
	550	528	692	646	5	0.30	2.28	3.40	2.23	295	290
	580	536	794	724	6	0.32	2.12	3.16	2.08	584	566
	572	536	794	703	6	0.39	1.72	2.57	1.69	716	705
	600	536	884	773	6	0.39	1.74	2.59	1.70	1 000	971
530	579	552	688	654	4	0.17	3.95	5.88	3.86	157	152
	594	558	752	704	5	0.22	3.03	4.52	2.97	306	295
	586	558	752	689	5	0.30	2.24	3.33	2.19	413	406
	617	566	834	757	6	0.30	2.22	3.30	2.17	653	633
	605	566	834	737	6	0.38	1.79	2.67	1.75	800	788
	600	574	936	723	8	0.39	1.74	2.59	1.70	1 200	1 170
560	547	582	728	621	4	0.16	4.10	6.10	4.01	182	176
	627	588	792	741	5	0.22	3.03	4.51	2.96	353	340
	620	588	792	726	5	0.30	2.29	3.40	2.24	467	459
	650	596	884	801	6	0.30	2.27	3.38	2.22	752	729
	638	596	884	787	6	0.39	1.75	2.61	1.71	948	934
	677	604	986	867	8	0.36	1.88	2.80	1.84	1 360	1 320
600	654	622	778	739	4	0.18	3.85	5.73	3.76	218	211
	672	628	842	785	5	0.21	3.17	4.72	3.10	400	386
	667	628	842	770	5	0.29	2.33	3.47	2.28	544	535
	694	636	944	860	6	0.30	2.22	3.30	2.17	908	880
	685	636	944	832	6	0.37	1.81	2.70	1.77	1 130	1 110
	722	644	1 046	919	8	0.36	1.86	2.77	1.82	1 540	1 490
630	690	658	822	781	5	0.18	3.66	5.46	3.58	277	268
	704	666	884	834	6	0.22	3.14	4.67	3.07	481	464
	697	666	884	815	6	0.30	2.28	3.40	2.23	657	646
	731	666	994	899	6	0.30	2.27	3.38	2.22	1 050	1 020
	718	666	994	872	6	0.38	1.78	2.66	1.74	1 330	1 310
	760	684	1 096	969	10	0.36	1.87	2.78	1.83	1 900	1 840

Note: Outer ring oil inlets/oil grooves are provided.



Cylindrical bore

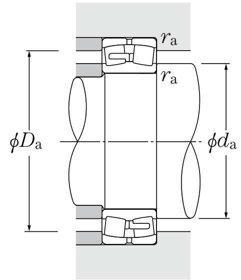


Tapered bore

d 670 ～ 950mm

d	D	B	$r_{s\,min}$ 2)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 1)
Boundary dimensions mm						Basic load rating dynamic / static kN		Fatigue load limit kN	Allowable speed min-1		Bearing numbers	
670	900	170	6	27	16	4 550	10 300	795	300	390	**239/670**	**239/670K**
	980	230	7.5	33	20	7 300	14 600	1 000	280	360	**230/670B**	**230/670BK**
	980	308	7.5	33	20	9 650	20 600	1 040	250	320	**240/670B**	**240/670BK30**
	1 090	336	7.5	42	25	12 500	23 600	1 400	230	300	**231/670B**	**231/670BK**
	1 090	412	7.5	42	25	14 100	28 000	1 340	230	300	**241/670B**	**241/670BK30**
	1 220	438	12	42	25	17 900	32 000	1 770	220	280	**232/670B**	**232/670BK**
710	950	180	6	27	16	4 950	11 500	665	280	370	**239/710**	**239/710K**
	1 030	236	7.5	33	20	8 000	16 200	1 140	260	340	**230/710B**	**230/710BK**
	1 030	315	7.5	33	20	10 300	22 500	1 150	230	300	**240/710B**	**240/710BK30**
	1 150	345	9.5	42	25	13 000	24 900	1 470	220	280	**231/710B**	**231/710BK**
	1 150	438	9.5	42	25	16 100	32 000	1 190	220	280	**241/710B**	**241/710BK30**
	1 280	450	12	42	25	18 100	32 500	1 200	200	260	**232/710B**	**232/710BK**
750	1 000	185	6	27	16	5 600	13 000	990	260	340	**239/750**	**239/750K**
	1 090	250	7.5	33	20	9 100	18 300	1 290	250	320	**230/750B**	**230/750BK**
	1 090	335	7.5	42	25	11 300	24 600	1 230	220	280	**240/750B**	**240/750BK30**
	1 220	365	9.5	42	25	14 300	27 200	1 130	200	260	**231/750B**	**231/750BK**
	1 360	475	15	42	25	20 300	36 500	1 980	180	240	**232/750B**	**232/750BK**
800	1 060	195	6	27	16	6 000	13 700	1 040	240	310	**239/800**	**239/800K**
	1 150	258	7.5	33	20	9 350	19 500	1 340	220	290	**230/800B**	**230/800BK**
	1 150	345	7.5	42	25	12 400	27 800	1 360	200	260	**240/800B**	**240/800BK30**
	1 280	375	9.5	42	25	16 000	31 000	1 780	180	240	**231/800B**	**231/800BK**
850	1 120	200	6	27	16	6 500	15 100	1 080	220	290	**239/850**	**239/850K**
	1 220	272	7.5	33	20	10 900	22 700	1 510	210	270	**230/850B**	**230/850BK**
	1 220	365	7.5	42	25	13 900	31 500	1 490	180	240	**240/850B**	**240/850BK30**
	1 360	400	12	42	25	17 300	34 000	1 380	170	220	**231/850B**	**231/850BK**
900	1 180	206	6	33	20	7 400	17 300	1 230	210	270	**239/900**	**239/900K**
	1 280	280	7.5	33	20	11 400	24 700	1 580	190	250	**230/900B**	**230/900BK**
	1 280	375	7.5	42	25	14 700	33 500	1 580	170	220	**240/900B**	**240/900BK30**
	1 420	412	12	42	25	18 700	38 000	2 030	150	200	**231/900B**	**231/900BK**
950	1 250	224	7.5	33	20	8 650	20 500	1 390	190	250	**239/950**	**239/950K**
	1 360	300	7.5	33	20	12 800	28 400	1 750	180	230	**230/950B**	**230/950BK**
	1 360	412	7.5	42	25	17 200	40 000	1 780	160	210	**240/950B**	**240/950BK30**

1) Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
2) Smallest allowable dimension for chamfer dimension r.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

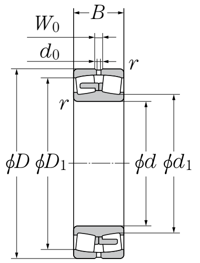
Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

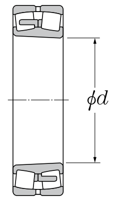
For values of e, Y_1, Y_2 and Y_0 see the table below.

d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
733	698	872	830	5	0.18	3.76	5.59	3.67	317	307
750	706	944	886	6	0.22	3.07	4.57	3.00	594	573
741	706	944	870	6	0.29	2.29	3.41	2.24	794	781
773	706	1 054	956	6	0.30	2.22	3.30	2.17	1 250	1 210
764	706	1 054	926	6	0.37	1.83	2.73	1.79	1 530	1 510
807	724	1 166	1 034	10	0.36	1.89	2.81	1.85	2 270	2 200
778	738	922	876	5	0.18	3.85	5.73	3.76	375	363
792	746	994	937	6	0.22	3.02	4.50	2.96	663	640
783	746	994	916	6	0.29	2.36	3.51	2.31	884	870
822	754	1 106	1 005	8	0.29	2.32	3.45	2.27	1 420	1 380
805	754	1 106	979	8	0.37	1.83	2.72	1.79	1 800	1 770
851	764	1 226	1 081	10	0.35	1.91	2.84	1.87	2 540	2 470
818	778	972	924	5	0.17	3.90	5.81	3.81	412	399
834	786	1 054	991	6	0.21	3.20	4.76	3.13	790	763
828	786	1 054	969	6	0.29	2.35	3.49	2.29	1 060	1 040
868	794	1 176	1 066	8	0.29	2.32	3.45	2.27	1 700	1 650
903	814	1 296	1 149	12	0.35	1.92	2.86	1.88	3 050	2 960
868	828	1 032	983	5	0.17	4.05	6.04	3.96	487	471
893	836	1 114	1 049	6	0.21	3.15	4.69	3.08	890	859
881	836	1 114	1 026	6	0.28	2.41	3.59	2.36	1 190	1 170
912	844	1 236	1 122	8	0.29	2.32	3.45	2.27	1 890	1 830
924	878	1 092	1 043	5	0.16	4.25	6.32	4.15	550	532
945	886	1 184	1 114	6	0.20	3.32	4.95	3.25	1 050	1 010
936	886	1 184	1 089	6	0.28	2.42	3.61	2.37	1 410	1 390
979	904	1 306	1 194	10	0.28	2.37	3.54	2.32	2 270	2 200
974	928	1 152	1 101	5	0.16	4.32	6.44	4.23	623	603
999	936	1 244	1 167	6	0.20	3.32	4.95	3.25	1 170	1 130
988	936	1 244	1 147	6	0.27	2.48	3.70	2.43	1 570	1 540
1 031	954	1 366	1 251	10	0.28	2.42	3.60	2.36	2 500	2 420
1 029	986	1 214	1 165	6	0.16	4.20	6.26	4.11	774	749
1 063	986	1 324	1 239	6	0.21	3.26	4.85	3.18	1 430	1 380
1 044	986	1 324	1 213	6	0.28	2.39	3.56	2.34	1 970	1 940

Note: Outer ring oil inlets/oil grooves are provided.



Cylindrical bore

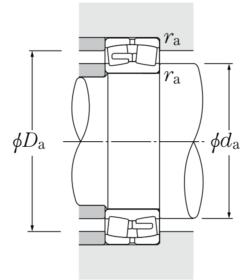


Tapered bore

d 1000 ～ 1400mm

d	D	B	$r_{s\,min}$ 2)	W_0	d_0	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 1)
Boundary dimensions mm						Basic load rating dynamic / static kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers	
1000	1 320	236	7.5	33	20	9 550	22 700	1 520	180	230	**239/1000**	**239/1000K**
	1 420	308	7.5	33	20	13 800	30 000	1 460	170	220	**230/1000B**	**230/1000BK**
	1 420	412	7.5	42	25	17 800	42 000	1 890	150	190	**240/1000B**	**240/1000BK30**
1060	1 400	250	7.5	33	20	10 400	24 700	1 670	160	210	**239/1060**	**239/1060K**
	1 500	325	9.5	42	25	15 100	33 500	1 610	150	200	**230/1060B**	**230/1060BK**
	1 500	438	9.5	42	25	19 800	47 000	2 060	140	180	**240/1060B**	**240/1060BK30**
1120	1 460	250	7.5	33	20	10 900	26 700	1 470	150	200	**239/1120**	**239/1120K**
	1 580	345	9.5	42	25	17 400	39 000	2 310	150	190	**230/1120B**	**230/1120BK**
	1 580	462	9.5	42	25	21 700	52 500	2 230	120	160	**240/1120B**	**240/1120BK30**
1180	1 540	272	7.5	33	20	12 200	29 800	1 650	140	180	**239/1180**	**239/1180K**
1250	1 630	280	7.5	33	20	13 400	33 500	1 810	120	160	**239/1250**	**239/1250K**
1320	1 720	300	7.5	33	20	15 100	38 000	1 930	120	150	**239/1320**	**239/1320K**
1400	1 820	315	9.5	33	20	16 800	43 000	2 570	100	130	**239/1400**	**239/1400K**

1) Bearings appended with "**K**" have a tapered bore ratio of 1:12; bearings appended with "**K30**" have a tapered bore ratio of 1:30.
2) Smallest allowable dimension for chamfer dimension r.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

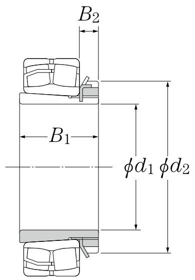
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

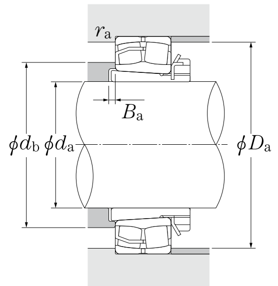
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
1 084	1 036	1 284	1 230	6	0.16	4.21	6.26	4.11	916	887
1 107	1 036	1 384	1 294	6	0.20	3.37	5.02	3.29	1 580	1 520
1 097	1 036	1 384	1 272	6	0.27	2.51	3.73	2.45	2 110	2 080
1 153	1 096	1 364	1 400	6	0.16	4.20	6.26	4.11	1 090	1 060
1 172	1 104	1 456	1 368	8	0.20	3.36	5.00	3.28	1 850	1 790
1 160	1 104	1 456	1 343	8	0.27	2.49	3.71	2.44	2 450	2 140
1 208	1 156	1 424	1 362	6	0.15	4.42	6.58	4.32	1 140	1 100
1 234	1 164	1 536	1 442	8	0.21	3.19	4.75	3.12	2 160	2 090
1 227	1 164	1 536	1 418	8	0.27	2.50	3.72	2.44	2 890	2 840
1 271	1 216	1 504	1 437	6	0.15	4.40	6.56	4.31	1 390	1 340
1 352	1 286	1 594	1 525	6	0.15	4.42	6.58	4.32	1 600	1 550
1 423	1 356	1 684	1 605	6	0.16	4.34	6.46	4.24	1 900	1 840
1 513	1 444	1 776	1 703	8	0.15	4.39	6.54	4.29	2 230	2 160

Note: Outer ring oil inlets/oil grooves are provided.

Adapters

(For spherical roller bearings)





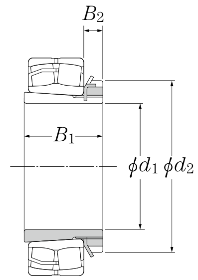
d_1 35 ～ 70mm

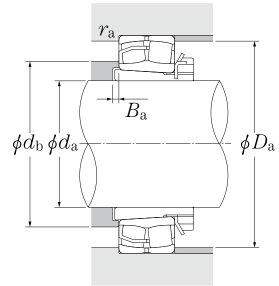
Boundary dimensions mm d_1	B_1	d_2	B_2	Numbers[1] Bearing	Adapter	Installation-related dimensions mm d_a Min.	d_b Max.	B_a Min.	D_a Min.	D_a Max.	r_{as} Max.	Mass[2] kg (approx.)
35	36	58	10	∗ 22208EAKD1;	**H 308X**	44	50	5	71	73	1.1	0.189
	36	58	10	21308CK;	**H 308X**	44	52	5	76	81.5	1.5	0.189
	46	58	10	∗ 22308EAKD1;	**H2308X**	45	52	5	78	81	1.5	0.224
40	39	65	11	∗ 22209EAKD1;	**H 309X**	49	54	8	76	78	1.1	0.248
	39	65	11	21309CK;	**H 309X**	49	57	5	85	91.5	1.5	0.248
	50	65	11	∗ 22309EAKD1;	**H2309X**	50	58	5	87	91	1.5	0.280
45	42	70	12	∗ 22210EAKD1;	**H 310X**	54	59	10	81	83	1.1	0.303
	42	70	12	21310CK;	**H 310X**	54	65	5	93	100	2	0.303
	55	70	12	∗ 22310EAKD1;	**H2310X**	56	63	5	95	99	2	0.362
50	45	75	12	∗ 22211EAKD1;	**H 311X**	60	66	11	90	91	1.5	0.345
	45	75	12	21311K;	**H 311X**	60	73	6	102	110	2	0.345
	59	75	12	∗ 22311EAKD1;	**H2311X**	61	68	6	104	109	2	0.420
55	47	80	13	∗ 22212EAKD1;	**H 312X**	65	71	9	99	101	1.5	0.394
	47	80	13	21312K;	**H 312X**	65	78	5	109	118	2	0.394
	62	80	13	∗ 22312EAKD1;	**H2312X**	66	75	5	113	118	2.1	0.481
60	50	85	14	∗ 22213EAKD1;	**H 313X**	70	78	8	107	111	1.5	0.458
	50	85	14	21313K;	**H 313X**	70	85	5	119	128	2	0.458
	65	85	14	∗ 22313EAKD1;	**H2313X**	72	81	5	122	128	2.1	0.557
65	55	98	15	∗ 22215EAKD1;	**H 315X**	80	88	12	118	121	1.5	0.831
	55	98	15	21315K;	**H 315X**	80	99	5	136	148	2	0.831
	73	98	15	∗ 22315EAKD1;	**H2315X**	82	91	5	139	148	2.1	1.05
70	59	105	17	∗ 22216EAKD1;	**H 316X**	86	94	12	127	129	2	1.03
	59	105	17	21316K;	**H 316X**	86	105	5	144	158	2	1.03
	78	105	17	∗ 22316EAKD1;	**H2316X**	87	98	5	148	158	2.1	1.28

1) Bearing numbers marked "∗" designate ULTAGE Series. 2) Indicates the adapter mass.
Note: 1. Refer to pages B-218 to B-221 for bearing dimensions, rated loads, and mass.
2. Refer to pages D-2 to D-10 and D-12 to D-14 for adapter locknut and washer dimensions.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.

Adapters

(For spherical roller bearings)





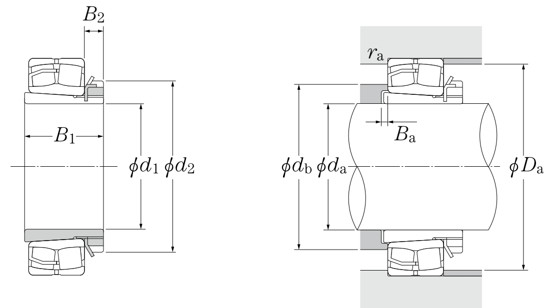
d_1 75 ～ 115mm

Boundary dimensions mm d_1	B_1	d_2	B_2	Numbers[1] Bearing	Adapter	Installation-related dimensions mm d_a Min.	d_b Max.	B_a Min.	D_a Min.	D_a Max.	r_{as} Max.	Mass[2] kg (approx.)
75	63	110	18	∗ 22217EAKD1;	**H 317X**	91	100	12	137	139	2	1.18
	63	110	18	21317K;	**H 317X**	91	111	6	152	166	2.5	1.18
	82	110	18	∗ 22317EAKD1;	**H2317X**	94	107	6	157	166	3	1.45
80	65	120	18	∗ 22218EAKD1;	**H 318X**	96	105	10	144	149	2	1.37
	86	120	18	∗ 23218EMKD1;	**H2318X**	99	104	18	141	149	2	1.69
	65	120	18	21318K;	**H 318X**	96	119	6	162	176	2.5	1.37
	86	120	18	∗ 22318EAKD1;	**H2318X**	99	110	6	166	176	3	1.69
85	68	125	19	∗ 22219EAKD1;	**H 319X**	102	110	9	153	158	2.1	1.56
	68	125	19	21319K;	**H 319X**	102	127	7	171	186	2.5	1.56
	90	125	19	∗ 22319EAKD1;	**H2319X**	105	120	7	174	186	3	1.92
90	71	130	20	∗ 22220EAKD1;	**H 320X**	107	118	8	161	168	2.1	1.69
	97	130	20	∗ 23220EMKD1;	**H2320X**	110	118	19	159	168	2.1	2.15
	71	130	20	21320K;	**H 320X**	107	133	7	179	201	2.5	1.69
	97	130	20	∗ 22320EAKD1;	**H2320X**	110	127	7	187	201	3	2.15
100	81	145	21	∗ 23122EAKD1;	**H3122X**	117	125	7	161	169	2	2.25
	77	145	21	∗ 22222EAKD1;	**H 322X**	117	130	6	179	188	2.1	2.18
	105	145	21	∗ 23222EMKD1;	**H2322X**	121	130	17	176	188	2.1	2.74
	77	145	21	21322K;	**H 322X**	117	146	9	203	226	2.5	2.18
	105	145	21	∗ 22322EAKD1;	**H2322X**	121	139	7	209	226	3	2.74
110	72	145	22	∗ 23024EAKD1;	**H3024X**	127	134	7	165	171	2	1.93
	88	155	22	∗ 23124EAKD1;	**H3124X**	128	138	7	179	189	2	2.64
	88	155	22	∗ 22224EAKD1;	**H3124X**	128	141	11	193	203	2.1	2.64
	112	155	22	∗ 23224EMKD1;	**H2324X**	131	139	17	190	203	2.1	3.19
	112	155	22	∗ 22324EAKD1;	**H2324X**	131	156	7	225	246	3	3.19
115	80	155	23	∗ 23026EAKD1;	**H3026**	137	145	8	183	191	2	2.85
	92	165	23	∗ 23126EAKD1;	**H3126**	138	148	8	189	199	2	3.66
	92	165	23	∗ 22226EAKD1;	**H3126**	138	151	8	206	216	3	3.66
	121	165	23	∗ 23226EMKD1;	**H2326**	142	150	21	203	216	3	4.6
	121	165	23	∗ 22326EAKD1;	**H2326**	142	164	8	243	263	4	4.6

1) Bearing numbers marked "∗" designate ULTAGE Series. 2) Indicates the adapter mass.
Note: 1. Refer to pages B-220 to B-225 for bearing dimensions, rated loads, and mass.
2. Refer to pages D-2 to D-10 and D-12 to D-14 for adapter locknut and washer dimensions.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.

Adapters

(For spherical roller bearings)



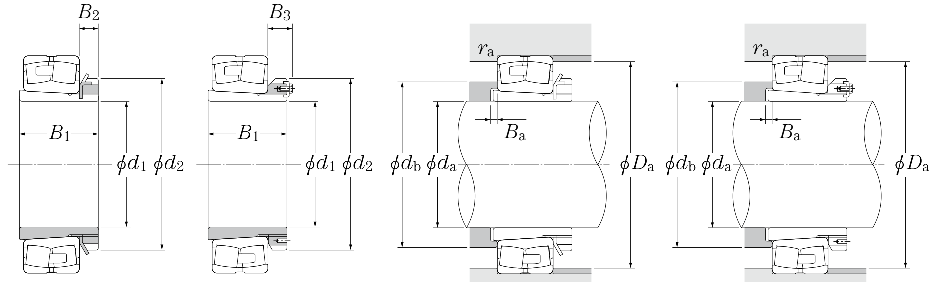
d_1 125 ～ 170mm

Boundary dimensions (mm)				Numbers 1)	Installation-related dimensions (mm)						Mass 2) kg
d_1	B_1	d_2	B_2	Bearing; Adapter	d_a Min.	d_b Max.	B_a Min.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)
125	82	165	24	* 23028EAKD1;**H3028**	147	155	8	193	201	2	3.16
	97	180	24	* 23128EAKD1;**H3128**	149	159	8	203	213	2.1	4.34
	97	180	24	* 22228EAKD1;**H3128**	149	163	8	224	236	3	4.34
	131	180	24	* 23228EMKD1;**H2328**	152	162	22	220	236	3	5.55
	131	180	24	* 22328EAKD1;**H2328**	152	181	8	261	283	4	5.55
135	87	180	26	* 23030EAKD1;**H3030**	158	167	8	207	214	2.1	3.89
	111	195	26	* 23130EAKD1;**H3130**	160	171	8	223	238	2.1	5.52
	111	195	26	* 22230EAKD1;**H3130**	160	177	15	242	256	3	5.52
	139	195	26	* 23230EMKD1;**H2330**	163	174	20	237	256	3	6.63
	139	195	26	* 22330EMKD1;**H2330**	163	188	8	279	303	4	6.63
140	93	190	28	* 23032EAKD1;**H3032**	168	177	8	221	229	2.1	5.21
	119	210	28	* 23132EAKD1;**H3132**	170	185	8	240	258	2.1	7.67
	119	210	28	* 22232EAKD1;**H3132**	170	190	14	260	276	3	7.67
	147	210	28	* 23232EMKD1;**H2332**	174	187	18	254	276	3	9.14
	147	210	28	* 22332EMKD1;**H2332**	174	205	8	296	323	4	9.14
150	101	200	29	* 23034EAKD1;**H3034**	179	190	8	238	249	2.1	5.99
	122	220	29	* 23134EAKD1;**H3134**	180	195	8	250	268	2.1	8.38
	122	220	29	* 22234EAKD1;**H3134**	180	201	10	277	293	4	8.38
	154	220	29	* 23234EMKD1;**H2334**	185	199	18	272	293	4	10.2
	154	220	29	* 22334EMKD1;**H2334**	185	223	8	313	343	4	10.2
160	109	210	30	* 23036EAKD1;**H3036**	189	201	8	255	269	2.1	6.83
	131	230	30	* 23136EAKD1;**H3136**	191	205	8	267	286	3	9.5
	131	230	30	* 22236EMKD1;**H3136**	191	209	18	287	303	4	9.5
	161	230	30	* 23236EMKD1;**H2336**	195	210	22	282	303	4	11.3
	161	230	30	* 22336EMKD1;**H2336**	195	229	8	329	363	4	11.3
170	112	220	31	* 23038EAKD1;**H3038**	199	213	9	266	279	2.1	7.45
	141	240	31	* 23138EMKD1;**H3138**	202	221	9	284	306	3	10.8
	141	240	31	* 22238EMKD1;**H3138**	202	222	21	305	323	4	10.8
	169	240	31	* 23238EMKD1;**H2338**	206	220	21	299	323	4	12.6
	169	240	31	* 22338EMKD1;**H2338**	206	247	9	346	380	5	12.6

1) Bearing numbers marked "*" designate **ULTAGE Series**. 2) Indicates the adapter mass.
Note: 1. Refer to pages **B-224** to **B-227** for bearing dimensions, rated loads, and mass.
2. Refer to pages **D-2** to **D-10** and **D-12** to **D-14** for adapter locknut and washer dimensions.

Adapters

(For spherical roller bearings)



d_1≦180mm d_1≧200mm

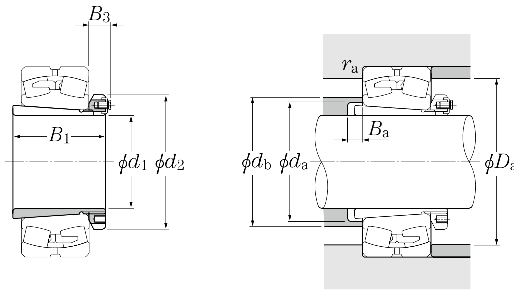
d_1 180 ～ 300mm

Boundary dimensions (mm)					Numbers 1)	Installation-related dimensions (mm)						Mass 2) kg
d_1	B_1	d_2	B_2		Bearing; Adapter	d_a Min.	d_b Max.	B_a Min.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)
180	120	240	32	–	* 23040EMKD1;**H3040**	210	223	10	283	299	2.1	9.19
	150	250	32	–	* 23140EMKD1;**H3140**	212	231	10	301	326	3	12.1
	150	250	32	–	* 22240EMKD1;**H3140**	212	234	24	323	343	4	12.1
	176	250	32	–	* 23240EMKD1;**H2340**	216	232	20	315	343	4	13.9
	176	250	32	–	* 22340EMKD1;**H2340**	216	265	10	364	400	5	13.9
200	126	260	–	41	* 23044EMKD1;**H3044**	231	246	12	310	327	3	10.3
	158	280	–	44	* 23144EMKD1;**H3144**	233	252	10	328	353	4	14.7
	158	280	–	44	* 22244EMKD1;**H3144**	233	264	22	358	383	4	14.7
	183	280	–	44	* 23244EMKD1;**H2344**	236	261	11	349	383	4	16.7
	183	280	–	44	* 22344EMKD1;**H2344**	236	277	10	388	440	5	16.7
220	133	290	–	46	* 23048EMKD1;**H3048**	251	267	11	329	347	3	13.2
	169	300	–	46	* 23148EMKD1;**H3148**	254	276	11	356	383	4	17.3
	169	300	–	46	* 22248EMKD1;**H3148**	254	288	19	383	423	4	17.3
	196	300	–	46	* 23248EMKD1;**H2348**	257	284	6	372	423	4	19.7
	196	300	–	46	* 22348EMKD1;**H2348**	257	299	11	421	480	5	19.7
240	145	310	–	46	* 23052EMKD1;**H3052**	272	291	13	366	385	4	15.3
	187	330	–	49	* 23152EMKD1;**H3152**	276	302	11	380	423	4	22
	187	330	–	49	* 22252EMKD1;**H3152**	276	312	25	415	460	5	22
	208	330	–	49	* 23252EMKD1;**H2352**	278	310	2	405	460	5	24.2
	208	330	–	49	* 22352EMKD1;**H2352**	278	324	11	456	514	6	24.2
260	152	330	–	50	* 23056EMKD1;**H3056**	292	310	12	386	405	4	17.7
	192	350	–	51	* 23156EMKD1;**H3156**	296	322	12	403	440	5	24.5
	192	350	–	51	* 22256EMKD1;**H3156**	296	333	28	437	480	5	24.5
	221	350	–	51	* 23256EMKD1;**H2356**	299	331	11	426	480	5	27.8
	221	350	–	51	* 22356EMKD1;**H2356**	299	349	12	489	554	6	27.8
280	168	360	–	54	* 23060EMKD1;**H3060**	313	338	12	413	445	4	22.8
	208	380	–	53	* 23160EMKD1;**H3160**	317	345	12	436	480	5	30.2
	208	380	–	53	* 22260EMKD1;**H3160**	317	358	32	469	520	5	30.2
	240	380	–	53	* 23260EMKD1;**H3260**	321	352	12	461	520	5	34.1
300	171	380	–	55	* 23064EMKD1;**H3064**	334	360	13	433	465	4	24.6
	226	400	–	56	* 23164EMKD1;**H3164**	339	373	13	468	520	5	34.9
	226	400	–	56	* 22264EMKD1;**H3164**	339	383	39	510	560	5	34.9

1) Bearing numbers marked "*" designate **ULTAGE Series**. 2) Indicates the adapter mass.
Note: 1. Refer to pages **B-228** to **B-231** for bearing dimensions, rated loads, and mass.
2. Refer to pages **D-2** to **D-10** and **D-12** to **D-14** for adapter locknut, washer, and lockplate dimensions.

Adapters

(For spherical roller bearings)



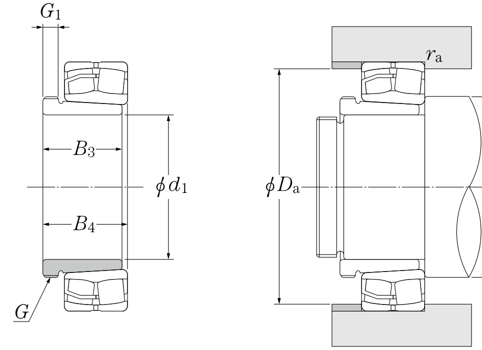
d_1 300 ～ 470mm

Boundary dimensions (mm)				Numbers[1)]	Installation-related dimensions (mm)						Mass[2)] kg
d_1	B_1	d_2	B_2	Bearing; Adapter	d_a Min.	d_b Max.	B_a Min.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)
300	258	400	56	∗ 23264EMKD1;**H3264**	343	376	13	493	560	5	39.3
320	187	400	58	∗ 23068EMKD1;**H3068**	355	384	14	466	502	5	28.7
	254	440	72	∗ 23168EMKD1;**H3168**	360	393	14	500	560	5	49.5
	288	440	72	23268BK;**H3268**	364	410	14	524	592	5	54.6
340	188	420	58	∗ 23072EMKD1;**H3072**	375	405	14	488	522	5	30.5
	259	460	75	23172BK;**H3172**	380	417	14	520	578	4	54.2
	299	460	75	23272BK;**H3272**	385	429	14	551	622	5	60.2
360	193	450	62	∗ 23076EMKD1;**H3076**	396	425	15	509	542	5	35.8
	264	490	77	23176BK;**H3176**	401	436	15	540	598	4	61.7
	310	490	77	23276BK;**H3276**	405	453	15	575	652	5	69.6
380	210	470	66	23080BK;**H3080**	417	451	15	542	578	4	41.3
	272	520	82	23180BK;**H3180**	421	458	15	568	622	5	70.6
	328	520	82	23280BK;**H3280**	427	473	15	612	692	5	81
400	212	490	66	23084BK;**H3084**	437	471	16	562	598	4	43.7
	304	540	90	23184BK;**H3184**	443	488	16	611	672	5	84.2
410	228	520	77	23088BK;**H3088**	458	490	17	585	622	5	65.2
	307	560	90	23188BK;**H3188**	464	504	17	627	692	5	104
430	234	540	77	23092BK;**H3092**	478	512	17	613	652	5	69.5
	326	580	95	23192BK;**H3192**	485	534	17	660	724	6	116
450	237	560	77	23096BK;**H3096**	499	532	18	633	672	5	73.3
	335	620	95	23196BK;**H3196**	505	554	18	687	754	6	133
470	247	580	85	230/500BK;**H30/500**	519	552	18	653	692	5	81.8
	356	630	100	231/500BK;**H31/500**	527	580	18	724	794	6	143

1) Bearing numbers marked "∗" designate ULTAGE Series. 2) Indicates the adapter mass.
Note: 1. Refer to pages B-230 to B-235 for bearing dimensions, rated loads, and mass.
2. Refer to pages D-2 to D-10 and D-12 to D-14 for adapter locknut and lockplate dimensions.

Withdrawal Sleeves

(For spherical roller bearings)



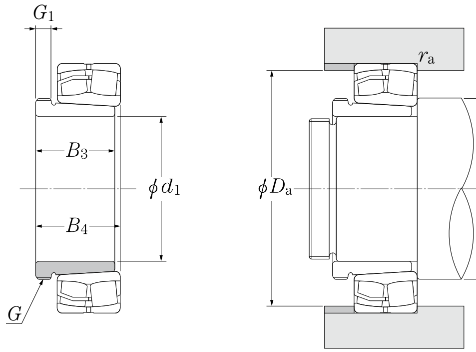
d_1 35 ～ 70 mm

Boundary dimensions (mm)					Numbers[3)]		Installation-related dimensions (mm)					Mass[4)] kg	Applied nut number
d_1	Thread nominal dimension[1)] G	B_3	G_1	B_4[2)]	Bearing	Withdrawal sleeve	d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)	Bearing number[5)]
35	M45×1.5	29	6	32	∗ 22208EAKD1	;**AH 308**	47	50	71	73	1.1	0.09	AN09
	M45×1.5	29	6	32	21308CK	;**AH 308**	48.5	52	76	81.5	1.5	0.09	AN09
	M45×1.5	40	7	43	∗ 22308EAKD1	;**AH 2308**	49	52	78	81	1.5	0.128	AN09
40	M50×1.5	31	6	34	∗ 22209EAKD1	;**AH 309**	52	54	76	78	1.1	0.109	AN10
	M50×1.5	31	6	34	21309CK	;**AH 309**	53.5	57	85	91.5	1.5	0.109	AN10
	M50×1.5	44	7	47	∗ 22309EAKD1	;**AH 2309**	54	58	87	91	1.5	0.164	AN10
45	M55×2	35	7	38	∗ 22210EAKD1	;**AHX 310**	57	59	81	83	1.1	0.137	AN11
	M55×2	35	7	38	21310CK	;**AHX 310**	60	65	93	100	2	0.137	AN11
	M55×2	50	9	53	∗ 22310EAKD1	;**AHX 2310**	61	63	95	99	2	0.209	AN11
50	M60×2	37	7	40	∗ 22211EAKD1	;**AHX 311**	64	66	90	91	1.5	0.161	AN12
	M60×2	37	7	40	21311K	;**AHX 311**	65	73	102	110	2	0.161	AN12
	M60×2	54	10	57	∗ 22311EAKD1	;**AHX 2311**	66	68	104	109	2	0.253	AN12
55	M65×2	40	8	43	∗ 22212EAKD1	;**AHX 312**	69	71	99	101	1.5	0.189	AN13
	M65×2	40	8	43	21312K	;**AHX 312**	72	78	109	118	2.1	0.189	AN13
	M65×2	58	11	61	∗ 22312EAKD1	;**AHX 2312**	72	75	113	118	2.1	0.297	AN13
60	M75×2	42	8	45	∗ 22213EAKD1	;**AH 313**	74	78	107	111	1.5	0.253	AN15
	M75×2	42	8	45	21313K	;**AH 313**	77	85	119	128	2.1	0.253	AN15
	M75×2	61	12	64	∗ 22313EAKD1	;**AH 2313**	77	81	122	128	2.1	0.395	AN15
65	M80×2	43	8	47	∗ 22214EAKD1	;**AH 314**	79	84	113	116	1.5	0.28	AN16
	M80×2	43	8	47	21314K	;**AH 314**	82	91	126	138	2.1	0.28	AN16
	M80×2	64	12	68	∗ 22314EAKD1	;**AHX 2314**	82	85	131	138	2.1	0.466	AN16
70	M85×2	45	8	49	∗ 22215EAKD1	;**AH 315**	84	88	118	121	1.5	0.313	AN17
	M85×2	45	8	49	21315K	;**AH 315**	87	99	136	148	2.1	0.313	AN17
	M85×2	68	12	72	∗ 22315EAKD1	;**AHX 2315**	87	91	139	148	2.1	0.534	AN17

1) Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general metric thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "∗" designate ULTAGE Series.
4) Indicates withdrawal sleeve mass.
5) Indicates the number of nuts to be used at the time of disassembly. Refer to pages D-2 to D-10 for nut dimensions.
Note: Refer to pages B-218 to B-221 for bearing dimensions, rated loads, and mass.

Withdrawal Sleeves

(For spherical roller bearings)



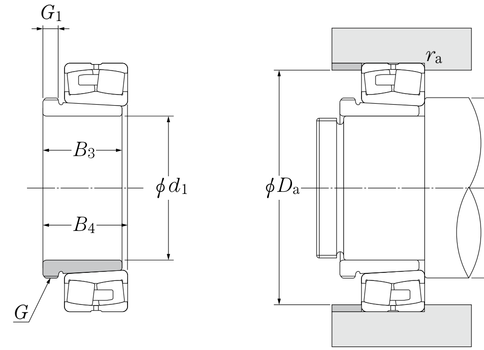
d_1 75 ～ 115mm

Boundary dimensions mm					Numbers [3]		Installation-related dimensions mm					Mass [4] kg	Applied nut number
d_1	Thread nominal dimension [1] G	B_3	G_1	B_4 [2]	Bearing	Withdrawal sleeve	d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)	Bearing number [5]
75	M90×2	48	8	52	＊22216EAKD1	;AH 316	91	94	127	129	2	0.365	AN18
	M90×2	48	8	52	21316K	;AH 316	92	105	144	158	2	0.365	AN18
	M90×2	71	12	75	＊22316EAKD1	;AHX 2316	92	98	148	158	2.1	0.597	AN18
80	M95×2	52	9	56	＊22217EAKD1	;AHX 317	96	100	137	139	2	0.429	AN19
	M95×2	52	9	56	21317K	;AHX 317	99	111	152	166	2.5	0.429	AN19
	M95×2	74	13	78	＊22317EAKD1	;AHX 2317	99	107	157	166	3.0	0.67	AN19
85	M100×2	53	9	57	＊22218EAKD1	;AHX 318	101	105	144	149	2	0.461	AN20
	M100×2	63	10	67	＊23218EMKD1	;AHX 3218	101	104	141	149	2	0.576	AN20
	M100×2	53	9	57	21318K	;AHX 318	104	119	162	176	2.5	0.461	AN20
	M100×2	79	14	83	＊22318EAKD1	;AHX 2318	104	110	166	176	3	0.779	AN20
90	M105×2	57	10	61	＊22219EAKD1	;AHX 319	107	110	153	158	2.1	0.532	AN21
	M105×2	57	10	61	21319K	;AHX 319	109	127	171	186	2.5	0.532	AN21
	M105×2	85	16	89	＊22319EAKD1	;AHX 2319	109	120	174	186	3	0.886	AN21
95	M110×2	59	10	63	＊22220EAKD1	;AHX 320	112	118	161	168	2.1	0.582	AN22
	M110×2	73	11	77	＊23220EMKD1	;AHX 3220	112	118	159	168	2.1	0.767	AN22
	M110×2	59	10	63	21320K	;AHX 320	114	133	179	201	2.5	0.582	AN22
	M110×2	90	16	94	＊22320EAKD1	;AHX 2320	114	127	187	201	3	0.998	AN22
105	M120×2	68	11	72	＊23122EAKD1	;AHX 3122	121	125	161	169	2	0.76	AN24
	M115×2	82	13	91	＊24122EMK30D1	;AH 24122	121	121	158	169	2	0.73	AN23
	M120×2	68	11	72	＊22222EAKD1	;AHX 3122	122	130	179	188	2.1	0.76	AN24
	M125×2	82	11	86	＊23222EMKD1	;AHX 3222	122	130	176	188	2.1	1.04	AN25
	M120×2	63	12	67	21322K	;AHX 322	124	146	203	226	2.5	0.663	AN24
	M125×2	98	16	102	＊22322EAKD1	;AHX 2322	124	139	209	226	3	1.35	AN25
115	M130×2	60	13	64	＊23024EAKD1	;AHX 3024	129	134	165	171	2	0.75	AN26
	M125×2	73	13	82	＊24024EMK30D1	;AH 24024	129	132	161	171	2	0.65	AN25
	M130×2	75	12	79	＊23124EAKD1	;AHX 3124	131	138	179	189	2	0.95	AN26
	M130×2	93	13	102	＊24124EMK30D1	;AH 24124	131	136	173	189	2	1	AN26

1) Standard thread shapes and dimensions are as per **JIS B 0205-1** and **JIS B 0205-4** (general metric thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "＊" designate **ULTAGE Series**.
4) Indicates withdrawal sleeve mass.
5) Indicates the number of nuts to be used at the time of disassembly. Refer to pages **D-2** to **D-10** for nut dimensions.
Note: Refer to pages **B-220** to **B-223** for bearing dimensions, rated loads, and mass.

Withdrawal Sleeves

(For spherical roller bearings)



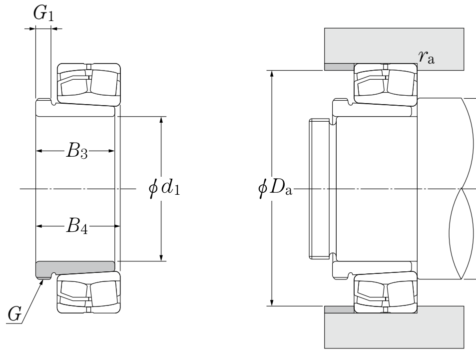
d_1 115 ～ 150mm

Boundary dimensions mm					Numbers [3]		Installation-related dimensions mm					Mass [4] kg	Applied nut number
d_1	Thread nominal dimension [1] G	B_3	G_1	B_4 [2]	Bearing	Withdrawal sleeve	d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)	Bearing number [5]
115	M130×2	75	12	79	＊22224EAKD1	;AHX 3124	132	141	193	203	2.1	0.95	AN26
	M135×2	90	13	94	＊23224EMKD1	;AHX 3224	132	139	190	203	2.1	1.3	AN27
	M135×2	105	17	109	＊22324EAKD1	;AHX 2324	134	156	225	246	3	1.6	AN27
125	M140×2	67	14	71	＊23026EAKD1	;AHX 3026	139	145	183	191	2	0.93	AN28
	M135×2	83	14	93	＊24026EMK30D1	;AH 24026	139	143	178	191	2	0.84	AN27
	M140×2	78	12	82	＊23126EAKD1	;AHX 3126	141	148	189	199	2	1.08	AN28
	M140×2	94	14	104	＊24126EMK30D1	;AH 24126	141	146	183	199	2	1.11	AN28
	M140×2	78	12	82	＊22226EAKD1	;AHX 3126	144	151	206	216	3	1.08	AN28
	M145×2	98	15	102	＊23226EMKD1	;AHX 3226	144	150	203	216	3	1.58	AN29
	M145×2	115	19	119	＊22326EAKD1	;AHX 2326	147	164	243	263	4	1.97	AN29
135	M150×2	68	14	73	＊23028EAKD1	;AHX 3028	149	155	193	201	2	1.01	AN30
	M145×2	83	14	93	＊24028EMK30D1	;AH 24028	149	153	188	201	2	0.91	AN29
	M150×2	83	14	88	＊23128EAKD1	;AHX 3128	152	159	203	213	2.1	1.28	AN30
	M150×2	99	14	109	＊24128EMK30D1	;AH 24128	152	156	198	213	2.1	1.25	AN30
	M150×2	83	14	88	＊22228EAKD1	;AHX 3128	154	163	224	236	3	1.28	AN30
	M155×3	104	15	109	＊23228EMKD1	;AHX 3228	154	162	220	236	3	1.84	AN31
	M155×3	125	20	130	＊22328EAKD1	;AHX 2328	157	181	261	283	4	2.33	AN31
145	M160×3	72	15	77	＊23030EAKD1	;AHX 3030	161	167	207	214	2.1	1.15	AN32
	M155×3	90	15	101	＊24030EMK30D1	;AH 24030	161	165	202	214	2.1	1.04	AN31
	M165×3	96	15	101	＊23130EAKD1	;AHX 3130	162	171	223	238	2.1	1.79	AN33
	M160×3	115	15	126	＊24130EMK30D1	;AH 24130	162	168	216	238	2.1	1.56	AN32
	M165×3	96	15	101	＊22230EAKD1	;AHX 3130	164	177	242	256	3	1.79	AN33
	M165×3	114	17	119	＊23230EMKD1	;AHX 3230	164	174	237	256	3	2.22	AN33
	M165×3	135	24	140	＊22330EMKD1	;AHX 2330	167	188	279	303	4	2.82	AN33
150	M170×3	77	16	82	＊23032EAKD1	;AH 3032	171	177	221	229	2.1	2.06	AN34
	M170×3	95	15	106	＊24032EMK30D1	;AH 24032	171	175	215	229	2.1	2.33	AN34
	M180×3	103	16	108	＊23132EAKD1	;AH 3132	172	185	240	258	2.1	3.21	AN36
	M170×3	124	15	135	＊24132EMK30D1	;AH 24132	172	181	232	258	2.1	3	AN34
	M180×3	103	16	108	＊22232EAKD1	;AH 3132	174	190	260	276	3	3.21	AN36

1) Standard thread shapes and dimensions are as per **JIS B 0205-1** and **JIS B 0205-4** (metric trapezoidal screw thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "＊" designate **ULTAGE Series**.
4) Indicates withdrawal sleeve mass.
5) Indicates the number of nuts to be used at the time of disassembly. Refer to pages **D-2** to **D-10** for nut dimensions.
Note: Refer to pages **B-222** to **B-227** for bearing dimensions, rated loads, and mass.

Withdrawal Sleeves

(For spherical roller bearings)



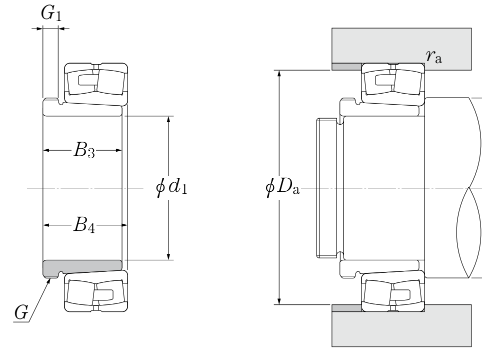
d_1 150 ～ 190mm

d_1	Boundary dimensions (mm) Thread nominal dimension [1] G	B_3	G_1	B_4 [2]	Numbers [3] Bearing	Withdrawal sleeve	Installation-related dimensions (mm) d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	Mass [4] (kg) (approx.)	Applied nut number Bearing number [5]
150	M180×3	124	20	130	∗ 23232EMKD1	;AH **3232**	174	187	254	276	3	4.08	AN36
	M180×3	140	24	146	∗ 22332EMKD1	;AH **2332**	177	205	296	323	4	4.72	AN36
160	M180×3	85	17	90	∗ 23034EAKD1	;AH **3034**	181	190	238	249	2.1	2.43	AN36
	M180×3	106	16	117	∗ 24034EMK30D1	;AH **24034**	181	186	231	249	2.1	2.8	AN36
	M190×3	104	16	109	∗ 23134EAKD1	;AH **3134**	182	195	250	268	2.1	3.4	AN38
	M180×3	125	16	136	∗ 24134EMK30D1	;AH **24134**	182	193	243	268	2.1	3.21	AN36
	M190×3	104	16	109	∗ 22234EMKD1	;AH **3134**	187	201	277	293	4	3.4	AN38
	M190×3	134	24	140	∗ 23234EMKD1	;AH **3234**	187	199	272	293	4	4.8	AN38
	M190×3	146	24	152	∗ 22334EMKD1	;AH **2334**	187	223	313	343	4	5.25	AN38
170	M190×3	92	17	98	∗ 23036EAKD1	;AH **3036**	191	201	255	269	2.1	2.81	AN38
	M190×3	116	16	127	∗ 24036EMK30D1	;AH **24036**	191	199	248	269	2.1	3.1	AN38
	M200×3	116	19	122	∗ 23136EAKD1	;AH **3136**	194	205	267	286	3	4.22	AN40
	M190×3	134	16	145	∗ 24136EMK30D1	;AH **24136**	194	202	254	286	3	3.68	AN38
	M200×3	105	17	110	∗ 22236EMKD1	;AH **2236**	197	209	287	303	4	3.73	AN40
	M200×3	140	24	146	∗ 23236EMKD1	;AH **3236**	197	210	282	303	4	5.32	AN40
	M200×3	154	26	160	∗ 22336EMKD1	;AH **2336**	197	229	324	363	4	5.83	AN40
180	Tr205×4	96	18	102	∗ 23038EAKD1	;AH **3038**	201	213	266	279	2.1	3.32	HNL41
	M200×3	118	18	131	∗ 24038EMK30D1	;AH **24038**	201	209	258	279	2.1	3.5	AN40
	Tr210×4	125	20	131	∗ 23138EMKD1	;AH **3138**	204	221	284	306	3	4.89	HN42
	M200×3	146	18	159	∗ 24138EMK30D1	;AH **24138**	204	216	275	306	3	4.28	AN40
	Tr210×4	112	18	117	∗ 22238EMKD1	;AH **2238**	207	222	305	323	4	4.25	HN42
	Tr210×4	145	25	152	∗ 23238EMKD1	;AH **3238**	207	220	299	323	4	5.9	HN42
	Tr210×4	160	26	167	∗ 22338EMKD1	;AH **2338**	210	247	346	380	5	6.63	HN42
190	Tr215×4	102	19	108	∗ 23040EMKD1	;AH **3040**	211	223	283	299	2.1	3.8	HNL43
	Tr210×4	127	18	140	∗ 24040EMK30D1	;AH **24040**	211	221	275	299	2.1	3.93	HN42
	Tr220×4	134	21	140	∗ 23140EMKD1	;AH **3140**	214	231	301	326	3	5.49	HN44
	Tr210×4	158	18	171	∗ 24140EMK30D1	;AH **24140**	214	224	291	326	3	5.1	HN42

1) Standard thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general metric thread), and JIS B 0206 (metric trapezoidal screw thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "∗" designate ULTAGE Series.
4) Indicates withdrawal sleeve mass.
5) Indicates the number of nuts to be used at the time of disassembly. Refer to pages D-2 to D-10 for nut dimensions.
Note: Refer to pages B-226 to B-229 for bearing dimensions, rated loads, and mass.

Withdrawal Sleeves

(For spherical roller bearings)



d_1 190 ～ 260mm

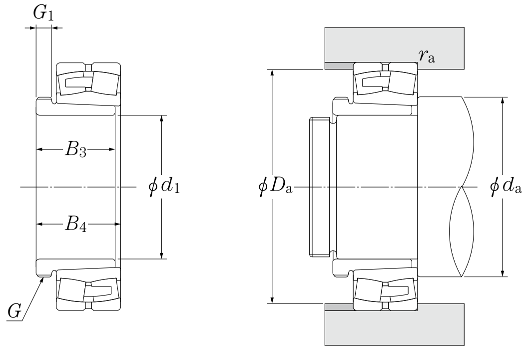
d_1	Boundary dimensions (mm) Thread nominal dimension [1] G	B_3	G_1	B_4 [2]	Numbers [3][4] Bearing	Withdrawal sleeve	Installation-related dimensions (mm) d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	Mass [5] (kg) (approx.)	Applied nut number Bearing number [6]
190	Tr220×4	118	19	123	∗ 22240EMKD1	;AH **2240**	217	234	323	343	4	4.68	HN44
	Tr220×4	153	25	160	∗ 23240EMKD1	;AH **3240**	217	232	315	343	4	6.68	HN44
	Tr220×4	170	30	177	∗ 22340EMKD1	;AH **2340**	220	265	364	400	5	7.54	HN44
200	Tr235×4	111	20	117	∗ 23044EMKD1	;AH **3044**	233	246	310	327	3	7.4	HNL47
	Tr230×4	138	20	152	∗ 24044EMK30D1	;AH **24044H**	233	243	302	327	3	8.25	HN46
	Tr240×4	145	23	151	∗ 23144EMKD1	;AH **3144**	237	252	328	353	4	10.4	HN48
	Tr230×4	170	20	184	∗ 24144EMK30D1	;AH **24144H**	237	247	317	353	4	10.2	HN46
	Tr240×4	130	20	136	∗ 22244EMKD1	;AH **2244**	237	264	358	383	4	9.1	HN48
	Tr240×4	181	30	189	∗ 23244EMKD1	;AH **2344**	237	261	349	383	4	13.5	HN48
	Tr240×4	181	30	189	∗ 22344EMKD1	;AH **2344**	240	277	388	440	5	13.5	HN48
220	Tr260×4	116	21	123	∗ 23048EMKD1	;AH **3048**	253	267	329	347	3	8.75	HNL52
	Tr250×4	138	20	153	∗ 24048EMK30D1	;AH **24048H**	253	264	322	347	3	8.98	HN50
	Tr260×4	154	25	161	∗ 23148EMKD1	;AH **3148**	257	276	356	383	4	12	HN52
	Tr260×4	180	20	195	∗ 24148EMK30D1	;AH **24148H**	257	270	344	383	4	12.5	HN52
	Tr260×4	144	21	150	∗ 22248EMKD1	;AH **2248**	257	288	383	423	4	11.1	HN52
	Tr260×4	189	30	197	∗ 23248EMKD1	;AH **2348**	257	284	372	423	4	15.5	HN52
	Tr260×4	189	30	197	∗ 22348EMKD1	;AH **2348**	260	299	421	480	5	15.5	HN52
240	Tr280×4	128	23	135	∗ 23052EMKD1	;AH **3052**	275	291	366	385	4	10.7	HNL56
	Tr270×4	162	22	178	∗ 24052EMK30D1	;AH **24052**	275	286	354	385	4	11.8	HN54
	Tr290×4	172	26	179	∗ 23152EMKD1	;AH **3152**	277	302	380	423	4	16.2	HN58
	Tr280×4	202	22	218	∗ 24152EMK30D1	;AH **24152H**	277	295	371	423	4	15.4	HN56
	Tr290×4	155	23	161	∗ 22252EMKD1	;AH **2252**	280	312	415	460	5	14	HN58
	Tr290×4	205	30	213	∗ 23252EMKD1	;AH **2352**	280	310	405	460	5	19.6	HN58
	Tr290×4	205	30	213	∗ 22352EMKD1	;AH **2352**	286	324	458	514	6	19.6	HN58
260	Tr300×4	131	24	139	∗ 23056EMKD1	;AH **3056**	295	310	386	405	4	12	HNL60
	Tr290×4	162	22	179	∗ 24056EMK30D1	;AH **24056H**	295	306	376	405	4	12.8	HN58
	Tr310×5	175	28	183	∗ 23156EMKD1	;AH **3156**	300	322	403	440	5	17.5	HN62

1) Standard thread shapes and dimensions are as per JIS B 0206 (metric trapezoidal screw thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "∗" designate ULTAGE Series.
4) Withdrawal sleeve numbers appended with the suffix "H" signify the high pressure oil (hydraulic) design.
5) Indicates withdrawal sleeve mass.
6) Indicates the number of nuts to be used at the time of disassembly. Refer to pages D-2 to D-10 for nut dimensions.
Note: Refer to pages B-228 to B-231 for bearing dimensions, rated loads, and mass.

●Withdrawal Sleeves

NTN

(For spherical roller bearings)



d_1 260 ～ 360mm

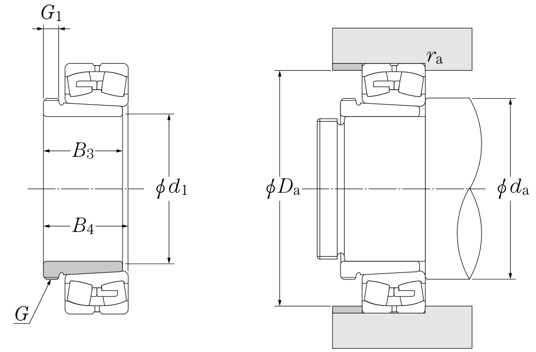
Boundary dimensions mm					Numbers 3) 4)		Installation-related dimensions mm					Mass 5) kg	Applied nut number
d_1	Thread nominal dimension 1) G	B_3	G_1	B_4 2)	Bearing	Withdrawal sleeve	d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)	Bearing number 6)
260	Tr300×4	202	22	219	∗ 24156EMK30D1	;AH **24156H**	300	316	394	440	5	16.3	HN60
	Tr310×5	155	24	163	∗ 22256EMKD1	;AH **2256**	300	333	437	480	5	15.2	HN62
	Tr310×5	212	30	220	∗ 23256EMKD1	;AH **2356**	300	331	426	480	5	21.6	HN62
	Tr310×5	212	30	220	∗ 22356EMKD1	;AH **2356**	306	349	489	554	6	21.6	HN62
280	Tr320×5	145	26	153	∗ 23060EMKD1	;AH **3060**	315	338	413	445	4	14.4	HNL64
	Tr310×5	184	24	202	∗ 24060EMK30D1	;AH **24060H**	315	332	401	445	4	15.5	HNL62
	Tr330×5	192	30	200	∗ 23160EMKD1	;AH **3160**	320	345	436	480	5	20.8	HN66
	Tr320×5	224	24	242	∗ 24160EMK30D1	;AH **24160H**	320	340	425	480	5	19.5	HN64
	Tr330×5	170	26	178	∗ 22260EMKD1	;AH **2260**	320	358	469	520	5	18.1	HN66
	Tr330×5	228	34	236	∗ 23260EMKD1	;AH **3260**	320	352	461	520	5	26	HN66
300	Tr345×5	149	27	157	∗ 23064EMKD1	;AH **3064**	335	360	433	465	4	16	HNL69
	Tr340×5	184	24	202	∗ 24064EMK30D1	;AH **24064H**	335	352	423	465	4	16.6	HNL68
	Tr350×5	209	31	217	∗ 23164EMKD1	;AH **3164**	340	373	468	520	5	24.5	HN70
	Tr340×5	242	24	260	∗ 24164EMK30D1	;AH **24164H**	340	363	457	520	5	21.4	HN68
	Tr350×5	180	27	190	∗ 22264EMKD1	;AH **2264**	340	383	510	560	5	20.2	HN70
	Tr350×5	246	36	254	∗ 23264EMKD1	;AH **3264**	340	376	493	560	5	30.6	HN70
320	Tr365×5	162	28	171	∗ 23068EMKD1	;AH **3068**	358	384	466	502	5	19.5	HNL73
	Tr360×5	206	26	225	∗ 24068EMK30D1	;AH **24068H**	358	377	456	502	5	21.7	HNL72
	Tr370×5	225	33	234	∗ 23168EMKD1	;AH **3168**	360	393	500	560	5	29	HN74
	Tr360×5	269	26	288	∗ 24168EMK30D1	;AH **24168H**	360	385	486	560	5	27.1	HNL72
340	Tr385×5	167	30	176	∗ 23072EMKD1	;AH **3072**	378	405	488	522	5	21	HNL77
	Tr380×5	206	26	226	∗ 24072EMK30D1	;AH **24072H**	378	398	478	522	5	22.7	HNL76
	Tr400×5	229	35	238	23172BK	;AH **3172**	382	417	520	578	5	33	HN80
	Tr380×5	269	26	289	24172BK30	;AH **24172H**	382	414	507	578	5	29.6	HNL76
360	Tr410×5	170	31	180	∗ 23076EMKD1	;AH **3076**	398	425	509	542	5	23.2	HNL82
	Tr400×5	208	28	228	∗ 24076EMK30D1	;AH **24076H**	398	420	499	542	5	23.7	HNL80
	Tr420×5	232	36	242	23176BK	;AH **3176**	402	436	540	598	5	35.7	HN84
	Tr400×5	271	28	291	24176BK30	;AH **24176H**	402	431	529	598	5	31.3	HNL80

1) Standard thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Bearing numbers marked "∗" designate ULTAGE Series.
4) Withdrawal sleeve numbers appended with the suffix "H" signify the high pressure oil (hydraulic) design.
5) Indicates withdrawal sleeve mass.
6) Indicates the number of nuts to be used at the time of disassembly. Refer to pages D-2 to D-10 for nut dimensions.
Note: Refer to pages B-230 to B-233 for bearing dimensions, rated loads, and mass.

●Withdrawal Sleeves

NTN

(For spherical roller bearings)

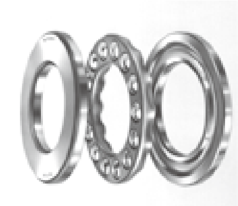


d_1 380 ～ 460mm

Boundary dimensions mm					Numbers 3)		Installation-related dimensions mm					Mass 4) kg	Applied nut number
d_1	Thread nominal dimension 1) G	B_3	G_1	B_4 2)	Bearing	Withdrawal sleeve	d_a Min.	d_a Max.	D_a Min.	D_a Max.	r_{as} Max.	(approx.)	Bearing number 5)
380	Tr430×5	183	33	193	23080BK	;AH **3080**	422	451	542	578	5	27.3	HNL86
	Tr420×5	228	28	248	24080BK30	;AH **24080H**	422	446	528	578	5	27.1	HNL84
	Tr440×5	240	38	250	23180BK	;AH **3180**	428	458	568	622	6	39.5	HN88
	Tr420×5	278	28	298	24180BK30	;AH **24180H**	428	452	552	622	6	34.4	HNL84
400	Tr450×5	186	34	196	23084BK	;AH **3084**	442	471	562	598	5	29	HNL90
	Tr440×5	230	30	252	24084BK30	;AH **24084H**	442	465	551	598	5	29	HNL88
	Tr460×5	266	40	276	23184BK	;AH **3184**	448	488	611	672	6	46.5	HN92
	Tr440×5	310	30	332	24184BK30	;AH **24184H**	448	477	592	672	6	40.3	HNL88
420	Tr470×5	194	35	205	23088BK	;AHX **3088**	468	490	585	622	6	32	HNL94
	Tr460×5	242	30	264	24088BK30	;AH **24088H**	468	485	576	622	6	31.9	HNL92
	Tr480×5	270	42	281	23188BK	;AHX **3188**	468	504	627	692	6	49.8	HN96
	Tr460×5	310	30	332	24188BK30	;AH **24188H**	468	498	614	692	6	42.3	HN92
440	Tr490×5	202	37	213	23092BK	;AHX **3092**	488	512	613	652	6	35.2	HNL98
	Tr510×6	285	43	296	23192BK	;AHX **3192**	496	534	660	724	7.5	57.9	HN102
	Tr480×5	332	32	355	24192BK30	;AH **24192H**	496	523	645	724	7.5	47.4	HNL96
460	Tr520×6	205	38	217	23096BK	;AHX **3096**	508	532	633	672	6	39.2	HNL104
	Tr530×6	295	45	307	23196BK	;AHX **3196**	516	554	687	754	7.5	63.1	HN106

1) Standard thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw thread).
2) Indicates reference dimensions before withdrawal sleeves are attached.
3) Withdrawal sleeve numbers appended with the suffix "H" signify the high pressure oil (hydraulic) design.
4) Indicates withdrawal sleeve mass.
5) Indicates the number of nuts to be used at the time of disassembly. Refer to pages D-2 to D-10 for nut dimensions.
Note: Refer to pages B-232 to B-235 for bearing dimensions, rated loads, and mass.

Thrust Bearings



Single direction thrust ball bearings

Thrust spherical roller bearings

Thrust bearings are designed primarily to support axial loads at contact angles between 30° and 90°. Similar to radial bearings, thrust bearing designs may incorporate balls or rollers as rolling elements.

The configuration and characteristics of each type of bearing are given below.

With thrust bearings, it is necessary to supply an axial preload in order to prevent slipping between the bearing's rolling elements and raceways.

For more detailed information, please refer to section "8.3 Bearing preload."

1. Single direction thrust ball bearings

As shown in **Fig. 1**, the steel balls of single direction thrust ball bearings are arranged between a pair of a pair of washers (shaft washer and housing washer), and the normal contact angle is 90°. Axial loads can be supported in only one direction, and radial loads cannot be accommodated. These bearings are not suitable for high speed operation.

Table 1 lists the standard cage types for single direction thrust ball bearings.

Fig. 1 Single direction thrust ball bearing (example of pressed cage)

Table 1 Standard cage types for single direction thrust ball bearings

Cage type / Bearing series	Resin cage	Pressed cage	Machined cage
			
511	51100 ~51107	51108 ~51152	51156 ~511/530
512	51200 ~51207	51208 ~51224	51226 ~51260
513	—	51305 ~51320	51322 ~51340
514	—	51405 ~51415	51416 ~51420

Note: Due to their material properties, resin cages can not be used in applications where temperatures exceed 120°C.

2. Thrust spherical roller bearings

Just like spherical roller bearings, the center of the spherical surface for thrust spherical roller bearings is the point where the raceway surface of the housing raceway washer meets the center axis of the bearing. Since thrust spherical roller bearings incorporate barrel-shaped rollers as rolling elements, they also have self-aligning properties. (See **Fig. 2**) Under normal load conditions, the allowable misalignment is 1/60 to 1/30, although this will vary depending upon the bearing's dimension series.

These bearings use machined copper alloy cages and a guide sleeve for the cage is attached to the inner ring. These bearings have a high axial load capacity, and can accommodate some radial load when the ring is axially loaded. It is necessary to operate these bearings where the load condition meets $F_r / F_a \leqq 0.55$.

The design for spherical thrust bearings is such that lubricant cannot enter the gap between the cage and the guide sleeve. Therefore, oil lubrication should be used, even in low speed operation.

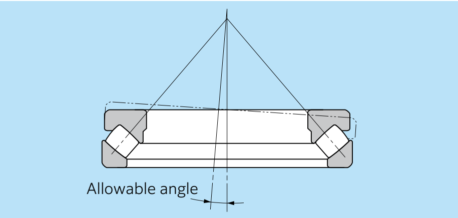


Fig. 2 Thrust spherical roller bearings

3. Thrust cylindrical roller bearings

Thrust bearings incorporating cylindrical rollers are available in single row, double row, triple row, and four row varieties. (See **Fig. 3**) **NTN** Engineering offers the 811, 812 and 893 series that conform to dimension series 11, 12 and 93 prescribed in JIS, as well as other special dimensions.

While thrust cylindrical roller bearings are only able to receive axial loads, the axial loads can be heavy due to the high axial rigidity of the bearing. For series 811, 812, and 893, the dimension tables are listed section "E. Needle roller bearings." Bearings with dimensions not listed in the dimension tables are also manufactured. Contact **NTN** Engineering for more information.

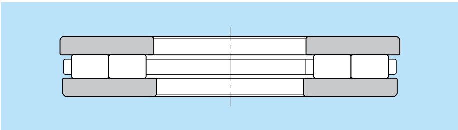


Fig. 3 Double row thrust cylindrical roller bearings

4. Thrust tapered roller bearings

Although not listed in the dimension tables, tapered roller bearings like those in **Fig. 4** are also manufactured. Contact **NTN** Engineering for more detailed information.

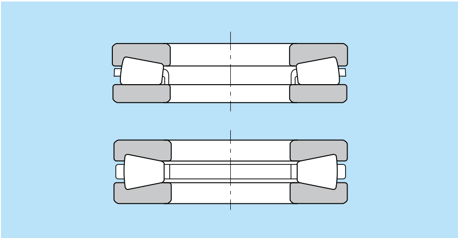
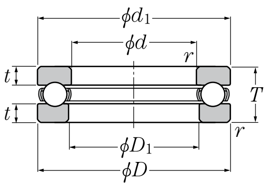
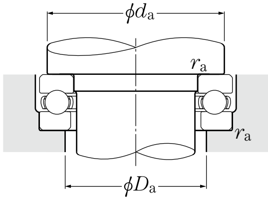


Fig. 4 Thrust tapered roller bearings



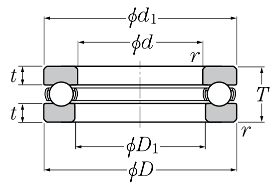


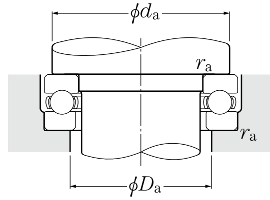
Dynamic equivalent axial load
$P_a = F_a$
Static equivalent axial load
$P_{0a} = F_a$

d 10 ~ 50mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers	Dimensions mm			Installation-related dimensions mm			Mass kg
				dynamic	static		Grease lubrication	Oil lubrication								
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u				$d_{1s\,max}$ 2)	$D_{1s\,min}$ 3)	t	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
10	24	9	0.3	10.0	14.0	0.630	6 700	9 500	**51100**	24	11	2.5	18	16	0.3	0.021
	26	11	0.6	12.7	17.1	0.770	5 800	8 300	**51200**	26	12	3.3	20	16	0.6	0.03
12	26	9	0.3	10.3	15.4	0.695	6 400	9 200	**51101**	26	13	2.5	20	18	0.3	0.023
	28	11	0.6	13.2	19.0	0.860	5 600	8 000	**51201**	28	14	3.3	22	18	0.6	0.034
15	28	9	0.3	10.5	16.8	0.755	6 200	8 800	**51102**	28	16	2.5	23	20	0.3	0.024
	32	12	0.6	16.6	24.8	1.12	5 000	7 100	**51202**	32	17	3.5	25	22	0.6	0.046
17	30	9	0.3	10.8	18.2	0.820	6 000	8 500	**51103**	30	18	2.5	25	22	0.3	0.026
	35	12	0.6	17.2	27.3	1.23	4 800	6 800	**51203**	35	19	3.5	28	24	0.6	0.054
20	35	10	0.3	14.2	24.7	1.12	5 200	7 500	**51104**	35	21	2.5	29	26	0.3	0.04
	40	14	0.6	22.3	37.5	1.70	4 100	5 900	**51204**	40	22	4.1	32	28	0.6	0.081
25	42	11	0.6	19.6	37.0	1.68	4 600	6 500	**51105**	42	26	3	35	32	0.6	0.06
	47	15	0.6	27.8	50.5	2.28	3 700	5 300	**51205**	47	27	4.3	38	34	0.6	0.111
	52	18	1	35.5	61.5	2.77	3 200	4 600	**51305**	52	27	5	41	36	1	0.176
	60	24	1	55.5	89.5	4.05	2 600	3 700	**51405**	60	27	6.9	46	39	1	0.33
30	47	11	0.6	20.4	42.0	1.90	4 300	6 200	**51106**	47	32	3	40	37	0.6	0.069
	52	16	0.6	29.3	58.0	2.63	3 400	4 900	**51206**	52	32	5	43	39	0.6	0.139
	60	21	1	43.0	78.5	3.55	2 800	3 900	**51306**	60	32	6.4	48	42	1	0.269
	70	28	1	72.5	126	5.65	2 200	3 200	**51406**	70	32	8.3	54	46	1	0.516
35	52	12	0.6	20.4	44.5	2.02	3 900	5 600	**51107**	52	37	3.5	45	42	0.6	0.085
	62	18	1	39.0	78.0	3.55	2 900	4 200	**51207**	62	37	5.2	51	46	1	0.215
	68	24	1	55.5	105	4.75	2 400	3 500	**51307**	68	37	7.2	55	48	1	0.383
	80	32	1.1	87.0	155	7.00	1 900	2 800	**51407**	80	37	9.6	62	53	1	0.759
40	60	13	0.6	26.9	63.0	2.84	3 500	5 000	**51108**	60	42	3.8	52	48	0.6	0.125
	68	19	1	47.0	98.5	4.45	2 700	3 900	**51208**	68	42	5.5	57	51	1	0.276
	78	26	1	69.0	135	6.05	2 200	3 100	**51308**	78	42	7.6	63	55	1	0.548
	90	36	1.1	112	205	9.25	1 700	2 500	**51408**	90	42	10.7	70	60	1	1.08
45	65	14	0.6	27.9	69.0	3.10	3 200	4 600	**51109**	65	47	4	57	53	0.6	0.148
	73	20	1	47.5	105	4.75	2 600	3 700	**51209**	73	47	6	62	56	1	0.317
	85	28	1	80.0	163	7.35	2 000	2 900	**51309**	85	47	8.3	69	61	1	0.684
	100	39	1.1	130	242	10.9	1 600	2 200	**51409**	100	47	11.6	78	67	1	1.43
50	70	14	0.6	28.8	75.5	3.40	3 100	4 500	**51110**	70	52	4	62	58	0.6	0.161
	78	22	1	48.5	111	5.05	2 400	3 400	**51210**	78	52	7	67	61	1	0.378

1) Smallest allowable dimension for chamfer dimension r. 2) Maximum allowable dimension for shaft washer outer dimension d_1.
3) Smallest allowable dimension for housing washer inner dimension D_1.



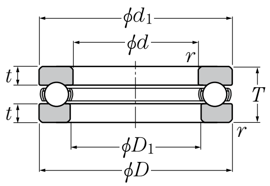


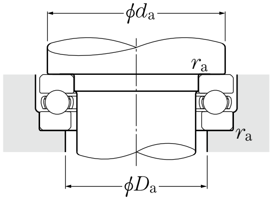
Dynamic equivalent axial load
$P_a = F_a$
Static equivalent axial load
$P_{0a} = F_a$

d 50 ~ 90mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers 4)	Dimensions mm			Installation-related dimensions mm			Mass kg
				dynamic	static		Grease lubrication	Oil lubrication								
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u				$d_{1s\,max}$ 2)	$D_{1s\,min}$ 3)	t	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
50	95	31	1.1	96.5	202	9.10	1 800	2 600	**51310**	95	52	9.2	77	68	1	0.951
	110	43	1.5	148	283	12.8	1 400	2 000	**51410A**	110	52	12.9	86	74	1.5	1.9
55	78	16	0.6	35.0	93.0	4.20	2 800	4 000	**51111**	78	57	5	69	64	0.6	0.226
	90	25	1	69.5	159	7.15	2 100	3 000	**51211**	90	57	7.5	76	69	1	0.608
	105	35	1.1	119	246	11.1	1 600	2 300	**51311**	105	57	10.2	85	75	1	1.29
	120	48	1.5	178	360	16.2	1 300	1 800	**51411**	120	57	14.8	94	81	1.5	2.52
60	85	17	1	41.5	113	5.10	2 600	3 700	**51112**	85	62	5	75	70	1	0.296
	95	26	1	73.5	179	8.05	2 000	2 800	**51212**	95	62	8	81	74	1	0.676
	110	35	1.1	123	267	12.0	1 600	2 300	**51312**	110	62	10.2	90	80	1	1.37
	130	51	1.5	214	435	19.7	1 200	1 700	**51412**	130	62	15.3	102	88	1.5	3.12
65	90	18	1	41.5	117	5.30	2 400	3 500	**51113**	90	67	5.5	80	75	1	0.338
	100	27	1	75.0	189	8.50	1 900	2 700	**51213**	100	67	8.4	86	79	1	0.767
	115	36	1.1	128	287	13.0	1 500	2 200	**51313**	115	67	10.7	95	85	1	1.51
	140	56	2	232	495	22.0	1 100	1 600	**51413**	140	68	17.2	110	95	2	3.96
70	95	18	1	43.0	127	5.70	2 400	3 400	**51114**	95	72	5.5	85	80	1	0.356
	105	27	1	76.0	199	8.95	1 800	2 600	**51214**	105	72	8.4	91	84	1	0.793
	125	40	1.1	148	340	15.3	1 400	2 000	**51314**	125	72	12	103	92	1	2.01
	150	60	2	250	555	23.8	1 000	1 500	**51414**	150	73	18.6	118	102	2	4.86
75	100	19	1	44.5	136	6.15	2 200	3 200	**51115**	100	77	6	90	85	1	0.399
	110	27	1	77.5	209	9.40	1 800	2 600	**51215**	110	77	8.4	96	89	1	0.874
	135	44	1.5	171	395	17.4	1 300	1 800	**51315**	135	77	13.4	111	99	1.5	2.61
	160	65	2	269	615	25.6	940	1 400	**51415**	160	78	20.4	125	110	2	5.97
80	105	19	1	44.5	141	6.35	2 200	3 100	**51116**	105	82	6	95	90	1	0.422
	115	28	1	78.5	218	9.85	1 700	2 400	**51216**	115	82	8.9	101	94	1	0.916
	140	44	1.5	176	425	18.2	1 200	1 800	**51316**	140	82	13.4	116	104	1.5	2.72
	170	68	2.1	270	620	25.0	890	1 300	**51416**	170	83	21.3	133	117	2	7.77
85	110	19	1	46.0	150	6.80	2 100	3 000	**51117**	110	87	6	100	95	1	0.444
	125	31	1	95.5	264	11.6	1 600	2 200	**51217**	125	88	9.8	109	101	1	1.25
	150	49	1.5	206	490	20.3	1 100	1 600	**51317**	150	88	15	124	111	1.5	3.52
	180	72	2.1	288	685	26.8	840	1 200	∗ **51417**	177	88	22.7	141	124	2	9.17
90	120	22	1	59.5	190	8.35	1 900	2 700	**51118**	120	92	7	108	102	1	0.687
	135	35	1.1	117	325	13.9	1 400	2 000	**51218**	135	93	11.2	117	108	1	1.7
	155	50	1.5	213	525	21.3	1 100	1 600	**51318**	155	93	15.5	129	116	1.5	3.74
	190	77	2.1	305	750	28.6	790	1 100	∗ **51418**	187	93	24.5	149	131	2	11

1) Smallest allowable dimension for chamfer dimension r. 2) Maximum allowable dimension for shaft washer outer dimension d_1. 3) Smallest allowable dimension for housing washer inner dimension D_1. 4) Bearing numbers marked "∗" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.





Dynamic equivalent axial load

$P_a = F_a$

Static equivalent axial load

$P_{0a} = F_a$

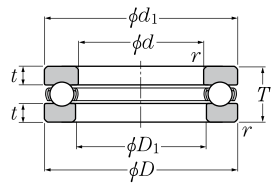
d 100 ～ 200mm

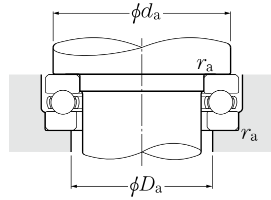
Boundary dimensions mm				Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers 4)	Dimensions mm			Installation-related dimensions mm			Mass kg
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u	Grease lubrication	Oil lubrication		$d_{1s\,max}$ 2)	$D_{1s\,min}$ 3)	t	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
100	135	25	1	85.0	268	11.2	1 700	2 400	**51120**	135	102	7.5	121	114	1	0.987
	150	38	1.1	147	410	16.6	1 300	1 800	**51220**	150	103	11.7	130	120	1	2.29
	170	55	1.5	237	595	23.1	990	1 400	**51320**	170	103	17.3	142	128	1.5	4.88
	210	85	3	370	970	35.0	710	1 000	∗ **51420**	205	103	26.6	165	145	2.5	14.7
110	145	25	1	87.0	288	11.5	1 600	2 300	**51122**	145	112	7.5	131	124	1	1.07
	160	38	1.1	153	450	17.5	1 200	1 800	**51222**	160	113	11.7	140	130	1	2.46
	190	63	2	267	705	25.9	870	1 200	∗ **51322**	187	113	20	158	142	2	7.67
120	155	25	1	89.0	310	11.8	1 500	2 200	**51124**	155	122	7.5	141	134	1	1.11
	170	39	1.1	154	470	17.7	1 200	1 700	**51224**	170	123	12.2	150	140	1	2.71
	210	70	2.1	296	805	28.3	780	1 100	∗ **51324**	205	123	22.3	173	157	2	10.8
130	170	30	1	104	350	13.0	1 300	1 900	**51126**	170	132	9	154	146	1	1.73
	190	45	1.5	191	565	20.2	1 000	1 500	∗ **51226**	187	133	13.9	166	154	1.5	4.22
	225	75	2.1	330	960	32.5	720	1 000	∗ **51326**	220	134	24.2	186	169	2	12.7
140	180	31	1	107	375	13.4	1 300	1 800	∗ **51128**	178	142	9.5	164	156	1	1.9
	200	46	1.5	193	595	20.6	980	1 400	∗ **51228**	197	143	14.4	176	164	1.5	4.77
	240	80	2.1	350	1 050	34.5	670	960	∗ **51328**	235	144	26	199	181	2	15.3
150	190	31	1	109	400	13.9	1 200	1 800	∗ **51130**	188	152	10	174	166	1	2
	215	50	1.5	227	720	24.0	900	1 300	∗ **51230**	212	153	15.8	189	176	1.5	5.87
	250	80	2.1	360	1 130	36.0	660	940	∗ **51330**	245	154	26	209	191	2	16.1
160	200	31	1	112	425	14.4	1 200	1 700	∗ **51132**	198	162	10	184	176	1	2.1
	225	51	1.5	223	720	23.3	870	1 200	∗ **51232**	222	163	16.3	199	186	1.5	6.32
	270	87	3	450	1 470	45.0	600	860	∗ **51332**	265	164	27	225	205	2.5	20.7
170	215	34	1.1	134	510	16.7	1 100	1 600	∗ **51134**	213	172	10.5	197	188	1	2.77
	240	55	1.5	261	835	26.3	810	1 200	∗ **51234**	237	173	17.3	212	198	1.5	7.81
	280	87	3	465	1 570	47.5	590	840	∗ **51334**	275	174	27	235	215	2.5	21.6
180	225	34	1.1	135	525	16.7	1 100	1 500	∗ **51136**	222	183	10.5	207	198	1	2.92
	250	56	1.5	266	875	26.9	780	1 100	∗ **51236**	247	183	17.8	222	208	1.5	8.34
	300	95	3	490	1 700	49.5	540	780	∗ **51336**	295	184	29.7	251	229	2.5	27.5
190	240	37	1.1	170	655	20.2	980	1 400	∗ **51138**	237	193	11	220	210	1	3.75
	270	62	2	310	1 060	31.5	710	1 000	∗ **51238**	267	194	19.6	238	222	2	11.3
	320	105	4	545	1 950	55.0	500	710	∗ **51338**	315	195	33.5	266	244	3	35
200	250	37	1.1	172	675	20.4	960	1 400	∗ **51140**	247	203	11.5	230	220	1	3.92

1) Smallest allowable dimension for chamfer dimension r. 2) Maximum allowable dimension for shaft washer outer dimension d_1. 3) Smallest allowable dimension for housing washer inner dimension D_1. 4) Bearing numbers marked "∗" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.

Thrust Ball Bearings

NTN





Dynamic equivalent axial load

$P_a = F_a$

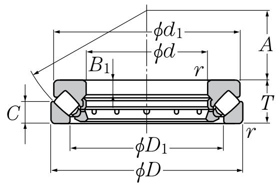
Static equivalent axial load

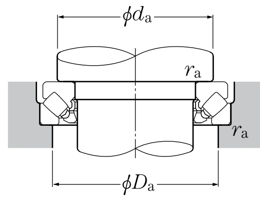
$P_{0a} = F_a$

d 200 ～ 530mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min⁻¹		Bearing numbers 4)	Dimensions mm			Installation-related dimensions mm			Mass kg
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u	Grease lubrication	Oil lubrication		$d_{1s\,max}$ 2)	$D_{1s\,min}$ 3)	t	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
200	280	62	2	315	1 110	32.0	700	990	∗ **51240**	277	204	19.6	248	232	2	11.8
	340	110	4	595	2 220	61.0	470	670	∗ **51340**	335	205	34.7	282	258	3	41.8
220	270	37	1.1	177	740	21.3	920	1 300	∗ **51144**	267	223	11.5	250	240	1	4.27
	300	63	2	325	1 210	34.0	660	950	∗ **51244**	297	224	20.1	268	252	2	13
240	300	45	1.5	228	935	25.6	780	1 100	∗ **51148**	297	243	14	276	264	1.5	6.87
	340	78	2.1	415	1 650	44.0	550	790	∗ **51248**	335	244	25	299	281	2	22.4
260	320	45	1.5	232	990	26.2	750	1 100	∗ **51152**	317	263	14	296	284	1.5	7.38
	360	79	2.1	440	1 810	46.5	530	760	∗ **51252**	355	264	24.9	319	301	2	24.2
280	350	53	1.5	305	1 270	32.5	650	940	∗ **51156**	347	283	16	322	308	1.5	11.8
	380	80	2.1	460	1 970	49.0	510	730	∗ **51256**	375	284	25.4	339	321	2	26.1
300	380	62	2	355	1 560	38.0	580	820	∗ **51160**	376	304	19.5	348	332	2	17.2
	420	95	3	590	2 680	63.5	440	630	∗ **51260**	415	304	29.7	371	349	2.5	40.6
320	400	63	2	365	1 660	39.5	550	790	∗ **51164**	396	324	20	368	352	2	18.4
340	420	64	2	375	1 760	40.5	530	760	∗ **51168**	416	344	20.5	388	372	2	19.7
360	440	65	2	380	1 860	42.0	510	730	∗ **51172**	436	364	21	408	392	2	21.1
380	460	65	2	380	1 910	42.0	500	710	∗ **51176**	456	384	21	428	412	2	22.3
400	480	65	2	390	2 010	43.5	480	690	∗ **51180**	476	404	21	448	432	2	23.3
420	500	65	2	395	2 110	44.5	470	670	∗ **51184**	495	424	21	468	452	2	24.4
440	540	80	2.1	515	2 850	58.0	400	580	∗ **51188**	535	444	26	499	481	2	40
460	560	80	2.1	525	3 000	60.0	390	560	∗ **51192**	555	464	26	519	501	2	41.6
480	580	80	2.1	525	3 100	60.5	380	550	∗ **51196**	575	484	29.5	539	521	2	43.3
500	600	80	2.1	575	3 400	65.5	370	540	**511/500**	595	504	25	559	541	2	45
530	640	85	3	645	4 000	74.5	350	500	**511/530**	635	534	26	595	575	2.5	55.8

1) Smallest allowable dimension for chamfer dimension r. 2) Maximum allowable dimension for shaft washer outer dimension d_1.
3) Smallest allowable dimension for housing washer inner dimension D_1.
4) Bearing numbers marked "∗" signify bearings where the bearing shaft washer outer diameter is smaller than the housing shaft washer outer diameter. Therefore when using these bearings, it is possible to use the housing bore as is, without providing a ground undercut on the outer diameter section of the bearing shaft washer as shown in the drawing.





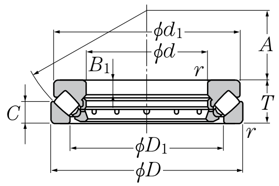
Dynamic equivalent axial load
$P_a = F_a + 1.2F_r$
Static equivalent axial load
$P_{0a} = F_a + 2.7F_r$
Provided that $\frac{F_r}{F_a} \leqq 0.55$ only.

d 60 ～ 160mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹	Bearing numbers	Dimensions mm				
d	D	T	$r_{s\,min}$ 1)	dynamic C_a	static C_{0a}	C_u	Oil lubrication		D_1	d_1	B_1	C	A
60	130	42	1.5	315	805	68.5	2 600	**29412**	89	123	15	20	38
65	140	45	2	370	945	75.5	2 400	**29413**	96	133	16	21	42
70	150	48	2	405	1 040	87.5	2 200	**29414**	103	142	17	23	44
75	160	51	2	465	1 190	102	2 100	**29415**	109	152	18	24	47
80	170	54	2.1	510	1 380	102	1 900	**29416**	117	162	19	26	50
85	150	39	1.5	295	820	78.5	2 300	**29317**	114	143.5	13	19	50
	180	58	2.1	545	1 480	118	1 800	**29417**	125	170	21	28	54
90	155	39	1.5	320	915	84.0	2 300	**29318**	117	148.5	13	19	52
	190	60	2.1	610	1 680	121	1 700	**29418**	132	180	22	29	56
100	170	42	1.5	385	1 160	96.0	2 100	**29320**	129	163	14	20.8	58
	210	67	3	760	2 130	156	1 500	**29420**	146	200	24	32	62
110	190	48	2	495	1 500	120	1 800	**29322**	143	182	16	23	64
	230	73	3	940	2 620	193	1 400	**29422**	162	220	26	35	69
120	210	54	2.1	595	1 770	151	1 600	**29324**	159	200	18	26	70
	250	78	4	1 080	3 050	212	1 300	**29424**	174	236	29	37	74
130	225	58	2.1	685	2 100	168	1 500	**29326**	171	215	19	28	76
	270	85	4	1 200	3 550	232	1 200	**29426**	189	255	31	41	81
140	240	60	2.1	760	2 360	182	1 400	**29328**	183	230	20	29	82
	280	85	4	1 240	3 750	252	1 200	**29428**	199	268	31	41	86
150	215	39	1.5	380	1 340	122	1 800	**29230**	178	208	14	19	82
	250	60	2.1	750	2 390	191	1 400	**29330**	194	240	20	29	87
	300	90	4	1 430	4 350	280	1 100	**29430**	214	285	32	44	92
160	225	39	1.5	400	1 460	126	1 700	**29232**	188	219	14	19	86
	270	67	3	915	2 860	223	1 300	**29332**	208	260	24	32	92
	320	95	5	1 670	5 150	320	1 000	**29432**	229	306	34	45	99

Installation-related dimensions mm			Mass kg
d_a Min.	D_a Max.	r_{as} Max.	(approx.)
90	108	1.5	2.78
100	115	2	3.44
105	125	2	4.19
115	132	2	5.07
120	140	2	6.09
115	135	1.5	2.94
130	150	2	7.2
120	140	1.5	3.08
135	157	2	8.38
130	150	1.5	3.94
150	175	2.5	11.5
145	165	2	5.78
165	190	2.5	15
160	180	2	7.92
180	205	3	18.6
170	195	2	9.76
195	225	3	23.7
185	205	2	11.4
205	235	3	25.2
179	196	1.5	4.56
195	215	2	12
220	250	3	30.5
189	206	1.5	4.88
210	235	2.5	15.9
230	265	4	37

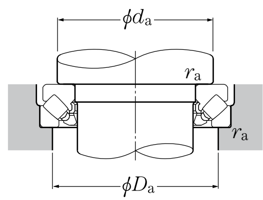
1) Smallest allowable dimension for chamfer dimension r.



d 170 ～ 320mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Fatigue load limit kN	Allowable speed min^{-1} Oil lubrication	Bearing numbers	Dimensions mm				
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u			D_1	d_1	B_1	C	A
170	240	42	1.5	475	1 770	146	1 600	**29234**	198	233	15	20	92
	280	67	3	950	3 050	238	1 200	**29334**	216	270	23	32	96
	340	103	5	1840	5 750	345	940	**29434**	243	324	37	50	104
180	250	42	1.5	500	1 920	160	1 600	**29236**	208	243	15	20	97
	300	73	3	1 110	3 600	272	1 100	**29336**	232	290	25	35	103
	360	109	5	2 050	6 200	400	890	**29436**	255	342	39	52	110
190	270	48	2	585	2 230	184	1 400	**29238**	223	262	15	24	104
	320	78	4	1 280	4 250	294	1 100	**29338**	246	308	27	38	110
	380	115	5	2 230	6 800	430	840	**29438**	271	360	41	55	117
200	280	48	2	595	2 300	183	1 400	**29240**	236	271	15	24	108
	340	85	4	1 420	4 600	330	980	**29340**	261	325	29	41	116
	400	122	5	2 490	7 650	465	790	**29440**	286	380	43	59	122
220	300	48	2	620	2 480	198	1 300	**29244**	254	292	15	24	117
	360	85	4	1 540	5 200	360	940	**29344**	280	345	29	41	125
	420	122	6	2 560	8 100	505	760	**29444**	308	400	43	58	132
240	340	60	2.1	890	3 600	271	1 100	**29248**	283	330	19	30	130
	380	85	4	1 530	5 250	390	910	**29348**	300	365	29	41	135
	440	122	6	2 680	8 700	530	740	**29448**	326	420	43	59	142
260	360	60	2.1	960	3 950	296	1 100	**29252**	302	350	19	30	139
	420	95	5	1 910	6 800	445	810	**29352**	329	405	32	45	148
	480	132	6	3 050	10 000	610	670	**29452**	357	460	48	64	154
280	380	60	2.1	975	4 050	245	1 000	**29256**	323	370	19	30	150
	440	95	5	2 010	7 250	480	790	**29356**	348	423	32	46	158
	520	145	6	3 700	12 400	710	610	**29456**	387	495	52	68	166
300	420	73	3	1 330	5 350	385	870	**29260**	353	405	21	38	162
	480	109	5	2 380	8 250	580	700	**29360**	379	460	37	50	168
	540	145	6	3 850	13 200	735	590	**29460**	402	515	52	70	175
320	440	73	3	1 400	5 800	415	840	**29264**	372	430	21	38	172
	500	109	5	2 470	8 800	605	680	**29364**	399	482	37	53	180
	580	155	7.5	4 100	14 200	820	550	**29464**	435	555	55	75	191

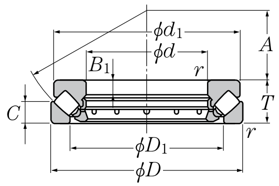
1) Smallest allowable dimension for chamfer dimension r.

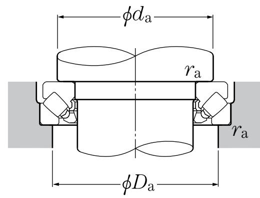


Dynamic equivalent axial load
$P_a = F_a + 1.2F_r$
Static equivalent axial load
$P_{0a} = F_a + 2.7F_r$
Provided that $\frac{F_r}{F_a} \leqq 0.55$ only.

Installation-related dimensions mm			Mass kg
d_a Min.	D_a Max.	r_{as} Max.	(approx.)
201	218	1.5	6.02
220	245	2.5	16.6
245	285	4	45
211	228	1.5	6.27
235	260	2.5	21.2
260	300	4	52.9
225	245	2	8.8
250	275	3	26
275	320	4	62
235	255	2	9.14
265	295	3	31.9
290	335	4	73.3
260	275	2	9.94
285	315	3	34.5
310	355	5	77.8
285	305	2	17.5
300	330	3	36.6
330	375	5	82.6
305	325	2	18.6
330	365	4	52
360	405	5	108
325	345	2	19.8
350	390	4	54.6
390	440	5	140
355	380	2.5	30.9
380	420	4	75.8
410	460	5	147
375	400	2.5	33.5
400	440	4	79.9
435	495	6	181

Thrust Spherical Roller Bearings NTN





Dynamic equivalent axial load
$P_a = F_a + 1.2F_r$
Static equivalent axial load
$P_{0a} = F_a + 2.7F_r$
Provided that $\frac{F_r}{F_a} \leqq 0.55$ only.

d 340 ～ 500mm

Boundary dimensions mm				Basic load rating kN		Fatigue load limit kN	Allowable speed min⁻¹	Bearing numbers	Dimensions mm					Installation-related dimensions mm			Mass kg
				dynamic	static		Oil lubrication										
d	D	T	$r_{s\,min}$ 1)	C_a	C_{0a}	C_u			D_1	d_1	B_1	C	A	d_a Min.	D_a Max.	r_{as} Max.	(approx.)
340	460	73	3	1 380	5 800	395	820	**29268**	395	445	21	37	183	395	420	2.5	34.4
	540	122	5	2 950	10 700	695	610	**29368**	428	520	41	59	192	430	470	4	107
	620	170	7.5	4 900	17 500	925	500	**29468**	462	590	61	82	201	465	530	6	230
360	500	85	4	1 680	7 050	480	720	**29272**	423	485	25	44	194	420	455	3	50.5
	560	122	5	3 000	11 100	915	590	**29372**	448	540	41	59	202	450	495	4	112
	640	170	7.5	5 000	18 500	950	490	**29472**	480	610	61	82	210	485	550	6	240
380	520	85	4	1 770	7 650	505	700	**29276**	441	505	27	42	202	440	475	3	53.4
	600	132	6	3 550	13 300	835	550	**29376**	477	580	44	63	216	480	525	5	143
	670	175	7.5	5 450	19 700	1 060	470	**29476**	504	640	63	85	230	510	575	6	267
400	540	85	4	1 800	7 950	525	680	**29280**	460	526	27	42	212	460	490	3	55.8
	620	132	6	3 750	14 500	865	530	**29380**	494	596	44	64	225	500	550	5	148
	710	185	7.5	6 050	22 100	1 140	440	**29480**	534	680	67	89	236	540	610	6	321
420	580	95	5	2 330	10 400	670	620	**29284**	489	564	30	46	225	490	525	4	76.6
	650	140	6	4 000	15 500	925	500	**29384**	520	626	48	68	235	525	575	5	172
	730	185	7.5	6 100	22 800	1 190	430	**29484**	556	700	67	89	244	560	630	6	333
440	600	95	5	2 390	10 900	695	600	**29288**	508	585	30	49	235	510	545	4	79.6
	680	145	6	4 200	16 400	965	480	**29388**	548	655	49	70	245	550	600	5	195
	780	206	9.5	7 100	26 200	1 340	390	**29488**	588	745	74	100	260	595	670	8	428
460	620	95	5	2 390	11 000	900	590	**29292**	530	605	30	46	245	530	570	4	82.8
	710	150	6	4 700	18 500	1060	460	**29392**	567	685	51	72	257	575	630	5	221
	800	206	9.5	7 350	27 900	1390	380	**29492**	608	765	74	100	272	615	690	8	443
480	650	103	5	2 670	12 000	760	550	**29296**	556	635	33	55	259	555	595	4	98.6
	730	150	6	4 700	18 700	1 100	450	**29396**	590	705	51	72	270	595	650	5	228
	850	224	9.5	8 350	31 500	1 490	350	**29496**	638	810	81	108	280	645	730	8	552
500	670	103	5	2 830	13 000	810	530	**292/500**	574	654	33	55	268	575	615	4	102
	750	150	6	4 750	19 300	1 140	440	**293/500**	611	725	51	74	280	615	670	5	235
	870	224	9.5	8 450	33 000	1 610	340	**294/500**	661	830	81	107	290	670	750	8	569

1) Smallest allowable dimension for chamfer dimension r.

Special Application Bearings Contents

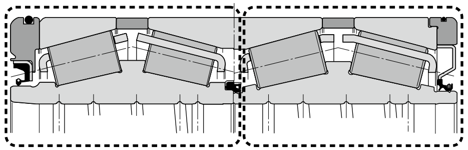
Special Application Bearings

The ULTAGE series sealed four-row tapered roller bearings [CROU···LL type] are designed to provide "high-load capacity," "high static load capacity," and "high sealing performance." These traits are required for steel rolling mill roll neck applications neck applications to improve reliability with a longer operating life.

1. Features

1) High-load capacity design

Higher load capacity and longer operating life are achieved by maximizing the size and number of rollers in the bearing.



Conventional specification | ULTAGE specification

2) World class static load capacity

Static load capacity is greatly improved due to optimized crowning of the rolling elements, reducing edge stress in the application under heavy loads.

3) Compact seal design with high sealing performance

The ULTAGE series four-row tapered roller bearing utilizes a specially designed fluorine rubber seal for high sealing performance, while minimizing the volume of the seal within the bearing.

Optimizing the tension force of the main seal lip and the overall design of the seal to minimize contamination ingress, reduces the internal water immersion by 50% or more while preventing grease from flowing out from the sub lip.

4) Standard adoption of long-life grease

This bearing is filled with an ample amount of long-life grease to avoid the need for cleaning or filling the bearing with grease before assembling into the application.

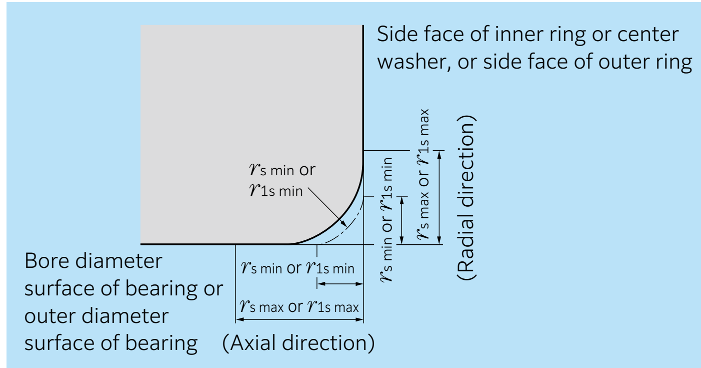
2. Part number

(A-) CROU- 6001 LLA1X PX1

- PX1 — Tolerance code
- LLA1X — Seal code
- 6001 — Bearing bore diameter No. + serial No.
- CROU- — Bearing type (ULTAGE series four-row tapered roller bearing)
- (A-) — Option (special heat treatment*)

* austenite-strengthening treatment

3. Chamfer dimension



Unit: mm

$r_{s\,min}$ or $r_{1s\,min}$	Nominal bearing bore diameter d Over	Incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
1	50	—	1.9	3
1.5	120	250	2.8	3.5
	250	—	3.5	4
2.5	120	250	4	5.5
	250	—	4.5	6
3	120	250	4.5	6.5
	250	400	5	7
	400	—	5.5	7.5

4. Operating temperature range

−20～120°C

5. Bearing fits (recommended)

Metric series : Shaft d6/housing G7
Inch series : Contact **NTN** Engineering.

6. Standard grease fill

Brand : Kyodo Yushi Palmax RBG (L373)
Amount : Space volume ratio 35%

7. Allowable speed

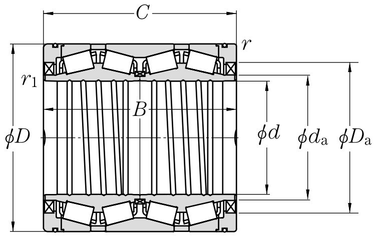
$d_m \cdot n \leqq 30 \times 10^4$

d_m : Roller pitch diameter (mm) ≒ $(d+D)/2$
d : Bearing bore diameter (mm)
D : Bearing outside diameter (mm)
n : Rotational speed (min^{-1})

The above are approximate standard values and may not be appropriate depending on the usage condition. For details, please contact **NTN** Engineering.

8. Material

Inner and outer rings : Case hardened steel
Rolling elements : Bearing steel
(* mark in the dimension table indicates case hardened steel.)



ULTAGE Sealed Four-Row Tapered Roller Bearings for Rolling Mill Roll Necks [CROU···LL Type] NTN

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

Series	Boundary dimensions mm						(approx.) Standard radial clearance 2)	Standard axial clearance 2)	Basic load rating kN		Bearing number 3)	Installation-related dimensions mm		Constant	Axial load factors		
	d	D	B	C	$r_{1s\,min}$ 1)	$r_{s\,min}$ 1)	mm	mm	dynamic C_r	static C_{0r}		d_a	D_a	e	Y_1	Y_2	Y_0
Metric series	220	295	315	315	1	2.5	0.093 ~ 0.106	0.420 ~ 0.480	1 890	4 650	CROU-4401LLA1X	235	267	0.33	2.03	3.02	1.98
	225	320	230	230	1	2.5	0.099 ~ 0.115	0.360 ~ 0.420	1 870	3 700	CROU-4501LLA1X	241	294	0.41	1.64	2.44	1.60
	240	338	248	248	1	2.5	0.104 ~ 0.118	0.450 ~ 0.510	2 320	4 600	CROU-4801LLA1X	257	309	0.35	1.95	2.90	1.91
	240	338	340	340	1	2.5	0.107 ~ 0.123	0.400 ~ 0.460	2 970	6 850	CROU-4802LLA1X	257	309	0.40	1.68	2.50	1.64
	250	365	270	270	1	2.5	0.113 ~ 0.129	0.420 ~ 0.480	2 760	5 300	CROU-5001LLA1X	272	333	0.40	1.68	2.50	1.64
	260	365	340	340	1	2.5	0.115 ~ 0.131	0.430 ~ 0.490	3 350	7 450	CROU-5201LLA1X	275	327	0.40	1.68	2.50	1.64
	300	420	310	310	1	2.5	0.131 ~ 0.147	0.490 ~ 0.550	3 600	7 650	CROU-6001LLA1X	318	382	0.40	1.68	2.50	1.64
	310	430	350	350	1	2.5	0.136 ~ 0.154	0.520 ~ 0.590	4 050	8 900	CROU-6201LLA1X	329	388	0.39	1.72	2.56	1.68
	410	546	400	400	1.5	2.5	0.173 ~ 0.188	0.780 ~ 0.850	5 500	13 300	CROU-8201LLA1X	434	504	0.33	2.03	3.02	1.98
	440	590	480	480	1.5	2.5	0.188 ~ 0.204	0.850 ~ 0.920	6 600	16 200	CROU-8801LLA1X	462	540	0.33	2.03	3.02	1.98
	440	620	454	454	3	2.5	0.195 ~ 0.211	0.880 ~ 0.950	7 650	16 700	CROU-8802LLA1X	473	570	0.33	2.03	3.02	1.98
	530	780	570	570	3	2.5	0.244 ~ 0.259	1.100 ~ 1.170	13 500	29 400	CROU-10601LLA1X*	581	710	0.33	2.03	3.02	1.98
Inch series	220.662	314.325	239.712	239.712	1	2.5	0.098 ~ 0.111	0.450 ~ 0.510	2 240	4 350	CROU-4402LLA1X	240	290	0.33	2.07	3.09	2.03
	254.000	358.775	269.875	269.875	1	2.5	0.111 ~ 0.127	0.430 ~ 0.490	2 770	5 700	CROU-5101LLA1X	274	328	0.39	1.74	2.59	1.70
	304.902	412.648	266.700	266.700	1	2.5	0.130 ~ 0.150	0.450 ~ 0.520	2 810	5 850	CROU-6101LLA1X	323	379	0.43	1.56	2.32	1.52
	343.052	457.098	254.000	254.000	1	2.5	0.136 ~ 0.158	0.430 ~ 0.500	2 830	5 950	CROU-6901LLA1X	364	423	0.47	1.43	2.12	1.40
	343.052	457.098	299.000	299.000	1	2.5	0.143 ~ 0.163	0.500 ~ 0.570	3 500	8 150	CROU-6902LLA1X	364	423	0.43	1.57	2.34	1.53
	501.650	711.200	520.700	520.700	3	2.5	0.206 ~ 0.226	0.730 ~ 0.800	10 100	23 900	CROU-10001LLA1X*	542	642	0.42	1.60	2.38	1.56
	595.312	844.550	615.950	615.950	3	2.5	0.266 ~ 0.282	1.200 ~ 1.270	14 000	33 000	CROU-11901LLA1X	638	770	0.33	2.03	3.02	1.98

1) Smallest allowable dimension for chamfer dimension r.
2) Consult with **NTN** Engineering because the appropriate value may change depending on the use conditions.
3) Bearing numbers marked "*" use rolling elements made of case hardened steel.

The ULTAGE series sealed spherical roller bearings [WA type] are designed to meet the demands of "long operating life," "improved reliability," and "improved easy handling," which are required for various types of industrial machinery.

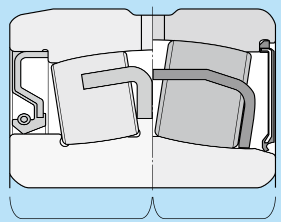
1. Features

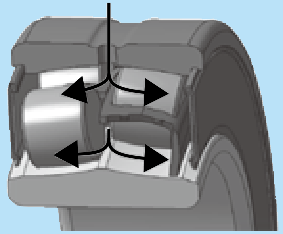
1) World class load capacity
Higher load capacity and longer operating life have been realized by adopting the internal specifications of the EA type, which includes maximum possible roller diameter size, maximum possible number of rollers, and a "basket-shaped" pressed steel cage.

2) Compact design with minimized seal volume
The standard seal design is a "contact type" dust resistant seal designed to minimize the volume of the seal within the bearing.
(1) Foreign matter intrusion is prevented by the adoption of the specially designed contact type rubber seal.
(2) Consistent dust resistance is achieved without changing the contact surface pressure of the seal with respect to the bearing alignment.

3) Standard adoption of long-life grease
This bearing is filled with an ample amount of long-life grease to avoid the need for cleaning or filling the bearing with grease before assembling into the application.
(1) Grease brand: Shell Alvania EP Grease 2 (8A) with extreme-pressure additive for heavy loads
(2) Grease amount: Space volume ratio 15 to 25%

4) Standard adoption of oil holes
The bearing is able to be re-greased due to the oil grooves and oil holes that are standard in the outer ring.





ULTAGE Spherical Roller Bearings with Seal【WA Type】 NTN

2. Part number

WA 222 20 EA LLS K D1 C3

- Seal type code (WA)
- Dimension series code (222)
- Bore diameter No. (20)
- Bearing type code (EA)
  - EA : basket-shaped pressed steel cage
- Both side contact seal (LLS)
- Raceway shape code (K)
  - No code : inner diameter cylindrical bore
  - K : inner diameter tapered bore
- Oil hole/oil groove code (D1)
  - D1 : with oil hole/oil groove (spec. D1 only)
  - W33 : with oil hole/oil groove (Europe specification)
- Internal clearance code (C3)

3. Allowable speed

When grease is supplied : $d_n \leqq 6 \times 10^4$
When no grease is supplied : $d_n \leqq 8 \times 10^4$

∗d_n value:
[d_n = bearing bore diameter d (mm) × rotational speed n (mm^{-1})]

4. Allowable temperature range

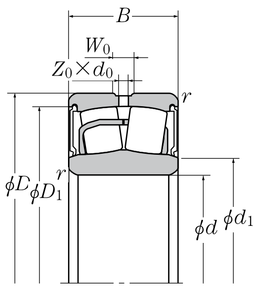
Bearing temperature: −20〜110°C

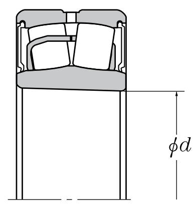
5. Allowable misalignment angle

1/115 (mm/mm)

6. Handling precautions

1) The radial internal clearance on an ULTAGE series sealed spherical roller bearing with tapered bore cannot be measured with a clearance (thickness) gauge. Please manage the clearance after assembly by measuring the movement in the axial direction shown in **Table 15.1** (A-159) in section "15. Bearing handling."
2) When the bearing misalignment exceeds the allowable misalignment (1/115), the rollers may come in contact with seal and cause seal deformation. It should be noted that the seal may come off when a large force is applied in this state.
3) Use Li-based mineral grease when re-greasing. Consult with **NTN** Engineering when using other types of grease.
4) When temperature mounting for assembly, the bearing temperature must be 100°C or below. The method of immersing bearings in hot oil cannot be used for this bearing type.



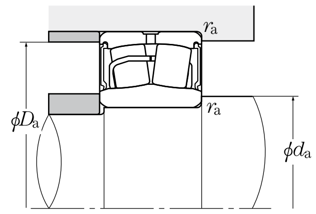


Number of oil holes on outer ring

Z_0	
D1	W33
4	3

Boundary dimensions (mm)						Basic load rating dynamic (kN)	Basic load rating static (kN)	Fatigue load limit (kN)	Bearing number Cylindrical bore	Bearing number Tapered bore [2)]
d	D	B	$r_{s\,min}$ [1)]	W_0	d_0	C_r	C_{0r}	C_u		
25	52	23	1	3	1.5	57.3	46.1	3.23	**WA22205EALLSW33/8A**	—
30	62	25	1	4	2	75.7	64.5	4.58	**WA22206EALLSW33/8A**	—
35	72	28	1.1	5	2	100	92.0	6.11	**WA22207EALLSW33/8A**	**WA22207EALLSKW33/8A**
40	80	28	1.1	5	2.5	116	105	7.78	**WA22208EALLSD1/8A**	**WA22208EALLSKD1/8A**
45	85	28	1.1	6	2.5	121	113	8.76	**WA22209EALLSD1/8A**	**WA22209EALLSKD1/8A**
50	90	28	1.1	6	2.5	130	124	10.1	**WA22210EALLSD1/8A**	**WA22210EALLSKD1/8A**
55	100	31	1.5	6	3	155	148	12.6	**WA22211EALLSD1/8A**	**WA22211EALLSKD1/8A**
60	110	34	1.5	7	3	187	181	15.4	**WA22212EALLSD1/8A**	**WA22212EALLSKD1/8A**
65	120	38	1.5	8	3.5	226	224	18.2	**WA22213EALLSD1/8A**	**WA22213EALLSKD1/8A**
70	125	38	1.5	7	3.5	235	240	20.1	**WA22214EALLSD1/8A**	**WA22214EALLSKD1/8A**
75	130	38	1.5	7	3.5	244	249	21.1	**WA22215EALLSD1/8A**	**WA22215EALLSKD1/8A**
80	140	40	2	8	3.5	278	287	24.0	**WA22216EALLSD1/8A**	**WA22216EALLSKD1/8A**
85	150	44	2	8	3.5	324	330	27.1	**WA22217EALLSD1/8A**	**WA22217EALLSKD1/8A**
90	160	48	2	10	4.5	384	398	30.2	**WA22218EALLSD1/8A**	**WA22218EALLSKD1/8A**
95	170	51	2.1	10	4.5	416	417	33.4	**WA22219EALLSD1/8A**	**WA22219EALLSKD1/8A**
100	180	55	2.1	11	5	472	495	36.9	**WA22220EALLSD1/8A**	**WA22220EALLSKD1/8A**
110	200	63	2.1	12	6	602	643	45.0	**WA22222EALLSD1/8A**	**WA22222EALLSKD1/8A**
120	215	69	2.1	12	6	688	753	49.9	**WA22224EALLSD1/8A**	**WA22224EALLSKD1/8A**
130	230	75	3	13	6	808	898	56.6	**WA22226EALLSD1/8A**	**WA22226EALLSKD1/8A**

1) Smallest allowable dimension for chamfer dimension r.
2) Indicates bearings with a tapered bore having a taper ratio of 1 / 12.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

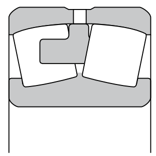
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Installation-related dimensions (mm)					Constant	Axial load factors			Mass (approx.) kg Cylindrical bore	Mass (approx.) kg Tapered bore	Amount of grease filled in (approx.) g
d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{s\,max}$	e	Y_1	Y_2	Y_0			
29	30	46	47	1	0.34	2.00	2.98	1.96	0.19	—	1.4 ～ 2.4
36	36	56	56	1	0.31	2.15	3.20	2.10	0.30	—	2.0 ～ 3.3
43	42	65	65	1.1	0.31	2.21	3.29	2.16	0.50	0.49	2.3 ～ 3.9
48	47	73	73	1.1	0.27	2.47	3.67	2.41	0.58	0.57	3.1 ～ 5.2
53	52	78	78	1.1	0.26	2.64	3.93	2.58	0.63	0.61	3.4 ～ 5.7
58	57	83	83	1.1	0.24	2.84	4.23	2.78	0.70	0.68	3.4 ～ 5.6
64	64	91	93	1.5	0.23	2.95	4.40	2.89	0.94	0.91	4.7 ～ 7.9
70	69	101	102	1.5	0.24	2.84	4.23	2.78	1.25	1.22	6.6 ～ 11.0
76	74	111	110	1.5	0.24	2.79	4.15	2.73	1.72	1.67	8.5 ～ 14.2
82	79	116	116	1.5	0.22	3.01	4.48	2.94	1.78	1.73	9.6 ～ 16.0
86	84	121	121	1.5	0.22	3.14	4.67	3.07	1.88	1.83	9.9 ～ 16.4
93	91	129	131	2	0.22	3.14	4.67	3.07	2.32	2.27	12.0 ～ 20.0
98	96	139	140	2	0.22	3.07	4.57	3.00	2.90	2.83	16.9 ～ 28.1
103	101	149	147	2	0.23	2.90	4.31	2.83	3.68	3.59	20.0 ～ 34.0
108	107	158	157	2.1	0.23	2.95	4.40	2.89	4.39	4.27	25.9 ～ 43.2
115	112	168	165	2.1	0.24	2.84	4.23	2.78	5.40	5.25	28.8 ～ 48.0
127	122	188	183	2.1	0.25	2.69	4.00	2.63	7.79	7.58	41.6 ～ 69.3
138	132	203	197	2.1	0.25	2.74	4.08	2.68	9.76	9.48	52.8 ～ 88.0
148	144	216	211	3	0.25	2.69	4.00	2.63	11.9	11.6	62.6 ～ 104.4

Special Application Bearings

1. Features

The ULTAGE series spherical roller bearings with high-strength cage [EMA type] use dedicated machined brass cages. These bearings are suitable for mining machinery (vibrating screens, crushers, etc.), which experience eccentric rotation and impact loads.

Design	
Bearing series	223 series inner diameter 70 to 200 mm
Roller	Symmetrical
Cage type	Special machined cage

2. Accuracy and clearance (specification for vibrating screens)

The inner and outer diameter tolerance and the radial internal clearance are set for vibrating screens to obtain the desired operating clearance. See the table below for the specifications of the ULTAGE series spherical roller bearings for the bearing specifications (accuracy, clearance, etc.) to be used with vibrating screens.

Unit: mm

Dimensional tolerance of mean bore diameter within plane				Dimensional tolerance of mean outside diameter within plane				Radial internal clearance (cylindrical bore)					
Nominal bearing bore diameter		VS1, VS2		Nominal bearing outside diameter		VS1, VS2		Nominal bearing bore diameter		VS1		VS2	
Over	Incl.	Upper	Lower	Over	Incl.	Upper	Lower	Over	Incl.	Min.	Max.	Min.	Max.
	80	0	−0.010		150	−0.005	−0.013		65	0.075	0.090	0.100	0.120
80	120	0	−0.013	150	180	−0.005	−0.018	65	80	0.090	0.110	0.120	0.145
120	180	0	−0.015	180	315	−0.010	−0.023	80	100	0.110	0.135	0.150	0.180
180	200	0	−0.018	315	400	−0.013	−0.028	100	120	0.135	0.160	0.180	0.210
				400	420	−0.014	−0.030	120	140	0.160	0.190	0.205	0.240
								140	160	0.190	0.220	0.240	0.280
								160	180	0.200	0.240	0.260	0.310
								180	200	0.220	0.260	0.285	0.340

ULTAGE Spherical Roller Bearings with High-strength Cage [EMA Type] NTN

3. Part number

2 23 20 EMA K D1 VS1

- VS1: Specification for vibrating screens (No code indicates general bearing clearance and accuracy.)
- D1: Oil hole/oil groove code (D1: with oil hole/oil groove)
- K: Raceway shape code (No code: inner diameter cylindrical bore, K: tapered bore)
- EMA: Type code
- 20: Bore diameter No. (20: 100 mm)
- 23: Dimension series code
- 2: Bearing type code (2: spherical roller bearing)

4. Allowable axial load

$F_a / F_r \leqq e$

F_a : Axial load

F_r : Radial load

e : Constant (see dimension table)

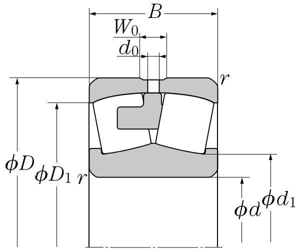
If this bearing type is used under a large axial load, the load on the rollers of the row that is not subject to the axial load can become small. This small load on the rollers can result in skidding of the rollers, which can cause bearing damage. If the ratio of the radial load exceeds the factor e in the dimension table ($F_a / F_r > e$), consult **NTN** Engineering.

5. Allowable misalignment angle

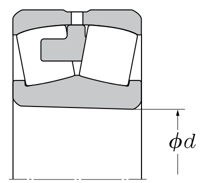
Normal load or more …… 1/115 (mm/mm)

Light load ………………… 1/30 (mm/mm)

∗For a rough estimate of normal loads and light loads, see Note 1 in General Description A-81.



Cylindrical bore



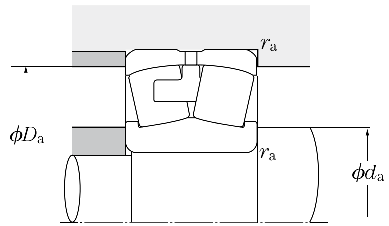
Tapered bore

Number of oil holes on outer ring

Nominal bearing outer diameter mm		Number of oil holes
Incl.	Below	Z_0
–	320	4
320	–	8

Boundary dimensions mm						Basic load rating kN		Allowable speed min^{-1}	Bearing number
						dynamic	static	Oil lubrication	Cylindrical bore
d	D	B	$r_{s\,min}$[1]	W_0	d_0	C_r	C_{0r}		
70	150	51	2.1	10	5	397	368	4 700	**22314EMAD1**
75	160	55	2.1	10	5	464	434	4 400	**22315EMAD1**
80	170	58	2.1	10	5	512	485	4 100	**22316EMAD1**
85	180	60	3	11	5	538	524	3 900	**22317EMAD1**
90	190	64	3	12	5	632	605	3 700	**22318EMAD1**
95	200	67	3	12	6	658	650	3 500	**22319EMAD1**
100	215	73	3	13	6	743	731	3 300	**22320EMAD1**
110	240	80	3	16	7	869	833	3 000	**22322EMAD1**
120	260	86	3	18	8	1 060	1 120	2 700	**22324EMAD1**
130	280	93	4	19	9	1 260	1 310	2 500	**22326EMAD1**
140	300	102	4	19	9	1 400	1 500	2 400	**22328EMAD1**
150	320	108	4	20	9	1 570	1 640	2 200	**22330EMAD1**
160	340	114	4	20	10	1 760	1 940	2 100	**22332EMAD1**
170	360	120	4	20	10	2 010	2 320	1 900	**22334EMAD1**
180	380	126	4	21	10	2 190	2 460	1 800	**22336EMAD1**
190	400	132	5	21	10	2 370	2 750	1 700	**22338EMAD1**
200	420	138	5	21	10	2 590	3 140	1 600	**22340EMAD1**

1) Smallest allowable dimension for chamfer dimension r.



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number	Installation-related dimensions mm					Constant	Axial load factors			Mass (approx.) kg	
Tapered bore[2]	d_1	$d_{a\,min}$	$D_{a\,max}$	D_1	$r_{as\,max}$	e	Y_1	Y_2	Y_0	Cylindrical bore	Tapered bore
22314EMAKD1	85	82	138	131	2.1	0.34	2.00	2.98	1.96	4.34	4.25
22315EMAKD1	91	87	148	139	2.1	0.34	2.00	2.98	1.96	5.30	5.19
22316EMAKD1	98	92	158	148	2.1	0.34	2.00	2.98	1.96	6.32	6.19
22317EMAKD1	107	99	166	157	3	0.32	2.09	3.11	2.04	7.19	7.05
22318EMAKD1	110	104	176	166	3	0.33	2.06	3.06	2.01	8.58	8.41
22319EMAKD1	120	109	186	174	3	0.32	2.09	3.11	2.04	9.80	9.60
22320EMAKD1	127	114	201	187	3	0.34	1.98	2.94	1.93	12.8	12.5
22322EMAKD1	139	124	226	209	3	0.32	2.09	3.11	2.04	17.3	16.9
22324EMAKD1	156	134	246	225	3	0.32	2.09	3.11	2.04	22.5	22.0
22326EMAKD1	164	147	263	243	4	0.33	2.06	3.06	2.01	28.4	27.8
22328EMAKD1	181	157	283	261	4	0.33	2.03	3.02	1.98	34.6	33.8
22330EMAKD1	188	167	303	279	4	0.34	2.00	2.98	1.96	41.9	41.0
22332EMAKD1	205	177	323	296	4	0.33	2.03	3.02	1.98	50.1	49.1
22334EMAKD1	223	187	343	313	4	0.32	2.09	3.11	2.04	59.7	58.5
22336EMAKD1	229	197	363	329	4	0.32	2.09	3.11	2.04	69.3	67.9
22338EMAKD1	247	210	380	346	5	0.32	2.12	3.15	2.07	81.0	79.4
22340EMAKD1	265	220	400	364	5	0.31	2.15	3.20	2.10	94.1	92.2

2) Bearings having a tapered bore with a taper ratio of 1:12.

The ULTAGE series deep groove ball bearings for high-speed servo motors [MA type] are next-generation bearings with an optimized internal design for high-speed servo motors. These bearings have improved durability and longer grease life for high-speed operation and rapid acceleration/deceleration.

1. Features

1) High speed and high reliability

Deformation from high-speed operation is reduced and limiting speeds of d_{mn} = 1 million are achieved by using high performance cages. These cages are made of self-lubricating resin and have interlocking tabs for high rigidity (**Fig. 1**).

∗d_{mn} value:
d_m (rolling element pitch diameter mm) ×
n (rotational speed min^{-1})

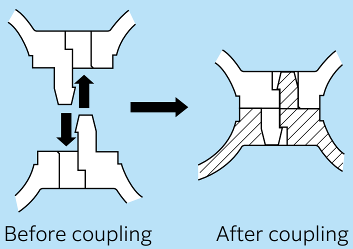


Fig.1 MA resin cage

2) Longer grease life

Outer ring grease pockets designed to maintain grease near the rolling elements improve lubrication reliability. In addition, long-life grease for motors "ME-1" (see **Table 11.6** (A-116)) is applied for the initial grease fill.

(Longer life of five times or more is achieved compared with the lithium-based grease used for general purposes.)

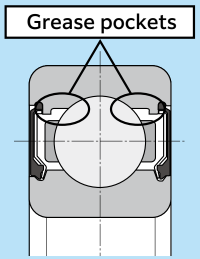


Fig. 2 Grease pockets

3) Low noise

A new resin interlocking cage design allows for low noise operation. The noise is reduced by 3 dB-A with respect to metal pressed cages.

Table 1 Measurement result of noise values

Specification	Noise value
Metal pressed cage	57 dB-A
ULTAGE product	**54 dB-A**

2. Part number

6 3 08 MA LLB-BR C3 P5 / L700 QTK

- **QTK** — Grease fill code
- **L700** — **Grease brand code:** ME-1
- **P5** — **Accuracy code:** JIS class 5
- **C3** — **Radial internal clearance:** C3 clearance (15 to 33 μm)
- **LLB-BR** — **Seal code:** Synthetic rubber seal (non-contact type)
- **MA** — **Cage code:** ULTAGE series MA type
- **08** — **Nominal bearing bore diameter:** 40 mm
- **3** — **Diameter series:** 3
- **6** — **Bearing type:** Deep groove ball bearing (type code 6)

3. Operating temperature range

−20～120°C

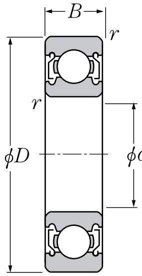
4. Allowable speed

The allowable speed refers to a rotational speed of the bearing based on:

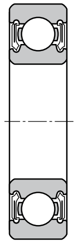
- Maximum outer ring temperature of 80°C
- Standard ME-1 grease filled to a fill volume of 15-20% of the free space.
- Spring preload is applied to the bearing.
- Bearing operation at room temperature after break-in procedure.

The bearing temperature increase differs depending on the usage condition (operating load, environmental temperature, rotational speed pattern, etc.); therefore, the bearings must be selected with sufficient allowable speed as specified in the catalog.

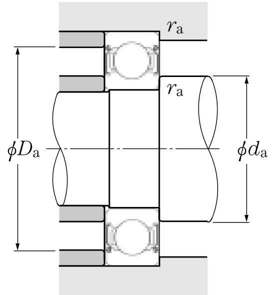
If the bearing will continuously operate above 80% of the limiting speed listed in the bearing dimension tables, please consult **NTN** Engineering.



Shielded type
(ZZ)



Non-contact sealed type
(LLB)



Boundary dimensions (mm)				Basic load rating (kN)		Fatigue load limit (kN)	Factor	Allowable speed (min^{-1})	Bearing number	
				dynamic	static			Grease lubrication	Shielded type	Non-contact sealed type
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	f_0	ZZ, LLB		
40	90	23	1.5	45.0	24.0	1.83	13.2	15,400	**6308MAZZ**	**6308MALLB**
45	85	19	1.1	36.0	20.4	1.60	14.1	14,300	**6209MAZZ**	**6209MALLB**
50	90	20	1.1	39.0	23.2	1.82	14.4	15,400	**6210MAZZ**	**6210MALLB**
	110	27	2	68.5	38.5	2.99	13.2	12,200	**6310MAZZ**	**6310MALLB**
60	130	31	2.1	90.5	52.0	4.10	13.2	10,500	**6312MAZZ**	**6312MALLB**

1) Smallest allowable dimension for chamfer dimension r.

ULTAGE Deep Groove Ball Bearings for High-Speed Servo Motors [MA Type] NTN

Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load
$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions (mm)				Mass (approx.)
d_a Min.	d_a Max.	D_a Max.	r_{as}	kg
48	54	82	1.5	0.634
51.5	55.5	78.5	1	0.398
56.5	60	83.5	1	0.454
59	68.5	101	2	1.07
71	80.5	119	2	1.73

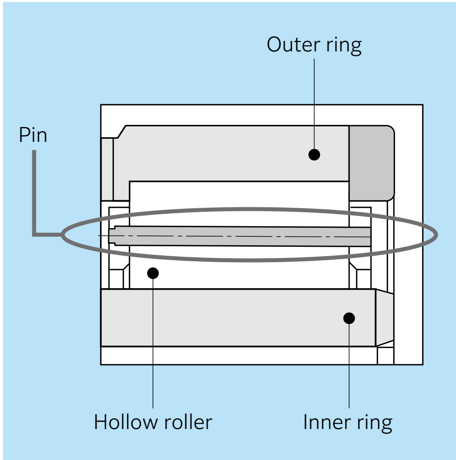
Note: For bearing models that are not specified in the list of series dimensions, please contact **NTN** Engineering.

Special Application Bearings

Four-row cylindrical roller bearings

1. Features

1) The bearings are mainly used in the roll necks of steel rolling mills and designed so that the load rating is maximized in the allowable space of the roll neck part.
2) The cage types include a comb type cage and a pin type cage (that uses hollow rollers). The pin type cage maximizes the number of rollers for high load capacity.
3) Carburizing steel is used in some cases to prevent inner ring cracks and to improve shock resistance.
4) Consult **NTN** Engineering for bearing internal clearance and fits to be used for back-up rolls of rolling mills.
5) There are many varieties of these bearings, including bearings which are sealed, have tapered bores, designed for high speed, have creep prevention, etc. Contact **NTN** Engineering for further details.



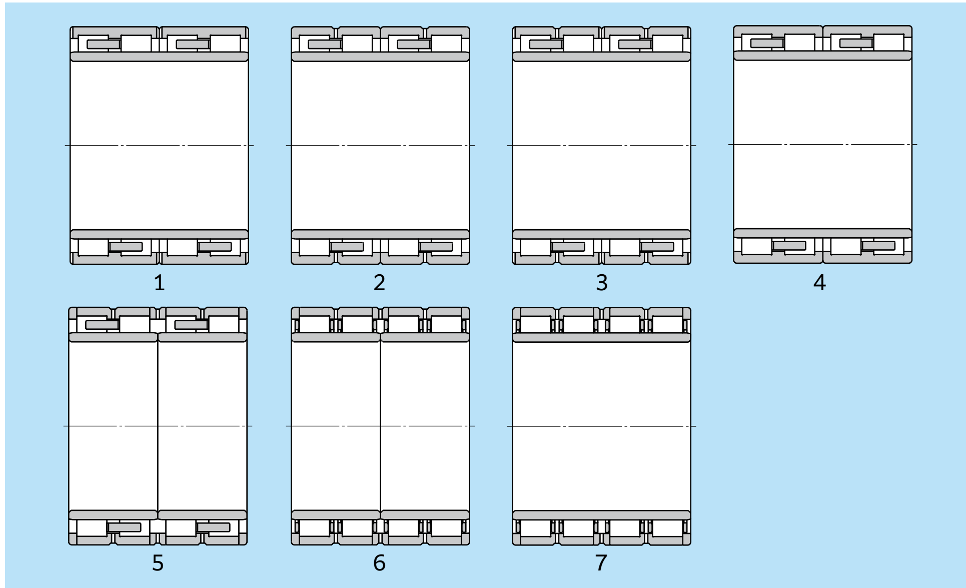
Pin type cage

2. Designs

Illustrations 1 to 7 show the several types of four-row cylindrical roller bearings that differ by the basic structure of inner rings, outer rings, and outer ring spacers.

The dimension table has the identification code (illustration + suffix code + oil groove code) specified in the illustration number column.

Example) In the case of illustration: 6, suffix code: M, oil groove code: ①, identification code "6M①" is specified in the illustration number column.



Design

Identification code

See the above illustrations 1 to 7.

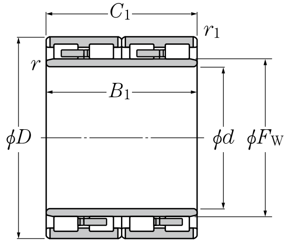
＊ Illustrations 1 to 5 use solid rollers + comb type machined cage.
＊ Illustrations 6 to 7 use hollow rollers + pin type cage.

Suffix code

M : The oil hole of the outer ring is provided with a fitting nozzle for oil mist.
R : The inner diameter surface of the inner ring has a helical groove.
S : Special specification

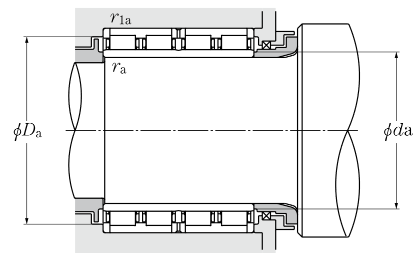
Oil groove code

① : Oil groove on both side faces of inner ring
② : Oil groove on one width surface of inner ring
③ : Oil groove on one width surface of outer ring
④ : No oil hole or oil groove on outer ring spacer



Drawings 1 to 5 [2)]

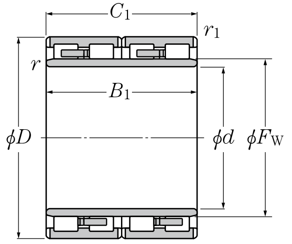
Four-Row Cylindrical Roller Bearings NTN



d 100 ～ 170mm

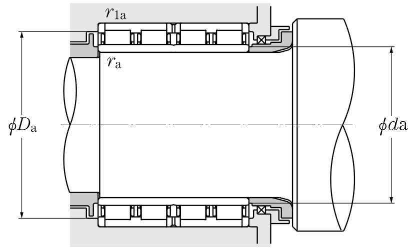
Boundary dimensions (mm)						Basic load rating dynamic (kN)	static (kN)	Fatigue load limit (kN)	Bearing number [2)]	Drawing number [3)]	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ [1)]	$r_{1s\,min}$ [1)]	C_r	C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
100	150	74	74	2	2	291	510	58.5	**4R2035**	1	115	109	141	2	2	4.68
120	180	92	92	2.5	2.5	445	785	84.5	**4R2437**	1	137	131	169	2	2	8.2
	180	105	105	2.5	2.5	495	855	92.5	**4R2438**	1	135	131	169	2	2	9.3
130	200	104	104	2.5	2.5	540	955	100	**4R2628**	1	150	141	189	2	2	12.1
140	190	119	119	1.5	1.5	550	1 190	125	**4R2832**	2②	154	148	182	1.5	1.5	9.93
	210	116	116	2.5	2.5	565	1 030	106	**4R2823**	1	160	151	199	2	2	13.9
145	210	155	155	2.5	2.5	780	1 640	168	**4R2906**	1	166	156	199	2	2	18
	225	156	156	2.5	2.5	900	1 750	177	**4R2904**	1	169	156	214	2	2	23.3
150	220	127	120	2.5	2.5	685	1 280	129	**4R3036**	1	168	161	209	2	2	15.7
	220	150	150	2.5	2.5	830	1 640	167	**4R3031**	1	168	161	209	2	2	19.4
	220	150	150	2.5	2.5	830	1 640	167	**4R3056**	1	168	161	209	2	2	19.6
	230	130	130	2.5	2.5	800	1 520	153	**4R3029**	1	174	161	219	2	2	20
	230	156	156	2.5	2.5	1 030	2 040	204	**4R3040**	1	174	161	219	2	2	24.5
	230	168	168	2	2	935	1 950	194	**4R3042**	1	178	159	221	2	2	25.8
	250	150	150	2.5	2.5	985	1 640	162	**4R3039**	1	177	161	239	2	2	29.6
151.5	230	168	168	1.5	2.5	945	2 060	205	**4R3033K**	1	179	159.5	219	1.5	2	25.4
160	220	180	180	2.5	2.5	1 020	2 490	250	**4R3224**	1	177	171	209	2	2	20.2
	230	130	130	2.5	2.5	740	1 340	133	**4R3226**	1	180	171	219	2	2	16.6
	230	168	168	2.5	2.5	1 020	2 170	217	**4R3232**	1	179	171	219	2	2	23.4
	230	168	168	2.5	2.5	995	2 200	220	**4R3229**	1	180	171	219	2	2	23.2
	230	168	168	2.5	2.5	990	2 210	219	**4R3231**	1	182	171	219	2	2	23.2
	230	180	180	2.5	2.5	1 020	2 490	250	**4R3228**	4③	177	171	219	2	2	24.8
	240	170	170	2	2.5	1 090	2 290	227	**4R3225**	1	183	169	229	2	2	27.8
170	230	120	120	2.5	2.5	685	1 520	151	**4R3426**	1	187	181	219	2	2	14.2
	230	120	120	2	2	685	1 520	151	**4R3443**	3	187	179	221	2	2	14.6
	240	156	156	2.5	2.5	1 000	2 170	213	**4R3429**	1	189	181	229	2	2	22.2
	240	160	160	2.5	2.5	1 000	2 180	213	**4R3423**	1	190	181	229	2	2	22.8
	250	168	168	2.5	2.5	1 080	2 220	216	**4R3432**	1	193	181	239	2	2	28.2
	250	168	168	2.5	2.5	1 140	2 390	232	**4R3428**	1	193	181	239	2	2	28.5
	255	180	180	2.5	2.5	1 220	2 430	236	**4R3425**	1	193	181	244	2	2	19.3
	260	150	150	2.5	2.5	925	1 750	171	**4R3433**	1	192	181	249	2	2	29.5

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings marked "K" have a tapered bore with a taper ratio of 1:12.
3) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.



Drawings 1 to 5 [2)]

Four-Row Cylindrical Roller Bearings NTN

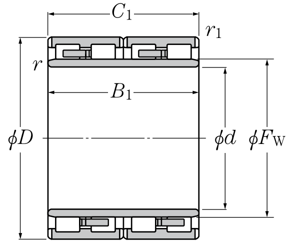


d 170 ～ 230mm

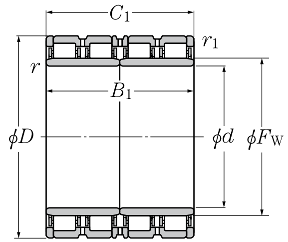
Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Bearing number	Drawing number [2)]	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ [1)]	$r_{1s\,min}$ [1)]	dynamic C_r	static C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
170	260	225	225	2.5	2.5	1 450	3 150	305	**4R3431**	1	196	181	249	2	2	44
180	250	156	156	2.5	2.5	995	2 180	211	**4R3625**	1	200	191	239	2	2	23.2
	250	168	168	2	2	980	2 470	239	**4R3639**	1	202	189	241	2	2	25.6
	260	168	168	2.5	2.5	1 130	2 400	230	**4R3628**	1	202	191	249	2	2	29.4
	265	180	180	2.5	2.5	1 200	2 510	241	**4R3618**	1	204	191	254	2	2	34.2
190	260	168	168	2.5	2.5	1 080	2 600	248	**4R3820**	1	212	201	249	2	2	26.9
	270	170	170	2.5	2.5	1 210	2 660	252	**4R3818**	1	213	201	259	2	2	31.7
	270	200	200	2.5	2.5	1 400	3 100	292	**4R3821**	1	212	201	259	2	2	37.5
	270	200	200	2.5	2.5	1 360	3 200	305	**4R3817**	1	212	201	259	2	2	37.2
	280	200	200	2.5	2.5	1 370	2 910	274	**4R3823**	2	214	201	269	2	2	41.5
	280	200	200	2.5	2.5	1 370	2 910	274	**4R3830**	3	214	201	269	2	2	42.8
200	270	170	170	2.5	2.5	1 080	2 610	245	**4R4039**	1	222	211	259	2	2	28.5
	280	152	152	2.1	2.1	1 110	2 320	217	**4R4054**	2②	222	211	269	2	2	29.5
	280	170	170	2.5	2.5	1 150	2 430	228	**4R4048**	1	222	211	269	2	2	33
	280	190	190	2.5	2.5	1 320	3 150	294	**4R4026**	1	223	211	269	2	2	36.7
	280	200	200	2.5	2.5	1 460	3 300	310	**4R4037**	1	222	211	269	2	2	40.5
	280	200	200	2.5	2.5	1 380	3 350	310	**4R4027**	1	224	211	269	2	2	38.8
	290	192	192	2.5	2.5	1 430	3 150	292	**4R4041**	1	226	211	279	2	2	42.5
210	290	192	192	2.5	2.5	1 370	3 350	310	**4R4206**	1	236	221	279	2	2	39.5
220	290	192	192	2.5	2.5	1 320	3 350	310	**4R4413**	1	239	231	279	2	2	33.8
	300	160	160	2.5	2.5	1 110	2 590	237	**4R4419**	1	245	231	289	2	2	32.8
	300	160	160	2.1	2.1	1 110	2 590	237	**4R4445**	3	245	231	289	2	2	33.7
	310	192	192	2.5	2.5	1 500	3 550	320	**4R4410**	1	247	231	299	2	2	46.3
	310	192	192	2.5	2.5	1 540	3 400	310	**4R4426**	1	246	231	299	2	2	46.9
	310	204	204	2.5	2.5	1 570	3 750	340	**4R4425**	1	247	231	299	2	2	49.8
	310	215	215	2.5	2.5	1 690	3 750	340	**4R4420**	1	242	231	299	2	2	51.5
	310	225	225	2.5	2.5	1 640	3 950	360	**4R4416**	1	245	231	299	2	2	54.9
	310	225	225	2.5	2.5	1 760	3 950	360	**4R4449**	1	244	231	299	2	2	54.3
	320	160	160	3	3	1 320	2 550	231	**4R4428**	1	245	233	307	2.5	2.5	46.5
	320	210	210	2.5	2.5	1 720	3 650	325	**4R4429**	1	248	231	309	2	2	60.5
	320	210	210	2.5	2.5	1 720	3 600	330	**4R4444**	1	246	231	309	2	2	57.3
230	330	206	206	2.5	2.5	1 680	3 900	345	**4R4610**	1	260	241	319	2	2	58.3
	330	206	206	2.5	2.5	1 690	3 800	340	**4R4614**	1	258	241	319	2	2	58.6

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.

Special Application Bearings

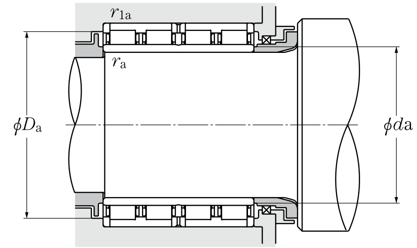


Drawings 1 to 5 [2)]



Drawings 6 [2)]

Four-Row Cylindrical Roller Bearings NTN



d 230 ～ 300mm

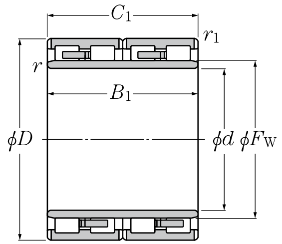
Boundary dimensions (mm)						Basic load rating (kN) dynamic	static	Fatigue load limit (kN)	Bearing number	Drawing number [2)]	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ [1)]	$r_{1s\,min}$ [1)]	C_r	C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
230	340	260	260	3	3	2 270	5 100	455	**4R4611**	1	261	243	327	2.5	2.5	82.6
240	330	220	220	3	3	1 650	4 150	365	**4R4811**	3	270	253	317	2.5	2.5	56.8
	330	220	220	3	3	1 790	4 250	380	**4R4819**	1	264	253	317	2.5	2.5	57.1
	330	220	220	3	3	1 650	4 150	365	**4R4821**	3	268	253	317	2.5	2.5	57.1
	330	220	220	3	3	1 690	4 250	375	**4R4804**	1	270	253	317	2.5	2.5	57.1
	340	220	220	3	3	1 850	4 200	370	**4R4806**	1	268	253	327	2.5	2.5	63.6
	360	220	220	2.5	2.5	1 950	4 050	355	**4R4807**	1	274	251	349	2	2	79.6
	360	220	220	2.5	2.5	1 950	4 050	355	**4R4813**	1	274	251	349	2	2	80.1
250	350	220	220	3	3	1 920	4 300	375	**4R5008**	1	278	263	337	2.5	2.5	66
260	360	220	200	2.5	2.5	1 710	4 150	360	**4R5221**	4	292	271	349	2	2	62.7
	360	260	260	2.5	2.1	2 030	4 850	420	**4R5231**	3 ①	287	271	349	2	2	81.5
	370	220	220	3	3	1 950	4 450	385	**4R5208**	1	292	273	357	2.5	2.5	77.1
	370	220	220	3	3	1 950	4 450	385	**4R5217**	1 ①	292	273	357	2.5	2.5	76.5
	380	280	280	3	3	2 680	6 250	535	**4R5213**	1	294	273	367	2.5	2.5	109
	400	290	290	4	2	3 400	7 150	610	**4R5218**	5 ④	296	276	391	3	2	135
265	370	234	234	1.5	1.5	2 250	5 000	425	**4R5306**	1 ①	300	273	362	1.5	1.5	78.9
270	380	280	280	2.5	2.5	2 510	5 750	490	**4R5407**	1	297	281	369	2	2	101
	380	280	280	2.5	2.5	2 860	6 850	585	**4R5405**	6 ④	299.7	281	369	2	2	105
280	350	208	208	2.5	2.5	1 430	3 950	345	**4R5614**	1	298	291	339	2	2	46.4
	390	220	220	3	3	1 970	4 650	395	**4R5611**	1	312	293	377	2.5	2.5	81.3
	390	220	220	3	3	2 020	4 800	405	**4R5604**	1	312	293	377	2.5	2.5	82
	390	275	275	2.5	2.5	2 540	6 250	525	**4R5612**	4 ③	312	291	379	2	2	105
	420	280	280	4	4	2 700	6 150	515	**4R5605**	1	323	296	404	3	3	139
290	410	240	240	3	3	2 480	5 550	465	**4R5806**	1	320	303	397	2.5	2.5	103
	420	300	300	3	3	3 150	7 500	625	**4R5805**	1	327	303	407	2.5	2.5	141
300	400	300	300	3	3	2 750	7 500	–	**E-4R6014**	1	328	313	387	2.5	2.5	104
	420	240	240	3	3	2 240	5 450	–	**E-4R6017**	1 ①	334	313	407	2.5	2.5	106
	420	240	240	3	3	2 240	5 450	–	**E-4R6012**	1	334	313	407	2.5	2.5	105
	420	240	240	3	3	2 230	5 450	–	**E-4R6023**	1 ①	336	313	407	2.5	2.5	105
	420	240	240	3	3	2 530	5 750	–	**E-4R6027**	1	332	313	407	2.5	2.5	105
	420	300	300	3	3	3 300	8 150	–	**E-4R6030**	6 ①	331	313	407	2.5	2.5	136

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.

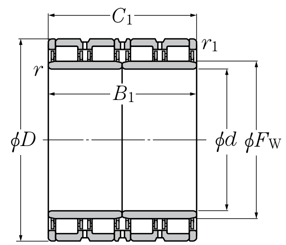
Special Application Bearings

Four-Row Cylindrical Roller Bearings

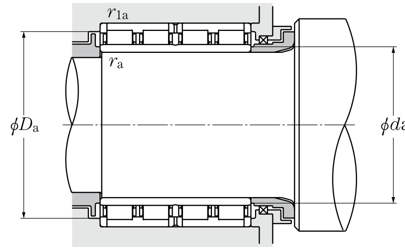
Four-Row Cylindrical Roller Bearings



Drawings 1 to 5 [2)]



Drawings 6 to 7 [2)]

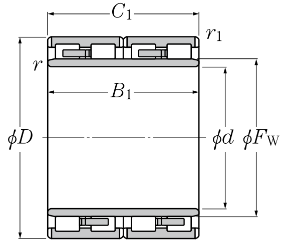


d 300 ～ 380mm

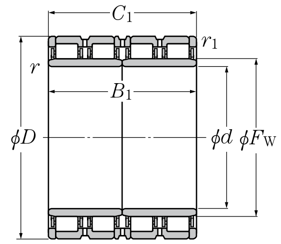
Boundary dimensions (mm)						Basic load rating (kN)		Fatigue load limit (kN)	Bearing number [2)]	Drawing number [3)]	Dimensions	Installation-related dimensions				Mass kg
						dynamic	static									
d	D	B_1	C_1	$r_{s\,min}$ [1)]	$r_{1s\,min}$ [1)]	C_r	C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
300	420	300	300	3	3	3 000	7 600	–	E-4R6015	1	334	313	407	2.5	2.5	125
	420	300	300	3	3	3 200	7 850	–	E-4R6020	6①	332	313	407	2.5	2.5	130
	420	320	300	3	3	3 200	7 850	–	E-4R6018	6②	332	313	407	2.5	2.5	136
	430	240	240	3	3	2 400	5 150	–	E-4R6021	1	338	313	417	2.5	2.5	115
	460	270	270	3	3	2 780	5 350	–	E-4R6019	1	344	313	447	2.5	2.5	162
310	430	240	240	3	3	2 480	5 950	–	E-4R6202	1	344.5	323	417	2.5	2.5	108
320	440	240	230	3	3	2 540	6 050	–	E-4R6414	1	351	333	427	2.5	2.5	106
	450	240	240	3	3	2 630	6 150	–	E-4R6411	1	358	333	437	2.5	2.5	125
	460	340	340	3	3	3 750	9 450	–	E-4R6412	1	360	333	447	2.5	2.5	178
	470	350	350	3	3	4 600	10 900	–	E-4R6406	6④	361.7	333	457	2.5	2.5	212
330	440	200	200	3	3	2 020	4 850	–	E-4R6603	2	360	343	427	2.5	2.5	83.6
	440	200	200	5	3	1 910	4 550	–	E-4R6608	2①	360	350	427	4	2.5	85.6
	460	340	340	4	4	3 600	8 850	–	E-4R6605	1	365	346	444	3	3	181
	460	340	340	4	4	3 650	9 550	–	E-4R6602	1	368	346	444	3	3	177
340	480	350	350	4	4	4 400	10 900	–	E-4R6819	6M①	378	356	464	3	3	211
	480	370	350	5	5	3 800	9 650	–	E-4R6811	1	378	360	460	4	4	198
	490	300	300	4	4	3 700	8 300	–	E-4R6804	1	377	356	474	3	3	187
	490	300	300	5	5	3 450	7 950	–	E-4R6805	1	380	360	470	4	4	189
356.76	550	400	400	4	4	5 650	13 800	–	E-4R7105K	5	426	372.757	534	3	3	354
360	480	290	290	3	3	3 300	8 150	–	E-4R7207	1	388	373	467	2.5	2.5	148
	510	370	370	4	4	3 950	9 700	–	E-4R7212	3	400	376	494	3	3	244
	510	400	380	4	2	4 850	11 900	–	E-4R7205	5①	399	376	509	3	2	251
	510	400	400	5	5	4 700	11 500	–	E-4R7203	2	397	380	490	4	4	262
370	480	230	230	5	5	2 330	6 250	–	E-4R7405	1	400	390	460	4	4	106
	480	250	250	3	3	2 440	6 450	–	E-4R7408	1	401	383	467	2.5	2.5	118
	520	380	380	5	5	4 350	10 800	–	E-4R7411	1	409	390	500	4	4	256
	520	400	400	5	5	5 150	13 500	–	E-4R7404	1	409	390	500	4	4	273
380	520	280	280	4	4	3 800	9 150	–	E-4R7605	1	417	396	504	3	3	174
	520	290	290	4	4	3 800	9 150	–	E-4R7617	1	417	396	504	3	3	185
	520	300	300	4	4	3 950	9 600	–	E-4R7607	7①	416	396	504	3	3	210
	540	400	400	4	4	5 750	15 200	–	E-4R7604	7②	422	396	524	3	3	325

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Bearings marked "K" have a tapered bore with a taper ratio of 1:12.
3) Boundary dimension parts are shown in the above drawing. Refer to C-19 for the details of drawings.

Special Application Bearings



Drawings 1 to 4 [2)]

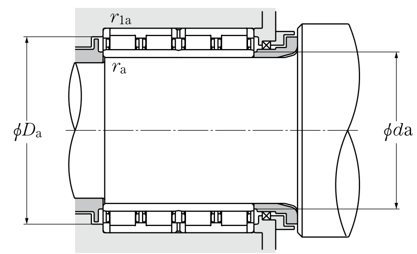


Drawings 6 to 7 [2)]

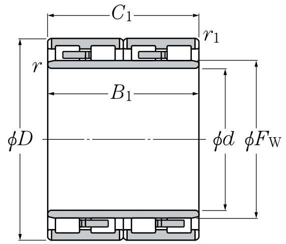
d 380 ～ 500mm

d	D	B_1	C_1	$r_{s\,min}$ [1)]	$r_{1s\,min}$ [1)]	C_r	C_{0r}	C_u	Bearing number	Drawing number [2)]
Boundary dimensions (mm)						Basic load rating (kN) dynamic	static	Fatigue load limit (kN)		
380	540	400	400	4	4	5 500	14 400	–	**E-4R7618**	6M①
	540	400	400	5	5	5 050	12 700	–	**E-4R7613**	2①③
400	560	400	400	5	5	4 700	11 800	–	**E-4R8007**	2
	560	410	410	4	4	6 350	17 000	–	**E-4R8010**	6
	590	420	420	4	4	5 750	13 000	–	**E-4R8011**	1
420	560	280	280	4	4	3 500	8 750	–	**E-4R8403**	1
	580	230	230	4	4	2 700	6 250	–	**E-4R8404**	1
	600	440	440	6	2.5	7 050	18 100	–	**E-4R8407**	6①
	620	400	400	5	5	5 550	13 400	–	**E-4R8401**	4③
430	591	420	420	5	5	6 100	17 400	–	**E-4R8605**	6M①④
440	600	450	450	1.5	5	6 700	17 900	–	**E-4R8806**	6R②
	600	450	450	1.5	5	7 050	19 100	–	**E-4R8805**	6R①
	620	450	450	5	5	7 150	18 700	–	**E-4R8803**	6①
	620	450	450	5	5	7 150	18 700	–	**E-4R8801**	6
460	620	400	400	4	4	5 900	16 700	–	**E-4R9211**	7S
	620	400	400	4	4	5 450	15 000	–	**E-4R9209**	1
	620	460	460	4	4	6 600	19 100	–	**E-4R9223**	6M①
	650	470	470	5	5	7 900	20 600	–	**E-4R9216**	6①
470	660	470	470	5	5	8 100	21 300	–	**E-4R9403**	6M①
480	600	236	236	3	3	2 900	7 850	–	**E-4R9610**	1
	650	420	420	5	5	6 350	17 200	–	**E-4R9613**	7①
	650	420	420	5	5	6 600	18 100	–	**E-4R9607**	7
	680	500	500	6	6	8 800	24 000	–	**E-4R9604**	6
500	680	420	405	5	5	7 900	22 900	–	**E-4R10010**	6②
	680	420	405	5	5	7 000	18 800	–	**E-4R10020**	6②
	690	470	470	5	5	8 500	22 500	–	**E-4R10016**	6①
	690	510	510	5	5	8 550	24 600	–	**E-4R10006**	6
	700	515	515	5	5	8 750	24 100	–	**E-4R10011**	6
	710	480	480	6	6	9 600	24 700	–	**E-4R10008**	6①
	720	530	530	5	5	9 150	25 000	–	**E-4R10015**	6①
	720	530	530	5	5	9 150	25 000	–	**E-4R10024**	6M①

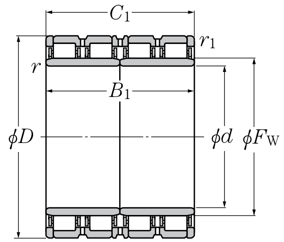
1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.



Dimensions F_w	Installation-related dimensions d_a	D_a	r_{as}	r_{1as}	Mass kg (approx.)
422	396	524	3	3	309
424	400	520	4	4	298
446	420	540	4	4	303
445	416	544	3	3	349
450	416	574	3	3	399
457	436	544	3	3	189
466	436	564	3	3	181
469.6	444	589	5	2	423
478	440	600	4	4	410
476	450	571	4	4	362
480	448	580	1.5	4	392
480	448	580	1.5	4	392
487	460	600	4	4	450
487	460	600	4	4	437
502	476	604	3	3	383
502	476	604	3	3	341
502	476	604	3	3	417
509	480	630	4	4	540
517	490	640	4	4	529
510	493	587	2.5	2.5	155
523	500	630	4	4	423
523	500	630	4	4	369
532	504	656	5	5	640
550	520	660	4	4	495
550	520	660	4	4	451
547	520	670	4	4	590
552	520	670	4	4	640
554	520	680	4	4	680
556	524	686	5	5	675
568	520	700	4	4	780
568	520	700	4	4	745

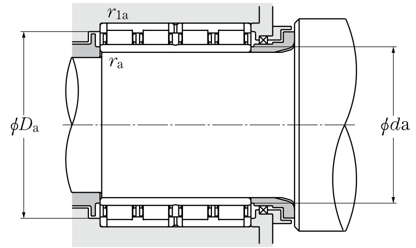


Drawings 1 2)



Drawings 6 to 7 2)

Four-Row Cylindrical Roller Bearings NTN



d 510 ～ 680mm

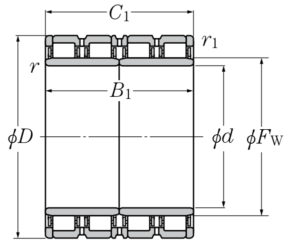
	Boundary dimensions (mm)					Basic load rating (kN) dynamic	static	Fatigue load limit (kN)	Bearing number	Drawing number 2)	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
510	670	320	320	5	5	5 050	13 500	–	**E-4R10201**	7①	554	530	650	4	4	335
	700	540	540	6	6	9 200	25 000	–	**E-4R10202**	6①	558	534	676	5	5	689
520	700	540	540	6	6	9 100	25 500	–	**E-4R10403**	6①	564	544	676	5	5	658
	720	550	550	5	5	10 400	27 700	–	**E-4R10406**	6R①	566	540	700	4	4	715
	735	535	535	5	5	9 950	26 600	–	**E-4R10402**	6②	574.5	540	715	4	4	740
530	700	540	540	6	6	8 700	25 400	–	**E-4R10603**	6①	574	554	676	5	5	626
	760	520	520	6	6	10 200	26 700	–	**E-4R10601**	6①	590	554	736	5	5	800
	780	570	570	6	6	11 400	29 100	–	**E-4R10602**	6①	601	554	756	5	5	1 010
	780	570	570	7.5	6	11 400	29 100	–	**E-4R10606**	6M①	595	562	756	6	5	978
536.18	762.03	558.8	558.8	5	6	11 200	29 200	–	**E-4R10704**	6②	600	556.176	738.03	4	5	859
550	800	520	520	6	6	10 500	27 000	–	**E-4R11001**	6①	622	574	776	5	5	965
560	680	360	360	3	3	5 150	16 500	–	**E-4R11202**	1	590	573	667	2.5	2.5	265
570	800	514	514	2.5	6	11 300	29 200	–	**E-4R11404**	6R①	626	581	776	2	5	849
	815	594	594	6	6	13 100	34 500	–	**E-4R11402**	6	628	594	791	5	5	1 040
600	820	575	575	7.5	7.5	11 100	31 500	–	**E-4R12006**	6M①	660	632	788	6	6	941
	870	540	540	7.5	7.5	11 800	29 600	–	**E-4R12002**	6①	672	632	838	6	6	1 150
	870	640	640	7.5	7.5	15 100	40 500	–	**E-4R12001**	6	672	632	838	6	6	1 330
610	870	660	660	9.5	7.5	14 000	40 000	–	**E-4R12202**	6①④	680	650	838	8	6	1 400
628	922	600	600	3	6	15 100	38 500	–	**E-4R12602**	6①	702	641	898	2.5	5	1 430
640	880	600	600	6	6	12 700	36 000	–	**E-4R12802**	6②	700	664	856	5	5	1 150
650	920	670	670	7.5	4	16 200	46 000	–	**E-4R13005**	6①	723	682	904	6	3	1 500
	920	680	680	7.5	7.5	16 600	47 000	–	**E-4R13010**	6R①	723	682	888	6	6	1 510
	920	690	690	7.5	7.5	15 900	46 500	–	**E-4R13003**	6	723	682	888	6	6	1 550
660	820	440	440	5	4	8 100	27 800	–	**E-4R13201**	6	702	680	804	4	3	580
680	1 020	650	650	6	6	17 400	48 000	–	**E-4R13603**	6M②	803	704	996	5	5	1 970
	1 020	680	680	3	5	19 200	49 500	–	**E-4R13604**	6②	775	693	1 000	2.5	4	2 060

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.

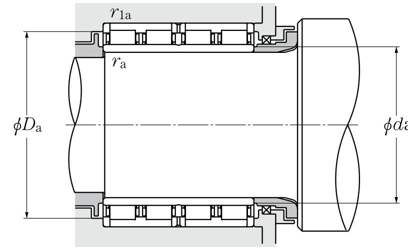
Special Application Bearings

Special Application Bearings

Four-Row Cylindrical Roller Bearings NTN



Drawings 6 2)

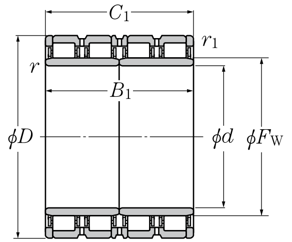


d 690 ～ 860mm

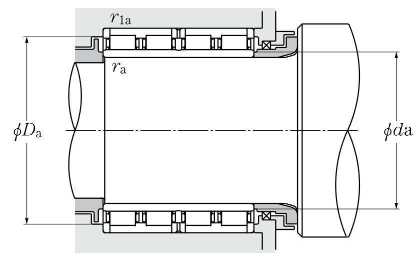
Boundary dimensions mm						Basic load rating kN		Fatigue load limit kN	Bearing number 3)	Drawing number 2)	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
690	980	715	715	7.5	7.5	18 700	54 500	–	E-4R13802	6 ②	767.5	722	948	6	6	1 850
	980	750	750	7.5	7.5	18 300	53 000	–	E-4R13803	6M ②	766	722	948	6	6	1 900
710	1 000	715	715	9.5	6	18 600	54 500	–	E-4R14205	6S ④	787.5	750	976	8	5	1 900
725	1 000	700	700	6	6	17 700	53 500	–	E-4R14501	6 ①	796	749	976	5	5	1 730
750	1 050	745	720	7.5	7.5	19 500	58 000	–	E-4R15001	6M ②	830	782	1 018	6	6	2 180
	1 090	745	720	7.5	7.5	21 200	60 500	–	E-4R15002	6M ②	845	782	1 058	6	6	2 530
755	1 070	750	750	7.5	7.5	20 800	58 500	–	E-4R15101	6 ①	837	787	1 038	6	6	2 260
760	1 030	750	750	7.5	7.5	19 200	59 500	–	E-4R15204	6M ①	828	792	998	6	6	2 000
	1 080	805	790	6	6	20 700	61 000	–	E-4R15207	6M ②	845	784	1 056	5	5	2 550
	1 100	745	720	7.5	7.5	21 200	60 500	–	E-4R15203	6M ②	855	792	1 068	6	6	2 560
761.43	1 079.6	787.4	787.4	9.5	7.5	21 900	63 000	–	E-4R15201	6 ①	846	801.425	1 047.6	8	6	2 420
800	1 080	700	700	7.5	7.5	18 300	55 000	–	E-4R16004	6 ①	870	832	1 048	6	6	1 950
	1 080	750	750	6	6	19 200	59 000	–	E-4R16005	6 ①	880	824	1 056	5	5	2 090
820	1 130	800	800	7.5	7.5	21 800	66 500	–	E-4R16406	6M ①	903	852	1 098	6	6	2 450
	1 130	800	800	7.5	7.5	23 900	72 000	–	E-4R16413	6MS ②	903	852	1 098	6	6	2 530
	1 130	800	800	7.5	7.5	21 800	66 500	–	E-4R16415	6 ②	903	852	1 098	6	6	2 530
	1 130	825	800	7.5	7.5	21 800	66 500	–	E-4R16405	6M ①	903	852	1 098	6	6	2 520
	1 160	840	840	7.5	7.5	24 000	71 000	–	E-4R16403	6 ②	910	852	1 128	6	6	2 930
830	1 080	710	710	6	6	18 000	59 500	–	E-4R16601	6 ②	896	854	1 056	5	5	1 780
840	1 160	840	840	5	7.5	23 900	71 000	–	E-4R16801	6 ①	920	860	1 128	4	6	2 840
850	1 150	650	650	9.5	9.5	17 500	51 000	–	E-4R17001	6 ①	941	890	1 110	8	8	1 980
	1 150	800	800	6	6	21 800	71 000	–	E-4R17003	6 ①	930	874	1 126	5	5	2 430
	1 150	840	840	6	6	24 400	77 500	–	E-4R17009	6 ①	928	874	1 126	5	5	2 640
	1 180	650	650	7.5	7.5	18 200	51 500	–	E-4R17004	6 ①	945	882	1 148	6	6	2 270
	1 180	850	850	9.5	9.5	26 700	78 500	–	E-4R17002	6	928	890	1 140	8	8	2 970
	1 180	850	850	7.5	7.5	24 100	72 000	–	E-4R17014	6 ②	940	882	1 148	6	6	2 980
860	1 140	750	750	7.5	7.5	19 100	61 000	–	E-4R17202	6 ②	938	892	1 108	6	6	2 200

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to C-19 for the details of drawings.

● Four-Row Cylindrical Roller Bearings NTN



Drawings 6 2)



d 860 ～ 1 030mm

Boundary dimensions (mm)						Basic load rating (kN)		Fatigue load limit (kN)	Bearing number	Drawing number 2)	Dimensions	Installation-related dimensions				Mass kg
d	D	B_1	C_1	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	C_u			F_w	d_a	D_a	r_{as}	r_{1as}	(approx.)
860	1 160	735	710	6	6	19 700	62 500	–	**E-4R17201**	6①	940	884	1 136	5	5	2 310
900	1 230	895	870	7.5	7.5	27 400	88 000	–	**E-4R18001**	6M②	985	932	1 198	6	6	3 250
920	1 280	865	850	7.5	7.5	29 100	88 500	–	**E-4R18401**	6	1 015	952	1 248	6	6	3 560
1000	1 310	880	880	9.5	9.5	25 900	88 500	–	**E-4R20001**	6①	1 080	1 040	1 270	8	8	3 260
	1 360	800	800	7.5	7.5	27 700	85 000	–	**E-4R20002**	6①	1 090	1 032	1 328	6	6	3 530
1030	1 380	850	850	7.5	7.5	27 100	89 000	–	**E-4R20601**	6①	1 124	1 062	1 348	6	6	3 800

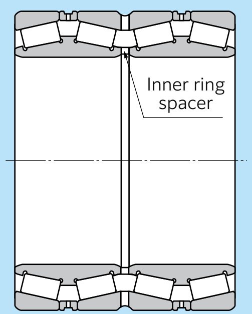
Special Application Bearings

1) Smallest allowable dimension for chamfer dimension r or r_1.
2) Boundary dimension parts are shown in the above drawing. Refer to **C-19** for the details of drawings.

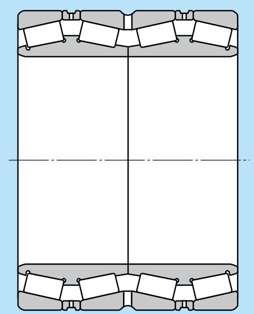
Four-row tapered roller bearings

1. Features

1) This type of bearing includes two double-row inner rings with rollers, one double-row outer ring, two single-row outer rings, and two outer ring spacers (**Fig. 1** TYPE B). There is also a type with an inner ring spacer (**Fig. 1** TYPE A). These bearings are manufactured so that the internal clearance values are fixed. Due to this, only parts with identical manufacturing numbers can be used, and they must be assembled according to their code numbers.
2) These bearings are mainly used in the roll necks of steel rolling mills and designed so that the load rating is maximized in the allowable space of the roll neck part.
3) Loose fitting is used to make the assembly and removal of the bearings easy. Carburizing steel is used to prevent inner ring cracks due to creeping and to improve shock resistance. There is also a bearing design with a helical groove in the inner ring bore to prevent wear.
4) The cage type includes a pressed steel cage and a pin type cage (that uses a hollow roller as shown in **Fig. 2**). The pin type cage maximizes the number of rollers in the bearing to provide increased load capacity.



(TYPE A)
With inner ring spacer



(TYPE B)
Without inner ring spacer

Fig. 1

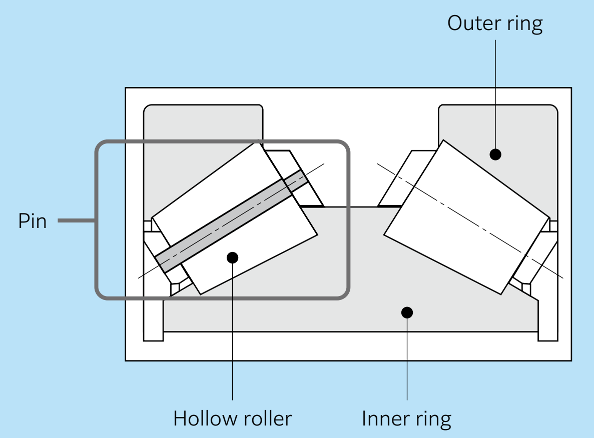


Fig. 2 Pin type cage

Inch series tapered roller bearings (four-row) index

Series number	Bearing number CONE / CUP	Page of bearing dimension table
8500	T-8576D / 8520 / 8520D	C-42
9900	9974D / 9920 / 9920D	C-42
46700	T-46791D / 46720 / 46721D	C-40
48200	T-48290D / 48220 / 48220D	C-40
48300	T-48393D / 48320 / 48320D	C-40
48600	T-48680D / 48620 / 48620D	C-40
67700	67791D / 67720 / 67721D	C-40
67800	T-67885D / 67820 / 67820D	C-42
67900	T-67986D / 67920 / 67921D	C-42
81000	81576D / 81962 / 81963D	C-40
82600	82681D / 82620 / 82620D	C-40
126000	EE126096D / 126150 / 126151D	C-44
127000	EE127097D / 127137 / 127137D	C-42
132000	EE132082D / 132125 / 132126D	C-42
134000	EE134102D / 134143 / 134144D	C-44
135000	EE135111D / 135155 / 135156D	C-44
L163100	T-L163149D / L163110 / L163110D	C-48
170000	EE171000D / 171450 / 171451D	C-44
180000	EE181455D / 182350 / 182351D	C-48
220000	EE221027D / 221575 / 221576D	C-44
M224700	T-M224749D / M224710 / M224710D	C-40
M231600	T-M231649D / M231610 / M231610D	C-40
234000	T-EE234161D / 234215 / 234216D	C-50
M238800	T-M238849D / M238810 / M238810D	C-42
M240600	M240648D / M240611 / M240611D	C-42
M241500	T-M241538D / M241510 / M241510D	C-42
244000	EE244181D / 244235 / 244236D	C-52
M244200	T-M244249D / M244210 / M244210D	C-42
LM247700	LM247748D / LM247710 / LM247710DA	C-44
M249700	T-M249748D / M249710 / M249710D	C-44
HM252300	T-HM252349D / HM252310 / HM252310D	C-44
M252300	T-M252349D / M252310 / M252310D	C-44
M255400	M255449D / M255410 / M255410DA	C-46
HM256800	T-HM256849D / HM256810 / HM256810DG2	C-46
M257100	M257149D / M257110 / M257110D	C-46

Series number	Bearing number CONE / CUP	Page of bearing dimension table
M257200	M257248D / M257210 / M257210D	C-46
LM258600	LM258649D / LM258610 / LM258610D	C-46
HM259000	T-HM259049D / HM259010 / HM259010D	C-46
HM261000	HM261049D / HM261010 / HM261010DA	C-48
M262400	M262449D / M262410 / M262410D	C-48
HM262700	T-HM262749D / HM262710 / HM262710DG2	C-48
LM263100	LM263149D / LM263110 / LM263110D	C-48
M263300	M263349D / M263310 / M263310D	C-48
HM265000	HM265049D / HM265010 / HM265010DG2	C-48
HM266400	T-HM266449D / HM266410 / HM266410DG2	C-50
M268700	T-M268749D / M268710 / M268710DG2	C-50
M270700	M270749D / M270710 / M270710DG2	C-50
LM272200	LM272249D / LM272210 / LM272210DG2	C-52
M274100	M274149D / M274110 / M274110DG2	C-52
LM274400	LM274449D / LM274410 / LM274410D	C-52
275000	EE275106D / 275155 / 275156D	C-44
275000	EE275109D / 275160 / 275161D	C-44
M275300	M275349D / M275310 / M275310DG2	C-52
M276400	M276449D / M276410 / M276410DG2	C-52
M278700	M278749D / M278710 / M278710DAG2	C-54
280000	EE280703D / 281200 / 281201D	C-40
M280000	M280049D / M280010 / M280010DG2	C-54
M280300	M280349D / M280310 / M280310DG2	C-54
L281100	L281149D / L281110 / L281110DG2	C-54
M283400	M283449D / M283410 / M283410DG2	C-54
LM283600	LM283649D / LM283610 / LM283610DG2	C-54
M284100	M284148D / M284111 / M284210DG2	C-56
M284200	M284249D / M284210 / M284210DG2	C-56
M285800	M285848D / M285810 / M288510DG2	C-56
LM286200	LM286249D / LM286210 / LM286210DG2	C-56
LM287600	LM287649D / LM287610 / LM287610DG2	C-56
290000	EE291202D / 291750 / 291751D	C-46
329000	EE329119D / 329172 / 329173D	C-46
LM377400	LM377449D / LM377410 / LM377410DG2	C-54
LM451300	T-LM451349D / LM451310 / LM451310D	C-44

Special Application Bearings

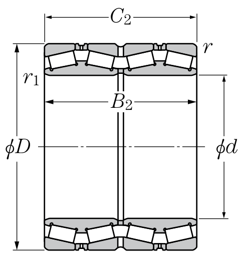
Inch series tapered roller bearings (four-row) index

Series number	Bearing number CONE / CUP	Page of bearing dimension table
526000	EE526131D / 526190 / 526191D	C-48
531000	EE531201D / 531300 / 531301XDG2	C-52
547000	EE547341D / 547480 / 547481DG2	C-56
640000	T-EE640193D / 640260 / 640261DG2	C-52
649000	EE649241D / 649310 / 649311DG2	C-54
LM654600	T-LM654644D / LM654610 / LM654610D	C-44
LM654600	T-LM654648D / LM654610 / LM654610D	C-44
655000	EE655271D / 655345 / 655346DG2	C-54
LM665900	LM665949D / LM665910 / LM665910D	C-50
M667900	M667947D / M667911 / M667911DG2	C-50
700000	EE700090D / 700167 / 700168D	C-42
722000	EE722111D / 722185 / 722186D	C-44
724000	EE724121D / 724195 / 724196D	C-46
736000	EE736173D / 736238 / 736239D	C-50
737000	EE737179D / 737260 / 737260D	C-52
LM742700	T-LM742749D / LM742714 / LM742714D	C-42
755000	EE755280D / 755360 / 755361DG2	C-54
M757400	M757448D / M757410 / M757410D	C-46
M757400	M757449D / M757410 / M757410D	C-46
LM761600	LM761648D / LM761610 / LM761610D	C-48
LM761600	LM761649D / LM761610 / LM761610D	C-48
LM763400	LM763449D / LM763410 / LM763410D	C-48
LM765100	LM765149D / LM765110 / LM765110D	C-48
LM767700	LM767745D / LM767710 / LM767710D	C-50
LM767700	LM767749D / LM767710 / LM767710D	C-50
LM769300	LM769349D / LM769310 / LM769310D	C-50
L770800	L770849D / L770810 / L770810DG2	C-52
LM772700	LM772749D / LM772710 / LM772710DA	C-52
LM778500	LM778549D / LM778510 / LM778510DG2	C-54
822000	EE822101D / 822175 / 822176D	C-44
833000	EE833161D / 833232 / 833233D	C-50
843000	EE843221D / 843290 / 843291D	C-54
LM869400	T-LM869449D / LM869410 / LM869410DG2	C-50
910000	EE911603D / 912400 / 912401D	C-50
920000	EE921150D / 921875 / 921876D	C-46

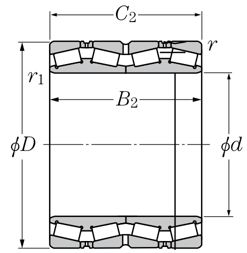
Series number	Bearing number CONE / CUP	Page of bearing dimension table
931000	EE931170D / 931250 / 931251XDG2	C-50
970000	EE971355D / 972100 / 972103D	C-48

Special Application Bearings

Four-Row Tapered Roller Bearings



(TYPE A)
With inner ring spacer



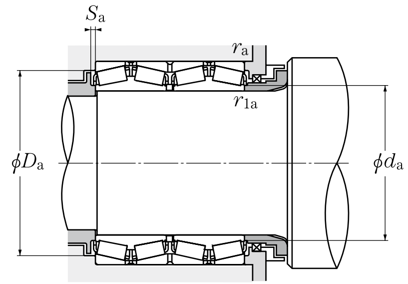
(TYPE B)
Without inner ring spacer

d 120 ～ 177.800mm

d	Boundary dimensions (mm) D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating (kN) dynamic C_r	static C_{0r}	a)	b) c)	Bearing number a) to d) (TYPE A) With inner ring spacer
120	170	124	124	2	2.5	430	1 020		∗	**E-625924**
	180	100	100	2	2.5	435	745		∗	**E-623024**
	200	132	132	2	2.5	710	1 220		∗	**E-623124**
	210	174	174	2.5	2.5	950	1 710		∗	**E-CRO-2418**
120.650	174.625	141.288	139.703	1.5	0.8	670	1 490	◎	∗	**T-E-M224749D/M224710/M224710D**
127	182.562	158.750	158.750	3.3	1.5	730	1 730	◎	∗	**T-E-48290D/48220/48220D**
130	184	134	134	2	2.5	535	1 190		∗	**E-625926**
135	180	160	160	2	1	555	1 360		∗	**E-CRO-2701**
136.525	190.500	161.925	161.925	3.3	1.5	770	1 900	◎	∗	**T-E-48393D/48320/48320D**
139.700	200.025	157.165	160.340	3.3	0.8	780	1 950	◎	∗	**T-E-48680D/48620/48620D**
140	198	144	144	2	2.5	640	1 460		∗	**E-625928**
	210	114	114	2	2.5	570	1 070		∗	**E-623028**
	210	115	115	2	2.5	570	1 070		∗	**E-CRO-2817**
146.050	244.475	192.088	187.325	3.3	1.5	1 060	1 980	◎	∗	**E-81576D/81962/81963D**
150	212	155	155	2.5	3	735	1 700		∗	**E-625930**
152.400	222.250	174.625	174.625	1.5	1.5	1 030	2 350	◎	∗	**T-E-M231649D/M231610/M231610D**
160	226	165	165	2.5	3	855	2 030		∗	**E-625932**
	265	173	173	2.5	2.5	1 220	2 270		∗	**E-CRO-3209**
165.100	225.425	165.100	168.275	3.3	0.8	830	2 220	◎	∗	**T-E-46791D/46720/46721D**
170	240	175	175	2.5	3	930	2 200		∗	**E-625934**
	260	144	144	2.5	3	930	1 730		∗	**E-623034**
	280	185	185	2.5	3	1 380	2 540		∗	**E-623134**
177.800	247.650	192.088	192.088	3.3	1.5	1 110	2 760	◎	∗	**E-67791D/67720/67721D**
	279.400	234.950	234.947	3.3	1.5	1 570	3 400	◎	∗	**E-82681D/82620/82620D**
	304.800	238.227	233.365	3.3	3.3	1 750	3 100	◎	∗	**E-EE280703D/281200/281201D**

1) Smallest allowable dimension for chamfer dimension r or r_1.

Four-Row Tapered Roller Bearings



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

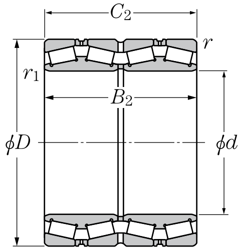
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

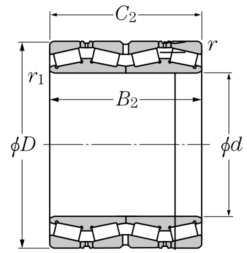
Bearing number a) to d) (TYPE B) Without inner ring spacer	Installation-related dimensions (mm) d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
E-CRO-2451	135	151	5	2	2	0.33	2.03	3.02	1.98	8.97
	137	162.5	3.8	2	2	0.37	1.80	2.69	1.76	8.87
	143.6	176	4.1	2	2	0.37	1.80	2.69	1.76	16.7
	143	178	4.5	2	2	0.40	1.68	2.50	1.64	22.2
	129	162	3	1.5	0.8	0.33	2.03	3.02	1.98	11.5
	137	168	4.5	3.3	1.5	0.31	2.21	3.29	2.16	14.3
	144.3	164	5	2	2	0.33	2.03	3.02	1.98	11.3
	144.7	161.5	2	2	1	0.33	2.03	3.02	1.98	13.5
	144	177	4	3.3	1.5	0.32	2.10	3.13	2.06	14.8
	150	185	3	3.3	0.8	0.34	2.01	2.99	1.96	17.3
	155.8	178	5	2	2	0.33	2.03	3.02	1.98	14
	160.7	187	3.5	2	2	0.37	1.84	2.74	1.80	13.8
	159.1	187.5	3.4	2	2	0.37	1.84	2.74	1.80	13.9
	163	225	6.5	3.3	1.5	0.35	1.92	2.86	1.88	36.8
	167.5	190	5.5	2	2.5	0.33	2.03	3.02	1.98	16.9
	164.5	207	4	1.5	1.5	0.33	2.03	3.02	1.98	24.7
	177.5	202.5	5.5	2	2.5	0.33	2.03	3.02	1.98	20.2
E-CRO-3210	190	231	4.5	2	2	0.33	2.03	3.02	1.98	37
	175	209	3	3.3	0.8	0.38	1.76	2.62	1.72	20.7
	187.5	213	5.5	2	2.5	0.33	2.03	3.02	1.98	24.4
	194.8	232	3.8	2	2.5	0.37	1.80	2.69	1.76	27.5
	196.4	254	6.4	2	2.5	0.37	1.80	2.69	1.76	45.2
E-CRO-3664	192.2	217.5	5	3.3	1.5	0.44	1.54	2.29	1.50	29.4
	195	251	5	3.3	1.5	0.53	1.28	1.91	1.25	55.3
E-CRO-3663	206.2	274.5	7	3.3	3.3	0.36	1.87	2.79	1.83	69.9

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "∗", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

Four-Row Tapered Roller Bearings



(TYPE A)
With inner ring spacer



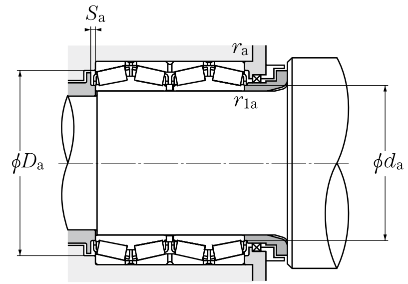
(TYPE B)
Without inner ring spacer

d 180 ～ 241.478mm

Boundary dimensions mm						Basic load rating kN			Bearing number a) to d)
d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	a) b) c)	(TYPE A) With inner ring spacer
180	254	185	185	2.5	3	1 010	2 390	*	**T-E-625936**
187.325	269.875	211.138	211.138	3.3	1.5	1 490	3 500	◎ *	**T-E-M238849D/M238810/M238810D**
190	268	196	196	2.5	3	1 170	2 850	*	**E-625938**
	270	190	190	2.5	0.6	1 350	3 050	*	**E-CRO-3813**
	292.100	225.425	225.425	3.3	1.5	1 740	4 150	◎ *	**T-E-M241538D/M241510/M241510D**
190.500	266.700	187.325	188.912	3.3	1.5	1 160	2 990	◎ *	**T-E-67885D/67820/67820D**
198.438	284.162	225.425	225.425	3.3	1.5	1 690	4 000	◎	**E-M240648D/M240611/M240611D**
200	282	206	206	2.5	3	1 330	3 300		**E-625940**
	290	160	160	2.5	2.5	1 060	2 210		**E-CRO-4013**
203.200	317.500	215.900	209.550	3.3	3.3	1 400	2 820	◎	**E-EE132082D/132125/132126D**
206.375	282.575	190.500	190.500	3.3	0.8	1 180	3 150	◎	**T-E-67986D/67920/67921D**
215.900	288.925	177.800	177.800	3.3	0.8	1 240	3 250	◎	**T-E-LM742749D/LM742714/LM742714D**
216.103	330.200	263.525	269.875	3.3	1.5	2 220	5 150	◎	**E-9974D/9920/9920D**
220	300	230	230	2.5	2.5	1 500	3 650		**E-CRO-4412**
	310	226	226	3	4	1 530	3 800		**E-625944**
	320	200	200	3	1	1 540	3 400		**E-CRO-4411**
	340	190	190	3	4	1 670	3 300		**E-623044**
220.662	314.325	239.712	239.712	3.3	1.5	2 040	4 900	◎	**T-E-M244249D/M244210/M244210D**
228.600	364.000	296.875	296.875	3.3	3.3	2 630	5 550		**E-CRO-4606**
	425.450	349.250	361.950	6.4	3.5	3 850	8 250	◎	**E-EE700090D/700167/700168D**
234.950	327.025	196.850	196.850	3.3	1.5	1 550	3 800	◎	**T-E-8576D/8520/8520D**
240	338	248	248	3	4	2 080	4 950		**E-625948A**
241.478	350.838	228.600	228.600	3.3	1.5	1 790	4 000	◎	**E-EE127097D/127137/127137D**

1) Smallest allowable dimension for chamfer dimension r or r_1.

Four-Row Tapered Roller Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

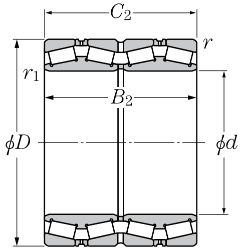
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

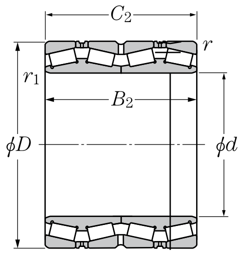
Bearing number a) to d)	Installation-related dimensions mm					Constant	Axial load factors			Mass kg
(TYPE B) Without inner ring spacer	d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	e	Y_1	Y_2	Y_0	(approx.)
	200.5	227	5.5	2	2.5	0.33	2.03	3.02	1.98	28.9
	200	254	4	3.3	1.5	0.33	2.03	3.02	1.98	41.8
	211	238	6	2	2.5	0.33	2.03	3.02	1.98	34.7
	207.2	248.5	2	2	0.6	0.40	1.68	2.50	1.64	34.5
	222	271	5	3.3	1.5	0.33	2.03	3.02	1.98	59.6
E-CRO-3814	208	234	3	3.3	1.5	0.48	1.41	2.11	1.38	33.6
	212.1	263.9	5.5	3.3	1.5	0.33	2.03	3.02	1.98	46
	219.5	260.5	6	2	2.5	0.33	2.03	3.02	1.98	40.5
	224	267.5	5	2	2	0.37	1.80	2.69	1.76	35.1
	224	293.9	9.5	3.3	3.3	0.31	2.15	3.20	2.10	62.5
	223	260	5	3.3	0.8	0.51	1.33	1.97	1.30	35.4
	229.4	267	5	3.3	0.8	0.48	1.40	2.09	1.37	34.3
	235	300	6	3.3	1.5	0.55	1.23	1.82	1.20	82.1
	236.5	277.5	6.5	2	2	0.43	1.59	2.36	1.55	42.1
	242	284.5	6	2.5	3	0.33	2.03	3.02	1.98	53.5
	245	297	6.5	2.5	1	0.35	1.95	2.90	1.91	53
	250.5	315	5.5	2.5	3	0.37	1.80	2.69	1.76	63.2
E-CRO-4442	239.5	288.5	4	3.3	1.5	0.33	2.03	3.02	1.98	60.2
	262	334.5	6.5	3.3	3.3	0.32	2.12	3.15	2.07	117.9
	259	381	3	6.4	3.5	0.33	2.03	3.02	1.98	232
E-CRO-4704	256	301	5	3.3	1.5	0.41	1.66	2.47	1.62	53.6
E-CRO-4825	260.5	312	6	2.5	3	0.33	2.03	3.02	1.98	70
	258	325	6.5	3.3	1.5	0.35	1.91	2.85	1.87	76.4

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "*", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

Four-Row Tapered Roller Bearings



(TYPE A)
With inner ring spacer



(TYPE B)
Without inner ring spacer

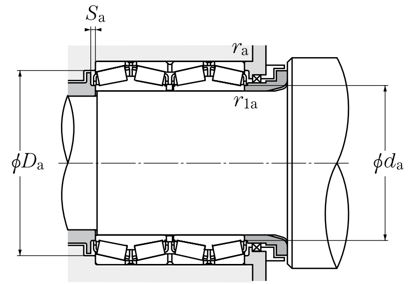
d 244.475 ～ 285.750mm

d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	a) b) c)	Bearing number a) to d) (TYPE A) With inner ring spacer
Boundary dimensions mm						Basic load rating dynamic / static kN			
244.475	327.025	193.675	193.675	3.3	1.5	1 580	4 100	◎	E-LM247748D/LM247710/LM247710DA
	381.000	304.800	304.800	4.8	3.3	2 470	5 750	◎	E-EE126096D/126150/126151D
245	380	255.5	254	6.4	1.5	2 280	4 750		E-CRO-4901
254	358.775	269.875	269.875	3.3	3.3	2 650	6 550	◎	T-E-M249748D/M249710/M249710D
	368.300	204.622	204.470	3.3	1.5	1 500	3 250	◎	E-EE171000D/171450/171451D
	444.500	279.400	279.400	6.4	3.3	3 200	5 900	◎	E-EE822101D/822175/822176D
260	360	272	272	2.5	1	2 300	5 750		E-CRO-5218
	368	268	268	4	5	2 210	5 700		E-625952
	400	220	220	4	5	2 180	4 400		E-623052
	400	255	255	7.5	4	2 450	5 300		E-CRO-5215
260.350	365.125	228.600	228.600	6.4	3.3	1 940	4 550	◎	E-EE134102D/134143/134144D
	400.050	255.588	253.995	6.4	1.5	2 320	4 950	◎	E-EE221027D/221575/221576D
	422.275	314.325	317.500	3.3	6.4	3 800	7 100	◎	T-E-HM252349D/HM252310/HM252310D
266.700	355.600	230.188	228.600	3.3	1.5	2 040	5 350	◎	T-E-LM451349D/LM451310/LM451310D
	355.600	230.188	228.600	3.3	1.5	1 580	4 350		E-CRO-5305
	393.700	269.878	269.878	6.4	3.3	2 340	6 000	◎	E-EE275106D/275155/275156D
269.875	381.000	282.575	282.575	3.3	3.3	2 890	6 850	◎	T-E-M252349D/M252310/M252310D
270	410	222	222	4	4	2 120	4 550		E-CRO-5403
276.225	406.400	268.290	260.355	6.4	1.5	2 340	6 000	◎	E-EE275109D/275160/275161D
279.400	381.000	269.875	269.875	3.3	1.5	2 490	6 450		E-CRO-5628
	393.700	269.875	269.875	6.4	1.5	2 150	5 350	◎	E-EE135111D/135155/135156D
	469.900	346.075	349.250	3.3	6.4	3 850	8 700	◎	E-EE722111D/722185/722186D
279.578	380.898	244.475	244.475	3.3	1.5	2 160	6 200	◎	T-E-LM654644D/LM654610/LM654610D
280	380	290	290	3.1	1.7	2 740	7 250		E-CRO-5650
	395	288	288	4	5	2 840	7 100		E-625956
285.750	380.898	244.475	244.475	3.3	1.5	2 160	6 200	◎	T-E-LM654648D/LM654610/LM654610D

1) Smallest allowable dimension for chamfer dimension r or r_1.

Special Application Bearings

Four-Row Tapered Roller Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

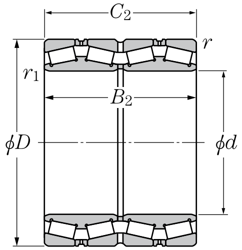
$P_{0r} = F_r + Y_0F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

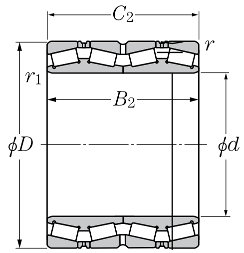
Bearing number a) to d) (TYPE B) Without inner ring spacer	d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
	Installation-related dimensions mm									
E-CRO-4905	265	306	5	3.3	1.5	0.32	2.09	3.11	2.04	46.1
	269	343	6.5	4.8	3.3	0.52	1.31	1.95	1.28	132
	275.5	349	6.5	6.4	1.5	0.37	1.80	2.69	1.76	106.7
	272	335	5	3.3	3.3	0.33	2.03	3.02	1.98	85.6
	269	340	6	3.3	1.5	0.36	1.85	2.75	1.81	71.8
	281.9	404.9	8	6.4	3.3	0.34	1.98	2.94	1.93	185
	279	335	6.5	2.5	1	0.41	1.66	2.47	1.62	74.2
	290	338.5	6	3	3	0.33	2.03	3.02	1.98	90.3
	292	370	6.5	3	3	0.37	1.80	2.69	1.76	98.9
	293.5	360.5	8	6	3	0.39	1.71	2.54	1.67	106
	280	339	6.5	6.4	3.3	0.37	1.80	2.69	1.76	76.5
	292	366	8	6.4	1.5	0.39	1.71	2.54	1.67	117
	290	356	5.5	3.3	6.4	0.33	2.03	3.02	1.98	180
E-CRO-5307	285	331.5	6.5	3.3	1.5	0.36	1.87	2.79	1.83	62
	287	333	3.5	3.3	1.5	0.37	1.83	2.72	1.79	62.3
	290	366	5	6.4	3.3	0.40	1.68	2.50	1.64	116
E-CRO-5409	291.5	351	6	3.3	3.3	0.33	2.03	3.02	1.98	97.5
	308	375.5	6	3	3	0.27	2.49	3.71	2.43	91
	293.6	373	8	6.4	1.5	0.40	1.68	2.50	1.64	122
	298.5	355.5	5	3.3	1.5	0.37	1.80	2.69	1.76	79.6
	297	368	6.5	6.4	1.5	0.40	1.68	2.50	1.64	103
	314	430	5	3.3	6.4	0.38	1.78	2.65	1.74	258
E-CRO-5679	304.5	350.5	5	3.3	1.5	0.43	1.56	2.33	1.53	83.2
E-CRO-5676	301	353.5	6.5	2.5	1.5	0.33	2.03	3.02	1.98	105
E-CRO-5684	304.5	363.5	7	3	4	0.33	2.03	3.02	1.98	111
E-CRO-5710	304.5	350.5	5	3.3	1.5	0.43	1.56	2.33	1.53	82.5

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "＊", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

Special Application Bearings



(TYPE A)
With inner ring spacer



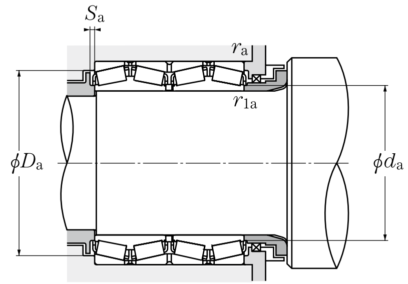
(TYPE B)
Without inner ring spacer

d 288.925 ～ 330mm

d	Boundary dimensions (mm) D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating (kN) dynamic C_r	static C_{0r}	a) b) c)	Bearing number a) to d) (TYPE A) With inner ring spacer
288.925	406.400	298.450	298.450	3.3	3.3	3 300	8 300	◎	**E-M255449D/M255410/M255410DA**
292.100	476.250	296.047	292.100	3.3	1.5	3 400	6 800	◎	**E-EE921150D/921875/921876D**
300	424	310	310	4	5	2 850	7 450		**E-625960**
	430	280	280	4	4	2 990	7 100		**E-CRO-6019**
	430	300	300	4	4	2 990	7 100		**E-CRO-6022**
	460	360	360	4	4	4 500	10 100		**E-CRO-6015**
	470	270	270	4	4	3 500	7 250	☆	**E-CRO-6012**
	470	292	292	4	4	3 900	8 300	☆	**E-CRO-6013**
	500	332	332	5	6	4 000	8 100		**E-623160**
300.038	422.275	311.150	311.150	3.3	3.3	3 700	9 600	◎ ☆	**T-E-HM256849D/HM256810/HM256810DG2**
304.648	438.048	279.400	279.400	3.3	3.3	2 740	6 500	◎	**E-EE329119D/329172/329173D**
	438.048	280.990	279.400	4.8	3.3	2 920	6 900	◎	**E-M757448D/M757410/M757410D**
304.800	419.100	269.875	269.875	6.4	1.5	2 650	6 850	◎	**E-M257149D/M257110/M257110D**
	444.500	247.650	241.300	1.5	8	2 050	4 600	◎	**E-EE291202D/291750/291751D**
	495.300	342.900	349.250	6.4	3.3	4 050	9 400	◎	**E-EE724121D/724195/724196D**
304.902	412.648	266.700	266.700	3.3	3.3	2 860	7 450	◎	**E-M257248D/M257210/M257210D**
305.003	438.048	280.990	279.400	4.8	3.3	2 920	6 900	◎	**E-M757449D/M757410/M757410D**
310	430	310	310	4	2.2	3 200	8 100		**E-CRO-6213**
	430	310	310	5.5	2.2	3 400	8 600		**E-CRO-6204**
317.500	422.275	269.875	269.875	3.3	1.5	2 510	7 050	◎	**E-LM258649D/LM258610/LM258610D**
	447.675	327.025	327.025	3.3	3.3	3 800	9 550	◎	**T-E-HM259049D/HM259010/HM259010D**
320	460	338	338	4	5	3 250	8 650		**E-625964**
327	445	230	230	4	2	2 380	5 650		**E-CRO-6501**
330	470	340	340	2.5	2.5	3 500	10 200		**E-CRO-6604**
	510	340	340	6	6	4 300	9 650		**E-CRO-6602**

1) Smallest allowable dimension for chamfer dimension r or r_1.

Special Application Bearings



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

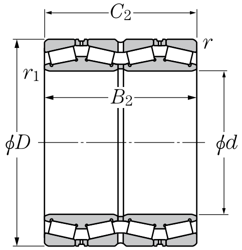
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

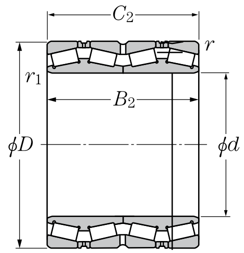
Bearing number a) to d) (TYPE B) Without inner ring spacer	Installation-related dimensions (mm) d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
E-CRO-5815	311	376	5	3.3	3.3	0.34	2.00	2.98	1.96	125
	314	442	7	3.3	1.5	0.29	2.30	3.42	2.25	208
	329	389.5	7	3	4	0.33	2.03	3.02	1.98	138
	325.5	394.5	8	3	3	0.47	1.45	2.16	1.42	132
	323	393.5	3	3	3	0.47	1.45	2.16	1.42	141
	333.5	421.5	10	3	3	0.31	2.21	3.29	2.16	180
	348	432.5	7	3	3	0.37	1.80	2.69	1.76	152
E-CRO-6033	347	430	7	3	3	0.37	1.80	2.69	1.76	164
	346.5	449	5	4	4	0.40	1.68	2.50	1.64	257
	322	394	6	3.3	3.3	0.34	2.00	2.99	1.96	143
	327	410	8	3.3	3.3	0.33	2.04	3.04	2.00	143
	328	407	7	4.8	3.3	0.47	1.43	2.12	1.40	140
E-CRO-6148	330.5	387	5	6.4	1.5	0.33	2.03	3.02	1.98	115
	328	416	9.5	1.5	8	0.38	1.78	2.65	1.74	127
	334	450	3	6.4	3.3	0.40	1.68	2.50	1.64	273
E-CRO-6144	328.5	385.5	5	3.3	3.3	0.32	2.12	3.15	2.07	107
	328	407	7	4.8	3.3	0.47	1.43	2.12	1.40	139
	333	396.5	8.5	3	2	0.40	1.68	2.50	1.64	133
	333.5	397	7.5	4	2	0.33	2.03	3.02	1.98	136
E-CRO-6431	342.5	393.5	7	3.3	1.5	0.32	2.10	3.13	2.06	110
	340	418	5	3.3	3.3	0.33	2.02	3.00	1.97	161
	355	420.5	7	3	4	0.33	2.03	3.02	1.98	183
	353.5	416	5.5	3	2	0.33	2.03	3.02	1.98	99.8
	370	431.5	5.5	2	2	0.33	2.02	3.00	1.97	141
	368	462	5	5	5	0.40	1.68	2.50	1.64	221

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "*", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

Special Application Bearings



(TYPE A)
With inner ring spacer

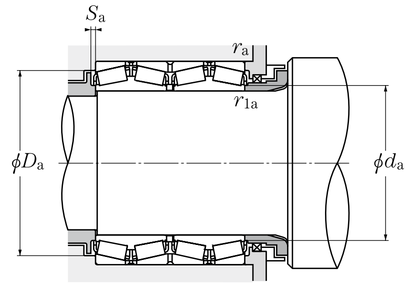


(TYPE B)
Without inner ring spacer

d 330.200 ～ 380mm

Boundary dimensions mm						Basic load rating kN					Bearing number a) to d)
d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	a)	b)	c)	(TYPE A) With inner ring spacer
330.200	482.600	306.388	311.150	3.3	1.5	3 100	7 900	◎			E-EE526131D/526190/526191D
	533.400	254	254	6	6	3 550	6 750				E-CRO-6606
333.375	469.900	342.900	342.900	3.3	3.3	4 400	11 000	◎			E-HM261049D/HM261010/HM261010DA
340	480	350	350	5	6	3 800	10 400				E-625968
	520	278	278	5	6	3 600	7 500				E-623068
341.312	457.098	254.000	254.000	3.3	1.5	2 630	6 900	◎			E-LM761648D/LM761610/LM761610D
342.900	533.400	307.985	301.625	3.3	3.3	3 500	6 900	◎			E-EE971355D/972100/972103D
343.052	457.098	254.000	254.000	3.3	1.5	2 640	6 900	◎			E-LM761649D/LM761610/LM761610D
	457.098	254.000	254.000	3.3	1.5	2 700	6 750				E-CRO-6910
346.075	488.950	358.775	358.775	3.3	3.3	4 850	12 800	◎		☆	T-E-HM262749D/HM262710/HM262710DG2
347.662	469.900	292.100	292.100	3.3	3.3	3 550	9 100	◎			E-M262449D/M262410/M262410D
355.600	444.500	241.300	241.300	3.3	1.5	2 020	6 450	◎			T-E-L163149D/L163110/L163110D
	457.200	252.412	252.412	3.3	1.5	2 730	7 850	◎			E-LM263149D/LM263110/LM263110D
	482.600	265.112	269.875	3.3	1.5	3 100	7 650	◎			E-LM763449D/LM763410/LM763410D
	488.950	317.500	317.500	3.3	1.5	3 850	10 000	◎			E-M263349D/M263310/M263310D
360	508	370	370	5	6	4 100	11 200				E-625972
	520	370	370	5.5	3.5	4 950	12 300				E-CRO-7220
	520	410	410	5	5	5 700	14 700			☆	E-CRO-7217
	540	340	340	5	3	4 850	11 100				E-CRO-7211
	600	396	396	5	6	6 100	13 000				E-623172
368.300	523.875	382.588	382.588	6.4	3.3	4 950	13 100	◎		☆	E-HM265049D/HM265010/HM265010DG2
	596.900	342.900	342.900	6.4	6.4	4 750	10 600	◎			E-EE181455D/182350/182351D
374.650	501.650	250.825	260.350	3.3	1.5	3 000	6 250	◎			E-LM765149D/LM765110/LM765110D
380	536	390	390	5	6	5 450	14 100				E-625976
	560	282	282	5	6	3 950	8 700				E-623076
	560	285	285	5	5	3 600	7 700				E-CRO-7612

1) Smallest allowable dimension for chamfer dimension r or r_1.



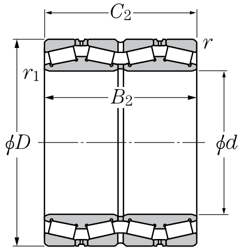
Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

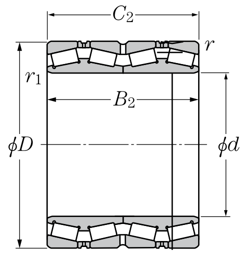
Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number a) to d)	Installation-related dimensions mm					Constant	Axial load factors			Mass kg
(TYPE B) Without inner ring spacer	d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	e	Y_1	Y_2	Y_0	(approx.)
	351	449	3	3.3	1.5	0.39	1.72	2.56	1.68	197
	378.5	488	6.5	5	5	0.37	1.80	2.69	1.76	221
E-CRO-6711	356.5	434	5	3.3	3.3	0.33	2.02	3.00	1.97	187
	373	440.5	7	4	5	0.33	2.03	3.02	1.98	200
	382.5	478	6.5	4	4	0.37	1.80	2.69	1.76	213
	359	432	5	3.3	1.5	0.47	1.43	2.12	1.40	125
	370	501	11	3.3	3.3	0.33	2.03	3.02	1.98	252
E-CRO-6945	367	424.5	5	3.3	1.5	0.47	1.43	2.12	1.40	117
E-CRO-6944	361	426	5	3.3	1.5	0.47	1.43	2.12	1.40	105
	368	456	6	3.3	3.3	0.33	2.02	3.00	1.97	227
	365	444	8	3.3	3.3	0.33	2.03	3.02	1.98	148
	370	422	6.5	3.3	1.5	0.31	2.20	3.27	2.15	89.5
	372	434	6	3.3	1.5	0.32	2.12	3.15	2.07	106
E-CRO-7123	379.5	449	3	3.3	1.5	0.47	1.43	2.14	1.40	145
	374	459	5	3.3	1.5	0.33	2.03	3.02	1.98	173
E-CRO-7227	394	466.5	7	4	5	0.33	2.03	3.02	1.98	236
	391.5	478	5	4.5	3	0.33	2.03	3.02	1.98	260
	396	478	8.5	4	4	0.33	2.03	3.02	1.98	297
	400	496	5	4	2.5	0.33	2.03	3.02	1.98	270
E-CRO-7228	416.5	541.5	8	4	5	0.40	1.68	2.50	1.64	447
E-CRO-7406	408	481.5	6	6.4	3.3	0.33	2.03	3.02	1.98	280
	421	552	7.5	6.4	6.4	0.42	1.62	2.42	1.59	373
	393	472	2	3.3	1.5	0.47	1.43	2.12	1.40	145
	410	494	8	4	5	0.33	2.03	3.02	1.98	277
	421	518.5	6.5	4	4	0.37	1.80	2.69	1.76	240
	420	517	7	4	4	0.40	1.68	2.50	1.64	208

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "＊", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

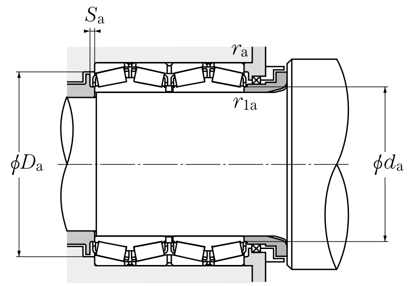


(TYPE A)
With inner ring spacer



(TYPE B)
Without inner ring spacer

● Four-Row Tapered Roller Bearings NTN



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

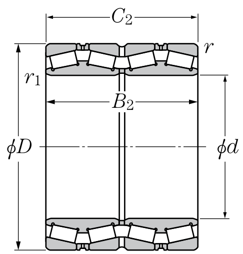
For values of e, Y_1, Y_2 and Y_0 see the table below.

d 380 ～ 447.675mm

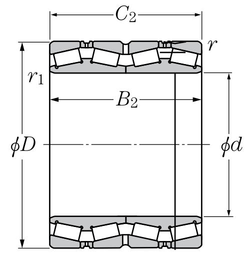
Boundary dimensions (mm) d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating (kN) dynamic C_r	static C_{0r}	a) b) c)	Bearing number a) to d) (TYPE A) With inner ring spacer	Bearing number a) to d) (TYPE B) Without inner ring spacer	Installation-related dimensions (mm) d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
380	560	360	360	6	1.5	5 150	12 100		E-CRO-7622		416.5	514	7	5	1.5	0.40	1.68	2.50	1.64	302
	560	360	360	5	1.5	5 600	13 500	☆	E-CRO-7621		423	514.5	6.5	4	1.5	0.40	1.68	2.50	1.64	312
384.175	546.100	400.050	400.050	6.4	3.3	6 000	16 100	◎ ☆	T-E-HM266449D/HM266410/HM266410DG2		411	507	6.5	6.4	3.3	0.33	2.03	3.02	1.98	312
385.762	514.350	317.500	317.500	3.3	3.3	4 000	11 100	◎	E-LM665949D/LM665910/LM665910D		409	482	7	3.3	3.3	0.42	1.61	2.40	1.58	240
390	510	350	350	3.5	1.5	4 100	11 800		E-CRO-7801		411.5	478	7	3	1.5	0.33	2.03	3.02	1.98	186
393.700	546.100	288.925	288.925	6.4	1.5	3 550	10 200	◎	E-LM767745D/LM767710/LM767710D		418	510	6.5	6.4	1.5	0.48	1.42	2.11	1.38	219
400	564	412	412	5	6	5 400	14 700		E-625980		434	518	7	4	5	0.33	2.03	3.02	1.98	324
	635	470	470	5	2.5	8 000	18 000		E-CRO-8010		447	579.5	6.5	4	2	0.33	2.03	3.02	1.98	564
406.400	546.100	268.288	288.925	6.4	1.5	2 740	7 000	◎	T-E-EE234161D/234215/234216D		425	504	1.5	6.4	1.5	0.48	1.42	2.11	1.39	190
	546.100	288.925	288.925	6.4	1.5	3 550	10 200	◎	E-LM767749D/LM767710/LM767710D		427	510	6.5	6.4	1.5	0.48	1.42	2.11	1.38	201
	565.150	381.000	381.000	6.4	3.3	5 300	14 100		E-CRO-8103		441	524.5	6.5	6.4	3.3	0.35	1.95	2.90	1.91	310
	590.550	400.050	400.050	6.4	3.3	5 350	13 600	◎	E-EE833161D/833232/833233D		435	549	6.5	6.4	3.3	0.33	2.07	3.09	2.03	395
	609.600	309.562	317.500	6.4	3.5	4 100	9 600	◎	E-EE911603D/912400/912401D		437	567	1.5	6.4	3.5	0.38	1.76	2.62	1.72	332
409.575	546.100	334.962	334.962	6.4	1.5	4 400	12 700	◎ ☆	E-M667947D/M667911/M667911DG2		431	510	5.5	6.4	1.5	0.42	1.61	2.40	1.58	226
415.925	590.550	434.975	434.975	6.4	3.3	6 950	18 900	◎ ☆	T-E-M268749D/M268710/M268710DG2		444	548.9	9	6.4	3.3	0.33	2.03	3.02	1.98	421
420	592	432	432	5	6	5 950	16 300		E-625984	E-CRO-8414	457	545	7	4	5	0.33	2.03	3.02	1.98	374
431.800	571.500	279.400	279.400	3.3	1.5	3 550	9 850	◎	T-E-LM869449D/LM869410/LM869410D		453	537	8	3.3	1.5	0.55	1.24	1.84	1.21	193
	571.500	336.550	336.550	6.4	1.5	4 100	11 800	◎	E-LM769349D/LM769310/LM769310D		453	534	6.5	6.4	1.5	0.44	1.52	2.26	1.49	232
	635.000	355.600	355.600	6.4	6.4	6 300	15 000	◎ ☆	E-EE931170D/931250/931251XDG2		468.1	591.1	6.6	6.4	6.4	0.32	2.12	3.15	2.07	402
432.003	609.524	317.500	317.500	6.4	3.5	4 850	11 500	◎	E-EE736173D/736238/736239D		459	570	6.5	6.4	3.5	0.35	1.95	2.90	1.91	297
440	620	454	454	6	6	7 200	19 900		E-625988	E-CRO-8839	479	572.5	8	5	5	0.33	2.03	3.02	1.98	430
	635	470	470	6.4	3.3	7 900	22 100	☆	E-CRO-8808		494	585	9	6.4	3.3	0.33	2.03	3.02	1.98	498
	650	355	355	7.5	4	5 950	13 400	☆	E-CRO-8807		498	601	9	6	3	0.33	2.03	3.02	1.98	400
447.675	635.000	463.550	463.550	6.4	3.3	7 900	22 100	◎ ☆	E-M270749D/M270710/M270710DG2		478	591	8	6.4	3.3	0.33	2.03	3.02	1.98	509

1) Smallest allowable dimension for chamfer dimension r or r_1.

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "*", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.



(TYPE A)
With inner ring spacer

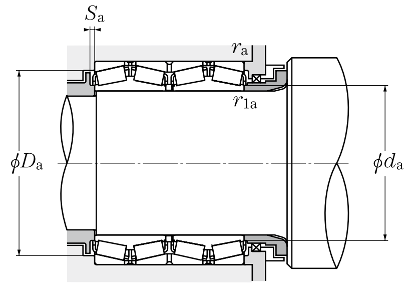


(TYPE B)
Without inner ring spacer

d 457.200 ～ 555.625mm

d	Boundary dimensions (mm) D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	Basic load rating (kN) dynamic C_r	static C_{0r}	a)	b)	c)	Bearing number a) to d) (TYPE A) With inner ring spacer
457.200	596.900	276.225	279.400	3.3	1.5	3 200	9 150	◎			E-L770849D/L770810/L770810D
	596.900	276.225	276.225	3.3	1.6	3 200	9 400	◎			E-EE244181D/244235/244236D
	660.400	323.850	323.847	6.4	3.3	4 600	11 200	◎			E-EE737179D/737260/737260D
460	650	474	474	6	6	7 200	19 900				E-625992A
475	660	450	450	5	3	7 250	20 400				E-CRO-9501
480	678	494	494	6	6	6 950	19 600				E-625996
	678	494	494	6	6	6 950	19 600				E-CRO-9612
482.600	615.950	330.200	330.200	6.4	3.3	4 400	13 400	◎		☆	E-LM272249D/LM272210/LM272210DG2
488.950	660.400	365.125	361.950	6.4	8	5 950	16 100	◎		☆	T-E-EE640193D/640260/640261DG2
489.026	634.873	320.675	320.675	3.3	3.3	4 750	12 000	◎			E-LM772749D/LM772710/LM772710DA
500	670	515	515	5	1.5	7 450	24 600				E-CRO-10008
	705	515	515	6	6	9 350	27 100			☆	E-6259/500
	730	420	420	6	6	8 250	19 900			☆	E-CRO-10023
501.650	711.200	520.700	520.700	6.4	3.3	9 600	27 300	◎		☆	E-M274149D/M274110/M274110DG2
508.000	762.000	463.550	463.550	6.4	6.4	8 600	21 400	◎		☆	E-EE531201D/531300/531301XDG2
509.948	654.924	377.000	379.000	6.4	1.5	5 650	17 600			☆	E-CRO-10208
514.350	673.100	422.275	422.275	6.4	3.3	6 600	20 500	◎			E-LM274449D/LM274410/LM274410D
519.112	736.600	536.575	536.575	6.4	3.3	10 100	28 700	◎		☆	E-M275349D/M275310/M275310DG2
520	735	535	535	5	7	10 100	28 700			☆	E-CRO-10402
533.400	965.200	495.300	495.300	7.5	7.5	12 300	28 700			☆	E-CRO-10702
536.575	761.873	558.800	558.800	6.4	3.3	11 200	30 500	◎		☆	E-M276449D/M276410/M276410DG2
555.625	698.500	349.250	349.250	6.4	3.2	4 850	14 300				E-CRO-11101

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

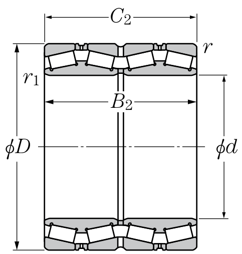
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

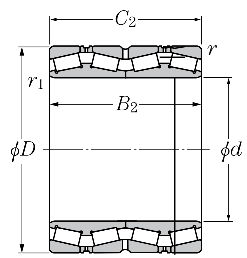
Bearing number a) to d) (TYPE B) Without inner ring spacer	Installation-related dimensions (mm) d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	Constant e	Axial load factors Y_1	Y_2	Y_0	Mass kg (approx.)
	478	567	5.5	3.3	1.5	0.47	1.43	2.12	1.40	201
	478	567	5.5	3.3	1.6	0.40	1.67	2.49	1.63	207
	489	614.9	6.5	6.4	3.3	0.37	1.80	2.69	1.76	379
	499	598.5	7	5	5	0.33	2.03	3.02	1.98	493
E-CRO-9508	510.5	611.5	10	4	2.5	0.34	1.98	2.94	1.93	465
	525.5	623	7	5	5	0.33	2.03	3.02	1.98	563
	525	622.5	2	5	5	0.33	2.03	3.02	1.98	554
	504	585	6.5	6.4	3.3	0.33	2.03	3.02	1.98	250
	516	624	9	6.4	8	0.31	2.20	3.27	2.15	364
	516	600	6.5	3.3	3.3	0.47	1.43	2.12	1.40	268
	526.5	619	8	4	1.5	0.40	1.68	2.50	1.64	598
	553	649.5	7.5	5	5	0.33	2.03	3.02	1.98	632
	554	675	7.5	5	5	0.40	1.68	2.50	1.64	606
	534	663	9.5	6.4	3.3	0.33	2.03	3.02	1.98	726
	550.7	710.9	9.5	6.4	6.4	0.38	1.77	2.64	1.73	740
E-CRO-10214	540	611.5	5	6.4	1.5	0.41	1.65	2.46	1.61	320
	540	636	8	6.4	3.3	0.33	2.03	3.02	1.98	390
E-CRO-10408	569	677	9.5	6.4	3.3	0.33	2.03	3.02	1.98	761
	569	676.5	11	4	6	0.33	2.03	3.02	1.98	750
	680	854.5	7.5	6	6	0.32	2.12	3.15	2.07	1 662
	564	711	9.5	6.4	3.3	0.33	2.03	3.02	1.98	890
E-CRO-11103	581	659	6.5	6.4	3.3	0.33	2.03	3.02	1.98	298

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "*", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

Special Application Bearings

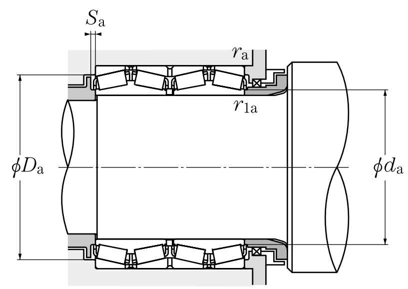


(TYPE A)
With inner ring spacer



(TYPE B)
Without inner ring spacer

Four-Row Tapered Roller Bearings



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

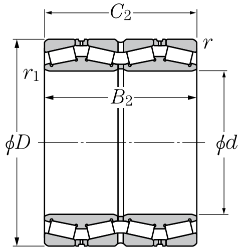
Static equivalent radial load
$P_{0r} = F_r + Y_0F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

d 558.800 ～ 749.300mm

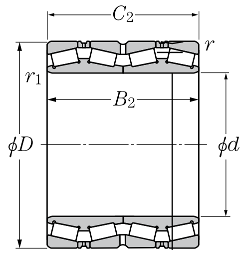
Boundary dimensions (mm)						Basic load rating (kN)			Bearing number a) to d)	Bearing number a) to d)	Installation-related dimensions (mm)					Constant	Axial load factors			Mass (kg)
d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	dynamic C_r	static C_{0r}	a) b) c)	(TYPE A) With inner ring spacer	(TYPE B) Without inner ring spacer	d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	e	Y_1	Y_2	Y_0	(approx.)
558.800	736.600	322.265	322.268	6.4	3.3	4 750	13 500	◎	**E-EE843221D/843290/843291D**		585	699	8.5	6.4	3.3	0.34	1.98	2.94	1.93	388
	736.600	409.575	409.575	6.4	3.3	6 750	20 500	◎ ☆	**E-LM377449D/LM377410/LM377410DG2**	**E-CRO-11216**	602	688	8	6.4	3.3	0.35	1.95	2.90	1.91	502
570	780	515	515	6	6	10 200	31 000	☆	**E-CRO-11402**		622	723	7.5	5	5	0.33	2.03	3.02	1.98	625
571.500	812.800	593.725	593.725	6.4	3.3	13 200	36 500	◎ ☆	**E-M278749D/M278710/M278710DAG2**		609	756	11	6.4	3.3	0.33	2.03	3.02	1.98	1 080
584.200	762.000	396.875	401.638	6.4	3.3	7 300	22 300	◎ ☆	**E-LM778549D/LM778510/LM778510DG2**		615	717	7	6.4	3.3	0.47	1.43	2.14	1.40	511
585.788	771.525	479.425	479.425	6.4	3.3	8 150	25 700	☆	**E-CRO-11701**		628	717.5	9.5	6.4	3.3	0.35	1.95	2.90	1.91	610
595.312	844.550	615.950	615.950	6.4	3.3	13 600	39 000	☆	**E-CRO-11913**		654	781	7	6.4	3.3	0.33	2.03	3.02	1.98	1 135
	844.550	615.950	615.950	6.4	3.3	14 000	40 500	◎ ☆	**E-M280049D/M280010/M280010DG2**		633	786	11	6.4	3.3	0.33	2.03	3.02	1.98	1 160
609.600	787.400	361.950	361.950	6.4	3.3	7 150	20 300	◎ ☆	**E-EE649241D/649310/649311DG2**		636	747	9.5	6.4	3.3	0.33	2.03	3.02	1.98	458
	863.600	660.400	660.400	6.4	3.3	15 000	42 000	◎ ☆	**E-M280349D/M280310/M280310DG2**		648	807	13.5	6.4	3.3	0.33	2.03	3.02	1.98	1 250
611.500	832.800	593.725	593.725	6.4	3.3	12 700	37 500	☆	**E-CRO-12202**		660	776	11.5	6.4	3.3	0.33	2.03	3.02	1.98	960
630	920	600	600	7.5	7.8	14 600	39 000	☆	**E-CRO-12604**		702	848.5	7.5	6	6	0.33	2.03	3.02	1.98	1 390
650	1 030	560	560	7.5	12	15 000	35 000	☆	**E-CRO-13001**		765	947.5	8.5	6	10	0.32	2.12	3.15	2.07	1 760
660	1 070	642	642	7.5	7.5	17 000	43 500	☆	**E-CRO-13202**		778	964	9	6	6	0.32	2.12	3.15	2.07	1 950
660.400	812.800	365.125	365.125	6.4	3.3	6 900	23 200	◎ ☆	**E-L281149D/L281110/L281110DG2**	**E-CRO-13211**	695	770.5	9	6.4	3.3	0.37	1.80	2.69	1.76	448
670	960	700	700	7.5	7.5	18 500	51 500	☆	**E-CRO-13401**		740	888.5	8	6	6	0.33	2.03	3.02	1.98	1 600
	1 090	710	710	7.5	7.5	21 200	50 000	☆	**E-CRO-13404**		782	996.5	13.5	6	6	0.29	2.32	3.45	2.26	2 690
	1 090	710	710	7.5	7.5	19 300	47 500	☆	**E-CRO-13402**		799	995.5	13.5	6	6	0.32	2.12	3.15	2.07	2 600
685.800	876.300	352.425	355.600	6.4	3.3	6 700	21 800	◎ ☆	**E-EE655271D/655345/655346DG2**	**E-CRO-13708**	738	824	8	6.4	3.3	0.42	1.61	2.40	1.58	539
711.200	914.400	317.500	317.500	6.4	16	5 900	17 900	◎ ☆	**E-EE755280D/755360/755361DG2**		762	873	8	6.4	16	0.38	1.77	2.64	1.73	527
730.250	1 035.050	755.650	755.650	6.4	3.3	20 100	59 500	◎ ☆	**E-M283449D/M283410/M283410DG2**	**E-CRO-14601**	804	961	13	6.4	3.3	0.33	2.03	3.02	1.98	2 210
749.300	990.600	605.000	605.000	6.4	3.3	14 000	45 500	◎ ☆	**E-LM283649D/LM283610/LM283610DG2**		786	936	10.5	6.4	3.3	0.33	2.03	3.02	1.98	1 250

1) Smallest allowable dimension for chamfer dimension r or r_1.

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "∗", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.



(TYPE A)
With inner ring spacer

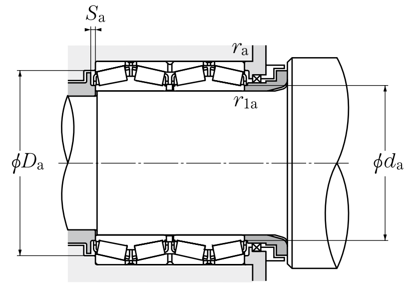


(TYPE B)
Without inner ring spacer

d 762 ～ 938.212mm

	Boundary dimensions					Basic load rating			Bearing number a) to d)
	mm					dynamic kN	static		
d	D	B_2	C_2	$r_{s\,min}$ 1)	$r_{1s\,min}$ 1)	C_r	C_{0r}	a) b) c)	(TYPE A) With inner ring spacer
762.000	1 066.800	723.900	736.600	12.7	4.3	19 500	58 500	◎ ☆	**E-M284148D/M284111/M284210DG2**
	1 079.500	787.400	787.400	12.7	4.8	21 100	65 000	◎ ☆	**E-M284249D/M284210/M284210DG2**
825.500	1 168.400	844.550	844.550	12.7	4.8	24 700	76 500	◎ ☆	**E-M285848D/M285810/M285810DG2**
840	1 170	840	840	6	6	24 300	76 500	☆	**E-CRO-16803**
863.600	1 130.300	669.925	669.925	12.7	4.8	17 500	59 500	◎ ☆	**E-LM286249D/LM286210/LM286210DG2**
	1 219.200	876.300	889.000	12.7	4.8	26 700	83 000	◎ ☆	**E-EE547341D/547480/547481DG2**
938.212	1 270.000	825.500	825.500	12.7	4.8	25 000	80 000	◎ ☆	**E-LM287649D/LM287610/LM287610DG2**

1) Smallest allowable dimension for chamfer dimension r or r_1.



Dynamic equivalent radial load
$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

Static equivalent radial load
$P_{0r} = F_r + Y_0 F_a$
For values of e, Y_1, Y_2 and Y_0 see the table below.

Bearing number a) to d)	Installation-related dimensions					Constant	Axial load factors			Mass
	mm									kg
(TYPE B) Without inner ring spacer	d_a	D_a	S_a Min.	r_{as} Max.	r_{1as} Max.	e	Y_1	Y_2	Y_0	(approx.)
	819	978	3.5	12.7	4.3	0.33	2.03	3.02	1.98	2 220
	810	1 005	13	12.7	4.8	0.33	2.03	3.02	1.98	2 480
	879	1 085	13	12.7	4.8	0.33	2.03	3.02	1.98	3 010
	918	1 081	12	5	5	0.33	2.03	3.02	1.98	3 970
E-CRO-17302	928	1 056	11	12.7	4.8	0.33	2.03	3.02	1.98	1 950
E-CRO-17301	946	1 123.5	6.5	12.7	4.8	0.33	2.03	3.02	1.98	3 640
E-CRO-18802	1 015	1 183	10	12.7	4.8	0.33	2.03	3.02	1.98	4 100

a) Bearing numbers marked "◎" designate inch series bearings. b) When adopting bearings with bearing numbers marked with "*", please consult **NTN** Engineering.
c) Bearing numbers marked "☆" designate bearings with hollow rollers and pin type cages. d) Contact **NTN** Engineering for bearing numbers (TYPE B) without an inner ring spacer that are not listed.

The **NTN** ultra-thin section type ball bearings are bearings with an extremely thin design. There are three ultra-thin ball bearing types: radial, four-point contact, and angular. Bearing seals are available for all types.

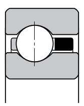
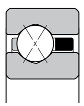
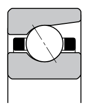
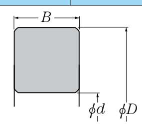
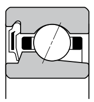
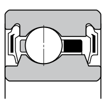
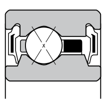
Each bearing type has different characteristics to best support a wide range of applications.

1. Types and features

Table 1 shows the types and features of ultra-thin section type ball bearings, corresponding dimension series code, bearing cross section dimension, and inner diameter dimension range.

The dimension table (from C-62 to C-65) shows dimension series codes S and A, and H and J for bearings with seal.

Table 1 Types and features

	Types			Dimension series code	Bearing cross section dimension mm	Inner diameter dimension range mm
	Radial type	4-point contact type	Angular type			
					 $\frac{D-d}{2} \times B$	 d
Features	A deep groove is present in both the inner and outer rings of the bearing, allowing them to support radial and axial loads in either direction as well as the complex loads which result from the combination of these forces. Deep groove ball bearings are used in the most applications.	When inner and outer rings are loaded in the radial direction, the ball comes into contact with the inner and outer rings at four points. The bearings are generally suitable for two contact points under a simple axial load or a complex load with a large axial load.	Angular contact ball bearings have a straight line that runs through the point where each ball contacts the inner and outer rings at two points at 30° with respect to the radial direction. The bearings can receive a unidirectional axial load or a complex load of radial load and axial load. The ability to include an increased number of balls increases the load capacity of the bearing. These bearings are normally used in pairs for applications where it is necessary to control the axial movement via axial internal clearance or preload.	S	4.762 × 4.762	25.4 ~ 38.1
				A	6.35 × 6.35	50.8 ~ 304.8
				B	7.938 × 7.938	50.8 ~ 508
				C	9.525 × 9.525	101.6 ~ 762
				D	12.7 × 12.7	101.6 ~ 762
				F	19.05 × 19.05	101.6 ~ 1 016
				G	25.4 × 25.4	101.6 ~ 1 016
With seal	—	—	 With single-seal	H	9.525 × 11.1	101.6 ~ 304.8
	 With double-seal	 With double-seal	—	J	9.525 × 12.7	101.6 ~ 304.8

Ultra-Thin Section Type Ball Bearings NTN

2. Part number

K X A 050

- Bore diameter No.
  The bearing bore diameter is represented in inches.
  050 → 5 inch   042 → 4.25 inch
- Dimension series code
  (see **Table 1**)
- Type code
  Code   Type
  R → Radial type
  X → 4-point contact type
  Y → Angular type
- Ultra-thin section type ball bearing

3. Accuracy and radial internal clearance

Tables 2 and **3** show the accuracy and radial internal clearance of ultra-thin section type ball bearings.

Table 2 Accuracy and radial internal clearance of radial type ball bearings

unit: μm

Bearing bore diameter No.	Tolerance and tolerance values: Mean bore diameter deviation Δ_{dmp}	Mean outside diameter deviation Δ_{Dmp}	Dimensional tolerance of inner ring and outer ring widths Δ_{Bs} Δ_{Cs}	Radial runout / Axial runout (Max.): Inner ring K_{ia} S_{ia}	Radial runout / Axial runout (Max.): Outer ring K_{ea} S_{ea}	Radial internal clearance
010	0 / −10	0 / −13	0 / −125	13	20	25~ 41
015	0 / −13			15		30~ 46
020	0 / −15			20	25	30~ 61
025						
030		0 / −15				
035	0 / −20			25	30	41~ 71
040						
042		0 / −20			36	
045						
047	0 / −25			30		51~ 86
050		0 / −25				
055					41	
060						
065						
070		0 / −30				
075	0 / −30			41	46	61~107
080						
090						
100	0 / −36	0 / −36		46	51	71~122
110						
120						
140	0 / −41	0 / −41	0 / −250			81~132
160	0 / −46	0 / −46				91~142
180				51		
200	0 / −51	0 / −51				102~152
250	0 / −76	0 / −76				152~203
300						
350	0 / −102	0 / −102				203~254
400						

Table 3 Accuracy and radial internal clearance of four-point contact ball bearings/angular type ball bearings

unit: μm

Bearing bore diameter No.	Tolerance and tolerance values: Mean bore diameter deviation Δ_{dmp}	Mean outside diameter deviation Δ_{Dmp}	Dimensional tolerance of inner ring and outer ring widths Δ_{Bs} Δ_{Cs}	Radial runout / Axial runout (Max.): Inner ring K_{ia} S_{ia}	Radial runout / Axial runout (Max.): Outer ring K_{ea} S_{ea}	Radial internal clearance (4-point contact type)
010	0 / −10	0 / −13	0 / −125	7.5	10	25~ 38
015	0 / −13			10		30~ 43
020	0 / −15			13	13	30~ 56
025						
030		0 / −15		15	15	
035	0 / −20					41~ 66
040						
042		0 / −20		20	20	
045						
047	0 / −25					51~ 76
050						
055		0 / −25		25	25	
060						
065						
070		0 / −30				
075	0 / −30			30	30	61~ 86
080						
090						
100	0 / −36	0 / −36		36	36	71~ 97
110						
120						
140			0 / −250			
160	0 / −41	0 / −41		41	41	81~107
180						
200	0 / −46	0 / −46		46	46	91~117
250						
300						
350	0 / −51	0 / −51		51	51	102~127
400						

4. Dimensional tolerance of shaft and housing bores

Table 4 shows the recommended tolerance of shaft and housing bores when using ultra-thin section type ball bearings.

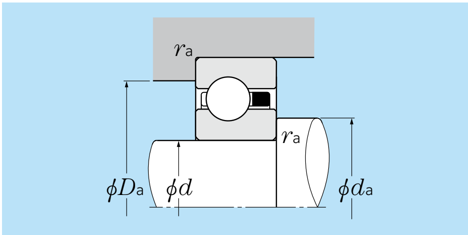


Table 4 Dimensional tolerance of shafts and housings

unit: μm

Bearing bore diameter No.	For radial type ball bearings				For four-point contact type/ angular type ball bearings			
	Inner ring rotation		Outer ring rotation		Inner ring rotation		Outer ring rotation	
	Shaft	Housing	Shaft	Housing	Shaft	Housing	Shaft	Housing
010	+10 0	+13 0	−10 −20	−13 −25	+10 0	+13 0	−10 −20	−13 −25
015	+13 0		−13 −25		+13 0		−13 −25	
020	+15 0	+15 0	−15 −30	−15 −30	+15 0		−15 −30	
025								
030						+15 0		−15 −30
035	+20 0		−20 −40		+20 0		−20 −40	
040								
042		+20 0		−20 −40		+20 0		−20 −40
045								
047	+25 0		−25 −50		+25 0		−25 −50	
050								
055		+25 0		−25 −50		+25 0		−25 −50
060								
065								
070		+30 0		−30 −60		+30 0		−30 −60
075	+30 0		−30 −60		+30 0		−30 −60	
080								
090								
100	+35 0	+35 0	−35 −70	−35 −70	+35 0	+35 0	−35 −70	−35 −70
110								
120								
140	+40 0	+40 0	−40 −80	−40 −80				
160	+45 0	+45 0	−45 −90	−45 −90	+40 0	+40 0	−40 −80	−40 −80
180								
200	+50 0	+50 0	−50 −100	−50 −100	+45 0	+45 0	−45 −90	−45 −90
250	+75 0	+75 0	−75 −150	−75 −150				
300								
350	+100 0	+100 0	−100 −200	−100 −200	+100 0	+100 0	−50 −100	−50 −100
400								

5. Installation-related dimensions of shafts and housings

Table 5 shows the installation-related dimensions of shafts and housings when using ultra-thin section type ball bearings.

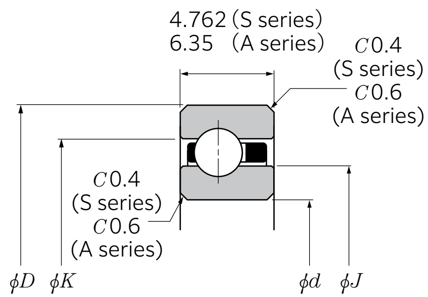
Table 5 Installation-related dimensions of shafts and housings

unit: mm

Dimension series code	d_a $d+f$ (Max.) $d+e$ (Min.)		D_a $d+h$ (Max.) $d+g$ (Min.)		r_{as} (Max.)
	e	f	g	h	
S	3.4	5.3	4.2	6.1	0.2
A	4.6	7.3	5.4	8.2	0.4
B	5.7	9.3	6.6	10.2	0.8
C	6.9	11.3	7.7	12.2	0.8
D	9.2	15.3	10.1	16.2	1.3
F	13.9	23.3	14.8	24.2	1.8
G	18.7	31.3	19.5	32.1	1.8
J,H [1]	6.9	11.3	7.7	12.2	0.2

1) Bearings with seal

S series
A series

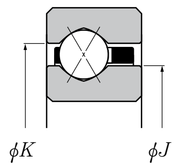


Radial type

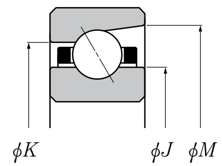
d 25.4 ～ 304.8mm

Boundary dimensions mm		Radial type Basic load rating kN dynamic	static	Fatigue load limit	4-point contact type Basic load rating kN Radial dynamic	static	Basic load rating Axial dynamic	static	Fatigue load limit	Angular type Basic load rating kN Radial dynamic	static	Basic load rating Axial dynamic	static	Fatigue load limit
d	D	C_r	C_{0r}	C_u	C_r	C_{0r}	C_a	C_{0a}	C_u	C_r	C_{0r}	C_a	C_{0a}	C_u
25.4	34.925	2.75	1.94	0.084	2.40	1.66	3.15	5.05	0.181	2.91	2.21	3.80	6.70	0.147
38.1	47.625	3.10	2.60	0.112	2.71	2.23	3.55	6.75	0.243	3.35	3.10	4.40	9.35	0.205
50.8	63.5	5.00	4.30	0.186	4.35	3.70	5.70	11.2	0.400	5.25	4.95	6.90	14.9	0.325
63.5	76.2	5.40	5.20	0.224	4.70	4.45	6.15	13.5	0.485	5.65	5.95	7.45	18.1	0.395
76.2	88.9	5.75	6.10	0.263	5.00	5.25	6.55	15.9	0.570	6.05	7.00	7.95	21.2	0.465
88.9	101.6	6.05	7.00	0.300	5.25	6.00	6.90	18.2	0.655	6.35	8.00	8.35	24.3	0.530
101.6	114.3	6.35	7.85	0.325	5.50	6.80	7.25	20.6	0.710	6.65	9.05	8.75	27.4	0.580
107.95	120.65	6.50	8.30	0.335	5.60	7.15	7.40	21.7	0.730	6.80	9.55	8.95	29.0	0.595
114.3	127	6.60	8.75	0.345	5.75	7.55	7.55	22.9	0.750	6.95	10.1	9.15	30.5	0.610
120.65	133.35	6.75	9.20	0.350	5.85	7.95	7.70	24.1	0.765	7.10	10.6	9.30	32.0	0.625
127	139.7	6.85	9.65	0.360	5.95	8.35	7.85	25.2	0.785	7.20	11.1	9.50	33.5	0.640
139.7	152.4	7.10	10.5	0.375	6.15	9.10	8.10	27.6	0.820	7.45	12.1	9.80	37.0	0.665
152.4	165.1	7.35	11.4	0.390	6.35	9.85	8.35	29.9	0.855	7.70	13.2	10.1	40.0	0.695
165.1	177.8	7.55	12.3	0.405	6.55	10.6	8.60	32.0	0.885	7.90	14.2	10.4	43.0	0.720
177.8	190.5	7.75	13.2	0.420	6.70	11.4	8.80	34.5	0.915	8.10	15.2	10.7	46.0	0.745
190.5	203.2	7.95	14.1	0.435	6.85	12.2	9.05	37.0	0.945	8.30	16.2	10.9	49.0	0.770
203.2	215.9	8.10	15.0	0.445	7.05	13.0	9.25	38.0	0.975	8.50	17.3	11.2	52.5	0.790
228.6	241.3	8.45	16.8	0.470	7.35	14.5	9.65	44.0	1.03	8.90	19.3	11.7	58.5	0.835
254	266.7	8.80	18.6	0.495	7.60	16.0	10.0	48.5	1.08	9.20	21.4	12.1	65.0	0.880
279.4	292.1	8.10	20.3	0.520	7.90	17.6	10.4	53.5	1.13	9.55	23.4	12.6	71.0	0.920
304.8	317.5	9.40	22.1	0.540	8.15	19.1	10.7	58.0	1.18	9.85	25.5	13.0	77.5	0.960

Note: The upper two rows indicate the S series, and the other rows indicate the A series.



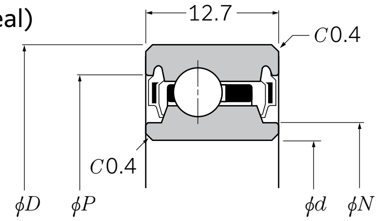
4-point contact type



Angular type

Bearing number Radial type	4-point contact type	Angular type	Approx. dimension mm J	K	M	Mass kg Radial type 4-point contact type (approx.)	Angular type
KRS010	**KXS**	**KYS**	29	31.4	32.6	0.012	0.011
KRS015	**KXS**	**KYS**	41.7	44.1	45.2	0.018	0.017
KRA020	**KXA**	**KYA**	55.5	58.8	60.3	0.048	0.045
KRA025	**KXA**	**KYA**	68.2	71.5	73	0.059	0.054
KRA030	**KXA**	**KYA**	80.9	84.2	85.7	0.068	0.064
KRA035	**KXA**	**KYA**	93.6	96.9	98.4	0.082	0.077
KRA040	**KXA**	**KYA**	106.3	109.6	111	0.09	0.086
KRA042	**KXA**	**KYA**	112.7	115.9	117.4	0.095	0.091
KRA045	**KXA**	**KYA**	119	122.3	123.7	0.1	0.095
KRA047	**KXA**	**KYA**	125.4	128.6	130.1	0.104	0.1
KRA050	**KXA**	**KYA**	131.7	135	136.4	0.109	0.104
KRA055	**KXA**	**KYA**	144.4	147.7	149.1	0.118	0.113
KRA060	**KXA**	**KYA**	157.1	160.4	161.8	0.13	0.127
KRA065	**KXA**	**KYA**	169.8	173.1	174.5	0.14	0.136
KRA070	**KXA**	**KYA**	182.5	185.8	187.1	0.15	0.145
KRA075	**KXA**	**KYA**	195.2	198.5	199.8	0.16	0.154
KRA080	**KXA**	**KYA**	207.9	211.2	212.5	0.172	0.163
KRA090	**KXA**	**KYA**	233.3	236.6	237.9	0.2	0.186
KRA100	**KXA**	**KYA**	258.7	262	263.2	0.227	0.204
KRA110	**KXA**	**KYA**	284.1	287.4	288.6	0.236	0.227
KRA120	**KXA**	**KYA**	309.5	312.8	314	0.254	0.245

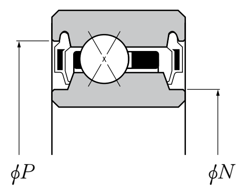
H series (with single-seal)
J series (with double-seal)



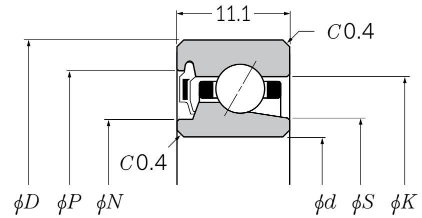
Radial type (with double-seal)

d 101.6 ～ 304.8mm

Boundary dimensions mm		Radial type Basic load rating kN Radial		Fatigue load limit	4-point contact type Basic load rating kN Radial		Basic load rating Axial		Fatigue load limit	Angular type Basic load rating kN Radial		Basic load rating Axial		Fatigue load limit
		dynamic	static		dynamic	static	dynamic	static		dynamic	static	dynamic	static	
d	D	C_r	C_{0r}	C_u	C_r	C_{0r}	C_a	C_{0a}	C_u	C_r	C_{0r}	C_a	C_{0a}	C_u
101.6	120.65	11.4	12.4	0.505	9.90	10.6	13.1	32.0	1.10	12.4	14.9	16.3	45.0	0.935
107.95	127	11.7	13.0	0.520	10.1	11.2	13.3	34.0	1.13	12.7	15.8	16.7	48.0	0.965
114.3	133.35	11.9	13.7	0.530	10.3	11.8	13.6	35.5	1.15	13.0	16.6	17.1	50.5	0.990
120.65	139.7	12.1	14.4	0.545	10.5	12.4	13.9	37.5	1.18	13.3	17.5	17.5	53.0	1.02
127	146.05	12.4	15.0	0.555	10.7	12.9	14.1	39.0	1.21	13.5	18.4	17.8	55.5	1.04
139.7	158.75	12.8	16.4	0.580	11.1	14.1	14.6	42.5	1.26	13.9	19.8	18.3	60.0	1.08
152.4	171.45	13.2	17.7	0.600	11.4	15.3	15.0	46.5	1.31	14.4	21.5	18.9	65.5	1.12
165.1	184.15	13.6	19.1	0.620	11.7	16.4	15.5	50.0	1.35	14.8	23.3	19.5	70.5	1.17
177.8	196.85	13.9	20.4	0.640	12.1	17.6	15.9	53.5	1.40	15.1	24.7	19.9	75.0	1.20
190.5	209.55	14.3	21.7	0.660	12.3	18.7	16.2	57.0	1.44	15.5	26.5	20.5	80.0	1.24
203.2	222.25	14.6	23.1	0.680	12.6	19.9	16.7	60.5	1.48	15.9	28.2	21.0	85.5	1.28
228.6	247.65	15.2	25.7	0.720	13.2	22.2	17.3	67.5	1.57	16.6	31.5	21.8	95.0	1.35
254	273.05	15.8	28.4	0.755	13.7	24.5	18.0	74.5	1.64	17.3	35.0	22.7	106	1.43
279.4	298.45	16.3	31.0	0.790	14.1	26.8	18.6	81.5	1.72	17.8	38.0	23.5	115	1.49
304.8	323.85	16.8	34.0	0.820	14.6	29.2	19.2	88.5	1.79	18.4	41.0	24.2	125	1.54



4-point contact type
(with double-seal)



Angular type
(with single-seal)

Bearing number Radial type	4-point contact type	Angular type	Approx. dimension mm N	P	S	K	Mass kg (approx.) Radial type 4-point contact type	Angular type
KRJ040LL	**KXJ**	**KYH**	105.5	115.9	106.2	113.6	0.249	0.222
KRJ042LL	**KXJ**	**KYH**	111.8	122.2	112.6	120	0.263	0.236
KRJ045LL	**KXJ**	**KYH**	118.2	128.6	119.1	126.3	0.277	0.254
KRJ047LL	**KXJ**	**KYH**	124.6	135	125.3	132.7	0.295	0.268
KRJ050LL	**KXJ**	**KYH**	130.9	141.3	131.7	139	0.308	0.281
KRJ055LL	**KXJ**	**KYH**	143.6	154	144.4	151.7	0.336	0.304
KRJ060LL	**KXJ**	**KYH**	156.3	166.7	157.1	164.4	0.367	0.331
KRJ065LL	**KXJ**	**KYH**	169	179.4	169.8	177.1	0.395	0.354
KRJ070LL	**KXJ**	**KYH**	181.7	192.1	182.4	189.8	0.422	0.381
KRJ075LL	**KXJ**	**KYH**	194.4	204.8	195.2	202.5	0.45	0.404
KRJ080LL	**KXJ**	**KYH**	207.1	217.5	207.9	215.2	0.481	0.431
KRJ090LL	**KXJ**	**KYH**	232.5	242.9	233.4	240.6	0.535	0.5
KRJ100LL	**KXJ**	**KYH**	257.9	268.3	258.8	266	0.594	0.531
KRJ110LL	**KXJ**	**KYH**	283.3	293.7	284.2	291.4	0.648	0.581
KRJ120LL	**KXJ**	**KYH**	308.7	319.1	309.7	316.8	0.708	0.63

Fixed side SL type cylindrical roller bearing (open type)

Floating side SL type cylindrical roller bearing (open type)

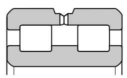
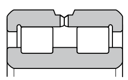
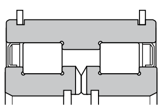
SL type cylindrical roller bearing for sheaves (sealed type)

1. Types, design features, and characteristics

SL type cylindrical roller bearings are double-row full complement cylindrical roller bearings that have a thin cross-section and can withstand extremely large radial loads and impact loads. These bearings are suitable for a wide range of slow-moderate speed, heavily loaded applications such as construction machinery, vehicles, steel machinery, and lifting machinery.

These bearings can be produced both with and without seals. **Table 1** shows the characteristics of this bearing type.

Table 1 SL type cylindrical roller bearing types and characteristics

Type		Features
Open type	 SL01 type  SL02 type	● The SL01 type is used for fixed side bearings and the SL02 is used for float side bearings. ● The outer ring is divided in the circumferential direction by a special method and reconnected after rollers are embedded. **The bearing side surface needs to be firmly fixed in the axial direction by the shoulders of shafts and housings**. ● The outer ring has oil grooves and oil holes. ● The SL01 type can receive an axial load in both directions. ● Dimensions D_a and d_a are applied for the shoulder dimension of shafts and housings. However, when a moment load or a large axial load is to be used, dimensions J and K are recommended. The dimension table (from C-68 to C-71) shows dimension series codes d_a, D_a, J and K.
Sealed type	 SL04 type	● The SL04 type is only designed as the fixed side bearing. ● The inner ring is divided in the circumferential direction by a special method and reconnected after rollers are embedded. **The bearing side surface needs to be firmly fixed in the axial direction by the shoulders of shafts and housings**. ● The inner ring has oil grooves and oil holes. ● A radial load and an axial load in both directions can be applied to the bearing. ● The bearings are shielded, filled with grease, and have snap rings in the outer ring. These bearings are allow easy design into the application. The bearings are mainly used for sheaves. ● Surface coating treatment is applied to prevent rust.

Note: For SL type cylindrical roller bearings, three-row, four-row, and five-row bearings are also available besides the double-row.
Please contact **NTN** Engineering.

2. Dimensional and rotational accuracy

SL type cylindrical roller bearings are made according to JIS class 0 (refer to **Table 6.4** (A-58 to A-59) in section "6. Bearing tolerances"). The outer ring accuracy of the SL01 type and the SL02 type is before division. Regarding the SL04 type, the inner ring accuracy is before surface treatment and division, and the outer ring accuracy is before surface treatment.

3. Radial internal clearance

Table 2 shows the radial internal clearance values. It should be noted that the values differ from standard cylindrical roller bearings.

4. Selection of recommended fits and radial internal clearance

Table 3 shows the recommended fits when the bearings are used in outer ring rotating applications such as sheaves and wheels. **Table 4** shows the relationship between the fits and the radial internal clearance.

It is necessary to equally apply load on the entire surface of the raceway end on the bearing side face at the time of assembly and removal.

Table 2 Radial internal clearance unit: μm

Nominal bearing bore diameter d mm		CN (normal)		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.
30	50	20	75	40	95	55	110
50	80	30	90	55	115	75	135
80	120	35	105	80	150	105	175
120	180	60	150	110	200	150	240
180	250	90	190	155	255	205	305
250	315	110	225	195	310	255	370
315	400	140	265	245	370	320	445
400	500	180	320	300	440	395	535

Table 3 Recommended fits

Condition		Shaft tolerance class	Housing tolerance class
Outer ring rotational load	Heavy load with thin wall housing	g6 or h6	P7
	Ordinary or heavy load		N7 [1]
	Light or fluctuating load		M7

1) N7 must be used for sheaves (to prevent snap ring from coming off).

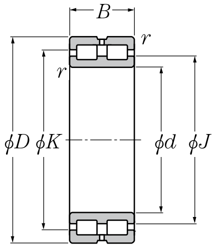
Refer to **Table 7.2** (A-80) in section "7. Bearing fits" for the inner ring rotational load.

Table 4 Relationship between fits and radial internal clearance

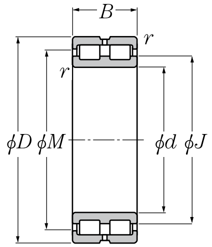
Housing fits	Housing fits: G 7	H 6	J 6	J 7	K 6	K 7	g 6	M 6	M 7	N 6	N 7	P 6	P 7
g 6	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3
h 6	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3
j 5	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3	C 4	C 4
j 6	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3	C 4	C 4
k 5	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3	C 4	C 4
k 6	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3	C 4	C 4
m 5	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 3	C 3	C 4	C 4	C 4	C 4
m 6	CN(normal)	CN(normal)	CN(normal)	CN(normal)	CN(normal)	C 3	C 3	C 4	C 4	C 4	C 4		
n 5	C 3	C 3	C 3	C 3	C 3	C 3	C 3	C 4	C 4	C 4	C 4		
n 6	C 3	C 3	C 3	C 3	C 3	C 3	C 3	C 4	C 4	C 4	C 4		
p 6	C 4	C 4	C 4	C 4	C 4	C 4	C 4						

Note: Use CN (normal) clearance when the shaft fit is g6, the housing fit is N7 (N6), and the speed is low (for sheaves, etc.)

SL Type Cylindrical Roller Bearings

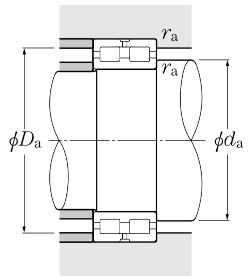


SL01-48 type
SL01-49 type
(fixed side)

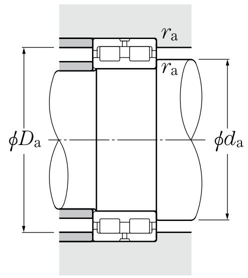


SL02-48 type
SL02-49 type
(floating side)

SL Type Cylindrical Roller Bearings NTN



Fixed side



Floating side

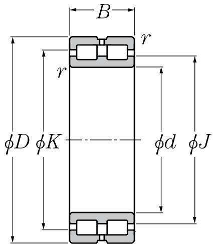
d 50 ～ 220mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Bearing number Fixed side	Floating side	Dimensions mm				Installation-related dimensions mm			Mass (approx.) kg	
d	D	B	$r_{s\,min}$[1]	C_r	C_{0r}	Grease lubrication	Oil lubrication	Fixed side	Floating side	J	K	M	e[2]	d_a[3] Min.	D_a[3] Max.	r_{as} Max.	Fixed side	Floating side
50	72	22	0.6	49.5	83.0	2 000	4 000	**SL01-4910**	**SL02-4910**	58	63	64	1	54	68	0.6	0.3	0.29
60	85	25	1	73.0	136	1 700	3 300	**SL01-4912**	**SL02-4912**	69.5	74.5	75.5	1	65	80	1	0.46	0.44
70	100	30	1	105	193	1 400	2 900	**SL01-4914**	**SL02-4914**	81.5	88	89.5	1	75	95	1	0.78	0.75
80	110	30	1	111	215	1 300	2 500	**SL01-4916**	**SL02-4916**	90	97	98.5	1	85	105	1	0.88	0.85
90	125	35	1.1	150	300	1 100	2 200	**SL01-4918**	**SL02-4918**	103	111	112.5	1.5	96.5	118.5	1	1.35	1.3
100	140	40	1.1	194	400	1 000	2 000	**SL01-4920**	**SL02-4920**	116	125	126.5	2	106.5	133.5	1	1.95	1.9
110	150	40	1.1	202	430	910	1 800	**SL01-4922**	**SL02-4922**	125	134	135.5	2	116.5	143.5	1	2.15	2.1
120	165	45	1.1	226	480	830	1 700	**SL01-4924**	**SL02-4924**	138.5	148.5	150.5	3	126.5	158.5	1	2.95	2.85
130	180	50	1.5	262	555	770	1 500	**SL01-4926**	**SL02-4926**	149	160	162	4	138	172	1.5	3.95	3.8
140	190	50	1.5	272	595	710	1 400	**SL01-4928**	**SL02-4928**	159.5	170	172.5	4	148	182	1.5	4.2	4.1
150	190	40	1.1	235	575	670	1 300	**SL01-4830**	**SL02-4830**	165.5	173.5	175.5	2	156.5	183.5	1	2.9	2.8
	210	60	2	410	865	670	1 300	**SL01-4930**	**SL02-4930**	171.5	186	189.5	4	159	201	2	6.65	6.45
160	200	40	1.1	241	605	630	1 300	**SL01-4832**	**SL02-4832**	173.5	182.5	184	2	166.5	193.5	1	3.05	2.9
	220	60	2	425	935	630	1 300	**SL01-4932**	**SL02-4932**	185	199	203	4	169	211	2	7	6.8
170	215	45	1.1	265	650	590	1 200	**SL01-4834**	**SL02-4834**	186.5	196.5	198	3	176.5	208.5	1	4.1	3.95
	230	60	2	435	980	590	1 200	**SL01-4934**	**SL02-4934**	194	208	211.5	4	179	221	2	7.35	7.1
180	225	45	1.1	275	695	560	1 100	**SL01-4836**	**SL02-4836**	199	209	211	3	186.5	218.5	1	4.3	4.15
	250	69	2	550	1 230	560	1 100	**SL01-4936**	**SL02-4936**	206	222	225.5	4	189	241	2	10.7	10.5
190	240	50	1.5	315	785	530	1 100	**SL01-4838**	**SL02-4838**	208.5	219.5	221.5	4	198	232	1.5	5.65	5.45
	260	69	2	565	1 290	530	1 100	**SL01-4938**	**SL02-4938**	216.5	232.5	235.5	4	199	251	2	11.2	10.9
200	250	50	1.5	320	825	500	1 000	**SL01-4840**	**SL02-4840**	219	230	232	4	208	242	1.5	5.9	5.7
	280	80	2.1	665	1 500	500	1 000	**SL01-4940**	**SL02-4940**	232	250	253.5	5	211	269	2	15.7	15.3
220	270	50	1.5	340	905	450	910	**SL01-4844**	**SL02-4844**	240	251	253	4	228	262	1.5	6.4	6.2

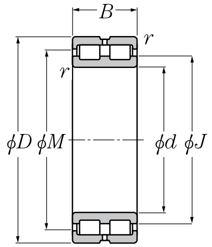
1) Smallest allowable dimension for chamfer dimension r. 2) Effective movement amount in axial direction.

3) If the bearing on the fixed side supports an eccentric axial load or a large axial load, shoulder dimension J and dimension K are recommended.

SL Type Cylindrical Roller Bearings

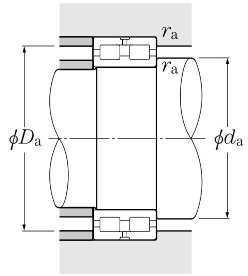


SL01-48 type
SL01-49 type
(fixed side)

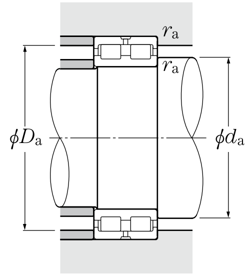


SL02-48 type
SL02-49 type
(floating side)

SL Type Cylindrical Roller Bearings NTN



Fixed side



Floating side

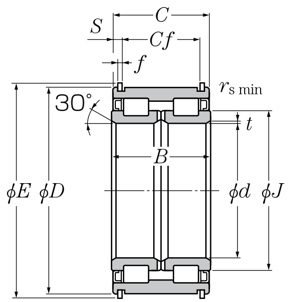
d 220 ～ 440mm

Boundary dimensions mm				Basic load rating kN dynamic	static	Allowable speed min⁻¹		Bearing number		Dimensions mm				Installation-related dimensions mm			Mass (approx.) kg	
d	D	B	$r_{s\,min}$ 1)	C_r	C_{0r}	Grease lubrication	Oil lubrication	Fixed side	Floating side	J	K	M	e 2)	d_a 3) Min.	D_a 3) Max.	r_{as} Max.	Fixed side	Floating side
220	300	80	2.1	695	1 620	450	910	**SL01-4944**	**SL02-4944**	249.5	267.5	271	5	231	289	2	17.1	16.6
240	300	60	2	510	1 330	420	830	**SL01-4848**	**SL02-4848**	261	275	276.5	4	249	291	2	10.2	9.9
	320	80	2.1	730	1 770	420	830	**SL01-4948**	**SL02-4948**	272.5	290.5	294	5	251	309	2	18.4	17.9
260	320	60	2	535	1 450	380	770	**SL01-4852**	**SL02-4852**	283	297	300	4	269	311	2	11	10.6
	360	100	2.1	1 070	2 520	380	770	**SL01-4952**	**SL02-4952**	297	320	324.5	6	271	349	2	32	31.2
280	350	69	2	685	1 860	360	710	**SL01-4856**	**SL02-4856**	308	324	327	4	289	341	2	16	15.6
	380	100	2.1	1 110	2 710	360	710	**SL01-4956**	**SL02-4956**	319	342	346	6	291	369	2	33.9	33.1
300	380	80	2.1	805	2 160	330	670	**SL01-4860**	**SL02-4860**	330	348	351	6	311	369	2	23	22.2
	420	118	3	1 580	3 800	330	670	**SL01-4960**	**SL02-4960**	344	371	377	6	313	407	2.5	53	51.9
320	400	80	2.1	835	2 310	310	630	**SL01-4864**	**SL02-4864**	353	371	374	6	331	389	2	24.3	23.5
	440	118	3	1 650	4 100	310	630	**SL01-4964**	**SL02-4964**	371	398	404	6	333	427	2.5	56	54.9
340	420	80	2.1	855	2 430	290	590	**SL01-4868**	**SL02-4868**	370	388	391	6	351	409	2	25.6	24.8
	460	118	3	1 690	4 300	290	590	**SL01-4968**	**SL02-4968**	388	416	421	6	353	447	2.5	59	57.8
360	440	80	2.1	885	2 580	280	560	**SL01-4872**	**SL02-4872**	393	411	414	6	371	429	2	27	26
	480	118	3	1 730	4 500	280	560	**SL01-4972**	**SL02-4972**	406	434	439	6	373	467	2.5	62	60.8
380	480	100	2.1	1 290	3 600	260	530	**SL01-4876**	**SL02-4876**	422	444	449	6	391	469	2	45.3	44
	520	140	4	2 300	5 900	260	530	**SL01-4976**	**SL02-4976**	437	469	475	7	396	504	3	92.3	90.5
400	540	140	4	2 410	6 200	250	500	**SL01-4980**	**SL02-4980**	450	484	490	7	416	524	3	96.4	94.6
420	560	140	4	2 470	6 500	240	480	**SL01-4984**	**SL02-4984**	472	505	512	7	436	544	3	101	98.6
440	600	160	4	3 000	7 850	230	450	**SL01-4988**	**SL02-4988**	503	540	546	7	456	584	3	139	137

Special Application Bearings

1) Smallest allowable dimension for chamfer dimension r. 2) Effective movement amount in axial direction.

3) If the bearing on the fixed side supports an eccentric axial load or a large axial load, shoulder dimension J and dimension K are recommended.

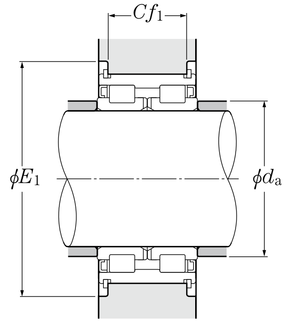


d 40 ～ 170mm

Boundary dimensions						Basic load rating		Allowable speed	Bearing number	Dimensions				
mm						dynamic kN	static	min^{-1} Grease lubrication		mm				
d	D	B	C	t	$r_{s\,min}$	C_r	C_{0r}			J	E (approx.)	f	Cf	S
40	68	38	37	0.8	0.6	79.5	116	2 500	**SL04-5008NR**	51	71.8	2	28	4.5
45	75	40	39	0.8	0.6	95.5	144	2 200	**SL04-5009NR**	56.6	79	2	30	4.5
50	80	40	39	0.8	0.6	100	158	2 000	**SL04-5010NR**	61	83.8	2	30	4.5
55	90	46	45	1	0.6	118	193	1 800	**SL04-5011NR**	67.9	95	2.5	34	5.5
60	95	46	45	1	0.6	123	208	1 700	**SL04-5012NR**	73.4	100	2.5	34	5.5
65	100	46	45	1	0.6	128	224	1 500	**SL04-5013NR**	78	105	2.5	34	5.5
70	110	54	53	1	0.6	171	285	1 400	**SL04-5014NR**	84.5	114.5	2.5	42	5.5
75	115	54	53	1	0.6	197	325	1 300	**SL04-5015NR**	90	119.7	2.5	42	5.5
80	125	60	59	1	0.6	205	350	1 300	**SL04-5016NR**	96.5	129.7	2.5	48	5.5
85	130	60	59	1	0.6	214	380	1 200	**SL04-5017NR**	103.7	134.5	2.5	48	5.5
90	140	67	66	1.5	0.6	305	540	1 100	**SL04-5018NR**	110	146.3	2.5	54	6
95	145	67	66	1.5	0.6	310	560	1 100	**SL04-5019NR**	114.4	151.3	2.5	54	6
100	150	67	66	1.5	0.6	330	580	1 000	**SL04-5020NR**	118.5	156.3	2.5	54	6
110	170	80	79	1.8	1	385	695	910	**SL04-5022NR**	131.5	176.4	2.5	65	7
120	180	80	79	1.8	1	400	750	830	**SL04-5024NR**	141.5	188.4	3	65	7
130	200	95	94	1.8	1	535	1 000	770	**SL04-5026NR**	158	208.4	3	77	8.5
140	210	95	94	1.8	1	600	1 120	710	**SL04-5028NR**	167	218.5	3	77	8.5
150	225	100	99	2	1	690	1 290	670	**SL04-5030NR**	178.3	233.5	3	81	9
160	240	109	108	2	1.1	720	1 390	630	**SL04-5032NR**	191	248.5	3	89	9.5
170	260	122	121	2	1.1	925	1 790	590	**SL04-5034NR**	202.7	270.5	4	99	11

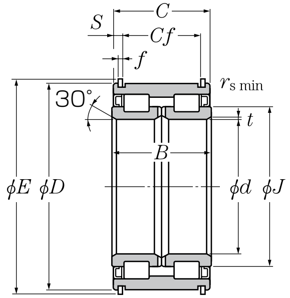
Note: 1. The bearings have grease filled in. 2. Surface treatment is applied to bearings to prevent rust.
3. The bearings are non-contact shielded type bearings, but contact sealed type bearings are also available based on your request.

●SL Type Cylindrical Roller Bearings for Sheaves NTN



Installation-related dimensions			Mass
mm			kg
d_a (Min.)	E_1	Cf_1 1)	(approx.)
43.5	82	28	0.552
48.5	88	30	0.688
53.5	94	30	0.752
60	106	34	1.12
65	112	34	1.2
70	116	34	1.27
75	130	42	1.87
80	135	42	1.97
85	145	48	2.66
90	155	48	2.79
96	165	54	3.71
101	175	54	3.87
106	180	54	4.03
116.5	200	65	7
126.5	210	65	7.5
136.5	230	77	11.4
146.5	245	77	12.1
157	260	81	14.6
167	275	89	18.2
177	300	99	24.6

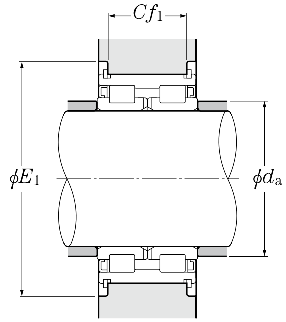
1) Tolerance of dimension Cf_1 SL04-5008NR ～ SL04-5034NR : -0.1 ～ -0.5mm
SL04-5036NR ～ SL04-5040NR : -0.1 ～ -0.7mm



d 180 ～ 440mm

Boundary dimensions						Basic load rating		Allowable speed	Bearing number	Dimensions				
mm						dynamic kN	static kN	min⁻¹ Grease lubrication		mm				
d	D	B	C	t	$r_{s\,min}$	C_r	C_{0r}			J	E (approx.)	f	Cf	S
180	280	136	135	2	1.1	1 090	2 140	560	**SL04-5036NR**	220	290.5	4	110	12.5
190	290	136	135	2	1.1	1 120	2 230	530	**SL04-5038NR**	226	300.5	4	110	12.5
200	310	150	149	2	1.1	1 310	2 650	500	**SL04-5040NR**	245.5	320.5	4	120	14.5
220	340	160	159	2.5	1.1	1 640	3 300	450	**SL04-5044NR**	260	357	6	130	14.5
240	360	160	159	2.5	1.1	1 710	3 550	420	**SL04-5048NR**	280.5	377	6	130	14.5
260	400	190	189	3	1.5	1 950	4 200	380	**SL04-5052NR**	310	417	7	154	17.5
280	420	190	189	3	1.5	2 170	4 700	360	**SL04-5056NR**	325	437	7	154	17.5
300	460	218	216	3	1.5	2 670	5 850	330	**SL04-5060NR**	363	481	8	176	20
320	480	218	216	3	1.5	2 720	6 100	310	**SL04-5064NR**	376	501	8	176	20
340	520	243	241	3.5	2	3 650	8 000	290	**SL04-5068NR**	406	545	8	194	23.5
360	540	243	241	3.5	2	3 750	8 300	280	**SL04-5072NR**	421	565	10	194	23.5
380	560	243	241	3.5	2	3 800	8 750	260	**SL04-5076NR**	442	585	10	194	23.5
400	600	272	270	3.5	2	4 250	9 950	250	**SL04-5080NR**	470	627	12	210	30
420	620	272	270	3.5	2	4 350	10 300	240	**SL04-5084NR**	486	647	12	210	30
440	650	280	278	4.5	3	4 500	11 000	230	**SL04-5088NR**	518	677	12	210	34

Note: 1. The bearings have grease filled in. 2. Surface treatment is applied to bearings to prevent rust.
3. The bearings are non-contact shielded type bearings, but contact sealed type bearings are also available based on your request.



Installation-related dimensions			Mass
mm			kg
d_a (Min.)	E_1	Cf_1 1)	(approx.)
187	320	110	32.3
197	330	110	33.7
207	350	120	43.5
228.5	380	130	55.5
248.5	400	130	59.5
270	445	154	90.7
290	465	154	96.2
310	510	176	137
330	530	176	144
352	580	194	194
372	600	194	203
392	620	194	212
412	675	210	281
432	695	210	292
456	725	210	331

1) Tolerance of dimension Cf_1 SL04-5008NR ～ SL04-5034NR : -0.1 ～ -0.5mm
SL04-5036NR ～ SL04-5040NR : -0.1 ～ -0.7mm

●*ULTAGE* Precision Rolling Bearings for Machine Tools

For angular contact ball bearings for machine tools with a contact angle of 15° and bearing tolerance of JIS class 5 or higher, cylindrical roller bearings having bearing tolerance of JIS class 5 or higher, tapered roller bearings having bearing tolerance of JIS class 5 or higher, and bearings for supporting ball screws, see the special catalog "**Precision rolling bearings (CAT. No. 2260/E)**".

●Bearings for Special Environments

Bearings for special environments are bearings that can be used for clean environments and high vacuum environments, where conventional bearings would not be acceptable. Bearings for special environments can also be used for the development of space equipment, vacuum equipment, and semiconductor manufacturing equipment. For details, see the special catalog "**Ultra final series bearings for clean environment (CAT. No. 3028/E)**."

●Rubber Molded Bearings

Rubber molded bearings are rubber rollers made by baking and bonding urethane rubber directly to the outer diameter of small deep groove ball bearings. Rubber molded bearings are suitable for low vibration and low noise applications, and feed mechanisms that require accuracy. For details, see the special catalog "**Rubber molded bearings (CAT. No. 3021/J)**."

●MEGAOHM™ Series Insulated Bearings

Bearings used for electric equipment such as motors and generators may cause electrolytic corrosion due to leakage current, which shortens the bearing life. MEGAOHM™ series insulated bearings are the bearings developed to prevent this electrolytic corrosion. The series includes ceramic and resin type bearings. For details, see the special catalog "**MEGAOHM™ series insulated bearings (CAT. No. 3030/E)**."

●Clutches/Torque Limiters

1) One-way clutch

The driving force is transmitted only in one direction. In the opposite direction, the driving and idling can be switched by a clutch with a mechanism for idling. **NTN** provides a variety of one-way clutches to meet various needs.

For the clutch models, handling precautions, and other details, see the special catalog "**Clutches (CAT. No. 2900/E)**."

2) Torque limiter units

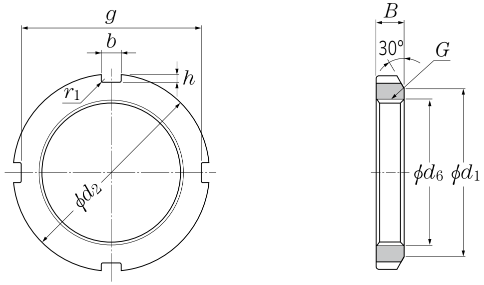
The **NTN** torque limiter unit (NTS type) is a unit composed of an inner ring, a coil spring, an external resin part, and a lid. When the torque acting between the inner ring and the external resin part is low, the inner ring and the outer resin part are rotated simultaneously. Under high torque conditions, the inner ring and the outer resin part are relatively rotated while keeping a constant torque.

For the torque limiter models, handling precautions, and other details, see the special catalog "**Torque limiter units (CAT. No. 6404/J)**."

Rolling Bearing Accessories

Rolling Bearing Accessories Contents

(For adapter sleeve, withdrawal sleeve and shaft)
Series AN



Number	Thread no. G 1)	d_2	d_1	g	b	h	d_6	B	r_1 Max.	Mass kg (approx.)	Bore diameter no. of adapter 2) (approx.)	Lockwasher no. 3) (approx.)
AN00	M10 × 0.75	18	13.5	14	3	2	10.5	4	0.4	0.005	—	**AW00**
AN01	M12 × 1	22	17	18	3	2	12.5	4	0.4	0.007	—	**AW01**
AN02	M15 × 1	25	21	21	4	2	15.5	5	0.4	0.010	—	**AW02**
AN03	M17 × 1	28	24	24	4	2	17.5	5	0.4	0.013	—	**AW03**
AN04	M20 × 1	32	26	28	4	2	20.5	6	0.4	0.019	04	**AW04**
AN/22	M22 × 1	34	28	30	4	2	22.5	6	0.4	0.023	—	**AW/22**
AN05	M25 × 1.5	38	32	34	5	2	25.8	7	0.4	0.025	05	**AW05**
AN/28	M28 × 1.5	42	36	38	5	2	28.8	7	0.4	0.040	—	**AW/28**
AN06	M30 × 1.5	45	38	41	5	2	30.8	7	0.4	0.043	06	**AW06**
AN/32	M32 × 1.5	48	40	44	5	2	32.8	8	0.4	0.058	—	**AW/32**
AN07	M35 × 1.5	52	44	48	5	2	35.8	8	0.4	0.053	07	**AW07**
AN08	M40 × 1.5	58	50	53	6	2.5	40.8	9	0.5	0.085	08	**AW08**
AN09	M45 × 1.5	65	56	60	6	2.5	45.8	10	0.5	0.119	09	**AW09**
AN10	M50 × 1.5	70	61	65	6	2.5	50.8	11	0.5	0.148	10	**AW10**
AN11	M55 × 2	75	67	69	7	3	56	11	0.5	0.158	11	**AW11**
AN12	M60 × 2	80	73	74	7	3	61	11	0.5	0.174	12	**AW12**
AN13	M65 × 2	85	79	79	7	3	66	12	0.5	0.203	13	**AW13**
AN14	M70 × 2	92	85	85	8	3.5	71	12	0.5	0.242	14	**AW14**
AN15	M75 × 2	98	90	91	8	3.5	76	13	0.5	0.287	15	**AW15**
AN16	M80 × 2	105	95	98	8	3.5	81	15	0.6	0.397	16	**AW16**
AN17	M85 × 2	110	102	103	8	3.5	86	16	0.6	0.451	17	**AW17**
AN18	M90 × 2	120	108	112	10	4	91	16	0.6	0.556	18	**AW18**
AN19	M95 × 2	125	113	117	10	4	96	17	0.6	0.658	19	**AW19**
AN20	M100 × 2	130	120	122	10	4	101	18	0.6	0.698	20	**AW20**
AN21	M105 × 2	140	126	130	12	5	106	18	0.7	0.845	21	**AW21**
AN22	M110 × 2	145	133	135	12	5	111	19	0.7	0.965	22	**AW22**
AN23	M115 × 2	150	137	140	12	5	116	19	0.7	1.01	—	**AW23**
AN24	M120 × 2	155	138	145	12	5	121	20	0.7	1.08	24	**AW24**
AN25	M125 × 2	160	148	150	12	5	126	21	0.7	1.19	—	**AW25**
AN26	M130 × 2	165	149	155	12	5	131	21	0.7	1.25	26	**AW26**
AN27	M135 × 2	175	160	163	14	6	136	22	0.7	1.55	—	**AW27**
AN28	M140 × 2	180	160	168	14	6	141	22	0.7	1.56	28	**AW28**
AN29	M145 × 2	190	171	178	14	6	146	24	0.7	2.00	—	**AW29**
AN30	M150 × 2	195	171	183	14	6	151	24	0.7	2.03	30	**AW30**
AN31	M155 × 3	200	182	186	16	7	156.5	25	0.7	2.21	—	**AW31**
AN32	M160 × 3	210	182	196	16	7	161.5	25	0.7	2.59	32	**AW32**
AN33	M165 × 3	210	193	196	16	7	166.5	26	0.7	2.43	—	**AW33**
AN34	M170 × 3	220	193	206	16	7	171.5	26	0.7	2.80	34	**AW34**
AN36	M180 × 3	230	203	214	18	8	181.5	27	0.7	3.07	36	**AW36**
AN38	M190 × 3	240	214	224	18	8	191.5	28	0.7	3.39	38	**AW38**
AN40	M200 × 3	250	226	234	18	8	201.5	29	0.7	3.69	40	**AW40**

(Dimensions in mm)

1) Thread shapes and dimensions are as per **JIS B 0205-1** and **JIS B 0205-4** (general metric threads).
2) Used for adapter series **H31**, **H2**, **H3**, and **H23**.
3) Washers with straight inner tabs that have code "X" after the number can also be used.

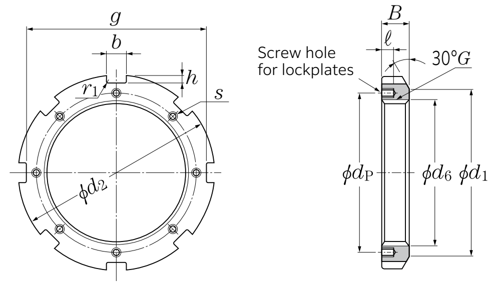
Rolling Bearing Accessories

Locknuts NTN

Number	AH30	AH240	AH31	AH241	AH2	AH32	AH3	AH23	Shaft dia. mm (for shaft)
	(approx.) Withdrawal sleeve no.								
AN00	—	—	—	—	—	—	—	—	10
AN01	—	—	—	—	—	—	—	—	12
AN02	—	—	—	—	—	—	—	—	15
AN03	—	—	—	—	—	—	—	—	17
AN04	—	—	—	—	—	—	—	—	20
AN/22	—	—	—	—	—	—	—	—	22
AN05	—	—	—	—	—	—	—	—	25
AN/28	—	—	—	—	—	—	—	—	28
AN06	—	—	—	—	—	—	—	—	30
AN/32	—	—	—	—	—	—	—	—	32
AN07	—	—	—	—	—	—	—	—	35
AN08	—	—	—	—	—	—	—	—	40
AN09	—	—	—	—	**AH208**	—	**AH 308**	**AH2308**	45
AN10	—	—	—	—	**AH209**	—	**AH 309**	**AH2309**	50
AN11	—	—	—	—	**AH210**	—	**AHX310**	**AHX2310**	55
AN12	—	—	—	—	**AH211**	—	**AHX311**	**AHX2311**	60
AN13	—	—	—	—	**AH212**	—	**AHX312**	**AHX2312**	65
AN14	—	—	—	—	—	—	—	—	70
AN15	—	—	—	—	**AH213**	—	**AH 313**	**AH2313**	75
AN16	—	—	—	—	**AH214**	—	**AH 314**	**AHX2314**	80
AN17	—	—	—	—	**AH215**	—	**AH 315**	**AHX2315**	85
AN18	—	—	—	—	**AH216**	—	**AH 316**	**AHX2316**	90
AN19	—	—	—	—	**AH217**	—	**AHX317**	**AHX2317**	95
AN20	—	—	—	—	**AH218**	**AHX3218**	**AHX318**	**AHX2318**	100
AN21	—	—	—	—	**AH219**	—	**AHX319**	**AHX2319**	105
AN22	—	—	—	—	**AH220**	**AHX3220**	**AHX320**	**AHX2320**	110
AN23	—	—	—	**AH24122**	**AH221**	—	**AHX321**	—	115
AN24	—	—	**AHX3122**	—	**AH222**	—	**AHX322**	—	120
AN25	—	**AH24024**	—	—	—	**AHX3222**	—	**AHX2322**	125
AN26	**AHX3024**	—	**AHX3124**	**AH24124**	**AH224**	—	**AHX324**	—	130
AN27	—	**AH24026**	—	—	—	**AHX3224**	—	**AHX2324**	135
AN28	**AHX3026**	—	**AHX3126**	**AH24126**	**AH226**	—	**AHX326**	—	140
AN29	—	**AH24028**	—	—	—	**AHX3226**	—	**AHX2326**	145
AN30	**AHX3028**	—	**AHX3128**	**AH24128**	**AH228**	—	**AHX328**	—	150
AN31	—	**AH24030**	—	—	—	**AHX3228**	—	**AHX2328**	155
AN32	**AHX3030**	—	—	**AH24130**	**AH230**	—	—	—	160
AN33	—	—	**AHX3130**	—	—	**AHX3230**	**AHX330**	**AHX2330**	165
AN34	**AH 3032**	**AH24032**	—	**AH24132**	**AH232**	—	—	—	170
AN36	**AH 3034**	**AH24034**	**AH3132**	**AH24134**	**AH234**	**AH3232**	**AH332**	**AH2332**	180
AN38	**AH 3036**	**AH24036**	**AH3134**	**AH24136**	**AH236**	**AH3234**	**AH334**	**AH2334**	190
AN40	—	**AH24038**	**AH 3136**	**AH24138**	—	**AH3236**	—	**AH2336**	200

Rolling Bearing Accessories

(For adapter sleeve and shaft)
Series AN

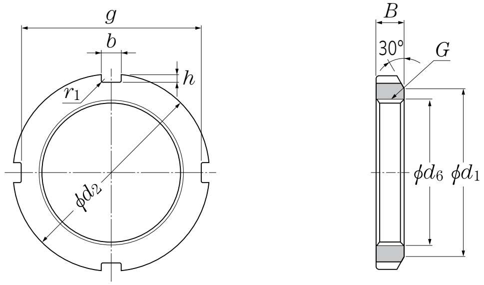


Number						Dimensions mm							Mass kg		(approx.)	
	Thread no. G 1)	d_2	d_1	g	b	h	d_6	B	r_1 Max.	l	Screw hole for lockplates s 2)	d_P	(approx.)	Bore diameter no. of adapter 3)	Lockplate no.	Shaft dia. mm (for shaft)
AN44	Tr220 × 4	280	250	260	20	10	222	32	0.8	15	M8	238	5.20	44	**AL44**	220
AN48	Tr240 × 4	300	270	280	20	10	242	34	0.8	15	M8	258	5.95	48	**AL44**	240
AN52	Tr260 × 4	330	300	306	24	12	262	36	0.8	18	M10	281	8.05	52	**AL52**	260
AN56	Tr280 × 4	350	320	326	24	12	282	38	0.8	18	M10	301	9.05	56	**AL52**	280
AN60	Tr300 × 4	380	340	356	24	12	302	40	0.8	18	M10	326	11.8	60	**AL60**	300
AN64	Tr320 × 5	400	360	376	24	12	322.5	42	0.8	18	M10	345	13.1	64	**AL64**	320
AN68	Tr340 × 5	440	400	410	28	15	342.5	55	1	21	M12	372	23.1	68	**AL68**	340
AN72	Tr360 × 5	460	420	430	28	15	362.5	58	1	21	M12	392	25.1	72	**AL68**	360
AN76	Tr380 × 5	490	450	454	32	18	382.5	60	1	21	M12	414	30.9	76	**AL76**	380
AN80	Tr400 × 5	520	470	484	32	18	402.5	62	1	27	M16	439	36.9	80	**AL80**	400
AN84	Tr420 × 5	540	490	504	32	18	422.5	70	1	27	M16	459	43.5	84	**AL80**	420
AN88	Tr440 × 5	560	510	520	36	20	442.5	70	1	27	M16	477	45.3	88	**AL88**	440
AN92	Tr460 × 5	580	540	540	36	20	462.5	75	1	27	M16	497	50.4	92	**AL88**	460
AN96	Tr480 × 5	620	560	580	36	20	482.5	75	1	27	M16	527	62.2	96	**AL96**	480
AN100	Tr500 × 5	630	580	584	40	23	502.5	80	1	27	M16	539	63.3	/500	**AL100**	500

1) Thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).
2) Thread shapes and dimensions of screw holes are as per JIS B 0205-1 and JIS B 0205-4 (general metric threads).
3) Used for adapter series H31, H32, and H23.

●Locknuts NTN

(For adapter sleeve and shaft)
Series ANL

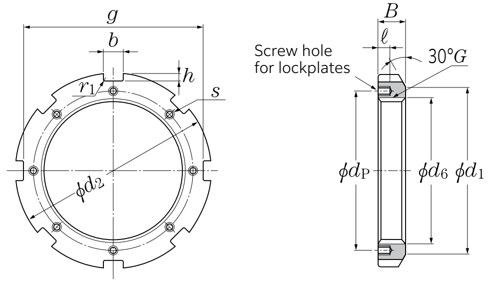


Number	Thread no. G 1)	d_2	d_1	g	b	h	d_6	B	r_1 Max.	Mass kg (approx.)	Bore diameter no. of adapter 2)	Lockwasher no. 3)	Shaft dia. mm (for shaft)
ANL24	M120 × 2	145	133	135	12	5	121	20	0.7	0.78	24	**AWL24**	120
ANL26	M130 × 2	155	143	145	12	5	131	21	0.7	0.88	26	**AWL26**	130
ANL28	M140 × 2	165	151	153	14	6	141	22	0.7	0.99	28	**AWL28**	140
ANL30	M150 × 2	180	164	168	14	6	151	24	0.7	1.38	30	**AWL30**	150
ANL32	M160 × 3	190	174	176	16	7	161.5	25	0.7	1.56	32	**AWL32**	160
ANL34	M170 × 3	200	184	186	16	7	171.5	26	0.7	1.72	34	**AWL34**	170
ANL36	M180 × 3	210	192	194	18	8	181.5	27	0.7	1.95	36	**AWL36**	180
ANL38	M190 × 3	220	202	204	18	8	191.5	28	0.7	2.08	38	**AWL38**	190
ANL40	M200 × 3	240	218	224	18	8	201.5	29	0.7	2.98	40	**AWL40**	200

1) Thread shapes and dimensions are as per JIS B 0205-1 and JIS B 0205-4 (general metric threads).
2) Applied to adapter series H30.
3) Washers with straight inner tabs that have code "X" after the number can also be used.

Rolling Bearing Accessories

Locknuts
NTN



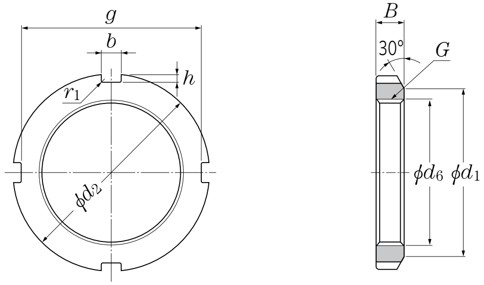
Number	Thread no. G 1)	d_2	d_1	g	b	h	d_6	B	r_1 Max.	l	Screw hole for lockplates s 2)	d_p	Mass kg (approx.)
ANL44	Tr220 × 4	260	242	242	20	9	222	30	0.8	12	M6	229	3.09
ANL48	Tr240 × 4	290	270	270	20	10	242	34	0.8	15	M8	253	5.16
ANL52	Tr260 × 4	310	290	290	20	10	262	34	0.8	15	M8	273	5.67
ANL56	Tr280 × 4	330	310	310	24	10	282	38	0.8	15	M8	293	6.78
ANL60	Tr300 × 4	360	336	336	24	12	302	42	0.8	15	M8	316	9.62
ANL64	Tr320 × 5	380	356	356	24	12	322.5	42	0.8	15	M8	335	9.94
ANL68	Tr340 × 5	400	376	376	24	12	342.5	45	1	15	M8	355	11.7
ANL72	Tr360 × 5	420	394	394	28	13	362.5	45	1	15	M8	374	12.0
ANL76	Tr380 × 5	450	422	422	28	14	382.5	48	1	18	M10	398	14.9
ANL80	Tr400 × 5	470	442	442	28	14	402.5	52	1	18	M10	418	16.9
ANL84	Tr420 × 5	490	462	462	32	14	422.5	52	1	18	M10	438	17.4
ANL88	Tr440 × 5	520	490	490	32	15	442.5	60	1	21	M12	462	26.2
ANL92	Tr460 × 5	540	510	510	32	15	462.5	60	1	21	M12	482	29.6
ANL96	Tr480 × 5	560	530	530	36	15	482.5	60	1	21	M12	502	28.3
ANL100	Tr500 × 5	580	550	550	36	15	502.5	68	1	21	M12	522	33.6

1) Thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).
2) Thread shapes and dimensions of screw holes are as per JIS B 0205-1 and JIS B 0205-4 (general metric threads).
3) Applied to adapter series H30.

Bore diameter no. of adapter 3)	(approx.) Lockplate no.	Shaft dia. mm (for shaft)	Number
44	ALL44	220	**ANL44**
48	ALL48	240	**ANL48**
52	ALL48	260	**ANL52**
56	ALL56	280	**ANL56**
60	ALL60	300	**ANL60**
64	ALL64	320	**ANL64**
68	ALL64	340	**ANL68**
72	ALL72	360	**ANL72**
76	ALL76	380	**ANL76**
80	ALL76	400	**ANL80**
84	ALL84	420	**ANL84**
88	ALL88	440	**ANL88**
92	ALL88	460	**ANL92**
96	ALL96	480	**ANL96**
/500	ALL96	500	**ANL100**

Rolling Bearing Accessories

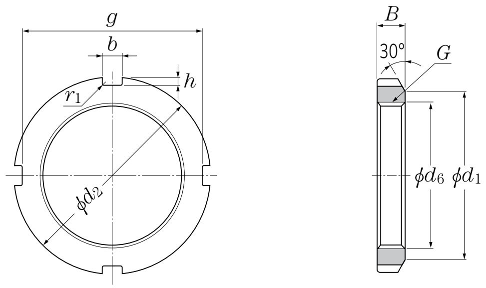
(For withdrawal sleeve)
Series HN



Number	Thread no. G [1)]	d_2	d_1	g	b	h	d_6	B	r_1 Max.	Mass kg (approx.)	Withdrawal sleeve no. AH240	AH31	AH241	AH22	AH32	AH23
		Dimensions mm														
HN42	Tr210 × 4	270	238	250	20	10	212	30	0.8	4.75	**AH24040**	**AH 3138**	**AH24140H**	**AH2238**	**AH 3238**	**AH2338**
HN44	Tr220 × 4	280	250	260	20	10	222	32	0.8	5.35	—	**AH 3140**	—	**AH2240**	**AH 3240**	**AH2340**
HN46	Tr230 × 4	290	260	270	20	10	232	34	0.8	5.80	**AH24044H**	—	**AH24144H**	—	—	—
HN48	Tr240 × 4	300	270	280	20	10	242	34	0.8	6.20	—	**AH 3144**	—	**AH2244**	—	**AH2344**
HN50	Tr250 × 4	320	290	300	20	10	252	36	0.8	7.00	**AH24048H**	—	—	—	—	—
HN52	Tr260 × 4	330	300	306	24	12	262	36	0.8	8.55	—	**AH 3148**	**AH24148H**	**AH2248**	—	**AH2348**
HN54	Tr270 × 4	340	310	316	24	12	272	38	0.8	9.20	**AH24052H**	—	—	—	—	—
HN56	Tr280 × 4	350	320	326	24	12	282	38	0.8	10.0	—	—	**AH24152H**	—	—	—
HN58	Tr290 × 4	370	330	346	24	12	292	40	0.8	11.8	**AH24056H**	**AH 3152**	—	**AH2252**	—	**AH2352**
HN60	Tr300 × 4	380	340	356	24	12	302	40	0.8	12.0	—	—	**AH24156H**	—	—	—
HN62	Tr310 × 5	390	350	366	24	12	312.5	42	0.8	13.4	**AH24060H**	**AH 3156**	—	**AH2256**	—	**AH2356**
HN64	Tr320 × 5	400	360	376	24	12	322.5	42	0.8	13.5	—	—	**AH24160H**	—	—	—
HN66	Tr330 × 5	420	380	390	28	15	332.5	52	1	20.4	**AH24064H**	**AH 3160**	—	**AH2260**	**AH 3260**	—
HN68	Tr340 × 5	440	400	410	28	15	342.5	55	1	24.5	—	—	**AH24164H**	—	—	—
HN70	Tr350 × 5	450	410	420	28	15	352.5	55	1	25.2	—	**AH 3164**	—	**AH2264**	**AH 3264**	—
HN72	Tr360 × 5	460	420	430	28	15	362.5	58	1	27.5	—	—	**AH24168H**	—	—	—
HN74	Tr370 × 5	470	430	440	28	15	372.5	58	1	28.2	—	**AH 3168**	—	—	**AH 3268**	—
HN76	Tr380 × 5	490	450	454	32	18	382.5	60	1	33.5	—	—	**AH24172H**	—	—	—
HN80	Tr400 × 5	520	470	484	32	18	402.5	62	1	40.0	—	**AH 3172**	**AH24176H**	—	**AH 3272**	—
HN84	Tr420 × 5	540	490	504	32	18	422.5	70	1	46.9	—	**AH 3176**	**AH24180H**	—	**AH 3276**	—
HN88	Tr440 × 5	560	510	520	36	20	442.5	70	1	48.5	—	**AH 3180**	**AH24184H**	—	**AH 3280**	—
HN92	Tr460 × 5	580	540	540	36	20	462.5	75	1	55.0	—	**AH 3184**	**AH24188H**	—	**AH 3284**	—
HN96	Tr480 × 5	620	560	580	36	20	482.5	75	1	67.0	—	**AHX3188**	**AH24192H**	—	**AHX3288**	—
HN100	Tr500 × 5	630	580	584	40	23	502.5	80	1	69.0	—	—	—	—	—	—
HN102	Tr510 × 6	650	590	604	40	23	513	80	1	75.0	—	**AHX3192**	—	—	**AHX3292**	—
HN106	Tr530 × 6	670	610	624	40	23	533	80	1	78.0	—	**AHX3196**	—	—	**AHX3296**	—
HN110	Tr550 × 6	700	640	654	40	23	553	80	1	92.5	—	—	—	—	—	—

1) Thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).
Note: Number HN54 indicates dimensions that are not indicated in JIS B 1554.

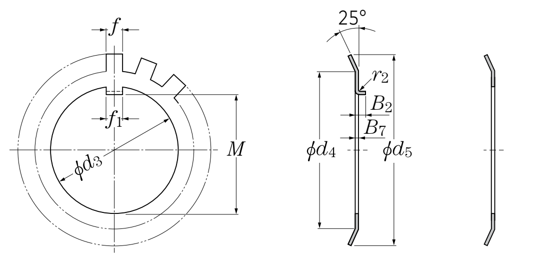
(For withdrawal sleeve)
Series HNL



Number	Thread no. G [1]	Dimensions mm d_2	d_1	g	b	h	d_6	B	r_1 Max.	Mass kg (approx.)	Withdrawal sleeve no. AH30	AH240	AH2
HNL41	Tr205 × 4	250	232	234	18	8	207	30	0.8	3.43	**AH 3038**	—	**AH238**
HNL43	Tr215 × 4	260	242	242	20	9	217	30	0.8	3.72	**AH 3040**	—	**AH240**
HNL47	Tr235 × 4	280	262	262	20	9	237	34	0.8	4.60	**AH 3044**	—	**AH244**
HNL52	Tr260 × 4	310	290	290	20	10	262	34	0.8	5.80	**AH 3048**	—	**AH248**
HNL56	Tr280 × 4	330	310	310	24	10	282	38	0.8	6.72	**AH 3052**	—	**AH252**
HNL60	Tr300 × 4	360	336	336	24	12	302	42	0.8	9.60	**AH 3056**	—	**AH256**
HNL64	Tr320 × 5	380	356	356	24	12	322.5	42	1	10.3	**AH 3060**	—	—
HNL69	Tr345 × 5	410	384	384	28	13	347.5	45	1	11.5	**AH 3064**	—	—
HNL72	Tr360 × 5	420	394	394	28	13	362.5	45	1	12.1	—	**AH24068H**	—
HNL73	Tr365 × 5	430	404	404	28	13	367.5	48	1	14.2	**AH 3068**	—	—
HNL76	Tr380 × 5	450	422	422	28	14	382.5	48	1	16.0	—	**AH24072H**	—
HNL77	Tr385 × 5	450	422	422	28	14	387.5	48	1	15.0	**AH 3072**	—	—
HNL80	Tr400 × 5	470	442	442	28	14	402.5	52	1	18.5	—	**AH24076H**	—
HNL82	Tr410 × 5	480	452	452	32	14	412.5	52	1	19.0	**AH 3076**	—	—
HNL84	Tr420 × 5	490	462	462	32	14	422.5	52	1	19.4	—	**AH24080H**	—
HNL86	Tr430 × 5	500	472	472	32	14	432.5	52	1	19.8	**AH 3080**	—	—
HNL88	Tr440 × 5	520	490	490	32	15	442.5	60	1	27.0	—	**AH24084H**	—
HNL90	Tr450 × 5	520	490	490	32	15	452.5	60	1	23.8	**AH 3084**	—	—
HNL92	Tr460 × 5	540	510	510	32	15	462.5	60	1	28.0	—	**AH24088H**	—
HNL94	Tr470 × 5	540	510	510	32	15	472.5	60	1	25.0	**AHX3088**	—	—
HNL96	Tr480 × 5	560	530	530	36	15	482.5	60	1	29.5	—	—	—
HNL98	Tr490 × 5	580	550	550	36	15	492.5	60	1	34.0	**AHX3092**	—	—
HNL100	Tr500 × 5	580	550	550	36	15	502.5	68	1	35.0	—	—	—
HNL104	Tr520 × 6	600	570	570	36	15	523	68	1	37.0	**AHX3096**	—	—
HNL106	Tr530 × 6	630	590	590	40	20	533	68	1	47.0	—	—	—
HNL108	Tr540 × 6	630	590	590	40	20	543	68	1	43.5	—	—	—

1) Thread shapes and dimensions are as per JIS B 0216 (metric trapezoidal screw threads).

Series AW



Bent inner tab type　　Straight inner tab type

Number: Bent inner tab type	Number: Straight inner tab type	Dimensions mm: d_3	M	f_1	B_7	f	Bent inner tab type: d_4	d_5	r_2	B_2	No.of tabs	Mass kg 100 pieces (approx.)
AW00	**AW00X**	10	8.5	3	1	3	13.5	21	0.5	3	9	0.131
AW01	**AW01X**	12	10.5	3	1	3	17	25	0.5	3	11	0.192
AW02	**AW02X**	15	13.5	4	1	4	21	28	1	3.5	13	0.253
AW03	**AW03X**	17	15.5	4	1	4	24	32	1	3.5	13	0.313
AW04	**AW04X**	20	18.5	4	1	4	26	36	1	3.5	13	0.350
AW/22	**AW/22X**	22	20.5	4	1	4	28	38	1	3.5	13	0.394
AW05	**AW05X**	25	23	5	1.25	5	32	42	1	3.75	13	0.640
AW/28	**AW/28X**	28	26	5	1.25	5	36	46	1	3.75	13	0.723
AW06	**AW06X**	30	27.5	5	1.25	5	38	49	1	3.75	13	0.780
AW/32	**AW/32X**	32	29.5	5	1.25	5	40	52	1	3.75	13	0.839
AW07	**AW07X**	35	32.5	6	1.25	5	44	57	1	3.75	15	1.04
AW08	**AW08X**	40	37.5	6	1.25	6	50	62	1	3.75	15	1.23
AW09	**AW09X**	45	42.5	6	1.25	6	56	69	1	3.75	17	1.52
AW10	**AW10X**	50	47.5	6	1.25	6	61	74	1	3.75	17	1.60
AW11	**AW11X**	55	52.5	8	1.5	7	67	81	1	5.5	17	1.96
AW12	**AW12X**	60	57.5	8	1.5	7	73	86	1.2	5.5	17	2.53
AW13	**AW13X**	65	62.5	8	1.5	7	79	92	1.2	5.5	19	2.90
AW14	**AW14X**	70	66.5	8	1.5	8	85	98	1.2	5.5	19	3.34
AW15	**AW15X**	75	71.5	8	1.5	8	90	104	1.2	5.5	19	3.56
AW16	**AW16X**	80	76.5	10	1.8	8	95	112	1.2	5.8	19	4.64
AW17	**AW17X**	85	81.5	10	1.8	8	102	119	1.2	5.8	19	5.24
AW18	**AW18X**	90	86.5	10	1.8	10	108	126	1.2	5.8	19	6.23
AW19	**AW19X**	95	91.5	10	1.8	10	113	133	1.2	5.8	19	6.70
AW20	**AW20X**	100	96.5	12	1.8	10	120	142	1.2	7.8	19	7.65
AW21	**AW21X**	105	100.5	12	1.8	12	126	145	1.2	7.8	19	8.26
AW22	**AW22X**	110	105.5	12	1.8	12	133	154	1.2	7.8	19	9.40
AW23	**AW23X**	115	110.5	12	2	12	137	159	1.5	8	19	10.8
AW24	**AW24X**	120	115	14	2	12	138	164	1.5	8	19	10.5
AW25	**AW25X**	125	120	14	2	12	148	170	1.5	8	19	11.8
AW26	**AW26X**	130	125	14	2	12	149	175	1.5	8	19	11.3
AW27	**AW27X**	135	130	14	2	14	160	185	1.5	8	19	14.4
AW28	**AW28X**	140	135	16	2	14	160	192	1.5	10	19	14.2
AW29	**AW29X**	145	140	16	2	14	171	202	1.5	10	19	16.8
AW30	**AW30X**	150	145	16	2	14	171	205	1.5	10	19	15.5
AW31	**AW31X**	155	147.5	16	2.5	16	182	212	1.5	10.5	19	20.9
AW32	**AW32X**	160	154	18	2.5	16	182	217	1.5	10.5	19	22.2
AW33	**AW33X**	165	157.5	18	2.5	16	193	222	1.5	10.5	19	24.1
AW34	**AW34X**	170	164	18	2.5	16	193	232	1.5	10.5	19	24.7
AW36	**AW36X**	180	174	20	2.5	18	203	242	1.5	10.5	19	26.8
AW38	**AW38X**	190	184	20	2.5	18	214	252	1.5	10.5	19	27.8
AW40	**AW40X**	200	194	20	2.5	18	226	262	1.5	10.5	19	29.3

1) Used for adapter series H31, H2, H32, H3, and H23.
Note: Numbers AW00 and AW01 (bent inner tab type) indicate dimensions that are not indicated in JIS B 1554.

Allowable washer dimensions(bent inner tab type) Unit: mm

Bore dia. of lockwasher d_3 mm: Over	Incl.	Dimensional tolerance of distance between lockwasher tab to bore diameter face ΔM_S: Upper	Lower	Dimensional tolerance of lockwasher tab width Δf_{1S}: Upper	Lower
10[1]	50	+0.3	0	0	−0.4
50	80	+0.3	0	0	−1
80	120	+0.5	0	0	−1.4
120	200	+0.5	0	0	−2

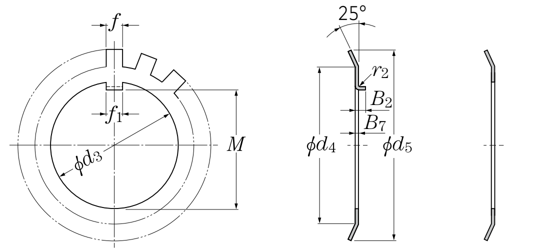
1) 10 mm is included in this dimensional division.
Note: The dimensional tolerance in the table also applies to the **AWL** series bent inner tab type.

Bore diameter no. of adapter 1)	(approx.) Nut no.	Shaft dia. mm (for shaft)
—	**AN00**	10
—	**AN01**	12
—	**AN02**	15
—	**AN03**	17
04	**AN04**	20
—	**AN/22**	22
05	**AN05**	25
—	**AN/28**	28
06	**AN06**	30
—	**AN/32**	32
07	**AN07**	35
08	**AN08**	40
09	**AN09**	45
10	**AN10**	50
11	**AN11**	55
12	**AN12**	60
13	**AN13**	65
14	**AN14**	70
15	**AN15**	75
16	**AN16**	80
17	**AN17**	85
18	**AN18**	90
19	**AN19**	95
20	**AN20**	100
21	**AN21**	105
22	**AN22**	110
—	**AN23**	115
24	**AN24**	120
—	**AN25**	125
26	**AN26**	130
—	**AN27**	135
28	**AN28**	140
—	**AN29**	145
30	**AN30**	150
—	**AN31**	155
32	**AN32**	160
—	**AN33**	165
34	**AN34**	170
36	**AN36**	180
38	**AN38**	190
40	**AN40**	200

Note: For narrow slit type adapter sleeves that have code suffix "X" after the H2, H3, and H23 series number, use straight inner tab washers. In addition, for wide slit type adapter sleeves that have no suffix "X" after the adapter number, either straight or bent inner tab washers can be used.

Lockwashers

Series AWL



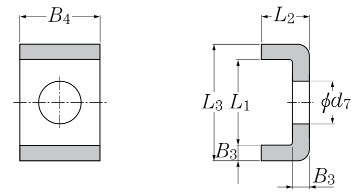
Bent inner tab type
Straight inner tab type

Number		Dimensions mm									No. of tabs	Mass kg	(approx.)	Nut no.	Shaft dia. mm
Bent inner tab type	Straight inner tab type	d_3	M	f_1	B_7	f	d_4	d_5	Bent inner tab type r_2	B_2		100 pieces (approx.)	Bore diameter no. of adapter 1)		(for shaft)
AWL24	**AWL24X**	120	115	14	2	12	133	155	1.5	8	19	7.70	24	**ANL24**	120
AWL26	**AWL26X**	130	125	14	2	12	143	165	1.5	8	19	8.70	26	**ANL26**	130
AWL28	**AWL28X**	140	135	16	2	14	151	175	1.5	10	19	10.9	28	**ANL28**	140
AWL30	**AWL30X**	150	145	16	2	14	164	190	1.5	10	19	11.3	30	**ANL30**	150
AWL32	**AWL32X**	160	154	18	2.5	16	174	200	1.5	10.5	19	16.2	32	**ANL32**	160
AWL34	**AWL34X**	170	164	18	2.5	16	184	210	1.5	10.5	19	19.0	34	**ANL34**	170
AWL36	**AWL36X**	180	174	20	2.5	18	192	220	1.5	10.5	19	18.0	36	**ANL36**	180
AWL38	**AWL38X**	190	184	20	2.5	18	202	230	1.5	10.5	19	20.5	38	**ANL38**	190
AWL40	**AWL40X**	200	194	20	2.5	18	218	250	1.5	10.5	19	21.4	40	**ANL40**	200

1) Used for adapter series H31, H32, and H23.
Note: For wide slit type adapter sleeves that have no suffix "X" after the adapter number, either straight or bent inner tab washers can be used.

Locking Clip

Series AL, ALL



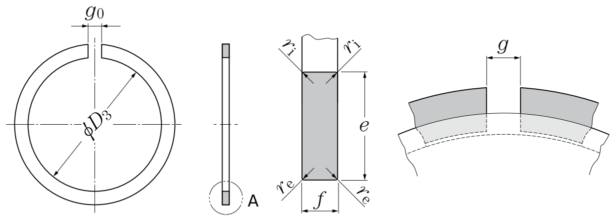
Number	Dimensions mm						Mass kg	(approx.)
	B_3	B_4	L_2	d_7	L_1	L_3	100 pieces (approx.)	Nut no.
AL44	4	20	12	9	22.5	30.5	2.60	**AN44, AN48**
AL52	4	24	12	12	25.5	33.5	3.39	**AN52, AN56**
AL60	4	24	12	12	30.5	38.5	3.79	**AN60**
AL64	5	24	15	12	31	41	5.35	**AN64**
AL68	5	28	15	14	38	48	6.65	**AN68, AN72**
AL76	5	32	15	14	40	50	7.96	**AN76**
AL80	5	32	15	18	45	55	8.20	**AN80, AN84**
AL88	5	36	15	18	43	53	9.00	**AN88, AN92**
AL96	5	36	15	18	53	63	10.4	**AN96**
AL100	5	40	15	18	45	55	10.5	**AN100**

Note: This series uses series H31, H32, and H23 adapters.

Number	Dimensions mm						Mass kg	(approx.)
	B_3	B_4	L_2	d_7	L_1	L_3	100 pieces (approx.)	Nut no.
ALL44	4	20	12	7	13.5	21.5	2.12	**ANL44**
ALL48	4	20	12	9	17.5	25.5	2.29	**ANL48, ANL52**
ALL56	4	24	12	9	17.5	25.5	2.92	**ANL56**
ALL60	4	24	12	9	20.5	28.5	3.16	**ANL60**
ALL64	5	24	15	9	21	31	4.56	**ANL64, ANL68**
ALL72	5	28	15	9	20	30	5.03	**ANL72**
ALL76	5	28	15	12	24	34	5.28	**ANL76, ANL80**
ALL84	5	32	15	12	24	34	6.11	**ANL84**
ALL88	5	32	15	14	28	38	6.45	**ANL88, ANL92**
ALL96	5	36	15	14	28	38	7.29	**ANL96, ANL100**

Note: This series uses H30 adapters.

Snap rings
For dimension series 18 and 19 bearings



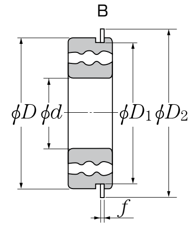
A (enlarged view)

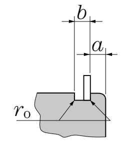
Unit: mm

Number	Bearing outside diameter D	Snap rings Bore diameter D_3	Tolerance of D_3 Δ_{D3S} Upper	Lower	e Max.	Min.	f Max.	Min.	Snap ring fitted inside groove 1) Snap ring outer diameter D_2 Max.	g Approx.	(approx.) g_0	r_i Min.	r_e Min.	Thickness variation V_f Max.	Bearing bore diameter series d 18	19
NR1022	22	20.5	0	−0.3	2.00	1.85	0.7	0.6	24.8	2	1	0.2	0.1	0.06	—	10
NR1024	24	22.5	0	−0.3	2.00	1.85	0.7	0.6	26.8	2	1	0.2	0.1	0.06	—	12
NR1028	28	26.4	0	−0.3	2.05	1.90	0.85	0.75	30.8	3	2	0.25	0.15	0.06	—	15
NR1030	30	28.3	0	−0.3	2.05	1.90	0.85	0.75	32.8	3	2	0.25	0.15	0.06	—	17
NR1032	32	30.3	0	−0.3	2.05	1.90	0.85	0.75	34.8	3	2	0.25	0.15	0.06	20	—
NR1034	34	32.3	0	−0.3	2.05	1.90	0.85	0.75	36.8	3	2	0.25	0.15	0.06	22	—
NR1037	37	35.3	0	−0.3	2.05	1.90	0.85	0.75	39.8	3	2	0.25	0.15	0.06	25	20
NR1039	39	37.3	0	−0.3	2.05	1.90	0.85	0.75	41.8	3	2	0.25	0.15	0.06	—	22
NR1040	40	38.3	0	−0.3	2.05	1.90	0.85	0.75	42.8	3	2	0.25	0.15	0.06	28	—
NR1042	42	40.3	0	−0.4	2.05	1.90	0.85	0.75	44.8	3	2	0.25	0.15	0.06	30	25
NR1044	44	42.3	0	−0.4	2.05	1.90	0.85	0.75	46.8	4	2.5	0.25	0.15	0.06	32	—
NR1045	45	43.3	0	−0.4	2.05	1.90	0.85	0.75	47.8	4	2.5	0.25	0.15	0.06	—	28
NR1047	47	45.3	0	−0.4	2.05	1.90	0.85	0.75	49.8	4	2.5	0.25	0.15	0.06	35	30
NR1052	52	50.3	0	−0.4	2.05	1.90	0.85	0.75	54.8	4	2.5	0.25	0.15	0.06	40	32
NR1055	55	53.3	0	−0.4	2.05	1.90	0.85	0.75	57.8	4	2.5	0.25	0.15	0.06	—	35
NR1058	58	56.3	0	−0.6	2.05	1.90	0.85	0.75	60.8	4	2.5	0.25	0.15	0.06	45	—
NR1062	62	60.2	0	−0.6	2.05	1.90	0.85	0.75	64.8	4	2.5	0.25	0.15	0.06	—	40
NR1065	65	63.2	0	−0.6	2.05	1.90	0.85	0.75	67.8	4	2.5	0.25	0.15	0.06	50	—
NR1068	68	66.2	0	−0.6	2.05	1.90	0.85	0.75	70.8	5	3	0.25	0.15	0.06	—	45
NR1072	72	70.2	0	−0.6	2.05	1.90	0.85	0.75	74.8	5	3	0.25	0.15	0.06	55	50
NR1078	78	75.7	0	−0.6	3.25	3.10	1.12	1.02	82.7	5	3	0.4	0.3	0.06	60	—
NR1080	80	77.4	0	−0.6	3.25	3.10	1.12	1.02	84.4	5	3	0.4	0.3	0.06	—	55
NR1085	85	82.4	0	−0.6	3.25	3.10	1.12	1.02	89.4	5	3	0.4	0.3	0.06	65	60
NR1090	90	87.4	0	−0.6	3.25	3.10	1.12	1.02	94.4	5	3	0.4	0.3	0.06	70	65
NR1095	95	92.4	0	−0.6	3.25	3.10	1.12	1.02	99.4	5	3	0.4	0.3	0.06	75	—
NR1100	100	97.4	0	−0.6	3.25	3.10	1.12	1.02	104.4	5	3	0.4	0.3	0.06	80	70
NR1105	105	101.9	0	−0.8	4.04	3.89	1.12	1.02	110.7	5	3	0.4	0.3	0.06	—	75
NR1110	110	106.9	0	−0.8	4.04	3.89	1.12	1.02	115.7	5	3	0.4	0.3	0.06	85	80
NR1115	115	111.9	0	−0.8	4.04	3.89	1.12	1.02	120.7	5	3	0.4	0.3	0.06	90	—
NR1120	120	116.9	0	−0.8	4.04	3.89	1.12	1.02	125.7	7	4	0.4	0.3	0.06	95	85
NR1125	125	121.8	0	−0.8	4.04	3.89	1.12	1.02	130.7	7	4	0.4	0.3	0.06	100	90
NR1130	130	126.8	0	−0.8	4.04	3.89	1.12	1.02	135.7	7	4	0.4	0.3	0.06	105	95
NR1140	140	136.8	0	−1.0	4.04	3.89	1.7	1.6	145.7	7	4	0.6	0.5	0.06	110	100
NR1145	145	141.8	0	−1.0	4.04	3.89	1.7	1.6	150.7	7	4	0.6	0.5	0.06	—	105
NR1150	150	146.8	0	−1.2	4.04	3.89	1.7	1.6	155.7	7	4	0.6	0.5	0.06	120	110
NR1165	165	161	0	−1.2	4.85	4.70	1.7	1.6	171.5	7	4	0.6	0.5	0.06	130	120
NR1175	175	171	0	−1.2	4.85	4.70	1.7	1.6	181.5	10	6	0.6	0.5	0.06	140	—
NR1180	180	176	0	−1.2	4.85	4.70	1.7	1.6	186.5	10	6	0.6	0.5	0.06	—	130
NR1190	190	186	0	−1.4	4.85	4.70	1.7	1.6	196.5	10	6	0.6	0.5	0.06	150	140
NR1200	200	196	0	−1.4	4.85	4.70	1.7	1.6	206.5	10	6	0.6	0.5	0.06	160	—

1) The snap ring must be fitted inside the groove in the radius direction free from looseness.

Groove





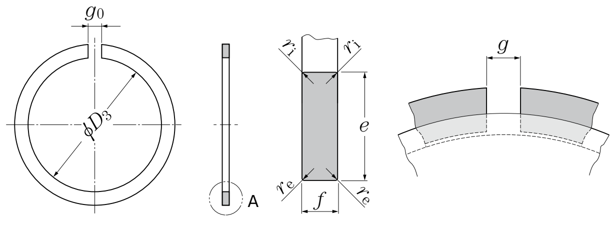
B (enlarged view)

Unit: mm

Bearing outside diameter D	Groove diameter D_1 Max.	Min.	Dimension series 18 Groove position a Max.	Min.	19 Max.	Min.	Groove width b Max.	Min.	Fillet radius of groove bottom r_o Max.
22	20.8	20.5	—	—	1.05	0.90	1.05	0.8	0.2
24	22.8	22.5	—	—	1.05	0.90	1.05	0.8	0.2
28	26.7	26.4	—	—	1.30	1.15	1.20	0.95	0.25
30	28.7	28.4	—	—	1.30	1.15	1.20	0.95	0.25
32	30.7	30.4	1.30	1.15	—	—	1.20	0.95	0.25
34	32.7	32.4	1.30	1.15	—	—	1.20	0.95	0.25
37	35.7	35.4	1.30	1.15	1.70	1.55	1.20	0.95	0.25
39	37.7	37.4	—	—	1.70	1.55	1.20	0.95	0.25
40	38.7	38.4	1.30	1.15	—	—	1.20	0.95	0.25
42	40.7	40.4	1.30	1.15	1.70	1.55	1.20	0.95	0.25
44	42.7	42.4	1.30	1.15	—	—	1.20	0.95	0.25
45	43.7	43.4	—	—	1.70	1.55	1.20	0.95	0.25
47	45.7	45.4	1.30	1.15	1.70	1.55	1.20	0.95	0.25
52	50.7	50.4	1.30	1.15	1.70	1.55	1.20	0.95	0.25
55	53.7	53.4	—	—	1.70	1.55	1.20	0.95	0.25
58	56.7	56.4	1.30	1.15	—	—	1.20	0.95	0.25
62	60.7	60.3	—	—	1.70	1.55	1.20	0.95	0.25
65	63.7	63.3	1.30	1.15	—	—	1.20	0.95	0.25
68	66.7	66.3	—	—	1.70	1.55	1.20	0.95	0.25
72	70.7	70.3	1.70	1.55	1.70	1.55	1.20	0.95	0.25
78	76.2	75.8	1.70	1.55	—	—	1.6	1.3	0.4
80	77.9	77.5	—	—	2.1	1.9	1.6	1.3	0.4
85	82.9	82.5	1.70	1.55	2.1	1.9	1.6	1.3	0.4
90	87.9	87.5	1.70	1.55	2.1	1.9	1.6	1.3	0.4
95	92.9	92.5	1.70	1.55	—	—	1.6	1.3	0.4
100	97.9	97.5	1.70	1.55	2.5	2.3	1.6	1.3	0.4
105	102.6	102.1	—	—	2.5	2.3	1.6	1.3	0.4
110	107.6	107.1	2.1	1.9	2.5	2.3	1.6	1.3	0.4
115	112.6	112.1	2.1	1.9	—	—	1.6	1.3	0.4
120	117.6	117.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4
125	122.6	122.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4
130	127.6	127.1	2.1	1.9	3.3	3.1	1.6	1.3	0.4
140	137.6	137.1	2.5	2.3	3.3	3.1	2.2	1.9	0.6
145	142.6	142.1	—	—	3.3	3.1	2.2	1.9	0.6
150	147.6	147.1	2.5	2.3	3.3	3.1	2.2	1.9	0.6
165	161.8	161.3	3.3	3.1	3.7	3.5	2.2	1.9	0.6
175	171.8	171.3	3.3	3.1	—	—	2.2	1.9	0.6
180	176.8	176.3	—	—	3.7	3.5	2.2	1.9	0.6
190	186.8	186.3	3.3	3.1	3.7	3.5	2.2	1.9	0.6
200	196.8	196.3	3.3	3.1	—	—	2.2	1.9	0.6

Snap rings

For diameter series 0, 2, 3 and 4 bearings



A (enlarged view)

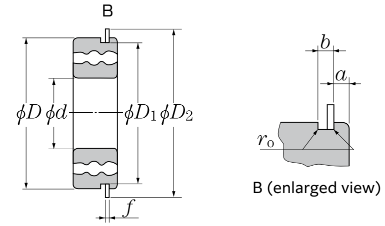
Unit: mm

Number	Bearing outside diameter D	Snap rings Bore diameter D_3	Tolerance of D_3 Δ_{D3S} Upper	Lower	e Max.	Min.	f Max.	Min.	Snap ring fitted inside groove 1) Snap ring outer diameter D_2 Max.	g Approx.	g_0	r_i Min.	r_e Min.	(approx.) Thickness variation V_f Max.	Bearing bore diameter dimension series d 0	2	3	4
NR30	30	27.9	0	−0.4	3.25	3.10	1.12	1.02	34.7	3	2	0.4	0.3	0.06	—	10	9	8
NR32	32	29.9	0	−0.4	3.25	3.10	1.12	1.02	36.7	3	2	0.4	0.3	0.06	15	12	—	9
NR35	35	32.9	0	−0.4	3.25	3.10	1.12	1.02	39.7	3	2	0.4	0.3	0.06	17	15	10	—
NR37	37	34.5	0	−0.4	3.25	3.10	1.12	1.02	41.3	3	2	0.4	0.3	0.06	—	—	12	10
NR40	40	37.8	0	−0.4	3.25	3.10	1.12	1.02	44.6	3	2	0.4	0.3	0.06	—	17	—	—
NR42	42	39.5	0	−0.5	3.25	3.10	1.12	1.02	46.3	3	2	0.4	0.3	0.06	20	—	15	12
NR44	44	41.5	0	−0.5	3.25	3.10	1.12	1.02	48.3	3	2	0.4	0.3	0.06	22	—	—	—
NR47	47	44.3	0	−0.5	4.04	3.89	1.12	1.02	52.7	4	2.5	0.4	0.3	0.06	25	20	17	—
NR50	50	47.3	0	−0.5	4.04	3.89	1.12	1.02	55.7	4	2.5	0.4	0.3	0.06	—	22	—	—
NR52	52	49.4	0	−0.5	4.04	3.89	1.12	1.02	57.9	4	2.5	0.4	0.3	0.06	28	25	20	15
NR55	55	52.3	0	−0.5	4.04	3.89	1.12	1.02	60.7	4	2.5	0.4	0.3	0.06	30	—	—	—
NR56	56	53.2	0	−0.6	4.04	3.89	1.12	1.02	61.7	4	2.5	0.4	0.3	0.06	—	—	22	—
NR58	58	55.2	0	−0.6	4.04	3.89	1.12	1.02	63.7	4	2.5	0.4	0.3	0.06	32	28	—	—
NR62	62	59.0	0	−0.6	4.04	3.89	1.7	1.6	67.7	4	2.5	0.6	0.5	0.06	35	30	25	17
NR65	65	62.0	0	−0.6	4.04	3.89	1.7	1.6	70.7	4	2.5	0.6	0.5	0.06	—	32	—	—
NR68	68	64.2	0	−0.6	4.85	4.70	1.7	1.6	74.6	5	3	0.6	0.5	0.06	40	—	28	—
NR72	72	68.2	0	−0.6	4.85	4.70	1.7	1.6	78.6	5	3	0.6	0.5	0.06	—	35	30	20
NR75	75	71.2	0	−0.6	4.85	4.70	1.7	1.6	81.6	5	3	0.6	0.5	0.06	45	—	32	—
NR80	80	76.2	0	−0.6	4.85	4.70	1.7	1.6	86.6	5	3	0.6	0.5	0.06	50	40	35	25
NR85	85	81.2	0	−0.6	4.85	4.70	1.7	1.6	91.6	5	3	0.6	0.5	0.06	—	45	—	—
NR90	90	86.2	0	−0.6	4.85	4.70	2.46	2.36	96.5	5	3	0.6	0.5	0.06	55	50	40	30
NR95	95	91.2	0	−0.6	4.85	4.70	2.46	2.36	101.6	5	3	0.6	0.5	0.06	60	—	—	—
NR100	100	96.2	0	−0.8	4.85	4.70	2.46	2.36	106.5	5	3	0.6	0.5	0.06	65	55	45	35
NR110	110	106.2	0	−0.8	4.85	4.70	2.46	2.36	116.6	5	3	0.6	0.5	0.06	70	60	50	40
NR115	115	111.2	0	−0.8	4.85	4.70	2.46	2.36	121.6	5	3	0.6	0.5	0.06	75	—	—	—
NR120	120	114.6	0	−0.8	7.21	7.06	2.82	2.72	129.7	7	4	0.6	0.5	0.06	—	65	55	45
NR125	125	119.6	0	−0.8	7.21	7.06	2.82	2.72	134.7	7	4	0.6	0.5	0.06	80	70	—	—
NR130	130	124.6	0	−0.8	7.21	7.06	2.82	2.72	139.7	7	4	0.6	0.5	0.06	85	75	60	50
NR140	140	134.6	0	−1.2	7.21	7.06	2.82	2.72	149.7	7	4	0.6	0.5	0.06	90	80	65	55
NR145	145	139.6	0	−1.2	7.21	7.06	2.82	2.72	154.7	7	4	0.6	0.5	0.06	95	—	—	—
NR150	150	144.5	0	−1.2	7.21	7.06	2.82	2.72	159.7	7	4	0.6	0.5	0.06	100	85	70	60
NR160	160	154.5	0	−1.2	7.21	7.06	2.82	2.72	169.7	7	4	0.6	0.5	0.06	105	90	75	65
NR170	170	162.9	0	−1.2	9.60	9.45	3.1	3.0	182.9	10	6	0.6	0.5	0.06	110	95	80	—
NR180	180	172.8	0	−1.2	9.60	9.45	3.1	3.0	192.9	10	6	0.6	0.5	0.06	120	100	85	70
NR190	190	182.8	0	−1.4	9.60	9.45	3.1	3.0	202.9	10	6	0.6	0.5	0.06	—	105	90	75
NR200	200	192.8	0	−1.4	9.60	9.45	3.1	3.0	212.9	10	6	0.6	0.5	0.06	130	110	95	80

1) The snap ring must be fitted inside the groove in the radius direction free from looseness.

Snap Rings and Grooves for Rolling Bearings NTN

Groove



B (enlarged view)

Unit: mm

Bearing outside diameter D	Groove diameter D_1 Max.	Min.	Dimension series 0 Groove position a Max.	Min.	Dimension series 2, 3, 4 Groove position a Max.	Min.	Groove width b Max.	Min.	Fillet radius of groove bottom r_o Max.
30	28.17	27.91	—	—	2.06	1.90	1.65	1.35	0.4
32	30.15	29.90	2.06	1.90	2.06	1.90	1.65	1.35	0.4
35	33.17	32.92	2.06	1.90	2.06	1.90	1.65	1.35	0.4
37	34.77	34.52	—	—	2.06	1.90	1.65	1.35	0.4
40	38.10	37.85	—	—	2.06	1.90	1.65	1.35	0.4
42	39.75	39.50	2.06	1.90	2.06	1.90	1.65	1.35	0.4
44	41.75	41.50	2.06	1.90	—	—	1.65	1.35	0.4
47	44.60	44.35	2.06	1.90	2.46	2.31	1.65	1.35	0.4
50	47.60	47.35	—	—	2.46	2.31	1.65	1.35	0.4
52	49.73	49.48	2.06	1.90	2.46	2.31	1.65	1.35	0.4
55	52.60	52.35	2.08	1.88	—	—	1.65	1.35	0.4
56	53.60	53.35	—	—	2.46	2.31	1.65	1.35	0.4
58	55.60	55.35	2.08	1.88	2.46	2.31	1.65	1.35	0.4
62	59.61	59.11	2.08	1.88	3.28	3.07	2.2	1.9	0.6
65	62.60	62.10	—	—	3.28	3.07	2.2	1.9	0.6
68	64.82	64.31	2.49	2.29	3.28	3.07	2.2	1.9	0.6
72	68.81	68.30	—	—	3.28	3.07	2.2	1.9	0.6
75	71.83	71.32	2.49	2.29	3.28	3.07	2.2	1.9	0.6
80	76.81	76.30	2.49	2.29	3.28	3.07	2.2	1.9	0.6
85	81.81	81.31	—	—	3.28	3.07	2.2	1.9	0.6
90	86.79	86.28	2.87	2.67	3.28	3.07	3.0	2.7	0.6
95	91.82	91.31	2.87	2.67	—	—	3.0	2.7	0.6
100	96.80	96.29	2.87	2.67	3.28	3.07	3.0	2.7	0.6
110	106.81	106.30	2.87	2.67	3.28	3.07	3.0	2.7	0.6
115	111.81	111.30	2.87	2.67	—	—	3.0	2.7	0.6
120	115.21	114.71	—	—	4.06	3.86	3.4	3.1	0.6
125	120.22	119.71	2.87	2.67	4.06	3.86	3.4	3.1	0.6
130	125.22	124.71	2.87	2.67	4.06	3.86	3.4	3.1	0.6
140	135.23	134.72	3.71	3.45	4.90	4.65	3.4	3.1	0.6
145	140.23	139.73	3.71	3.45	—	—	3.4	3.1	0.6
150	145.24	144.73	3.71	3.45	4.90	4.65	3.4	3.1	0.6
160	155.22	154.71	3.71	3.45	4.90	4.65	3.4	3.1	0.6
170	163.65	163.14	3.71	3.45	5.69	5.44	3.8	3.5	0.6
180	173.66	173.15	3.71	3.45	5.69	5.44	3.8	3.5	0.6
190	183.64	183.13	—	—	5.69	5.44	3.8	3.5	0.6
200	193.65	193.14	5.69	5.44	5.69	5.44	3.8	3.5	0.6

Rolling Bearing Accessories

Balls

The **NTN** steel balls conform to JIS B 1501 (steel ball for ball bearings). Contact **NTN** Engineering for any request.

High-carbon chromium bearing steel is generally used for the material. Some special types use stainless steel and heat-resistant steel.

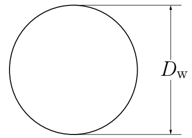
The accuracy conforms to the JIS (JIS B 1501). Please consult **NTN** Engineering for details.

1. Ball dimensions

Nominal dimension Metric	Inch	Nominal diameter D_W mm	Mass kg (approx.) 10 000 pieces
0.3mm		0.300 00	0.0011
0.4mm		0.400 00	0.0026
0.5mm		0.500 00	0.0051
0.6mm		0.600 00	0.0089
	0.025	0.635 00	0.0105
0.7mm		0.700 00	0.0141
	1/32	0.793 75	0.0205
0.8mm		0.800 00	0.0210
1mm		1.000 00	0.0410
	3/64	1.190 62	0.0692
1.2mm		1.200 00	0.0708
1.5mm		1.500 00	0.1384
	1/16	1.587 50	0.1640
	5/64	1.984 38	0.3204
2mm		2.000 00	0.3280
	3/32	2.381 25	0.5536
2.5mm		2.500 00	0.6406
	7/64	2.778 12	0.8790
2.8mm		2.800 00	0.9000
3mm		3.000 00	1.107
	1/8	3.175 00	1.312
3.5mm		3.500 00	1.758
	9/64	3.571 88	1.868
	5/32	3.968 75	2.563
4mm		4.000 00	2.624
4.5mm		4.500 00	3.736
	3/16	4.762 50	4.429
5mm		5.000 00	5.125
5.5mm		5.500 00	6.821
	7/32	5.556 25	7.032
	15/64	5.953 12	8.650
6mm		6.000 00	8.856
	1/4	6.350 00	10.50
6.5mm		6.500 00	11.26
	17/64	6.746 88	12.59
7m		7.000 00	14.06
	9/32	7.143 75	14.95
7.5mm		7.500 00	17.30
	5/16	7.937 50	20.50
8mm		8.000 00	20.99
8.5mm		8.500 00	25.18
	11/32	8.731 25	27.29
9mm		9.000 00	29.89

Nominal dimension Metric	Inch	Nominal diameter D_W mm	Mass kg (approx.) 1 000 pieces
	3/8	9.525 00	3.543
10mm		10.000 00	4.100
	13/32	10.318 75	4.504
11mm		11.000 00	5.457
	7/16	11.112 50	5.626
11.5mm		11.500 00	6.235
	15/32	11.906 25	6.920
12mm		12.000 00	7.084
	1/2	12.700 00	8.398
13mm		13.000 00	9.007
	17/32	13.493 75	10.07
14mm		14.000 00	11.25
	9/16	14.287 50	11.96
15mm		15.000 00	13.84
	19/32	15.081 25	14.06
	5/8	15.875 00	16.40
16mm		16.000 00	16.79
	21/32	16.668 75	18.99
17mm		17.000 00	20.14
	11/16	17.462 50	21.83
18mm		18.000 00	23.91
	23/32	18.256 25	24.95
19mm		19.000 00	28.12
	3/4	19.050 00	28.34
	25/32	19.843 75	32.04
20mm		20.000 00	32.80
	13/16	20.637 50	36.04
21mm		21.000 00	37.97
	27/32	21.431 25	40.36
22mm		22.000 00	43.65
	7/8	22.225 00	45.01
23mm		23.000 00	49.88
	29/32	23.018 75	50.00
	15/16	23.812 50	55.36
24mm		24.000 00	56.68
	31/32	24.606 25	61.08
25mm		25.000 00	64.06
	1	25.400 00	67.18
26mm		26.000 00	72.06
	1 1/16	26.987 50	80.58
28mm		28.000 00	90.00
	1 1/8	28.575 00	95.66

Balls



Nominal dimension Metric	Inch	Nominal diameter D_W mm	Mass kg (approx.) 10 pieces
30mm		30.000 00	1.107
	1 3/16	30.162 50	1.125
	1 1/4	31.750 00	1.312
32mm		32.000 00	1.343
	1 5/16	33.337 50	1.519
34mm		34.000 00	1.611
	1 3/8	34.925 00	1.747
35mm		35.000 00	1.758
36mm		36.000 00	1.913
	1 7/16	36.512 50	1.996
38mm		38.000 00	2.250
	1 1/2	38.100 00	2.267
	1 9/16	39.687 50	2.563
40mm		40.000 00	2.624
	1 5/8	41.275 00	2.883
	1 11/16	42.862 50	3.228
	1 3/4	44.450 00	3.601
45mm		45.000 00	3.736
	1 13/16	46.037 50	4.000
	1 7/8	47.625 00	4.429
	1 15/16	49.212 50	4.886
50mm		50.000 00	5.125
	2	50.800 00	5.375
	2 1/8	53.975 00	6.447
55mm		55.000 00	6.821
	2 1/4	57.150 00	7.653
60mm		60.000 00	8.856
	2 3/8	60.325 00	9.000
	2 1/2	63.500 00	10.50
65mm		65.000 00	11.26
	2 5/8	66.675 00	12.15
	2 3/4	69.850 00	13.97
	2 7/8	73.025 00	15.97
	3	76.200 00	18.14
	3 1/4	82.550 00	23.06
	3 1/2	88.900 00	28.80
	3 3/4	95.250 00	35.43
	4	101.600 00	43.00
	4 1/4	107.950 00	51.57
	4 1/2	114.300 00	61.22

2. Applicable range of class, accuracy of shapes and surface roughness, accuracy and gauges of classification

Unit: µm

Class	Accuracy and surface roughness of shapes[1)]			Accuracy and gauges of classification								
	Diameter variation (Max.)	Sphericity (Max.)	Surface roughness *Ra* (Max.)	Mutual tolerance of lot diameter (Max.)	Gauge interval	Gauge						
G3	0.08	0.08	0.010	0.13	0.5	−5,	......,	−0.5,	0,	+0.5,	......,	+5
G5	0.13	0.13	0.014	0.25	1	−5,	......,	−1,	0,	+1,	......,	+5
G10	0.25	0.25	0.020	0.5	1	−9,	......,	−1,	0,	+1,	......,	+9
G16	0.4	0.4	0.025	0.8	2	−10,	......,	−2,	0,	+2,	......,	+10
G20	0.5	0.5	0.032	1	2	−10,	......,	−2,	0,	+2,	......,	+10
G24	0.6	0.6	0.040	1.2	2	−12,	......,	−2,	0,	+2,	......,	+12
G28	0.7	0.7	0.050	1.4	2	−12,	......,	−2,	0,	+2,	......,	+12
G40	1	1	0.060	2	4	−16,	......,	−4,	0,	+4,	......,	+16
G60	1.5	1.5	0.080	3	6	−18,	......,	−6,	0,	+6,	......,	+18
G100	2.5	2.5	0.100	5	10	−40,	......,	−10,	0,	+10,	......,	+40
G200	5	5	0.150	10	15	−60,	......,	−15,	0,	+15,	......,	+60

1) Measure the dimension excluding the flaws because the values do not incorporate flaws on the surface.

3. Hardness

Nominal dimension	Hardness	
	HV	HRC
0.3mm to 3mm	772 to 900	(63 to 67)[2)]
1/8 to 30mm	—	62 to 67
1 3/16 to 4	—	61 to 67

2) The value in ( ) is shown by reference to the converted value.

Rolling Bearing Accessories

Rolling Bearing Accessories

High-carbon chromium bearing steel is used for needle rollers. The needle rollers ar ground and polished after heat treatment. The surface hardness is 60 to 65 HRC.

Needle rollers are provided as rolling elements or pins for operation directly on the shaft.

1. Shape of needle rollers

The standard shape of needle rollers has a flat surface on its end face (referred to as F type). Crowned contact surfaces are also available (suffix code: E) and can reduce the edge load on the rollers. Excessive edge load on rollers can result in premature failure. Contact **NTN** Engineering for more information.

Table 1 End face shape

Type	Designation	Shape
F	Flat surface	

2. Needle roller part number composition

The needle roller part number is composed of a model code (end face type), a dimension code [diameter (D_W) x length (L_W)], and a suffix code (Refer to **Fig. 1**).

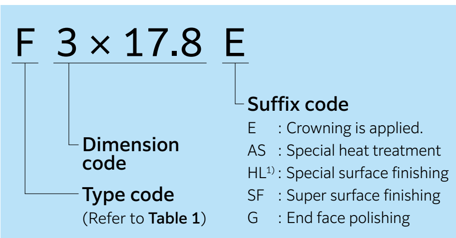


Fig. 1

1) For HL, contact **NTN** Engineering.

3. Accuracy of needle rollers

The dimensional accuracy of needle rollers is maintained in accordance with JIS B 1506 (Rolling bearings—Rollers). (Refer to **Table 2**)

Table 2 Accuracy of needle rollers Unit: μm

Characteristics	Tolerance and tolerance values
Tolerance of average value of diameter D_W	0 to −10
Mutual tolerance of lot diameter D_W (max.)	2
Roundness of diameter D_W, diameter variation in flat surface	1.0 ($L_W/D_W \leqq 6$) 1.5 ($L_W/D_W > 6$)
Tolerance of length L_W	h13
Accuracy class	Class 2

Needle rollers are separated into groupings of 2μm ranges based on the diameter of the roller and are separately packaged to maintain consistency between supplied rollers. Depending on the tolerance range, the needle rollers are classified by label colors such as red, black, and blue, and then delivered.

Bearing rollers in packages having different label colors must not be mixed.

Table 3 Diameter dimensional tolerance and classification of needle rollers

Label color	Tolerance range (μm)	Classification
Red	0 to −2	Standard
Navy	−1 to −3	
Blue	−2 to −4	
Black	−3 to −5	
White	−4 to −6	
Gray	−5 to −7	Sub standard
Green	−6 to −8	
Brown	−7 to −9	
Yellow	−8 to −10	

4. Application of needle rollers

When a full compliment needle roller bearing is made with a standard needle roller, the shaft diameter (d), the housing bore diameter (D), the circumferential clearance (Δ_C), and the radial internal clearance (Δr) are calculated from the needle roller diameter (D_W) and the number of rollers (Z) (see **Fig. 2**).

The minimum value of the circumferential clearance (Δ_C) is calculated by Equation (1). The radial internal clearance (Δr) is selected based on the shaft diameter and the usage conditions using section “E. Needle roller bearings 2.4 Solid type needle roller bearings **Table 9** (E-7)” as guidance. Full complement needle roller bearings generally require a larger radial inner clearance than a needle roller bearing with cage.

$$\Delta_C = (0.005 \sim 0.020) \times Z \text{ mm}$$
(minimum value) .... (1)

The minimum value of the housing bore diameter (D) and the maximum value of the shaft diameter (d) are calculated from Equations (2) and (3).

$$D = \frac{1}{\sin\left(\frac{\pi}{Z}\right)} \cdot \left(D_W + \frac{\Delta_C}{Z}\right) + D_W \text{ mm}$$
(minimum value) .... (2)

$$d = D - 2D_W - \Delta r \text{ mm}$$
(maximum value) .... (3)

In order to retain the needle rollers in the housing using the keystone method, the maximum value of the housing bore diameter (D) is calculated from the minimum value of the roller diameter ($D_{W\,min}$) and the number of rollers (Z) using Equation (4) (see **Fig. 3**). Factor K is shown in **Table 4**.

$$D = K \cdot D_{W\,min} \text{ mm (maximum value)} \cdots (4)$$

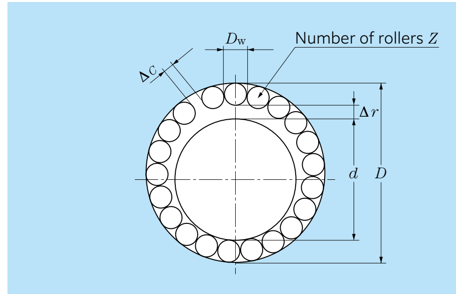


Fig. 2

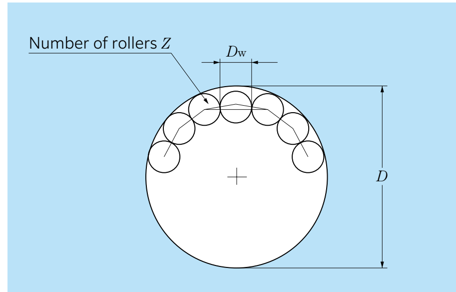
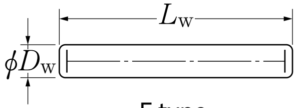


Fig. 3

Table 4 Values of factor K

Z	K	Z	K
8	3.6763333	17	6.4536463
9	3.9709394	18	6.7689303
10	4.2727719	19	7.0846088
11	4.5789545	20	7.4006100
12	4.8879667	21	7.7168786
13	5.1989251	22	8.0333713
14	5.5112799	23	8.3500534
15	5.8246707	24	8.6668970
16	6.1388508	25	8.9838796

F type



F type

d 1.5 ～ 4.5mm

Boundary dimensions mm		Number	Mass kg (approx.) 1 000 pieces
D_w	L_w	Flat type	
1.5	5.8	F1.5 × 5.8	0.080
	6.8	F1.5 × 6.8	0.090
	7.8	F1.5 × 7.8	0.104
	9.8	F1.5 × 9.8	0.131
	11.8	F1.5 × 11.8	0.159
	13.8	F1.5 × 13.8	0.186
2	6.8	F2 × 6.8	0.158
	7.8	F2 × 7.8	0.183
	9.8	F2 × 9.8	0.232
	11.8	F2 × 11.8	0.281
	13.8	F2 × 13.8	0.330
	15.8	F2 × 15.8	0.379
	17.8	F2 × 17.8	0.428
	19.8	F2 × 19.8	0.477
2.5	7.8	F2.5 × 7.8	0.284
	9.8	F2.5 × 9.8	0.351
	11.8	F2.5 × 11.8	0.438
	13.8	F2.5 × 13.8	0.514
	15.8	F2.5 × 15.8	0.591
	17.8	F2.5 × 17.8	0.668
	19.8	F2.5 × 19.8	0.745
	21.8	F2.5 × 21.8	0.821
	23.8	F2.5 × 23.8	0.898
3	9.8	F3 × 9.8	0.556
	11.8	F3 × 11.8	0.671
	13.8	F3 × 13.8	0.784
	15.8	F3 × 15.8	0.897
	17.8	F3 × 17.8	1.01
	19.8	F3 × 19.8	1.12
	21.8	F3 × 21.8	1.23
	23.8	F3 × 23.8	1.34
	25.8	F3 × 25.8	1.45
	27.8	F3 × 27.8	1.56
3.5	11.8	F3.5 × 11.8	0.849
	13.8	F3.5 × 13.8	1.00
	15.8	F3.5 × 15.8	1.15
	17.8	F3.5 × 17.8	1.30
	19.8	F3.5 × 19.8	1.45
	21.8	F3.5 × 21.8	1.60
	23.8	F3.5 × 23.8	1.75
	25.8	F3.5 × 25.8	1.90
	29.8	F3.5 × 29.8	2.20
	31.8	F3.5 × 31.8	2.35
	34.8	F3.5 × 34.8	2.58
4	13.8	F4 × 13.8	1.27
	15.8	F4 × 15.8	1.50
	17.8	F4 × 17.8	1.70
	19.8	F4 × 19.8	1.89
	21.8	F4 × 21.8	2.09
	23.8	F4 × 23.8	2.26
	25.8	F4 × 25.8	2.48
	27.8	F4 × 27.8	2.68
	29.8	F4 × 29.8	2.87
	31.8	F4 × 31.8	3.07
	34.8	F4 × 34.8	3.31
	37.8	F4 × 37.8	3.62
	39.8	F4 × 39.8	3.82
4.5	17.8	F4.5 × 17.8	2.11
	19.8	F4.5 × 19.8	2.36
	21.8	F4.5 × 21.8	2.61
	23.8	F4.5 × 23.8	2.86
	25.8	F4.5 × 25.8	3.11
	29.8	F4.5 × 29.8	3.62
	31.8	F4.5 × 31.8	3.87
	34.8	F4.5 × 34.8	4.25
	37.8	F4.5 × 37.8	4.63
	39.8	F4.5 × 39.8	4.88
	44.8	F4.5 × 44.8	5.51

d 5mm

Boundary dimensions mm		Number	Mass kg (approx.) 1 000 pieces
D_w	L_w	Flat type	
5	19.8	F5 × 19.8	2.89
	21.8	F5 × 21.8	3.20
	23.8	F5 × 23.8	3.52
	25.8	F5 × 25.8	3.82
	29.8	F5 × 29.8	4.45
	31.8	F5 × 31.8	4.74
	34.8	F5 × 34.8	5.11
	37.8	F5 × 37.8	5.55
	39.8	F5 × 39.8	5.85
	49.8	F5 × 49.8	7.33

Needle Roller Bearings

Needle Roller Bearings Contents

1. Characteristics and types of needle roller bearings

Needle roller bearing are rolling bearings which have small diameter cylindrical rolling elements whose length is relatively long compared with their diameter.

Needle roller bearings have a small cross-sectional height and have a larger load capacity and rigidity than other types of rolling bearings for their relative size. They are also suitable for oscillating motion due to their low moment of inertia. Types of needle roller bearings are shown in the table below. This catalog **provides dimension tables for the representative bearing types indicated by blue text in the table below**.

For more information about needle roller bearings, see the special catalog issued separately "**Needle roller bearings (CAT. No. 2300/E)**."

Bearing type		Type code	Shaft diameter	Page of bearing dimension table
Radial roller bearings	Needle roller bearing with cage	K, K···T2, K···S, KMJ···S, K···ZW, KV···S, KV···ZWS, K···L1	3~285	E-12~25
	Connecting rod needle roller bearings with cage	PK, KBK, GPK, KMJ···S, KBK, KV···S	―――	―――
	Drawn cup needle roller bearings	HK, HMK, HK···ZWD, HMK···ZWD, BK, BK···ZWD, HK···L, HMK···L, HK···LL, HMK···LL, DCL, HCK	3~ 50	E-26~33
	Solid type needle roller bearings	RNA48, RNA49, RNA49···R, RNA59, RNA69···R, NK, NK···R, NA48, NA49, NA49···R, NA59, NA69···R, NK+IR, NK···R+IR NA49···L, RNA49···L, NA49···LL, RNA49···LL, MR, MR+MI NKS, NKS+IR	5~440	E-34~55
	Separable solid type needle roller bearings	RNAO, RNAO···ZW, NAO, NAO···ZW	―――	―――
	Clearance adjusting needle roller bearings	RNA49···S, NA49···S	―――	―――
Thrust roller bearings	Thrust cylindrical roller bearings	811, 812, 893, K811, K812, K893 WS, GS, 874, K874	10~160	E-56~61
	Thrust needle roller bearings	AXK11, AS, WS, GS	10~160	E-62~65
Complex bearings	Complex bearings	NKX, NKX…Z, NKXR, NKXR…Z, NKX+IR, NKX…Z+IR, NKXR+IR, NKXR…Z+IR, NKIA, NKIB, AXN, ARN	―――	―――
Track rollers	Cam followers	KR···(F), KR···(F)LL, KRV···(F), KRV···(F)LL, KR···(F)H, KRV···(F)H, KRT, KRT···LL, KRVT, KRVT···LL, KRVU, KRVU···LL, CR, CR···LL, CRV, CRV···LL, CR···H, CRV···H, NUKR, NUKRT, NUKRU	3~ 64 (Stud diameter)	E-66~83
	Roller followers	RNAB2, NAB2, RNA22···LL, NA22···LL, NATR, NATR···LL, NATV, NACV, NATV···LL, NACV···LL, NUTR, NUTW	5~ 50	E-84~91
Components	Inner rings, needle rollers, snap rings, seals	IR, MI, F, WR, BR, G, GD, LEG, LEGD	―――	D-24~27
Linear motion bearings	Linear ball bearings	KLM, KH, KD, RLM, FF, FF···ZW, RF, BF	―――	―――
Textile machinery bearings	Bottom roller bearing tension pulleys	JPU···S, FRIS, FR	―――	―――

Note: 1. Bearings with polyamide resin cages (supplementary suffix code: T2/example: HK0408FT2) must be used at an allowable temperature of 120°C or below or 100°C or below for continuous use.
2. Bearings with an attached synthetic rubber seal and filled with grease inside (supplementary suffix code: L or LL/example: NATR20LL/3AS) must be used at an allowable temperature of -20 to 120°C or 100°C or below for continuous use.

2. Handling and accuracy of needle roller bearings

2.1 Required accuracy and surface hardness of raceway surfaces

For applications using needle roller bearings, the outer diameter of the shaft or the inner diameter of the housing or the gear is sometimes used directly as a raceway surface. **Table 1** shows the accuracy, surface roughness, and surface hardness required for raceway surfaces in order to keep radial clearance within the prescribed allowable tolerance range after needle roller bearing installation, and to ensuring high rotational accuracy. To set a surface hardness of the raceway surface from 58 to 64 HRC and obtain a sufficient load capacity, apply appropriate heat treatment to materials as shown in **Table 2**.

Depending on the usage conditions, the bearing function may not be satisfactory even with the following recommended values. If this applies, consult with **NTN** Engineering.

Table 1 Recommended accuracy of raceway surfaces

Characteristics		Shaft	Housing
Dimensional accuracy		IT5 (IT4)	IT6 (IT5)
Roundness Cylindricity (Max.)		IT3 (IT2)	IT4 (IT3)
Abutment squareness (Max.)	Radial	IT3	
	Thrust	IT5 (IT4)	
Surface roughness μm Ra		Shaft diameter ϕ80 or below: 0.2 Shaft diameter ϕ81 to ϕ120: 0.3 Shaft diameter over ϕ120 : 0.4	
Surface hardness		58 to 64 HRC	

Remarks: Accuracy in ( ) applies for high rotational accuracy.

Table 2 Materials used for raceways

Steel type	Representative example	Standard
High carbon chrome bearing steel	SUJ2	JIS G 4805
Carbon tool steel	SK85 (Former: SK5)	JIS G 4401
Nickel chrome molybdenum steel	SNCM420	JIS G 4053 (Former: JIS G 4103)
Chrome steel	SCr420	JIS G 4053 (Former: JIS G 4104)
Chrome molybdenum steel	SCM420	JIS G 4053 (Former: JIS G 4105)
Stainless steel	SUSU440C	JIS G 4303

When steel is surface-hardened by carburizing or carbonitriding, the depth from the surface to 550 HV is defined as effective case depth per JIS. The minimum value of the effective case depth is roughly estimated using formula (1).

$$Eht_{\min} \geqq 0.8D_{w}(0.1 + 0.002D_{w}) \cdots\cdots\cdots (1)$$

Where:
$Eht_{\min}$: Minimum effective case depth, mm
D_{w} : Roller diameter, mm

Needle roller bearings have low allowable misalignment because the ratio of roller length to roller diameter is high. For normal applications, bearing misalignment must not exceed the values shown in **Table 3**.

Table 3 Allowable misalignment of needle roller bearings

Bearing type	Allowable misalignment
Radial roller bearings	1/2 000
Thrust roller bearings	1/10 000

Mating part dimensions must be set so that the rolling surface does not come in contact with the recessed portion of the shaft or the chamfered area of the housing raceway surface. Contact **NTN** Engineering when dimension $A_{\min}$ (**Fig. 1**) must be confirmed.

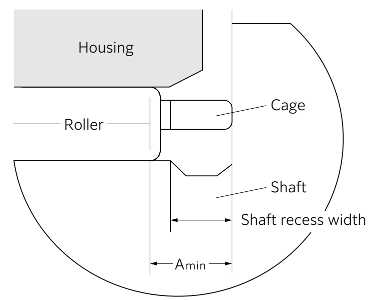


Fig. 1 Dimension $A_{\min}$

2.2 Needle roller bearing with cage

These needle roller bearings include needle rollers and cages that guide and hold the needle rollers. The structure is lightweight and compact because no inner ring or outer ring is used and the shaft and the housing are used as raceway surfaces.

Table 4 shows recommended fits for this bearing type, and **Table 5** shows the diameter dimensional tolerance and classification of needle rollers. See section 2.1 for the accuracy and surface hardness necessary for shafts and housings serving as the raceway surfaces for these bearings.

The needle roller diameter variation included in a single assembly is within 2 μm, and the standard classification shown in **Table 5** will be supplied if there is no particular designation. When two or more of the same bearings are to be used in tandem arrangement, it is necessary to use bearings having rollers of the same classification promote equal load sharing.

For caged needle roller bearings that are used for the connecting rod of small/medium reciprocating engines, see the catalog "**Needle roller bearings (CAT. No. 2300/E).**"

Table 4 Fits recommended for needle roller bearings with cage

Shaft diameter mm	Recommended fits					
	Internal clearance less than normal		Normal clearance		Internal clearance greater than normal	
	Shaft	Housing	Shaft	Housing	Shaft	Housing
Up to 80	j5	G6	h5	G6	g6	G6
80 to140	h5	G6	g5	G6	f6	G6
140 or more	h5	G6	f5	H6	f6	G6

Table 5 Diameter dimensional tolerance and classification of needle rollers

Label color	Tolerance range (μm)	Classification
Red	−0 to − 2	Standard
Navy	−1 to − 3	
Blue	−2 to − 4	
Black	−3 to − 5	
White	−4 to − 6	
Gray	−5 to − 7	Sub standard
Green	−6 to − 8	
Brown	−7 to − 9	
Yellow	−8 to −10	

When a caged needle roller bearing is used as a single body to be directly guided in the axial direction by a shaft shoulder (**Fig. 2**), any part coming into contact with the cage side surface must be sufficiently finished without burrs. For high speed or heavy load operation, the contact surface is hardened and finished by grinding.

When a cage is to be guided in the axial direction with a snap ring (**Fig. 2**), a thrust ring is used between the cage and the snap ring so that the snap ring lugs do not come in contact with the cage directly.

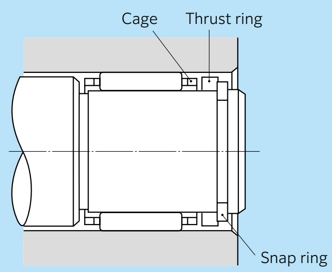


Fig. 2 Fixing using thrust ring

●Needle Roller Bearings NTN

2.3 Drawn cup needle roller bearings

The outer ring of drawn cup needle roller bearings is formed by precision drawing from a thin steel plate, and is designed to have an appropriate accuracy for its intended function when press-fit into a rigid housing.

Therefore, **it is meaningless to measure the dimensional accuracy of the bearing itself before press fitting. After pressing into a ring gage (with wall thickness of 20 mm or more) having appropriate dimensions, the bearing accuracy is evaluated by measuring the roller inscribed circle diameter (F_W) with a plug gauge or a tapered gauge**.

Recommended fits for drawn cup needle roller bearings are shown in **Table 6**, and recommended shaft and housing accuracy is shown in **Table 7**. **Tables 8.1** and **8.2** show the dimensional tolerances of the ring gauge inner diameter dimension and the roller inscribed circle diameter (F_W) with respect to the standard metric series HK and BK types and the heavy load series HMK type.

Table 6 Drawn cup needle roller bearing housing and shaft fits

Bearing type	Housing		Shaft	
	Iron-based	Light alloy	No inner ring	With an inner ring
HK, BK	N6(N7)	R6(R7)	h5(h6)	k5(j6)
HMK	J6(J7)	M6(M7)		

Table 7 Recommended shaft and housing accuracy

Characteristics	Shaft	Housing
Dimensional accuracy	IT6 (IT5)	IT7 (IT6)
Roundness Cylindricity (Max.)	IT3	IT4
Abutment squareness (Max.)	IT3	IT3
Fitting surface roughness Ra	0.8	1.6

Note: Accuracy in ( ) applies to bearings of accuracy class 5 and higher.

When a plug gauge is used for the measurement of the roller inscribed circle diameter (F_W), the dimension of the go side is the lower limit of the dimensional tolerance of the roller inscribed circle diameter, and the dimension of the no-go side is the value obtained by adding 2 μm to the upper limit of the dimensional tolerance of the roller inscribed circle diameter.

Since the outer ring is formed by a thin steel plate, **the safety factor (S_0) when the bearing is used must be $S_0 \geqq 3$ for standard specifications, and $S_0 \geqq 2$ must be maintained for the carburized/quenched specification (premium shell bearing[1]).**

1) Premium shell bearings
For details, see the special catalog issued separately "**Premium shell bearings (CAT. No. 3029/JE).**" (Suffix code F is added to the bearing number.)

Table 8.1 Accuracy of drawn cup needle roller bearings (1)

Dimensional tolerance of roller inscribed circle diameter (HK and BK types)

Unit: mm

Nominal roller inscribed circle diameter F_w	Nominal outer ring outer diameter D	Ring gauge inner diameter	Dimensional tolerance of roller inscribed circle diameter	
			Upper limit	Lower limit
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.010
5	9	8.984	5.022	5.010
6	10	9.984	6.022	6.010
7	11	10.980	7.028	7.013
8	12	11.980	8.028	8.013
9	13	12.980	9.028	9.013
10	14	13.980	10.028	10.013
12	16	15.980	12.034	12.016
12	18	17.980	12.034	12.016
13	19	18.976	13.034	13.016
14	20	19.976	14.034	14.016
15	21	20.976	15.034	15.016
16	22	21.976	16.034	16.016
17	23	22.976	17.034	17.016
18	24	23.976	18.034	18.016
20	26	25.976	20.041	20.020
22	28	27.976	22.041	22.020
25	32	31.972	25.041	25.020
28	35	34.972	28.041	28.020
30	37	36.972	30.041	30.020
35	42	41.972	35.050	35.025
40	47	46.972	40.050	40.025
45	52	51.967	45.050	45.025
50	58	57.967	50.050	50.025

Table 8.2 Accuracy of drawn cup needle roller bearings (2)

Dimensional tolerance of roller inscribed circle diameter (HMK type)

Unit: mm

Nominal roller inscribed circle diameter F_w	Nominal outer ring outer diameter D	Ring gauge inner diameter	Dimensional tolerance of roller inscribed circle diameter	
			Upper limit	Lower limit
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	16.034	16.016
17	24	23.995	17.034	17.016
18	25	24.995	18.034	18.016
19	27	26.995	19.041	19.020
20	27	26.995	20.041	20.020
21	29	28.995	21.041	21.020
22	29	28.995	22.041	22.020
24	31	30.994	24.041	24.020
25	33	32.994	25.041	25.020
26	34	33.994	26.041	26.020
28	37	36.994	28.041	28.020
29	38	37.994	29.041	29.020
30	40	39.994	30.041	30.020
32	42	41.994	32.050	32.025
35	45	44.994	35.050	35.025
37	47	46.994	37.050	37.025
38	48	47.994	38.050	38.025
40	50	49.994	40.050	40.025
45	55	54.994	45.050	45.025
50	62	61.994	50.050	50.025

When a drawn cup needle roller bearing is to be inserted into a housing, **the marked side of the bearing must be press-fit into the appropriate position with the use of a jig.** (There is no designation for the installation direction of pre-bent specification products[1].)

The bearings must not be directly struck by a hammer when being installed. Use an installation jig like that shown in **Fig. 3**, having a mandrel equipped with an O-ring for ease of installation, should be used to ensure the bearing will not fall off or become damaged during installation.

When inserting an inner ring or a shaft into a drawn cup needle roller bearing installed in a housing, insert it straightly by aligning the central axis of the inner ring or the shaft with the central axis of the housing.

Since a drawn cup needle roller bearing is positioned by means of the housing, it is unnecessary to provide a snap ring or a shoulder. However, when a drawn cup needle roller bearing is to be press-fitted into a housing having a shoulder, it is necessary to pay attention to prevent the bearing side surface from contacting the shoulder, thereby causing deformation of the bearing.

1) Pre-bent specification
The outer ring flange is hardened on both sides by heat treating the outer ring after inserting the cage and rollers and bending the edge of the ring.
Thus, bearings can be press-fitted from any direction compared with conventional products, which required applying a jig on the outer ring marking side. (Suffix code M is added to the bearing number.)

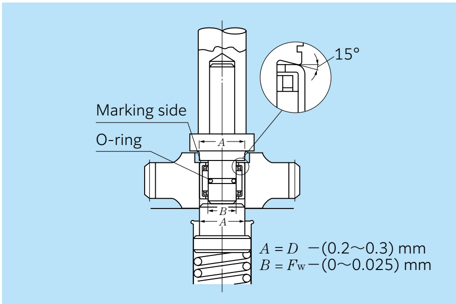


Fig. 3

2.4 Solid type needle roller bearings

These bearings have a non-separable construction held together by flanges or side plates on both sides of the outer ring, with needle rollers and cages contained within a solid (machined) outer ring. Since the outer ring is solid (machined), it has high rigidity and the bearing accuracy can be increased; therefore, the bearings are suitable for applications that require high speed, high load, and high rotational accuracy.

There are two types of solid type needle roller bearings: one having an inner ring and one having no inner ring. Bearings without an inner ring use the shaft directly as a raceway surface, and the required dimensional tolerance of the shaft diameter (raceway diameter) is as shown in **Table 9** based on required operating clearance (see **Table 1** required accuracy of other parameters). The corresponding dimensional tolerance of the housing bore is set to K7, which is widely used in general. Please consult **NTN** Engineering when setting the dimensional tolerance of the housing bore to other classes.

Table 9 Dimensional tolerance for shaft (raceway diameter)

Roller inscribed circle diameter F_w mm		Shaft tolerance class		
Over	Incl.	Internal clearance less than normal	Normal clearance	Internal clearance greater than normal
	80	k5	h5	f6
80	160	k5	g5	f6
160	180	k5	g5	e6
180	200	j5	g5	e6
200	250	j5	f6	e6
250	315	h5	f6	e6
315	400	g5	f6	d6

Tables 10.1 and **10.2** show values of the radial internal clearance of bearings with an inner ring. **Table 10.1** shows the clearance of interchangeable bearings, and the clearance values are satisfied even if the inner rings and outer rings are intermixed. **Table 10.2** shows the clearance of non-interchangeable bearings, and the clearance range is tightly controlled. Therefore, the inner rings and outer rings cannot be intermixed. The clearance codes are C2, normal, C3, and C4 from smallest to largest, and suffix code NA is added for the non-interchangeable clearance.

Table 10.1 Radial internal clearance of solid type needle roller bearings (1) interchangeable bearings

Unit: μm

Nominal bearing bore diameter d (mm)		Radial internal clearance							
		C2		Normal[1]		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	10	0	30	10	40	25	55	35	65
10	18	0	30	10	40	25	55	35	65
18	24	0	30	10	40	25	55	35	65
24	30	0	30	10	45	30	65	40	70
30	40	0	35	15	50	35	70	45	80
40	50	5	40	20	55	40	75	55	90
50	65	5	45	20	65	45	90	65	105
65	80	5	55	25	75	55	105	75	125
80	100	10	60	30	80	65	115	90	140
100	120	10	65	35	90	80	135	105	160
120	140	10	75	40	105	90	155	115	180
140	160	15	80	50	115	100	165	130	195
160	180	20	85	60	125	110	175	150	215
180	200	25	95	65	135	125	195	165	235
200	225	30	105	75	150	140	215	180	255
225	250	40	115	90	165	155	230	205	280
250	280	45	125	100	180	175	255	230	310
280	315	50	135	110	195	195	280	255	340
315	355	55	145	125	215	215	305	280	370
355	400	65	160	140	235	245	340	320	415
400	450	70	190	155	275	270	390	355	465

1) No clearance code is given to this type of bearings.

Table 10.2 Radial internal clearance of solid type needle roller bearings (2) non-interchangeable bearings

Unit: μm

Nominal bearing bore diameter d (mm)		Radial internal clearance							
		C2NA		Normal[1]		C3NA		C4NA	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—	10	10	20	20	30	35	45	45	55
10	18	10	20	20	30	35	45	45	55
18	24	10	20	20	30	35	45	45	55
24	30	10	25	25	35	40	50	50	60
30	40	12	25	25	40	45	55	55	70
40	50	15	30	30	45	50	65	65	80
50	65	15	35	35	50	55	75	75	90
65	80	20	40	40	60	70	90	90	110
80	100	25	45	45	70	80	105	105	125
100	120	25	50	50	80	95	120	120	145
120	140	30	60	60	90	105	135	135	160
140	60	35	65	65	100	115	150	150	180
160	180	35	75	75	110	125	165	165	200
180	200	40	80	80	120	140	180	180	220
200	225	45	90	90	135	155	200	200	240
225	250	50	100	100	150	170	215	215	265
250	280	55	110	110	165	185	240	240	295
280	315	60	120	120	180	205	265	265	325
315	355	65	135	135	200	225	295	295	360
355	400	75	150	150	225	255	330	330	405
400	450	85	170	170	255	285	370	370	455

1) Only code "NA" is given to this type of bearings. Example: NA4920NA

When there is an oil hole on the raceway surface, **bearings should be installed such that the oil hole position is located in the non-loaded region**. A bearing with an inner ring **must be used within the allowable movement amount (s) (a state in which the rollers are within the range of the inner ring effective contact length)**. The allowable movement amount (s) is illustrated in **Fig. 4**, values are listed in the bearing dimension tables.

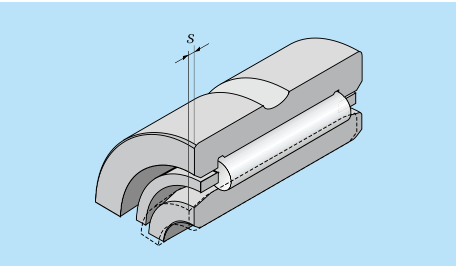


Fig. 4 Allowable movement amount (s)

2.5 Thrust roller bearing

Thrust roller bearings are bearings having a disc-shaped raceway combined with a cage-and-roller assembly having needle rollers or cylindrical rollers radially embedded, and are suitable for axial loads applied in a single direction.

Further, a shaft or housing can be directly used as a raceway surface without using a separate raceway ring. Thereby, size in the axial direction can be minimized, and lightweight and compact designs can be obtained. **Table 11** shows fits recommended for thrust roller bearings. See **Table 1** for the required accuracy of the raceway surface.

Table 11 Fits recommended for thrust roller bearings

Bearing parts			Type and class	
			Shaft diameter	Housing bore
AXK type, K811 type		Inner diameter guide	h8 1)	—
K812 type, K893 type		Outer diameter guide	—	H9 1)
WS type raceway (inner ring)			h6	—
GS type raceway (outer ring)			—	H7
Steel raceway	AS type	Shaft fixing	h10	Clearance with housing
		Housing fixing	Clearance with shaft Loose	H11

1) The guide surface is finished by grinding.

2.6 Cam follower/roller follower

A cam follower is a track roller having a stud in place of an inner ring, and the outer ring rolls on a track. It is a bearing used as an eccentric roller, a guide roller, etc., and it can have a cylindrical shape or a spherical shape for the outer ring outer diameter. Cam follower bearings are offered in both cage type and full complement designs.

When attaching a cam follower **do not strike the flange part with a hammer because sharp impact may cause cracks and rotational failure (Fig. 5)**. In addition, the oil supply hole position on the stud raceway surface of the cam follower is indicated by the **NTN** mark on the stud flange surface. **Install it by rotating the nut while the fixing the stud so that the mark (oil hole) is positioned in the non-loaded region (Fig. 6)**. The thread part may break if too much tightening torque is applied.

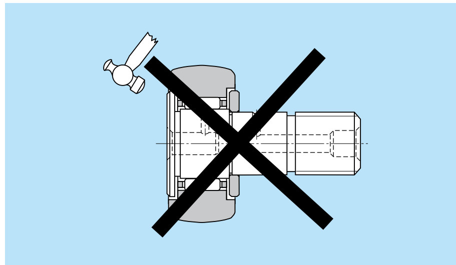


Fig. 5

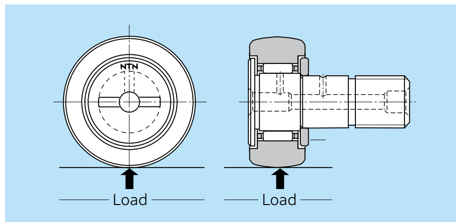


Fig. 6

A roller follower is a bearing in which the outer ring rolls on a track. As with the cam follower, there is a cylindrical shape or a spherical shape for the outer ring outer diameter, and are offered in both cage type and full complement designs. Common uses include use as an eccentric roller, guide roller, rocker arm roller, cam roller, pressure roller, etc.

A roller follower must be installed so that the oil hole is positioned in the non-loaded region because installing the oil hole position of the inner ring in the loaded region may shorten the bearing life.

Table 12 shows the radial internal clearance of cam followers and roller followers, **Tables 13** and **14** show the dimensional accuracy and recommended fits of cam followers, and **Table 15** shows the recommended fits of roller followers.

Table 12 Radial internal clearance of cam followers and roller followers

Nominal roller inscribed circle diameter F_w mm		Internal clearance μm							
		C2		CN (normal)		C3		C4	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
3	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

Table 13 Dimensional accuracy of cam followers

Unit: μm

Bearing	Outer ring shape	Stud diameter	Outer ring outer diameter	Outer ring width
Milli series	Spherical surface	h7	0 −50	JIS Class 0
	Cylindrical surface		JIS Class 0	
Inch series	Spherical surface	+25 0	0 −50	0 −130
	Cylindrical surface		0 −25	

Table 14 Fits recommended for cam followers

Bearing	Type and class of mounting hole
Metric series	H7
Inch series	F7

Note: Assembly must be done without backlash for impact loads.

Table 15 Fits recommended for roller followers

Type and class of shaft	
No inner ring	With an inner ring
k5 or k6	g6 or h6

The maximum radial load that can be statically permitted on the contact surface between the track and the track roller is referred to as the track load capacity, and the value differs depending on the hardness of the track. The track load capacity specified in the dimension table is a value considering a track hardness of 40 HRC, and the load capacity of tracks having different hardness may be obtained by multiplying the track load capacity in the dimension table by the correction coefficient G in **Table 16**. However, when the calculated track load capacity exceeds the basic static rating load C_{0r} of the bearing, the track load capacity is equal to the basic static rating load C_{0r} of the bearing.

Table 16 Correction coefficient G

Hardness (HRC)	Correction coefficient G	
	Cylindrical shape	Spherical shape
20	0.368	0.223
25	0.459	0.311
30	0.583	0.446
35	0.750	0.650
40	1.000	1.000
45	1.414	1.681
50	1.987	2.800
55	2.787	4.652

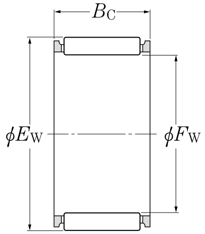
Since **NTN** cam followers and roller followers are generally installed with cantilever loading, a non-uniform load (one-sided load) may act on the bearing due to the influence of loosening of the fitting caused by continuous use. For stable operation of equipment, it is necessary to pay sufficient attention to the looseness of the fitting.

Further, lubrication is also necessary between the outer ring outer diameter surface and the track of the bearing. Even after lubrication, the bearing and the track may be damaged at an early stage when slippage occurs between the outer ring outer diameter surface and the track of the bearing due to rapid radial load fluctuation or rotational speed fluctuation during use.

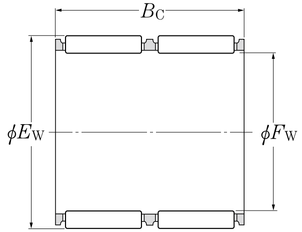
For details, see the special catalog “**Needle roller bearings (CAT. No. 2300/E)**” or “**Cam follower & roller follower (CAT. No. 3604/JE)**.”

Needle roller and cage assemblies

K type
K··T2 type
K··S type
K··ZW type
KMJ··S type
KV··S type



K type
K··T2 type
K··S type

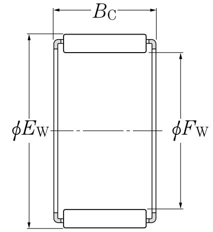


K··ZW type

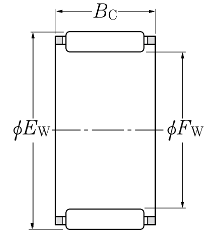
F_W 3～10mm

Boundary dimensions (mm) F_w	E_w	B_c		Basic load rating dynamic (N) C_r	static C_{0r}	Fatigue load limit (N) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
3	6	7	$^{-0.2}_{-0.55}$	1 460	970	118	33 000	50 000	**K3×6×7T2T**	0.0004
4	6	8	$^{-0.2}_{-0.55}$	1 560	1 330	162	30 000	45 000	**K4×6×7.8XT2**	0.0003
	7	7		1 770	1 270	155	30 000	45 000	**K4×7×7T2**	0.0005
5	8	8	$^{-0.2}_{-0.55}$	2 640	2 190	267	27 000	40 000	**K5×8×8T2**	0.0007
	8	10		2 720	2 250	275	27 000	40 000	**K5×8×10T2**	0.0009
6	9	8		2 660	2 280	278	25 000	37 000	**K6×9×8T2T**	0.0009
	9	10	$^{-0.2}_{-0.55}$	3 400	3 150	380	25 000	37 000	**K6×9×10T2T**	0.0011
	10	13		4 400	3 700	455	25 000	37 000	**K6×10×13T2**	0.0019
7	10	8		2 670	2 350	286	23 000	34 000	**K7×10×8T2**	0.0009
	10	10	$^{-0.2}_{-0.55}$	3 400	3 200	390	23 000	34 000	**K7×10×10T2**	0.0011
	10	13		5 050	5 400	655	23 000	34 000	**KV7×10×12.8X3S**	0.0023
8	11	8		3 150	3 000	365	21 000	32 000	**K8×11×8T2T**	0.0011
	11	9		3 150	3 000	365	21 000	32 000	**8E-KV8×11×8.8X2S**	0.0019
	11	10		4 000	4 100	500	21 000	32 000	**K8×11×10T2**	0.0013
	11	12	$^{-0.2}_{-0.55}$	4 450	4 650	570	21 000	32 000	**8E-KV8×11×11.8X2S**	0.0025
	11	13		4 850	5 200	635	21 000	32 000	**K8×11×13**	0.0026
	12	10		4 650	4 150	510	21 000	32 000	**K8×12×10T2**	0.0020
	12	12		5 600	5 300	650	21 000	32 000	**8E-KV8×12×11.8X1S**	0.0040
	12	13		5 050	4 650	565	21 000	32 000	**K8×12×13**	0.0036
9	12	10	$^{-0.2}_{-0.55}$	4 550	5 000	615	20 000	30 000	**K9×12×10T2**	0.0015
	12	13		5 500	6 400	780	20 000	30 000	**K9×12×13T2**	0.0021
10	13	10		4 550	5 100	620	19 000	28 000	**K10×13×10T2T**	0.0016
	13	13		5 450	6 450	790	19 000	28 000	**8E-KV10×13×12.8XS**	0.0032
	14	8		4 300	3 950	485	19 000	28 000	**K10×14×8**	0.0027
	14	10	$^{-0.2}_{-0.55}$	5 500	5 450	660	19 000	28 000	**K10×14×10T**	0.0034
	14	11		5 500	5 450	660	19 000	28 000	**8E-KV10×14×10.8XS**	0.0039
	14	11.5		6 800	7 200	875	19 000	28 000	**KMJ10×14×11.3XS**	0.0040
	14	13		6 600	6 900	840	19 000	28 000	**K10×14×13**	0.0044
	14	14		7 150	7 650	930	19 000	28 000	**8E-KV10×14×13.8X4S**	0.0050

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KMJ··S type



KV··S type

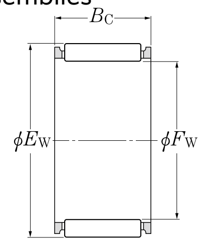
F_W 10～15mm

Boundary dimensions (mm) F_w	E_w	B_c		Basic load rating dynamic (N) C_r	static C_{0r}	Fatigue load limit (N) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
10	14	17	$^{-0.2}_{-0.55}$	8 050	8 850	1 080	19 000	28 000	**8E-K10×14×16.8X1**	0.0064
	16	12		7 100	5 950	730	19 000	28 000	**K10×16×12**	0.0066
11	14	10	$^{-0.2}_{-0.55}$	5 050	6 000	735	18 000	27 000	**K11×14×10**	0.0028
12	15	9		4 450	5 250	640	17 000	26 000	**K12×15×9**	0.0027
	15	10		5 000	6 100	740	17 000	26 000	**8Q-K12×15×10**	0.0030
	15	13		6 000	7 700	940	17 000	26 000	**K12×15×13**	0.0038
	15	20		8 550	12 200	1 480	17 000	26 000	**K12×15×20ZW**	0.0059
	16	8		4 850	4 900	600	17 000	26 000	**K12×16×8**	0.0034
	16	11.5		6 750	7 400	900	17 000	26 000	**KMJ12×16×11.3XS**	0.0047
	16	13	$^{-0.2}_{-0.55}$	7 500	8 500	1 040	17 000	26 000	**8Q-K12×16×13**	0.0060
	16	18		9 800	11 900	1 460	17 000	26 000	**8E-K12×16×17.8X1**	0.0070
	16	20		10 300	12 800	1 560	17 000	26 000	**K12×16×19.8X4**	0.010
	17	10		7 350	7 200	880	17 000	26 000	**KMJ12×17×9.8XS**	0.0050
	17	13		9 000	9 400	1 150	17 000	26 000	**K12×17×13**	0.0075
	17	18		12 600	14 400	1 760	17 000	26 000	**KV12×17×17.8XS**	0.0080
	18	12		8 650	8 000	975	17 000	26 000	**8Q-K12×18×12**	0.0089
14	17	10		5 400	7 050	860	16 000	24 000	**KV14×17×10ST**	0.0040
	18	10		6 900	8 000	975	16 000	24 000	**K14×18×10**	0.0046
	18	11		7 600	9 050	1 100	16 000	24 000	**K14×18×11**	0.0053
	18	13		8 300	10 100	1 240	16 000	24 000	**K14×18×13**	0.0063
	18	15	$^{-0.2}_{-0.55}$	9 650	12 300	1 500	16 000	24 000	**K14×18×15S**	0.0076
	18	17		10 900	14 400	1 760	16 000	24 000	**K14×18×17V5**	0.0079
	18	39		18 800	28 900	3 500	16 000	24 000	**K14×18×39ZW**	0.018
	19	13		8 950	9 650	1 180	16 000	24 000	**K14×19×13**	0.0080
	20	12		9 350	9 150	1 110	16 000	24 000	**K14×20×12**	0.0095
	20	17		13 500	14 600	1 780	16 000	24 000	**K14×20×17**	0.014
15	18	14		7 850	11 600	1 420	15 000	23 000	**K15×18×14**	0.0060
	19	8	$^{-0.2}_{-0.55}$	5 350	5 850	715	15 000	23 000	**KV15×19×7.8XS**	0.0033
	19	10		6 850	8 050	980	15 000	23 000	**K15×19×10T**	0.0055
	19	13		8 250	10 200	1 250	15 000	23 000	**K15×19×13**	0.0067

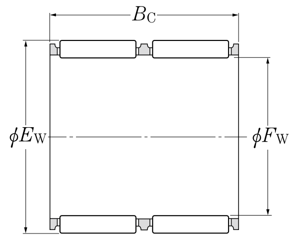
Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··T2 type
K··S type
K··ZW type
KMJ··S type



K type
K··T2 type
K··S type

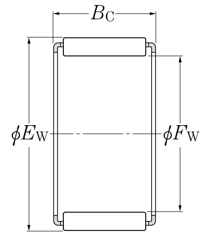


K··ZW type

F_w 15～18mm

Boundary dimensions mm				Basic load rating N		Fatigue load limit N	Allowable speed min⁻¹		Number	Mass kg
F_w	E_w	B_c		dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication		(approx.)
	19	17		10 900	14 600	1 780	15 000	23 000	K15×19×17	0.0090
	19	24		14 100	20 400	2 490	15 000	23 000	K15×19×24ZW	0.013
	20	13		10 100	11 500	1 410	15 000	23 000	K15×20×13	0.0088
15	20	16	$^{-0.2}_{-0.55}$	12 600	15 200	1 850	15 000	23 000	KMJ15×20×15.8XS	0.0090
	21	15		11 900	12 500	1 530	15 000	23 000	K15×21×15	0.013
	21	17		14 900	16 800	2 050	15 000	23 000	KMJ15×21×16.8X1SK	0.012
	21	21		16 500	19 100	2 330	15 000	23 000	K15×21×21	0.017
	20	10		7 500	9 250	1 130	15 000	23 000	K16×20×10T	0.0057
	20	11		8 300	10 500	1 280	15 000	23 000	K16×20×11T	0.0061
	20	13		9 050	11 800	1 430	15 000	23 000	K16×20×13	0.0071
	20	17		11 900	16 800	2 050	15 000	23 000	K16×20×17ST	0.0092
16	22	12	$^{-0.2}_{-0.55}$	11 700	12 500	1 530	15 000	23 000	K16×22×12	0.010
	22	13		12 600	13 900	1 690	15 000	23 000	KMJ16×22×13S	0.011
	22	16		13 600	15 200	1 850	15 000	23 000	K16×22×15.8X	0.014
	22	17		14 400	16 400	2 000	15 000	23 000	K16×22×17	0.015
	22	20		16 000	18 800	2 300	15 000	23 000	K16×22×20	0.017
	21	10		7 450	9 300	1 140	15 000	22 000	K17×21×10S	0.0056
	21	13		9 400	12 600	1 530	15 000	22 000	K17×21×13S	0.0075
	21	15		10 400	14 400	1 750	15 000	22 000	K17×21×15	0.0089
17	21	17	$^{-0.2}_{-0.55}$	11 800	16 900	2 060	15 000	22 000	K17×21×17	0.0095
	22	20		14 700	19 200	2 340	15 000	22 000	K17×22×20	0.015
	23	17		14 400	16 500	2 020	15 000	22 000	K17×23×17	0.016
	23	23		16 800	20 200	2 470	15 000	22 000	K17×23×22.8X1T2	0.013
	22	10		7 400	9 400	1 140	14 000	21 000	K18×22×10	0.0061
	22	13		8 900	11 900	1 450	14 000	21 000	K18×22×13	0.0077
	22	17	$^{-0.2}_{-0.55}$	11 700	17 000	2 070	14 000	21 000	K18×22×17	0.011
18	23	20		14 600	19 300	2 360	14 000	21 000	K18×23×20S	0.015
	24	12		12 300	13 800	1 690	14 000	21 000	K18×24×12	0.012
	24	13		11 600	12 800	1 560	14 000	21 000	K18×24×13	0.013

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KMJ··S type

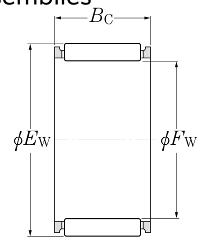
F_w 18～22mm

Boundary dimensions mm				Basic load rating N		Fatigue load limit N	Allowable speed min⁻¹		Number	Mass kg
F_w	E_w	B_c		dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication		(approx.)
	24	17		16 000	19 300	2 350	14 000	21 000	KMJ18×24×17SV1	0.014
18	24	20	$^{-0.2}_{-0.55}$	17 000	20 900	2 550	14 000	21 000	K18×24×20	0.019
	25	17		18 000	20 400	2 490	14 000	21 000	K18×25×17	0.019
	25	22		22 100	26 600	3 250	14 000	21 000	K18×25×22	0.024
19	23	13	$^{-0.2}_{-0.55}$	9 650	13 500	1 640	14 000	21 000	K19×23×13	0.0082
	23	17		12 700	19 200	2 340	14 000	21 000	K19×23×17	0.011
	24	10		8 300	11 200	1 370	13 000	20 000	K20×24×10S	0.0065
	24	11		9 500	13 400	1 640	13 000	20 000	K20×24×11	0.0072
	24	13		10 000	14 300	1 740	13 000	20 000	K20×24×13SV4	0.0086
	24	17		13 200	20 400	2 480	13 000	20 000	K20×24×17S	0.011
	24	45		16 400	27 100	3 300	13 000	20 000	K20×24×45ZW	0.028
	25	40		29 000	48 000	5 880	13 000	20 000	K20×25×40ZWT	0.033
	26	12	$^{-0.2}_{-0.55}$	12 900	15 100	1 840	13 000	20 000	K20×26×12	0.013
20	26	13		14 000	16 700	2 040	13 000	20 000	KMJ20×26×13ST	0.012
	26	14		15 800	19 600	2 390	13 000	13 000	KMJ20×26×13.8X1S	0.013
	26	17		17 800	22 800	2 780	13 000	20 000	KMJ20×26×17S	0.016
	26	20		20 600	27 600	3 350	13 000	20 000	KMJ20×26×20S	0.019
	28	17		21 700	24 600	3 000	13 000	20 000	KMJ20×28×16.8XS	0.022
	28	20		24 600	28 900	3 500	13 000	20 000	KMJ20×28×19.8X4S	0.026
	28	25		27 100	32 500	3 950	13 000	20 000	8Q-K20×28×25	0.039
21	25	13	$^{-0.2}_{-0.55}$	10 700	15 900	1 940	13 000	19 000	KMJ21×25×12.8X1S	0.0081
	25	17		13 600	21 500	2 630	13 000	19 000	K21×25×17	0.012
	26	10		8 500	11 900	1 450	12 000	18 000	K22×26×10S	0.0071
	26	11		10 100	14 900	1 820	12 000	18 000	8Q-K22×26×11	0.0090
	26	13		10 200	15 200	1 850	12 000	18 000	K22×26×13	0.0094
	26	17	$^{-0.2}_{-0.55}$	13 500	21 600	2 640	12 000	18 000	K22×26×17S	0.012
22	27	20		17 500	25 900	3 150	12 000	18 000	K22×27×20	0.020
	27	28.5		24 200	39 500	4 800	12 000	18 000	K22×27×28.3X	0.028
	27	40		29 900	51 500	6 300	12 000	18 000	K22×27×40ZW	0.039
	28	17		17 700	23 300	2 850	12 000	18 000	K22×28×17V1	0.020

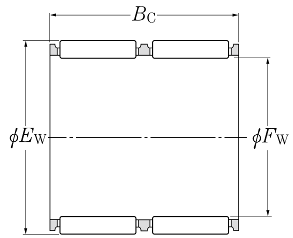
Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··T2 type
K··S type
K··ZW type
KMJ··S type
KV··S type



K type
K··T2 type
K··S type

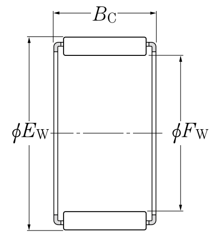


K··ZW type

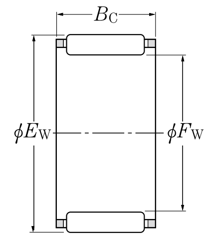
F_W 22 ～ 25mm

Boundary dimensions mm F_W	E_W	B_C		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
22	29	16		18 700	22 700	2 770	12 000	18 000	**K22×29×16**	0.023
	30	15	$^{-0.2}_{-0.55}$	19 300	21 700	2 640	12 000	18 000	**K22×30×15T**	0.022
	30	17.5		23 200	27 500	3 350	12 000	18 000	**KMJ22×30×17.3X2S**	0.024
	30	24		31 000	40 000	4 900	12 000	18 000	**KMJ22×30×23.8X3S**	0.035
23	27	13		11 400	17 700	2 160	11 000	17 000	**KMJ23×27×12.8X1S**	0.0086
	28	24	$^{-0.2}_{-0.55}$	19 800	31 000	3 750	11 000	17 000	**K23×28×24**	0.023
	29	18		20 600	28 800	3 500	11 000	17 000	**KMJ23×29×17.8X2S**	0.019
24	28	10		9 000	13 200	1 610	11 000	17 000	**K24×28×10T**	0.0080
	28	13		10 800	16 800	2 050	11 000	17 000	**K24×28×13**	0.010
	28	17	$^{-0.2}_{-0.55}$	14 300	23 900	2 920	11 000	17 000	**K24×28×17**	0.013
	29	13		12 300	16 900	2 060	11 000	17 000	**K24×29×13**	0.012
	30	17		18 400	25 200	3 050	11 000	17 000	**K24×30×17**	0.022
	30	31		27 900	43 000	5 200	11 000	17 000	**K24×30×31ZW**	0.039
25	29	10		8 950	13 300	1 620	11 000	16 000	**K25×29×10**	0.0083
	29	13		10 800	16 900	2 050	11 000	16 000	**K25×29×13**	0.010
	29	17		14 200	24 000	2 930	11 000	16 000	**K25×29×17S**	0.014
	30	13		13 200	18 800	2 290	11 000	16 000	**K25×30×13**	0.013
	30	17		17 400	26 800	3 250	11 000	16 000	**K25×30×17S**	0.017
	30	20		19 400	31 000	3 750	11 000	16 000	**K25×30×20SV3**	0.021
	30	22		22 300	37 000	4 500	11 000	16 000	**KMJ25×30×21.8XS**	0.020
	30	26	$^{-0.2}_{-0.55}$	21 800	35 500	4 350	11 000	16 000	**K25×30×26ZW**	0.027
	30	39		29 800	53 500	6 550	11 000	16 000	**K25×30×39ZW**	0.040
	31	13		15 200	19 900	2 430	11 000	16 000	**K25×31×13V3**	0.018
	31	14		16 500	22 100	2 700	11 000	16 000	**K25×31×14**	0.018
	31	17		18 300	25 300	3 100	11 000	16 000	**K25×31×17**	0.022
	31	18.5		21 000	30 000	3 650	11 000	16 000	**KMJ25×31×18.3X1SK**	0.021
	31	21		22 500	33 000	4 000	11 000	16 000	**K25×31×21V3**	0.028
	32	16		19 500	24 700	3 000	11 000	16 000	**K25×32×16**	0.027
	33	24		34 500	47 000	5 750	11 000	16 000	**KMJ25×33×24S**	0.040

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KMJ··S type



KV··S type

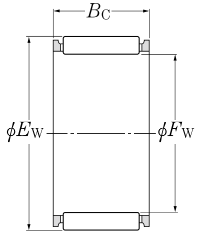
F_W 26 ～ 30mm

Boundary dimensions mm F_W	E_W	B_C		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
26	30	13		11 800	19 200	2 340	10 000	15 000	**K26×30×13**	0.011
	30	17	$^{-0.2}_{-0.55}$	15 500	27 400	3 350	10 000	15 000	**K26×30×17**	0.015
	31	24		21 400	35 500	4 300	10 000	15 000	**8E-K26×31×23.8X1ZW**	0.029
	34	22		24 200	30 000	3 700	10 000	15 000	**K26×34×22**	0.041
28	32	17		15 300	27 500	3 350	9 500	14 000	**K28×32×17**	0.017
	32	21		18 700	35 500	4 350	9 500	14 000	**K28×32×21T**	0.020
	33	13		13 900	20 900	2 550	9 500	14 000	**K28×33×13**	0.015
	33	17		18 300	29 800	3 650	9 500	14 000	**K28×33×17S**	0.020
	33	26	$^{-0.2}_{-0.55}$	23 900	42 000	5 100	9 500	14 000	**K28×33×26ZW**	0.033
	33	27		28 300	52 000	6 350	9 500	14 000	**K28×33×27**	0.032
	34	14		17 500	24 800	3 000	9 500	14 000	**K28×34×14**	0.020
	34	17		18 100	25 800	3 150	9 500	14 000	**K28×34×17V1**	0.025
	35	16		21 200	28 400	3 450	9 500	14 000	**K28×35×16**	0.029
	35	18		21 500	28 900	3 550	9 500	14 000	**K28×35×18**	0.031
29	34	17	$^{-0.2}_{-0.55}$	18 900	31 000	3 800	9 500	14 000	**K29×34×17S**	0.022
	34	27		28 100	52 000	6 350	9 500	14 000	**K29×34×27**	0.033
30	34	14		12 400	21 500	2 600	8 500	13 000	**KV30×34×13.8XS**	0.014
	34	23		18 000	34 500	4 200	8 500	13 000	**K30×34×22.8X1T2**	0.013
	35	11		12 200	18 000	2 200	8 500	13 000	**K30×35×11S**	0.014
	35	13		14 700	22 900	2 800	8 500	13 000	**KV30×35×13S**	0.017
	35	20		21 600	37 500	4 600	8 500	13 000	**K30×35×20S**	0.025
	35	26	$^{-0.2}_{-0.55}$	25 200	46 000	5 600	8 500	13 000	**K30×35×26ZWV1**	0.036
	35	27		29 900	57 000	6 950	8 500	13 000	**K30×35×27S**	0.033
	37	16		21 900	30 500	3 700	8 500	13 000	**K30×37×16**	0.029
	37	18		23 300	33 000	4 000	8 500	13 000	**K30×37×18**	0.034
	37	20		26 200	38 000	4 650	8 500	13 000	**KMJ30×37×20S**	0.032
	37	48		40 000	65 500	8 000	8 500	13 000	**K30×37×48ZW**	0.075
	38	18		25 000	33 000	4 000	8 500	13 000	**K30×38×18**	0.036

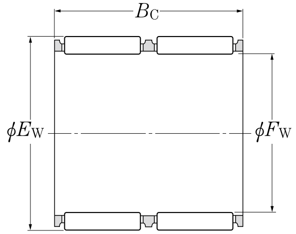
Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··T2 type
K··S type
K··ZW type
KMJ··S type
KV··S type



K type
K··T2 type
K··S type

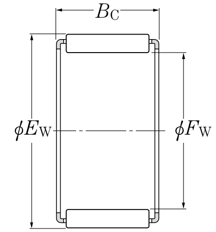


K··ZW type

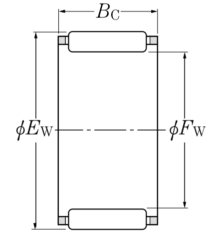
F_w 31 ～ 35mm

Boundary dimensions				Basic load rating		Fatigue load limit	Allowable speed		Number	Mass
mm				dynamic N	static	N	min⁻¹ Grease lubrication	Oil lubrication		kg
F_w	E_w	B_c		C_r	C_{0r}	C_u				(approx.)
31	35	24	$_{-0.55}^{-0.2}$	21 200	43 500	5 300	8 500	13 000	**KV31×35×23.8XS**	0.022
	36	14		15 800	25 400	3 100	8 500	13 000	**KV31×36×13.8XS**	0.017
32	36	15		14 300	26 400	3 200	8 500	13 000	**K32×36×15ST**	0.017
	37	13		14 500	23 000	2 810	8 500	13 000	**K32×37×13**	0.018
	37	17		19 200	33 000	4 000	8 500	13 000	**K32×37×17S**	0.022
	37	26		24 900	46 000	5 600	8 500	13 000	**K32×37×26ZWV3**	0.032
	37	27	$_{-0.55}^{-0.2}$	29 600	57 500	7 000	8 500	13 000	**K32×37×27**	0.037
	38	14		19 800	30 500	3 700	8 500	13 000	**KMJ32×38×14S**	0.022
	38	26		31 500	54 000	6 600	8 500	13 000	**K32×38×26**	0.041
	39	16		22 600	32 000	3 900	8 500	13 000	**K32×39×16V1**	0.033
	39	18		24 000	35 000	4 250	8 500	13 000	**K32×39×18**	0.037
33	38	30.5	$_{-0.55}^{-0.2}$	28 400	55 000	6 700	8 000	12 000	**K33×38×30.3X1T2**	0.026
34	40	39.5	$_{-0.55}^{-0.2}$	39 000	73 500	8 950	8 000	12 000	**KV34×40×39.3X1ZWS**	0.066
35	39	22.5		21 500	46 000	5 600	7 500	11 000	**KV35×39×22.3XS**	0.024
	39	24		21 300	45 000	5 500	7 500	11 000	**K35×39×23.8X1T2**	0.015
	40	13		15 200	25 100	3 050	7 500	11 000	**K35×40×13**	0.019
	40	17		20 000	36 000	4 350	7 500	11 000	**K35×40×17**	0.025
	40	19		22 300	41 000	5 000	7 500	11 000	**K35×40×19**	0.029
	40	26		26 100	50 000	6 100	7 500	11 000	**K35×40×26ZW**	0.037
	40	30	$_{-0.55}^{-0.2}$	26 100	50 000	6 100	7 500	11 000	**K35×40×30ZW**	0.043
	41	14		19 400	30 500	3 700	7 500	11 000	**K35×41×14**	0.026
	41	15		20 900	33 500	4 050	7 500	11 000	**K35×41×15**	0.027
	41	24		31 000	55 500	6 800	7 500	11 000	**K35×41×23.8X1**	0.042
	41	40		43 000	84 000	10 200	7 500	11 000	**K35×41×40ZW**	0.055
	42	16		24 100	36 000	4 350	7 500	11 000	**K35×42×16**	0.035
	42	18		24 700	37 000	4 500	7 500	11 000	**K35×42×18**	0.039

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KMJ··S type



KV··S type

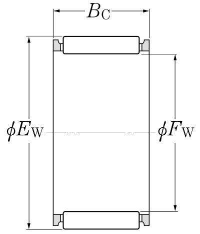
F_w 35 ～ 42mm

Boundary dimensions				Basic load rating		Fatigue load limit	Allowable speed		Number	Mass
mm				dynamic N	static	N	min⁻¹ Grease lubrication	Oil lubrication		kg
F_w	E_w	B_c		C_r	C_{0r}	C_u				(approx.)
35	42	20		26 500	40 500	4 950	7 500	11 000	**KV35×42×20SV2**	0.040
	42	30	$_{-0.55}^{-0.2}$	39 500	68 000	8 300	7 500	11 000	**K35×42×30**	0.062
	42	45		42 500	74 000	9 000	7 500	11 000	**K35×42×45ZW**	0.106
36	42	46	$_{-0.55}^{-0.2}$	51 000	106 000	12 900	7 500	11 000	**K36×42×46ZW**	0.086
37	42	13		15 900	27 100	3 300	7 500	11 000	**K37×42×13V4**	0.021
	42	17		21 000	38 500	4 700	7 500	11 000	**K37×42×17V2**	0.026
	43	33.5	$_{-0.55}^{-0.2}$	39 000	76 000	9 250	7 500	11 000	**KV37×43×33.3XS**	0.062
	44	18		26 300	41 000	5 000	7 500	11 000	**K37×44×18**	0.042
	45	25		37 000	58 000	7 050	7 500	11 000	**K37×45×24.8XT2**	0.039
38	43	17		20 900	38 500	4 700	7 500	11 000	**8E-K38×43×17**	0.027
	43	27		32 000	67 500	8 250	7 500	11 000	**K38×43×27**	0.043
	43	29	$_{-0.55}^{-0.2}$	32 500	68 000	8 300	7 500	11 000	**K38×43×28.8X**	0.047
	46	32		54 000	95 500	11 600	7 500	11 000	**K38×46×32**	0.073
40	45	13		16 500	29 200	3 550	6 500	10 000	**K40×45×13V2**	0.023
	45	17		21 800	41 500	5 100	6 500	10 000	**K40×45×17T**	0.027
	45	21		26 700	54 000	6 600	6 500	10 000	**K40×45×21V2**	0.035
	45	27		33 500	72 500	8 850	6 500	10 000	**K40×45×27**	0.044
	46	17	$_{-0.55}^{-0.2}$	24 600	43 000	5 200	6 500	10 000	**K40×46×17**	0.030
	46	34		40 500	80 500	9 850	6 500	10 000	**KV40×46×33.8XS**	0.063
	47	18		27 700	45 000	5 450	6 500	10 000	**K40×47×18**	0.045
	47	20		31 000	51 500	6 300	6 500	10 000	**K40×47×20**	0.048
	48	20		33 000	51 000	6 250	6 500	10 000	**K40×48×20**	0.052
	48	25		41 000	68 000	8 300	6 500	10 000	**KV40×48×25SV1**	0.065
41	49	22	$_{-0.55}^{-0.2}$	30 500	46 000	5 650	6 500	9 500	**8E-KV41×49×21.8XS**	0.065
42	47	17		22 100	43 000	5 250	6 500	9 500	**K42×47×17**	0.028
	47	27	$_{-0.55}^{-0.2}$	34 000	75 500	9 200	6 500	9 500	**K42×47×27**	0.047
	48	17		25 700	46 000	5 650	6 500	9 500	**K42×48×17**	0.036
	50	20		34 000	53 500	6 550	6 500	9 500	**K42×50×20**	0.054

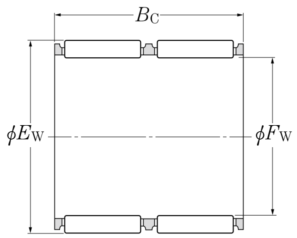
Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··T2 type
K··ZW type
KV··S type
KVS··ZWS type



K type
K··T2 type
K··S type

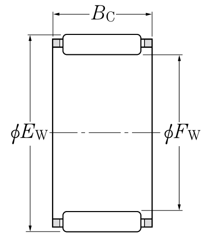


K··ZW type

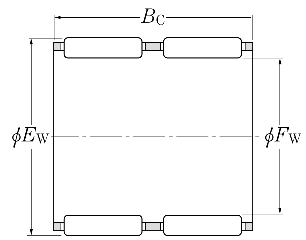
F_W 43～50mm

Boundary dimensions mm F_W	E_W	B_C		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
43	48	17		22 000	43 000	5 250	6 500	9 500	K43×48×17	0.029
	48	27	−0.2 −0.55	34 000	75 500	9 200	6 500	9 500	K43×48×27	0.046
	48	38		41 000	96 000	11 700	6 500	9 500	KV43×48×37.8XZWS	0.058
	50	18		29 100	49 000	5 950	6 500	9 500	K43×50×18	0.049
44	50	31	−0.2 −0.55	43 500	91 500	11 100	6 500	9 500	KV44×50×30.8XS	0.067
45	49	19		22 100	52 000	6 350	6 000	9 000	K45×49×19	0.027
	50	17		22 300	44 500	5 450	6 000	9 000	K45×50×17V3	0.033
	50	25.8		30 500	66 500	8 100	6 000	9 000	KV45×50×25.8XS	0.045
	50	27		34 500	78 000	9 500	6 000	9 000	K45×50×27	0.050
	51	27	−0.2 −0.55	34 500	68 000	8 300	6 000	9 000	KV45×51×26.8XS	0.058
	52	18		29 700	51 000	6 200	6 000	9 000	K45×52×18	0.051
	52	21		32 000	56 500	6 900	6 000	9 000	K45×52×21	0.061
	53	20		36 000	59 000	7 200	6 000	9 000	K45×53×20	0.062
	53	25		46 500	82 000	10 000	6 000	9 000	K45×53×25	0.077
47	52	15.5		19 400	38 000	4 650	5 500	8 500	8E-K47×52×15.3X2	0.031
	52	17		23 200	47 500	5 800	5 500	8 500	K47×52×17	0.033
	52	23	−0.2 −0.55	29 600	65 500	7 950	5 500	8 500	KV47×52×22.8X2S	0.044
	52	24		33 500	76 500	9 350	5 500	8 500	K47×52×23.8X	0.044
	52	27		35 500	83 000	10 100	5 500	8 500	K47×52×27	0.051
	52	33		38 000	90 500	11 100	5 500	8 500	KV47×52×32.8XZWS	0.064
48	53	22.5		31 000	69 500	8 450	5 500	8 500	KV48×53×22.3XS	0.042
	53	26		36 500	86 500	10 600	5 500	8 500	K48×53×25.8X3T2	0.029
	53	30		36 500	85 500	10 400	5 500	8 500	K48×53×29.8X1	0.062
	53	37	−0.2 −0.55	45 000	112 000	13 700	5 500	8 500	KV48×53×36.8XZWS	0.064
	53	37.5		41 500	101 000	12 300	5 500	8 500	K48×53×37.5ZW	0.072
	54	19		31 000	61 000	7 450	5 500	8 500	K48×54×19	0.044
	55	24.5		39 000	74 500	9 050	5 500	8 500	KV48×55×24.3XS	0.070
50	55	13.5	−0.2 −0.55	18 100	35 500	4 300	5 500	8 000	K50×55×13.5T	0.023
	55	20		27 900	62 000	7 550	5 500	8 000	KV50×55×20S	0.040

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KV··S type



KV··ZWS type

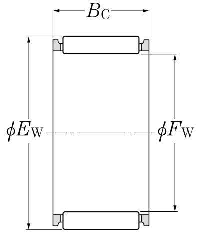
F_W 50～60mm

Boundary dimensions mm F_W	E_W	B_C		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
50	55	27		37 000	88 500	10 800	5 500	8 000	K50×55×27	0.053
	55	30		39 500	97 000	11 800	5 500	8 000	K50×55×30	0.059
	57	18	−0.2 −0.55	31 500	57 000	6 950	5 500	8 000	K50×57×18	0.053
	58	20		38 500	67 500	8 200	5 500	8 000	K50×58×20	0.065
	58	25		48 500	90 000	11 000	5 500	8 000	K50×58×25	0.081
	58	58		83 500	181 000	22 100	5 500	8 000	KV50×58×57.8XZWS	0.188
52	57	18		22 800	48 000	5 850	5 000	7 500	KV52×57×17.8XS	0.037
	57	23	−0.2 −0.55	30 500	69 500	8 500	5 000	7 500	KV52×57×22.8X1S	0.048
	58	19		32 000	65 500	7 950	5 000	7 500	K52×58×19	0.048
54	59	23	−0.2 −0.55	31 500	73 500	8 950	5 000	7 500	KV54×59×22.8XS	0.049
55	60	17		25 800	58 000	7 050	5 000	7 500	K55×60×17	0.043
	60	20		28 800	66 500	8 100	5 000	7 500	K55×60×20T	0.045
	60	30		42 000	108 000	13 200	5 000	7 500	KV55×60×30S	0.069
	60	37		47 500	127 000	15 500	5 000	7 500	K55×60×36.8X	0.086
	61	19		33 000	69 500	8 450	5 000	7 500	K55×61×19	0.051
	61	20	−0.2 −0.55	33 000	69 500	8 450	5 000	7 500	K55×61×20	0.054
	61	30		48 000	113 000	13 700	5 000	7 500	K55×61×30	0.081
	62	18		33 500	63 000	7 700	5 000	7 500	K55×62×18	0.054
	63	20		39 000	70 000	8 500	5 000	7 500	K55×63×20	0.073
	63	25		50 500	97 500	11 900	5 000	7 500	K55×63×25	0.088
	63	32		61 000	125 000	15 200	5 000	7 500	K55×63×32	0.117
56	66	41	−0.2 −0.55	90 000	178 000	21 700	5 000	7 500	K56×66×40.8XT2	0.148
57	65	40	−0.2 −0.55	66 000	140 000	17 100	4 700	7 000	KV57×65×39.8XZWS	0.145
58	64	19	−0.2 −0.55	34 000	73 500	8 950	4 700	7 000	K58×64×19	0.052
60	65	20		29 800	71 500	8 750	4 300	6 500	K60×65×20	0.051
	65	27		40 000	104 000	12 700	4 300	6 500	K60×65×26.8X	0.067
	65	30	−0.2 −0.55	43 500	116 000	14 200	4 300	6 500	K60×65×30	0.071
	66	19		33 500	73 500	8 950	4 300	6 500	K60×66×19	0.053
	66	20		33 500	73 500	8 950	4 300	6 500	K60×66×20	0.056

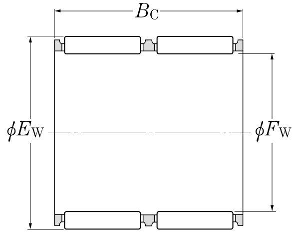
Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··T2 type
K··ZW type
KV··S type
KVS··ZWS type



K type
K··T2 type
K··S type

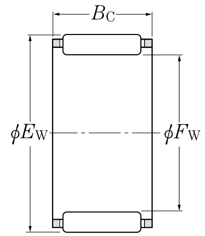


K··ZW type

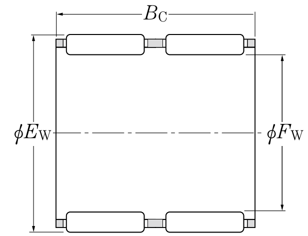
F_w 60 ～ 73mm

Boundary dimensions mm F_w	E_w	B_c		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
60	66	30		49 000	119 000	14 600	4 300	6 500	**K60×66×30**	0.084
	68	15		27 200	45 500	5 550	4 300	6 500	**K60×68×15**	0.058
	68	20		40 000	75 000	9 200	4 300	6 500	**K60×68×20**	0.077
	68	23	$^{-0.2}_{-0.55}$	44 500	85 000	10 400	4 300	6 500	**K60×68×23**	0.092
	68	25		52 000	105 000	12 800	4 300	6 500	**K60×68×25T**	0.097
	68	27		52 000	105 000	12 800	4 300	6 500	**K60×68×27**	0.098
	68	30		46 500	91 000	11 100	4 300	6 500	**K60×68×30ZW**	0.119
61	66	20	$^{-0.2}_{-0.55}$	29 700	71 500	8 750	4 300	6 500	**K61×66×20**	0.054
	66	30		43 500	116 000	14 200	4 300	6 500	**K61×66×30**	0.073
63	70	21	$^{-0.2}_{-0.55}$	44 500	95 500	11 600	4 300	6 500	**K63×70×21**	0.075
	71	50.5		74 500	167 000	20 400	4 300	6 500	**KV63×71×50.3XZWS**	0.193
64	70	16	$^{-0.2}_{-0.55}$	28 400	60 500	7 350	4 300	6 500	**K64×70×16**	0.053
65	70	20		30 500	75 000	9 150	4 000	6 000	**K65×70×20**	0.055
	70	21.5		30 500	75 000	9 150	4 000	6 000	**KV65×70×21.3X1S**	0.056
	70	30	$^{-0.2}_{-0.55}$	45 000	124 000	15 200	4 000	6 000	**K65×70×30**	0.083
	73	23		47 000	94 000	11 500	4 000	6 000	**K65×73×23**	0.100
	73	30		61 000	132 000	16 000	4 000	6 000	**K65×73×30**	0.126
68	74	20		36 000	83 500	10 200	4 000	6 000	**K68×74×20**	0.065
	74	30	$^{-0.2}_{-0.55}$	51 500	133 000	16 200	4 000	6 000	**K68×74×30**	0.097
	74	35		49 500	125 000	15 300	4 000	6 000	**K68×74×35ZW**	0.116
	75	21		45 500	101 000	12 300	4 000	6 000	**K68×75×21**	0.077
70	76	20		36 500	86 000	10 500	3 700	5 500	**K70×76×20**	0.070
	76	30		53 000	139 000	17 000	3 700	5 500	**K70×76×30**	0.100
	77	21	$^{-0.2}_{-0.55}$	45 000	101 000	12 300	3 700	5 500	**K70×77×21**	0.080
	78	23		49 500	103 000	12 600	3 700	5 500	**K70×78×23**	0.107
	78	30		65 500	149 000	18 100	3 700	5 500	**K70×78×30**	0.136
72	79	21	$^{-0.2}_{-0.55}$	46 500	106 000	12 900	3 700	5 500	**K72×79×21**	0.085
73	79	20	$^{-0.2}_{-0.55}$	37 500	90 000	11 000	3 700	5 500	**K73×79×20**	0.074
	79	30		54 500	146 000	17 800	3 700	5 500	**K73×79×30**	0.106

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.



KV··S type



KV··ZWS type

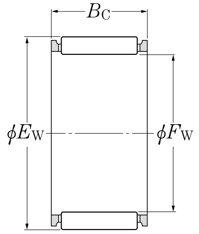
F_w 74 ～ 100mm

Boundary dimensions mm F_w	E_w	B_c		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
74	90	50	$^{-0.2}_{-0.55}$	157 000	287 000	35 000	3 700	5 500	**K74×90×49.8XT2**	0.380
75	81	20		40 000	99 500	12 200	3 700	5 500	**KV75×81×19.8X1S**	0.071
	81	30		56 000	152 000	18 600	3 700	5 500	**K75×81×30**	0.108
	82	21	$^{-0.2}_{-0.55}$	46 000	106 000	13 000	3 700	5 500	**K75×82×21**	0.088
	83	23		50 500	109 000	13 300	3 700	5 500	**K75×83×23**	0.113
	83	30		67 500	157 000	19 200	3 700	5 500	**K75×83×30**	0.147
80	86	20		39 000	98 000	11 900	3 300	5 000	**KV80×86×20SV1**	0.077
	86	30		57 000	159 000	19 400	3 300	5 000	**K80×86×30**	0.110
	88	23	$^{-0.2}_{-0.55}$	53 000	118 000	14 400	3 300	5 000	**K80×88×23**	0.125
	88	26		61 000	142 000	17 300	3 300	5 000	**K80×88×26**	0.131
	88	30		69 000	166 000	20 300	3 300	5 000	**K80×88×30**	0.157
85	92	30		66 000	176 000	21 500	3 100	4 700	**K85×92×30**	0.142
	93	27	$^{-0.2}_{-0.55}$	64 000	153 000	18 700	3 100	4 700	**K85×93×27**	0.145
	93	30		71 000	175 000	21 400	3 100	4 700	**8Q-K85×93×30**	0.174
90	97	20		46 000	113 000	13 700	2 900	4 400	**K90×97×20**	0.103
	97	30		67 500	184 000	22 400	2 900	4 400	**K90×97×30**	0.151
	98	26	$^{-0.2}_{-0.55}$	64 000	157 000	19 200	2 900	4 400	**K90×98×26**	0.148
	98	27		64 000	157 000	19 200	2 900	4 400	**K90×98×27**	0.150
	98	30		72 500	184 000	22 400	2 900	4 400	**K90×98×30**	0.172
95	102	21		48 000	122 000	14 900	2 800	4 200	**K95×102×21**	0.115
	102	31	$^{-0.2}_{-0.55}$	70 500	199 000	24 300	2 800	4 200	**K95×102×31**	0.172
	103	27		65 500	165 000	20 100	2 800	4 200	**K95×103×27**	0.159
	103	30		74 000	193 000	23 500	2 800	4 200	**K95×103×30**	0.165
100	107	21		47 500	122 000	14 700	2 700	4 000	**KV100×107×21S**	0.120
	107	31	$^{-0.3}_{-0.65}$	71 500	207 000	24 900	2 700	4 000	**K100×107×31**	0.173
	108	27		61 000	153 000	18 400	2 700	4 000	**K100×108×27**	0.176
	108	30		76 000	201 000	24 300	2 700	4 000	**K100×108×30**	0.190

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Needle roller and cage assemblies

K type
K··L1 type



K type
K··L1 type

F_W 105 ～ 170mm

Boundary dimensions mm F_w	E_w	B_c		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min^{-1} Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
105	112	21		48 500	127 000	15 100	2 500	3 800	**K105×112×21**	0.130
	112	31	−0.3 −0.65	71 000	207 000	24 600	2 500	3 800	**K105×112×31**	0.176
	113	30		77 500	210 000	25 000	2 500	3 800	**K105×113×30**	0.198
110	117	24		54 500	149 000	17 500	2 400	3 600	**K110×117×24**	0.145
	117	34	−0.3 −0.65	77 500	235 000	27 600	2 400	3 600	**K110×117×34**	0.205
	118	30		79 000	219 000	25 700	2 400	3 600	**K110×118×30**	0.217
115	123	27	−0.3 −0.65	64 000	170 000	19 700	2 300	3 500	**K115×123×27**	0.200
	125	34		95 000	241 000	27 800	2 300	3 500	**K115×125×34**	0.330
120	127	24	−0.3 −0.65	57 500	165 000	18 900	2 200	3 300	**K120×127×24**	0.160
	127	34		82 000	260 000	29 800	2 200	3 300	**K120×127×34**	0.235
125	133	35	−0.3 −0.65	87 000	260 000	29 300	2 100	3 200	**K125×133×35**	0.275
	135	34		100 000	265 000	29 800	2 100	3 200	**K125×135×34**	0.350
130	137	24	−0.3 −0.65	59 000	175 000	19 600	2 100	3 100	**K130×137×24**	0.170
	137	34		84 500	277 000	31 000	2 100	3 100	**K130×137×34**	0.240
135	143	35	−0.3 −0.65	92 500	288 000	32 000	2 000	3 000	**K135×143×35L1**	0.313
	150	38		145 000	325 000	36 000	2 000	3 000	**K135×150×38**	0.590
145	153	26		72 000	214 000	23 100	1 900	2 800	**K145×153×26**	0.250
	153	28	−0.3 −0.65	80 500	247 000	26 700	1 900	2 800	**K145×153×28**	0.252
	153	36		100 000	325 000	35 000	1 900	2 800	**K145×153×36**	0.335
150	160	46	−0.3 −0.65	149 000	470 000	50 500	1 800	2 700	**K150×160×46**	0.550
115	163	26	−0.3 −0.65	73 500	224 000	23 800	1 700	2 600	**K155×163×26**	0.270
	163	36		102 000	340 000	36 000	1 700	2 600	**K155×163×36**	0.355
160	170	46	−0.3 −0.65	155 000	505 000	53 000	1 700	2 500	**K160×170×46**	0.570
165	173	26		79 000	251 000	26 100	1 600	2 400	**K165×173×26**	0.290
	173	32	−0.3 −0.65	97 000	330 000	34 000	1 600	2 400	**K165×173×32**	0.340
	173	36		109 000	380 000	39 500	1 600	2 400	**K165×173×36**	0.375
170	180	46	−0.3 −0.65	160 000	540 000	55 500	1 600	2 400	**K170×180×46**	0.620

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

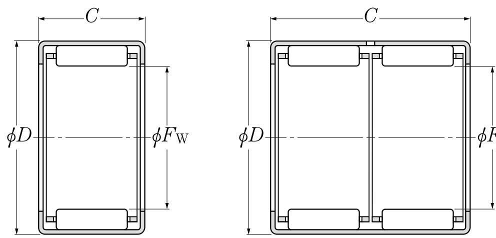
F_W 175 ～ 285mm

Boundary dimensions mm F_w	E_w	B_c		Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min^{-1} Grease lubrication	Oil lubrication	Number	Mass kg (approx.)
175	183	32	−0.3 −0.65	101 000	350 000	36 000	1 500	2 300	**K175×183×32L1**	0.379
185	195	37	−0.3 −0.65	131 000	425 000	43 000	1 500	2 200	**K185×195×37L1**	0.581
195	205	37	−0.3 −0.65	135 000	450 000	44 500	1 400	2 100	**K195×205×37L1**	0.620
210	220	42	−0.3 −0.65	156 000	560 000	54 000	1 300	1 900	**K210×220×42**	0.740
220	230	42	−0.3 −0.65	161 000	590 000	56 500	1 200	1 800	**K220×230×42**	0.790
240	250	42	−0.3 −0.65	167 000	635 000	59 000	1 100	1 700	**K240×250×42L1**	0.849
265	280	50	−0.3 −0.65	256 000	850 000	77 000	1 000	1 500	**K265×280×50L1**	1.77
285	300	50	−0.3 −0.65	268 000	930 000	82 000	950	1 400	**K285×300×50**	1.97

Note: Bearings may be delivered with a different cage type even if they are ordered by the bearing numbers in the table.

Drawn cup needle roller bearings

HK type, HK··ZWD type
HMK type
BK type, BK··ZWD type

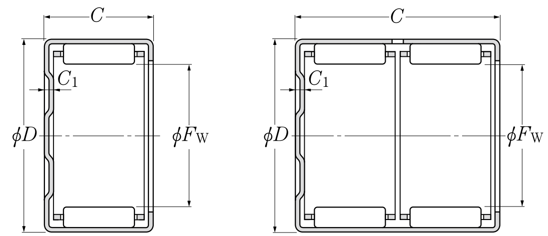


HK type, HMK type　　HK··ZWD type
(Open end type)

F_W 3～10mm

F_W (mm)	D (mm)	C $^{0}_{-0.2}$ (mm)	C_1 Max. (mm)	Basic load rating dynamic C_r (N)	Basic load rating static C_{0r} (N)	Fatigue load limit C_u (N)	Allowable speed min⁻¹ Grease lubrication	Allowable speed min⁻¹ Oil lubrication	Number Open end type	Number Closed end type	Mass kg (approx.)	Applied inner ring[1] (approx.)
3	6.5	6	—	925	565	69	33 000	50 000	**HK0306FT2**	—	0.0006	—
	6.5	6	0.8	925	565	69	33 000	50 000	—	**BK0306T2**	0.0007	—
4	8	8	—	1 770	1 270	155	30 000	45 000	**HK0408FT2**	—	0.0016	—
	8	8	1.6	1 770	1 270	155	30 000	45 000	—	**BK0408T2**	0.0018	—
5	9	9	—	2 450	1 990	243	27 000	40 000	**HK0509FM**	—	0.0019	—
	9	9	1.6	2 450	1 990	243	27 000	40 000	—	**BK0509**	0.0021	—
6	10	9	—	2 920	2 590	315	25 000	37 000	**HK0609FM**	—	0.0022	—
	10	9	1.6	2 660	2 280	278	25 000	37 000	—	**BK0609T2**	0.0024	—
7	11	9	—	3 150	2 930	355	23 000	34 000	**HK0709FM**	—	0.0025	—
	11	9	1.6	3 150	2 930	355	23 000	34 000	—	**BK0709CT**	0.0027	—
8	12	10	—	3 850	3 950	480	20 000	30 000	**HK0810FM**	—	0.0032	IR 5× 8×12
	12	10	1.6	3 850	3 950	480	20 000	30 000	—	**BK0810CT**	0.0034	IR 5× 8×12
	15	10	—	4 200	3 300	400	20 000	30 000	**HMK0810CT**	—	0.0067	IR 5× 8×12
	15	15	—	7 300	6 650	770	20 000	30 000	**HMK0815CT**	—	0.010	IR 5× 8×16
	15	20	—	9 050	8 750	1 070	20 000	30 000	**HMK0820T2**	—	0.013	—
9	13	10	—	4 300	4 650	570	18 000	27 000	**HK0910FM**	—	0.0035	IR 6× 9×12
	13	10	1.6	4 300	4 650	570	18 000	27 000	—	**BK0910CT**	0.0039	IR 6× 9×12
	13	12	—	5 400	6 250	765	18 000	27 000	**HK0912F**	—	0.0042	IR 6× 9×12
	13	12	1.6	5 400	6 250	765	18 000	27 000	—	**BK0912CT**	0.0045	IR 6× 9×12
	16	12	—	5 300	4 450	545	18 000	27 000	**HMK0912**	—	0.0087	IR 6× 9×16
	16	16	—	7 400	6 850	840	18 000	27 000	**HMK0916**	—	0.012	—
10	14	10	—	4 500	5 100	620	16 000	24 000	**HK1010FM**	—	0.0038	IR 7×10×10.5
	14	10	1.6	4 500	5 100	620	16 000	24 000	—	**BK1010**	0.0042	IR 7×10×10.5
	14	12	—	5 650	6 800	830	16 000	24 000	**HK1012F**	—	0.0045	IR 7×10×16
	14	12	1.6	5 900	7 250	880	16 000	24 000	—	**BK1012**	0.0050	IR 7×10×16
	14	15	—	7 250	9 400	1 140	16 000	24 000	**HK1015F**	—	0.0056	IR 7×10×16
	14	15	1.6	7 250	9 400	1 140	16 000	24 000	—	**BK1015CT**	0.0062	IR 7×10×16
	17	10	—	4 250	3 450	420	16 000	24 000	**HMK1010**	—	0.0079	IR 7×10×10.5
	17	12	—	5 600	4 850	590	16 000	24 000	**HMK1012**	—	0.0094	IR 7×10×16

1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK1012F + IR7 × 10 × 16



BK type　　BK··ZWD type
(Closed end type)

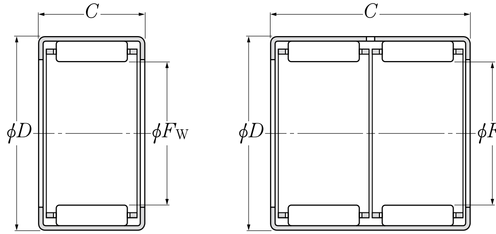
F_W 10～15mm

F_W (mm)	D (mm)	C $^{0}_{-0.2}$ (mm)	C_1 Max. (mm)	Basic load rating dynamic C_r (N)	Basic load rating static C_{0r} (N)	Fatigue load limit C_u (N)	Allowable speed min⁻¹ Grease lubrication	Allowable speed min⁻¹ Oil lubrication	Number Open end type	Number Closed end type	Mass kg (approx.)	Applied inner ring[1] (approx.)
10	17	15	—	7 400	6 950	850	16 000	24 000	**HMK1015**	—	0.012	IR 7×10×16
	17	20	—	9 900	10 100	1 240	16 000	24 000	**7E-HMK1020CT**	—	0.016	—
12	16	10	—	5 050	6 250	760	13 000	20 000	**HK1210FM**	—	0.0046	IR 8×12×10.5
	16	10	1.6	5 050	6 250	760	13 000	20 000	—	**BK1210**	0.0052	IR 8×12×10.5
	18	12	—	6 600	7 300	890	13 000	20 000	**HK1212FM**	—	0.0091	IR 8×12×12.5
	18	12	2.7	6 600	7 300	890	13 000	20 000	—	**BK1212**	0.010	IR 8×12×12.5
	19	12	—	7 100	6 900	845	13 000	20 000	**HMK1212**	—	0.011	IR 8×12×12.5
	19	15	—	9 400	9 900	1 210	13 000	20 000	**7E-HMK1215C**	—	0.014	IR 9×12×16
	19	20	—	12 900	14 900	1 820	13 000	20 000	**HMK1220CT**	—	0.018	—
	19	25	—	15 300	18 600	2 260	13 000	20 000	**HMK1225**	—	0.023	—
13	19	12	—	6 950	7 900	965	12 000	18 000	**HK1312FM**	—	0.010	IR10×13×12.5
	19	12	2.7	6 950	7 900	965	12 000	18 000	—	**BK1312**	0.011	IR10×13×12.5
14	20	12	—	7 200	8 500	1 040	11 000	17 000	**HK1412FM**	—	0.011	IR10×14×13
	20	12	2.7	7 200	8 500	1 040	11 000	17 000	—	**BK1412**	0.012	IR10×14×13
	20	16	—	10 300	13 400	1 640	11 000	17 000	**HK1416F**	—	0.015	—
	20	16	2.7	10 300	13 400	1 640	11 000	17 000	—	**BK1416CT**	0.016	—
	22	16	—	11 500	12 000	1 460	11 000	17 000	**HMK1416C**	—	0.019	IR10×14×20
	22	20	—	14 600	16 200	1 980	11 000	17 000	**HMK1420C**	—	0.024	—
15	21	12	—	7 500	9 100	1 110	11 000	16 000	**HK1512FM**	—	0.011	IR12×15×12.5
	21	12	2.7	7 500	9 100	1 110	11 000	16 000	—	**BK1512**	0.013	IR12×15×12.5
	21	16	—	10 700	14 400	1 750	11 000	16 000	**HK1516F**	—	0.015	IR12×15×16.5
	21	16	2.7	10 700	14 400	1 750	11 000	16 000	—	**BK1516**	0.017	IR12×15×16.5
	21	22	—	12 900	18 200	2 220	11 000	16 000	**HK1522ZWFD**	—	0.020	IR12×15×22.5
	21	22	2.7	12 900	18 200	2 220	11 000	16 000	—	**BK1522ZWD**	0.022	IR12×15×22.5
	22	10	—	6 100	6 000	730	11 000	16 000	**HMK1510**	—	0.011	IR10×15×12.5
	22	12	—	7 950	8 450	1 030	11 000	16 000	**HMK1512**	—	0.013	IR12×15×12.5
	22	15	—	10 500	12 100	1 480	11 000	16 000	**HMK1515C**	—	0.016	IR12×15×16
	22	20	—	15 300	19 700	2 400	11 000	16 000	**HMK1520CV6**	—	0.022	IR12×15×22.5
	22	25	—	18 500	25 000	3 050	11 000	16 000	**HMK1525**	—	0.027	—

1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK1312FM + IR10 × 13 × 12.5

Drawn cup needle roller bearings

HK type, HK··ZWD type
HMK type
BK type, BK··ZWD type

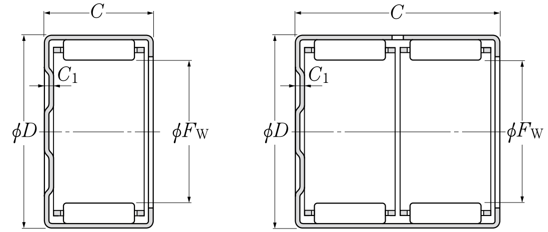


HK type, HMK type HK··ZWD type
(Open end type)

F_W 16 ～ 20mm

Boundary dimensions mm F_W	D	C 0 −0.2	C_1 Max.	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number Open end type	Closed end type	Mass kg (approx.)	Applied inner ring 1) (approx.)
16	22	12	—	7 750	9 700	1 180	10 000	15 000	**HK1612FM**	—	0.012	IR12×16×13
	22	12	2.7	7 750	9 700	1 180	10 000	15 000	—	**BK1612**	0.014	IR12×16×13
	22	16	—	11 100	15 300	1 870	10 000	15 000	**HK1616F**	—	0.016	IR12×16×20
	22	16	2.7	11 100	15 300	1 870	10 000	15 000	—	**BK1616**	0.018	IR12×16×20
	22	22	—	13 300	19 400	2 370	10 000	15 000	**HK1622ZWFD**	—	0.022	—
	22	22	2.7	13 300	19 400	2 370	10 000	15 000	—	**BK1622ZWD**	0.023	—
	24	16	—	12 400	13 500	1 640	10 000	15 000	**HMK1616**	—	0.021	IR12×16×20
	24	20	—	15 600	18 200	2 220	10 000	15 000	**7E-HMK1620CT**	—	0.027	IR12×16×22
17	23	12	—	8 050	10 300	1 260	9 500	14 000	**HK1712FM**	—	0.012	—
	23	12	2.7	8 050	10 300	1 260	9 500	14 000	—	**BK1712CT**	0.015	—
	24	15	—	11 600	14 200	1 740	9 500	14 000	**7E-HMK1715CT**	—	0.018	IR14×17×17
	24	20	—	15 200	20 000	2 440	9 500	14 000	**7E-HMK1720CT**	—	0.024	IR12×17×20.5
	24	25	—	19 000	26 700	3 250	9 500	14 000	**7E-HMK1725CT**	—	0.030	IR12×17×25.5
18	24	12	—	8 300	10 900	1 330	8 500	13 000	**HK1812FM**	—	0.013	IR15×18×12.5
	24	12	2.7	8 300	10 900	1 330	8 500	13 000	—	**BK1812**	0.015	IR15×18×12.5
	24	16	—	11 800	17 300	2 110	8 500	13 000	**HK1816F**	—	0.018	IR15×18×16.5
	24	16	2.7	11 800	17 300	2 110	8 500	13 000	—	**BK1816**	0.020	IR15×18×16.5
	25	13	—	10 200	12 200	1 480	8 500	13 000	**HMK1813**	—	0.016	IR15×18×16
	25	15	—	12 000	15 100	1 840	8 500	13 000	**HMK1815**	—	0.019	IR15×18×16
	25	17	—	13 300	17 200	2 100	8 500	13 000	**HMK1817C**	—	0.021	IR15×18×17.5
	25	19	—	15 500	20 900	2 540	8 500	13 000	**HMK1819**	—	0.024	IR15×18×20.5
	25	20	—	16 300	22 300	2 720	8 500	13 000	**HMK1820**	—	0.025	IR15×18×20.5
	25	25	—	20 900	31 000	3 750	8 500	13 000	**HMK1825V2**	—	0.031	IR15×18×25.5
19	27	16	—	13 900	16 300	2 000	8 500	13 000	**HMK1916**	—	0.025	IR15×19×20
	27	20	—	18 100	23 000	2 800	8 500	13 000	**HMK1920F**	—	0.031	—
20	26	12	—	8 750	12 100	1 480	8 000	12 000	**HK2012FM**	—	0.014	IR15×20×13
	26	12	2.7	9 250	13 000	1 590	8 000	12 000	—	**BK2012**	0.017	IR15×20×13
	26	16	—	12 500	19 200	2 340	8 000	12 000	**HK2016F**	—	0.019	IR17×20×16.5
	26	16	2.7	13 000	20 100	2 450	8 000	12 000	—	**BK2016**	0.022	IR17×20×16.5
	26	20	—	16 000	26 200	3 200	8 000	12 000	**HK2020F**	—	0.024	IR17×20×20.5

1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK1812FM + IR15 × 18 × 12.5



BK type BK··ZWD type
(Closed end type)

F_W 20 ～ 25mm

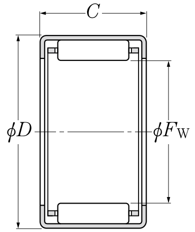
Boundary dimensions mm F_W	D	C 0 −0.2	C_1 Max.	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number Open end type	Closed end type	Mass kg (approx.)	Applied inner ring 1) (approx.)
20	26	20	2.7	16 000	26 200	3 200	8 000	12 000	—	**BK2020CT**	0.027	IR17×20×20.5
	26	30	—	21 500	38 500	4 700	8 000	12 000	**HK2030ZWFD**	—	0.035	IR17×20×30.5
	26	30	2.7	22 200	40 000	4 900	8 000	12 000	—	**BK2030ZWD**	0.037	IR17×20×30.5
	27	15	—	13 000	17 300	2 110	8 000	12 000	**HMK2015CV3**	—	0.021	IR17×20×16.5
	27	20	—	17 200	24 800	3 000	8 000	12 000	**HMK2020CT**	—	0.027	IR17×20×20.5
	27	25	—	22 000	34 000	4 150	8 000	12 000	**HMK2025C**	—	0.034	IR15×20×26
	27	30	—	26 100	42 000	5 150	8 000	12 000	**HMK2030**	—	0.041	IR17×20×30.5
21	29	16	—	15 300	19 100	2 320	7 500	11 000	**HMK2116**	—	0.027	IR17×21×20
	29	20	—	19 400	25 800	3 150	7 500	11 000	**HMK2120**	—	0.033	—
22	28	12	—	9 200	13 400	1 630	7 500	11 000	**HK2212FM**	—	0.013	IR17×22×13
	28	12	2.7	9 200	13 400	1 630	7 500	11 000	—	**BK2212CT**	0.015	IR17×22×13
	28	16	—	13 200	21 100	2 570	7 500	11 000	**HK2216F**	—	0.021	IR17×22×18
	28	16	2.7	13 600	22 100	2 700	7 500	11 000	—	**BK2216**	0.024	IR17×22×18
	28	20	—	16 800	28 800	3 500	7 500	11 000	**HK2220F**	—	0.026	IR17×22×20.5
	28	20	2.7	17 200	29 800	3 650	7 500	11 000	—	**BK2220**	0.030	IR17×22×20.5
	29	10	—	8 400	10 100	1 240	7 500	11 000	**HMK2210**	—	0.015	IR17×22×13
	29	15	—	12 900	17 600	2 150	7 500	11 000	**7E-HMK2215C**	—	0.022	IR17×22×16D
	29	20	—	18 200	27 400	3 350	7 500	11 000	**HMK2220CV2**	—	0.030	IR17×22×20.5
	29	25	—	23 200	37 500	4 550	7 500	11 000	**HMK2225CT**	—	0.037	IR17×22×26
	29	30	—	26 900	45 000	5 500	7 500	11 000	**HMK2230**	—	0.045	IR17×22×32
24	31	20	—	18 300	28 200	3 450	6 500	10 000	**HMK2420CT**	—	0.032	—
	31	28	—	26 000	44 500	5 400	6 500	10 000	**HMK2428**	—	0.045	IR20×24×28.5
25	32	12	—	11 100	15 200	1 850	6 500	9 500	**HK2512F**	—	0.021	IR20×25×12.5
	32	12	2.7	11 800	16 300	1 990	6 500	9 500	—	**BK2512**	0.023	IR20×25×12.5
	32	16	—	15 900	24 000	2 920	6 500	9 500	**HK2516F**	—	0.027	IR20×25×17
	32	16	2.7	15 900	24 000	2 920	6 500	9 500	—	**BK2516**	0.031	IR20×25×17
	32	20	—	20 300	33 000	4 000	6 500	9 500	**HK2520**	—	0.034	IR20×25×20.5
	32	20	2.7	20 300	33 000	4 000	6 500	9 500	—	**BK2520**	0.039	IR20×25×20.5
	32	26	—	26 400	46 000	5 600	6 500	9 500	**HK2526C**	—	0.045	IR20×25×26.5
	32	26	2.7	26 400	46 000	5 600	6 500	9 500	—	**BK2526C**	0.049	IR20×25×26.5

1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK2512F + IR20 × 25 × 12.5

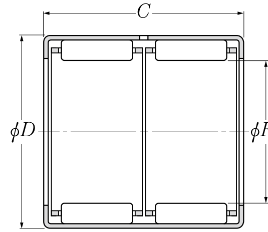
Needle Roller Bearings

Drawn cup needle roller bearings

HK type, HK··ZWD type
HMK type, HMK··ZWD type
BK type, BK··ZWD type



HK type, HMK type



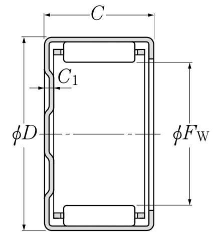
HK··ZWD type
HMK··ZWD type

(Open end type)

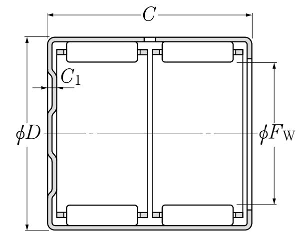
F_w 25 ～ 30mm

Boundary dimensions mm F_w	D	C 0 −0.2	C_1 Max.	Basic load rating dynamic N C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number Open end type	Closed end type	Mass kg (approx.)	Applied inner ring[1] (approx.)
25	32	38	—	35 000	65 500	8 000	6 500	9 500	**HK2538ZWD**	—	0.065	IR20×25×38.5
	32	38	2.7	35 000	65 500	8 000	6 500	9 500	—	**BK2538ZWD**	0.069	IR20×25×38.5
	33	10	—	9 150	10 400	1 270	6 500	9 500	**HMK2510**	—	0.019	IR20×25×12.5
	33	15	—	15 200	19 900	2 430	6 500	9 500	**HMK2515CT**	—	0.029	IR20×25×16
	33	20	—	21 200	30 500	3 750	6 500	9 500	**HMK2520CT**	—	0.039	IR20×25×20.5
	33	25	—	26 700	41 000	5 000	6 500	9 500	**HMK2525F**	—	0.048	IR20×25×26.5
	33	30	—	32 000	52 000	6 350	6 500	9 500	**7E-HMK2530C**	—	0.058	IR20×25×32
26	34	16	—	17 100	23 400	2 860	6 000	9 000	**7E-HMK2616**	—	0.032	IR22×26×20
	34	20	—	21 100	30 500	3 750	6 000	9 000	**7E-HMK2620CT**	—	0.040	—
28	35	16	—	16 700	26 400	3 200	5 500	8 500	**HK2816CT**	—	0.030	IR22×28×17
	35	16	2.7	16 700	26 400	3 200	5 500	8 500	—	**BK2816CT**	0.034	IR22×28×17
	35	20	—	21 300	36 000	4 400	5 500	8 500	**HK2820**	—	0.038	IR22×28×20.5
	35	20	2.7	21 300	36 000	4 400	5 500	8 500	—	**BK2820**	0.043	IR22×28×20.5
	37	20	—	23 600	32 500	4 000	5 500	8 500	**HMK2820**	—	0.049	IR22×28×20.5
	37	30	—	35 000	54 500	6 600	5 500	8 500	**7E-HMK2830C**	—	0.073	—
29	38	20	—	24 600	35 000	4 250	5 500	8 500	**HMK2920**	—	0.050	—
	38	30	—	34 500	54 000	6 600	5 500	8 500	**HMK2930**	—	0.075	—
30	37	12	—	12 300	18 200	2 220	5 500	8 000	**HK3012CT**	—	0.024	IR25×30×12.5
	37	12	2.7	12 300	18 200	2 220	5 500	8 000	—	**BK3012CT**	0.028	IR25×30×12.5
	37	16	—	18 100	30 000	3 650	5 500	8 000	**7E-HK3016C**	—	0.032	IR25×30×17
	37	16	2.7	18 100	30 000	3 650	5 500	8 000	—	**BK3016CT**	0.037	IR25×30×17
	37	20	—	22 300	39 500	4 800	5 500	8 000	**HK3020F**	—	0.040	IR25×30×20.5
	37	20	2.7	22 300	39 500	4 800	5 500	8 000	—	**BK3020**	0.047	IR25×30×20.5
	37	26	—	28 500	54 000	6 550	5 500	8 000	**HK3026F**	—	0.053	IR25×30×26.5
	37	26	2.7	28 500	54 000	6 550	5 500	8 000	—	**7E-BK3026T**	0.059	IR25×30×26.5
	37	38	—	38 500	78 500	9 600	5 500	8 000	**HK3038ZWD**	—	0.076	IR25×30×38.5
	37	38	2.7	38 500	78 500	9 600	5 500	8 000	—	**BK3038ZWD**	0.083	IR25×30×38.5
	40	13	—	14 100	17 100	2 090	5 500	8 000	**HMK3013**	—	0.040	IR25×30×16
	40	15	—	17 100	22 100	2 690	5 500	8 000	**HMK3015**	—	0.044	IR25×30×16
	40	20	—	24 200	34 500	4 200	5 500	8 000	**HMK3020**	—	0.058	IR25×30×20.5

1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK2820 + IR22 × 28 × 20.5



BK type



BK··ZWD type

(Closed end type)

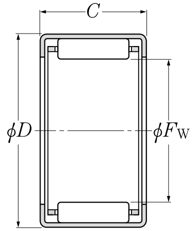
F_w 30 ～ 40mm

Boundary dimensions mm F_w	D	C 0 −0.2	C_1 Max.	Basic load rating dynamic N C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number Open end type	Closed end type	Mass kg (approx.)	Applied inner ring[1] (approx.)
30	40	25	—	31 000	47 500	5 800	5 500	8 000	**7E-HMK3025CT**	—	0.073	IR25×30×26.5
	40	30	—	36 000	57 500	7 000	5 500	8 000	**HMK3030**	—	0.087	IR25×30×32
32	42	20	—	27 500	38 000	4 600	5 000	7 500	**7E-HMK3220**	—	0.062	—
	42	30	—	41 500	64 500	7 850	5 000	7 500	**7E-HMK3230**	—	0.092	—
35	42	12	—	13 300	21 300	2 600	4 700	7 000	**HK3512CV2**	—	0.028	—
	42	12	2.7	13 300	21 300	2 600	4 700	7 000	—	**BK3512CT**	0.033	—
	42	16	—	19 000	33 500	4 100	4 700	7 000	**HK3516CT**	—	0.037	—
	42	16	2.7	19 000	33 500	4 100	4 700	7 000	—	**BK3516CT**	0.044	—
	42	20	—	24 800	47 500	5 800	4 700	7 000	**HK3520**	—	0.046	—
	42	20	2.7	24 800	47 500	5 800	4 700	7 000	—	**BK3520**	0.055	—
	45	12	—	14 900	17 600	2 150	4 700	7 000	**HMK3512**	—	0.040	—
	45	15	—	20 200	26 200	3 200	4 700	7 000	**HMK3515**	—	0.050	—
	45	20	—	28 400	40 500	4 900	4 700	7 000	**7E-HMK3520B**	—	0.067	—
	45	25	—	36 000	54 500	6 650	4 700	7 000	**HMK3525**	—	0.083	—
	45	30	—	44 000	71 000	8 650	4 700	7 000	**HMK3530CV1**	—	0.100	—
37	47	20	—	29 300	43 000	5 250	4 300	6 500	**HMK3720**	—	0.070	—
	47	30	—	44 500	73 000	8 900	4 300	6 500	**HMK3730**	—	0.105	—
38	48	15	—	21 700	29 300	3 550	4 300	6 500	**HMK3815**	—	0.054	—
	48	20	—	30 500	45 000	5 500	4 300	6 500	**HMK3820**	—	0.072	—
	48	25	—	38 500	61 000	7 450	4 300	6 500	**HMK3825**	—	0.090	—
	48	30	—	46 000	77 000	9 400	4 300	6 500	**HMK3830**	—	0.107	IR32×38×32
	48	45	—	62 000	113 000	13 700	4 300	6 500	**HMK3845ZWD**	—	0.161	—
40	47	12	—	12 100	19 500	2 380	4 000	6 000	**HK4012V2**	—	0.031	IR35×40×12.5
	47	12	2.7	12 600	20 800	2 530	4 000	6 000	—	**7E-BK4012CT**	0.038	IR35×40×12.5
	47	16	—	20 300	38 500	4 700	4 000	6 000	**HK4016CT**	—	0.041	IR35×40×17
	47	16	2.7	20 300	38 500	4 700	4 000	6 000	—	**BK4016CT**	0.051	IR35×40×17
	47	20	—	25 900	52 500	6 400	4 000	6 000	**HK4020F**	—	0.052	IR35×40×20.5
	47	20	2.7	25 900	52 500	6 400	4 000	6 000	—	**BK4020**	0.064	IR35×40×20.5
	50	15	—	23 100	32 500	3 950	4 000	6 000	**HMK4015**	—	0.056	IR35×40×17
	50	20	—	32 500	50 000	6 100	4 000	6 000	**7E-HMK4020**	—	0.075	IR35×40×20.5

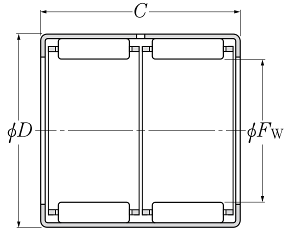
1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK4012 + IR35 × 40 × 12.5

Drawn cup needle roller bearings

HK type
HMK type, HMK··ZWD type
BK type



HK type, HMK type



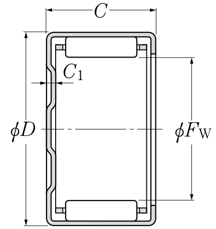
HMK··ZWD type

(Open end type)

F_W 40～50mm

Boundary dimensions mm				Basic load rating N		Fatigue load limit N	Allowable speed min^{-1}		Number		Mass kg	Applied inner ring[1)
F_W	D	C 0/−0.2	C_1 Max.	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	Open end type	Closed end type	(approx.)	(approx.)
40	50	25	—	41 000	67 500	8 250	4 000	6 000	**7E-HMK4025**	—	0.094	—
	50	30	—	49 000	85 000	10 400	4 000	6 000	**HMK4030**	—	0.112	IR35×40×34
	50	40	—	58 500	107 000	13 000	4 000	6 000	**HMK4040ZWD**	—	0.150	—
45	52	16	—	21 600	43 000	5 250	3 700	5 500	**HK4516**	—	0.046	IR40×45×17
	52	16	2.7	21 600	43 000	5 250	3 700	5 500	—	**BK4516**	0.058	IR40×45×17
	52	20	—	27 600	59 000	7 200	3 700	5 500	**HK4520**	—	0.058	IR40×45×20.5
	52	20	2.7	27 600	59 000	7 200	3 700	5 500	—	**BK4520**	0.072	IR40×45×20.5
	55	20	—	32 000	51 000	6 200	3 700	5 500	**7E-HMK4520CT**	—	0.083	IR40×45×20.5
	55	25	—	41 500	71 500	8 700	3 700	5 500	**HMK4525**	—	0.104	IR40×45×26.5
	55	30	—	49 500	90 000	11 000	3 700	5 500	**7E-HMK4530CT**	—	0.125	IR40×45×34
	55	40	—	59 500	113 000	13 800	3 700	5 500	**HMK4540ZWD**	—	0.167	—
50	58	20	—	31 500	63 000	7 700	3 200	4 800	**HK5020**	—	0.072	IR40×50×22
	58	20	2.7	31 500	63 000	7 700	3 200	4 800	—	**BK5020**	0.087	IR40×50×22
	58	25	—	38 500	82 000	10 000	3 200	4 800	**HK5025**	—	0.090	IR45×50×25.5
	58	25	2.7	38 500	82 000	10 000	3 200	4 800	—	**BK5025**	0.109	IR45×50×25.5
	62	12	—	18 200	23 600	2 880	3 200	4 800	**7E-HMK5012**	—	0.067	—
	62	15	—	25 900	37 000	4 550	3 200	4 800	**7E-HMK5015**	—	0.084	—
	62	20	—	37 500	60 000	7 300	3 200	4 800	**7E-HMK5020CT**	—	0.112	IR40×50×22
	62	25	—	48 000	82 500	10 100	3 200	4 800	**7E-HMK5025**	—	0.140	IR45×50×25.5
	62	30	—	58 500	105 000	12 800	3 200	4 800	**7E-HMK5030CPX1**	—	0.168	IR45×50×32
	62	40	—	70 000	134 000	16 300	3 200	4 800	**7E-HMK5040ZWD**	—	0.224	—
	62	45	—	79 000	156 000	19 100	3 200	4 800	**7E-HMK5045ZWCDPX1**	—	0.252	—

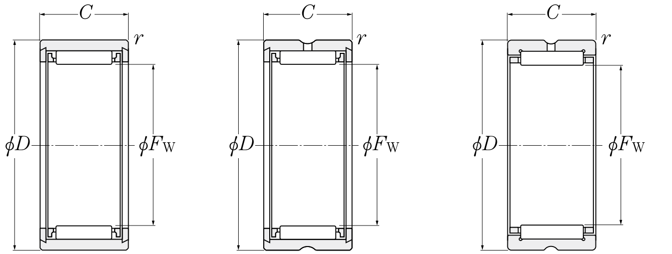
1) If the bearing has an inner ring, the value indicates HK + IR.
Example: HK4516 + IR40 × 45 × 17



BK type
(Closed end type)

Machined-ring needle roller bearings without an inner ring

RNA49 type
RNA59 type
RNA69 type
NK type



NK type
(ϕF_W≦12mm)

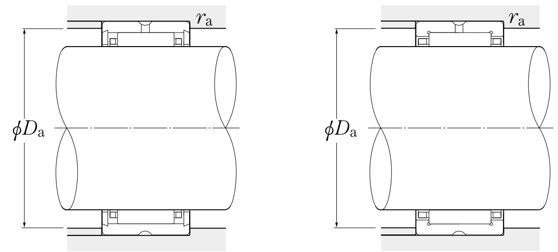
RNA49 type
(ϕF_W≦12mm)

RNA49‥R type (ϕF_W≧14mm)
RNA59 type
RNA69‥R type
NK‥R type (ϕF_W≧14mm)

F_W 5～16mm

Boundary dimensions (mm)					Basic load rating dynamic (N)	static (N)	Fatigue load limit (N)	Allowable speed (min⁻¹)		Number	Installation-related dimensions (mm)		Mass (kg)
F_W		D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
5	+0.018 / +0.010	10	10	0.15	2 640	2 190	267	27 000	40 000	NK5/10T2	6.5	0.15	0.0031
		10	12	0.15	2 720	2 250	275	27 000	40 000	NK5/12T2	6.5	0.15	0.0037
6	+0.018 / +0.010	12	10	0.15	2 660	2 280	278	25 000	37 000	NK6/10T2	7.5	0.15	0.0047
		12	12	0.15	3 400	3 150	380	25 000	37 000	NK6/12T2	7.5	0.15	0.0057
7	+0.022 / +0.013	13	10	0.15	2 670	2 350	286	23 000	34 000	RNA495T2	8.5	0.15	0.0055
		14	10	0.3	2 670	2 350	286	23 000	34 000	NK7/10T2	8.5	0.3	0.0069
		14	12	0.3	3 400	3 200	390	23 000	34 000	NK7/12T2	8.5	0.3	0.0082
8	+0.022 / +0.013	15	10	0.15	3 150	3 000	365	21 000	32 000	RNA496T2T	9.5	0.15	0.0073
		15	12	0.3	4 000	4 100	500	21 000	32 000	NK8/12T2	9.5	0.3	0.0087
		15	16	0.3	4 850	5 200	635	21 000	32 000	NK8/16	9.5	0.3	0.012
9	+0.022 / +0.013	16	12	0.3	4 550	5 000	615	20 000	30 000	NK9/12T2	10.5	0.3	0.010
		16	16	0.3	5 500	6 400	780	20 000	30 000	NK9/16T2	10.5	0.3	0.013
		17	10	0.15	3 600	3 650	445	20 000	30 000	RNA497	10.5	0.15	0.0095
10	+0.022 / +0.013	17	12	0.3	4 550	5 100	620	19 000	28 000	NK10/12T2	11.5	0.3	0.010
		17	16	0.3	5 450	6 450	790	19 000	28 000	8E-NK10/16CT	11.5	0.3	0.013
		19	11	0.15	5 250	5 150	630	19 000	28 000	RNA498CT	12	0.15	0.013
12	+0.027 / +0.016	19	12	0.3	5 000	6 100	740	17 000	26 000	NK12/12	13.5	0.3	0.013
		19	16	0.3	6 000	7 700	940	17 000	26 000	NK12/16	13.5	0.3	0.016
		20	11	0.3	4 850	4 900	600	17 000	26 000	RNA499	14	0.3	0.013
14	+0.027 / +0.016	22	13	0.3	8 600	9 200	1 120	16 000	24 000	RNA4900R	20	0.3	0.017
		22	16	0.3	10 300	11 500	1 400	16 000	24 000	NK14/16RCT	20	0.3	0.021
		22	20	0.3	13 000	15 600	1 900	16 000	24 000	NK14/20R	20	0.3	0.026
15	+0.027 / +0.016	23	16	0.3	10 900	12 700	1 550	15 000	23 000	NK15/16R	21	0.3	0.022
		23	20	0.3	13 800	17 200	2 100	15 000	23 000	NK15/20R	21	0.3	0.027
16	+0.027 / +0.016	24	13	0.3	9 550	10 900	1 330	15 000	23 000	RNA4901R	22	0.3	0.017
		24	16	0.3	12 200	14 900	1 820	15 000	23 000	NK16/16R	22	0.3	0.022
		24	20	0.3	14 600	18 800	2 290	15 000	23 000	NK16/20R	22	0.3	0.028
		24	22	0.3	15 400	20 000	2 440	15 000	23 000	RNA6901R	22	0.3	0.031

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.



F_W 17～28mm

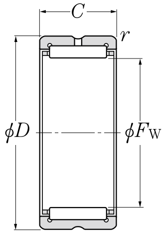
Boundary dimensions (mm)					Basic load rating dynamic (N)	static (N)	Fatigue load limit (N)	Allowable speed (min⁻¹)		Number	Installation-related dimensions (mm)		Mass (kg)
F_W		D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
17	+0.027 / +0.016	25	16	0.3	12 100	15 000	1 830	15 000	22 000	NK17/16R	23	0.3	0.024
		25	20	0.3	15 400	20 400	2 490	15 000	22 000	NK17/20R	23	0.3	0.030
18	+0.027 / +0.016	26	16	0.3	12 700	16 200	1 980	14 000	21 000	NK18/16R	24	0.3	0.025
		26	20	0.3	16 100	22 000	2 690	14 000	21 000	NK18/20RCT	24	0.3	0.031
19	+0.033 / +0.020	27	16	0.3	13 300	17 400	2 120	14 000	21 000	NK19/16R	25	0.3	0.026
		27	20	0.3	16 000	22 200	2 700	14 000	21 000	NK19/20R	25	0.3	0.032
20	+0.033 / +0.020	28	13	0.3	10 300	12 800	1 560	13 000	20 000	RNA4902R	26	0.3	0.022
		28	16	0.3	13 200	17 500	2 140	13 000	20 000	NK20/16RCT	26	0.3	0.027
		28	18	0.3	14 100	19 100	2 330	13 000	20 000	RNA5902CT	26	0.3	0.033
		28	20	0.3	16 700	23 800	2 900	13 000	20 000	NK20/20R	26	0.3	0.034
		28	23	0.3	17 600	25 300	3 100	13 000	20 000	RNA6902R	26	0.3	0.040
21	+0.033 / +0.020	29	16	0.3	13 700	18 700	2 280	13 000	19 000	NK21/16R	27	0.3	0.028
		29	20	0.3	17 400	25 400	3 100	13 000	19 000	NK21/20R	27	0.3	0.035
22	+0.033 / +0.020	30	16	0.3	14 200	19 900	2 430	12 000	18 000	NK22/16R	28	0.3	0.034
		30	20	0.3	18 000	27 000	3 300	12 000	18 000	NK22/20R	28	0.3	0.037
		30	13	0.3	11 200	14 600	1 780	12 000	18 000	RNA4903R	28	0.3	0.022
		30	18	0.3	15 200	21 700	2 650	12 000	18 000	RNA5903	28	0.3	0.035
		30	23	0.3	18 200	27 200	3 300	12 000	18 000	RNA6903R	28	0.3	0.042
24	+0.033 / +0.020	32	16	0.3	15 200	22 300	2 720	11 000	17 000	NK24/16R	30	0.3	0.032
		32	20	0.3	18 600	28 800	3 500	11 000	17 000	NK24/20R	30	0.3	0.040
25	+0.033 / +0.020	33	16	0.3	15 100	22 400	2 730	11 000	16 000	NK25/16R	31	0.3	0.033
		33	20	0.3	19 200	30 500	3 700	11 000	16 000	NK25/20RCT	31	0.3	0.042
		37	17	0.3	21 300	25 500	3 100	11 000	16 000	RNA4904RCT	35	0.3	0.052
		37	23	0.3	28 400	37 000	4 500	11 000	16 000	RNA5904	35	0.3	0.084
		37	30	0.3	36 500	50 500	6 150	11 000	16 000	RNA6904R	35	0.3	0.100
26	+0.033 / +0.020	34	16	0.3	15 600	23 600	2 880	10 000	15 000	8E-NK26/16RCT	32	0.3	0.034
		34	20	0.3	19 100	30 500	3 700	10 000	15 000	NK26/20R	32	0.3	0.042
28	+0.033 / +0.020	37	20	0.3	22 300	34 000	4 150	9 500	14 000	NK28/20R	35	0.3	0.052
		37	30	0.3	26 700	48 000	5 850	9 500	14 000	NK28/30RCT	35	0.3	0.082

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.

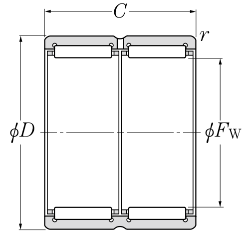
Needle Roller Bearings

Machined-ring needle roller bearings
without an inner ring

RNA49 type
RNA59 type
RNA69 type
NK type



RNA49··R type, RNA59 type
RNA69··R type (ϕF_W≦35mm)
NK··R type



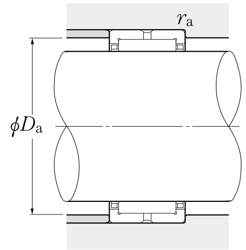
RNA69 type··R type
(ϕF_W≧40mm)

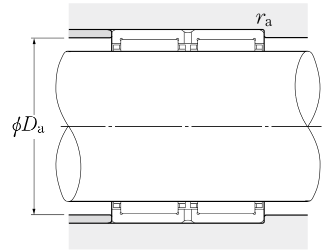
F_W 28～40mm

Boundary dimensions mm				Basic load rating N dynamic	static	Fatigue load limit N	Allowable speed min^{-1}		Number	Installation-related dimensions mm		Mass kg
F_W	D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
28 $^{+0.033}_{+0.020}$	39	17	0.3	23 200	29 300	3 600	9 500	14 000	RNA49/22R	37	0.3	0.050
	39	23	0.3	26 400	37 500	4 600	9 500	14 000	RNA59/22	37	0.3	0.092
	39	30	0.3	40 000	58 500	7 150	9 500	14 000	RNA69/22R	37	0.3	0.100
29 $^{+0.033}_{+0.020}$	38	20	0.3	22 200	34 000	4 150	9 500	14 000	NK29/20R	36	0.3	0.054
	38	30	0.3	27 500	50 500	6 150	9 500	14 000	NK29/30R	36	0.3	0.084
30 $^{+0.033}_{+0.020}$	40	20	0.3	22 100	34 000	4 150	8 500	13 000	NK30/20R	38	0.3	0.065
	40	30	0.3	33 000	57 000	6 950	8 500	13 000	NK30/30R	38	0.3	0.098
	42	17	0.3	24 000	31 500	3 800	8 500	13 000	RNA4905R	40	0.3	0.061
	42	23	0.3	30 500	43 000	5 200	8 500	13 000	RNA5905	40	0.3	0.101
	42	30	0.3	41 500	63 000	7 650	8 500	13 000	RNA6905R	40	0.3	0.112
32 $^{+0.041}_{+0.025}$	42	20	0.3	23 500	37 500	4 600	8 500	13 000	NK32/20R	40	0.3	0.068
	42	30	0.3	34 000	60 500	7 350	8 500	13 000	NK32/30R	40	0.3	0.102
	45	17	0.3	24 800	33 500	4 050	8 500	13 000	RNA49/28RCT	43	0.3	0.073
	45	23	0.3	32 000	45 500	5 550	8 500	13 000	RNA59/28	43	0.3	0.108
	45	30	0.3	43 000	67 000	8 150	8 500	13 000	RNA69/28R	43	0.3	0.135
35 $^{+0.041}_{+0.025}$	45	20	0.3	24 800	41 500	5 050	7 500	11 000	NK35/20RCT	43	0.3	0.074
	45	30	0.3	36 000	66 500	8 100	7 500	11 000	NK35/30R	43	0.3	0.112
	47	17	0.3	25 500	35 500	4 300	7 500	11 000	RNA4906R	45	0.3	0.069
	47	23	0.3	32 500	48 500	5 950	7 500	11 000	RNA5906	45	0.3	0.108
	47	30	0.3	42 500	67 500	8 250	7 500	11 000	RNA6906R	45	0.3	0.126
37 $^{+0.041}_{+0.025}$	47	20	0.3	25 300	43 500	5 300	7 500	11 000	NK37/20R	45	0.3	0.077
	47	30	0.3	36 500	69 500	8 500	7 500	11 000	NK37/30R	45	0.3	0.107
38 $^{+0.041}_{+0.025}$	48	20	0.3	25 900	45 000	5 500	7 500	11 000	NK38/20R	46	0.3	0.079
	48	30	0.3	37 500	73 000	8 900	7 500	11 000	NK38/30R	46	0.3	0.107
40 $^{+0.041}_{+0.025}$	50	20	0.3	26 400	47 000	5 750	6 500	10 000	NK40/20R	48	0.3	0.083
	50	30	0.3	38 500	76 000	9 250	6 500	10 000	NK40/30R	48	0.3	0.125
	52	20	0.6	31 500	47 500	5 800	6 500	10 000	RNA49/32R	48	0.6	0.089
	52	27	0.6	38 000	61 000	7 450	6 500	10 000	RNA59/32	48	0.6	0.149
	52	36	0.6	47 500	82 000	10 000	6 500	10 000	RNA69/32R	48	0.6	0.162

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.

Needle Roller Bearings





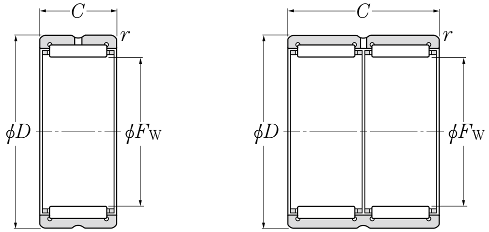
F_W 42～63mm

Boundary dimensions mm				Basic load rating N dynamic	static	Fatigue load limit N	Allowable speed min^{-1}		Number	Installation-related dimensions mm		Mass kg
F_W	D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
42 $^{+0.041}_{+0.025}$	52	20	0.3	26 900	49 000	5 950	6 500	9 500	NK42/20R	50	0.3	0.086
	52	30	0.3	39 000	79 000	9 650	6 500	9 500	NK42/30R	50	0.3	0.130
	55	20	0.6	32 000	50 000	6 100	6 500	9 500	RNA4907R	51	0.6	0.107
	55	27	0.6	39 000	64 500	7 850	6 500	9 500	RNA5907	51	0.6	0.176
	55	36	0.6	49 000	86 500	10 500	6 500	9 500	RNA6907R	51	0.6	0.193
43 $^{+0.041}_{+0.025}$	53	20	0.3	27 500	51 000	6 200	6 500	9 500	NK43/20R	51	0.3	0.086
	53	30	0.3	40 000	82 000	10 000	6 500	9 500	NK43/30R	51	0.3	0.133
45 $^{+0.041}_{+0.025}$	55	20	0.3	28 000	52 500	6 450	6 000	9 000	NK45/20R	53	0.3	0.092
	55	30	0.3	41 000	85 500	10 400	6 000	9 000	NK45/30RCT	53	0.3	0.139
47 $^{+0.041}_{+0.025}$	57	20	0.3	28 800	55 500	6 800	5 500	8 500	NK47/20RCT	55	0.3	0.095
	57	30	0.3	42 500	91 500	11 200	5 500	8 500	NK47/30R	55	0.3	0.142
48 $^{+0.041}_{+0.025}$	62	22	0.6	43 500	66 500	8 150	5 500	8 500	RNA4908R	58	0.6	0.140
	62	30	0.6	53 000	92 500	11 300	5 500	8 500	RNA5908	58	0.6	0.225
	62	40	0.6	67 000	116 000	14 100	5 500	8 500	RNA6908R	58	0.6	0.256
50 $^{+0.041}_{+0.025}$	62	25	0.6	38 500	74 500	9 050	5 500	8 000	NK50/25RCT	58	0.6	0.158
	62	35	0.6	51 000	106 000	12 900	5 500	8 000	NK50/35R	58	0.6	0.221
52 $^{+0.049}_{+0.030}$	68	22	0.6	46 000	73 000	8 950	5 000	7 500	RNA4909R	64	0.6	0.182
	68	30	0.6	56 000	101 000	12 300	5 000	7 500	RNA5909	64	0.6	0.232
	68	40	0.6	70 500	127 000	15 500	5 000	7 500	RNA6909R	64	0.6	0.273
55 $^{+0.049}_{+0.030}$	68	25	0.6	41 000	82 000	10 000	5 000	7 500	NK55/25R	64	0.6	0.193
	68	35	0.6	54 000	118 000	14 300	5 000	7 500	NK55/35R	64	0.6	0.26
58 $^{+0.049}_{+0.030}$	72	22	0.6	48 000	80 000	9 750	4 700	7 000	RNA4910R	68	0.6	0.163
	72	30	0.6	58 000	110 000	13 400	4 700	7 000	RNA5910	68	0.6	0.289
	72	40	0.6	74 000	139 000	17 000	4 700	7 000	RNA6910R	68	0.6	0.320
60 $^{+0.049}_{+0.030}$	72	25	0.6	41 000	85 000	10 400	4 300	6 500	NK60/25R	68	0.6	0.185
	72	35	0.6	57 000	130 000	15 800	4 300	6 500	NK60/35R	68	0.6	0.258
63 $^{+0.049}_{+0.030}$	80	25	1	58 500	99 500	12 100	4 300	6 500	RNA4911R	75	1	0.255
	80	34	1	76 500	140 000	17 100	4 300	6 500	RNA5911	75	1	0.367
	80	45	1	94 000	183 000	22 300	4 300	6 500	RNA6911R	75	1	0.470

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.

Machined-ring needle roller bearings without an inner ring

RNA49 type
RNA59 type
RNA69 type
NK type



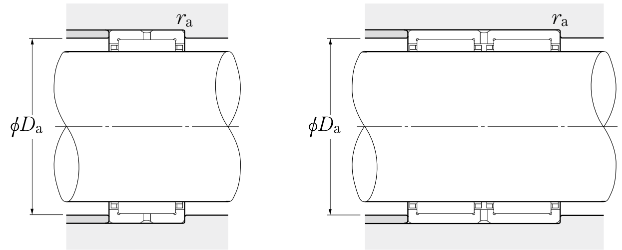
RNA48 type
RNA49··R type
RNA59 type
NK··R type

RNA69··R type

F_w 65 ～ 90mm

Boundary dimensions mm F_w			D	C	$r_{s\,min}$ 1)	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Installation-related dimensions mm D_a Max.	r_{as} 2) Max.	Mass kg (approx.)
65	+0.049	+0.030	78	25	0.6	45 000	98 000	12 000	4 000	6 000	**NK65/25R**	74	0.6	0.221
			78	35	0.6	60 000	142 000	17 300	4 000	6 000	**NK65/35R**	74	0.6	0.310
68	+0.049	+0.030	82	25	1	44 500	89 000	10 800	4 000	6 000	**NK68/25R**	77	0.6	0.241
			82	35	0.6	63 000	139 000	17 000	4 000	6 000	**NK68/35R**	78	0.6	0.338
			85	25	1	61 500	108 000	13 100	4 000	6 000	**RNA4912R**	80	1	0.275
			85	34	1	80 500	153 000	18 600	4 000	6 000	**RNA5912**	80	1	0.408
			85	45	1	95 500	191 000	23 200	4 000	6 000	**RNA6912R**	80	1	0.488
70	+0.049	+0.030	85	25	0.6	45 000	91 500	11 200	3 700	5 500	**NK70/25R**	81	0.6	0.275
			85	35	0.6	64 000	144 000	17 600	3 700	5 500	**NK70/35R**	81	0.6	0.386
72	+0.049	+0.030	90	25	1	62 500	112 000	13 700	3 700	5 500	**RNA4913R**	85	1	0.312
			90	34	1	84 000	165 000	20 100	3 700	5 500	**RNA5913**	85	1	0.462
			90	45	1	97 000	198 000	24 200	3 700	5 500	**RNA6913R**	85	1	0.520
73	+0.049	+0.030	90	25	0.6	54 000	100 000	12 200	3 700	5 500	**NK73/25R**	86	0.6	0.302
			90	35	0.6	76 500	156 000	19 100	3 700	5 500	**NK73/35R**	86	0.6	0.428
75	+0.049	+0.030	92	25	0.6	55 000	104 000	12 600	3 700	5 500	**NK75/25R**	88	0.6	0.315
			92	35	0.6	78 000	162 000	19 800	3 700	5 500	**NK75/35R**	88	0.6	0.492
80	+0.049	+0.030	95	25	1	57 000	119 000	14 500	3 300	5 000	**NK80/25R**	90	1	0.301
			95	35	1	79 500	184 000	22 400	3 300	5 000	**NK80/35R**	90	1	0.425
			100	30	1	85 500	156 000	19 000	3 300	5 000	**RNA4914R**	95	1	0.460
			100	40	1	103 000	187 000	22 800	3 300	5 000	**RNA5914**	95	1	0.706
			100	54	1	130 000	267 000	32 500	3 300	5 000	**RNA6914R**	95	1	0.857
85	+0.058	+0.036	105	25	1	70 500	123 000	15 000	3 100	4 700	**NK85/25R**	100	1	0.404
			105	30	1	87 000	162 000	19 700	3 100	4 700	**RNA4915R**	100	1	0.489
			105	35	1	100 000	193 000	23 600	3 100	4 700	**NK85/35R**	100	1	0.517
			105	40	1	109 000	205 000	25 000	3 100	4 700	**RNA5915**	100	1	0.745
			105	54	1	132 000	277 000	34 000	3 100	4 700	**RNA6915R**	100	1	0.935
90	+0.058	+0.036	110	25	1	71 500	128 000	15 600	2 900	4 400	**NK90/25R**	105	1	0.426
			110	30	1	90 500	174 000	21 200	2 900	4 400	**RNA4916R**	105	1	0.516
			110	35	1	104 000	208 000	25 400	2 900	4 400	**NK90/35R**	105	1	0.604

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.



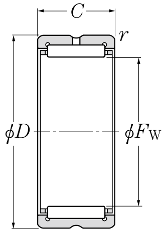
F_w 90 ～ 135mm

Boundary dimensions mm F_w			D	C	$r_{s\,min}$ 1)	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Oil lubrication	Number	Installation-related dimensions mm D_a Max.	r_{as} 2) Max.	Mass kg (approx.)
90	+0.058	+0.036	110	40	1	115 000	223 000	27 200	2 900	4 400	**RNA5916**	105	1	0.787
			110	54	1	138 000	298 000	36 500	2 900	4 400	**RNA6916R**	105	1	0.987
95	+0.058	+0.036	115	26	1	74 500	137 000	16 600	2 800	4 200	**NK95/26R**	110	1	0.364
			115	36	1	108 000	223 000	27 000	2 800	4 200	**NK95/36R**	110	1	0.652
100	+0.058	+0.036	120	26	1	73 500	137 000	16 500	2 700	4 000	**NK100/26R**	115	1	0.487
			120	35	1.1	112 000	237 000	28 400	2 700	4 000	**RNA4917R**	113.5	1	0.657
			120	36	1	107 000	223 000	26 700	2 700	4 000	**NK100/36R**	115	1	0.679
			120	46	1.1	137 000	290 000	34 500	2 700	4 000	**RNA5917**	113.5	1	1.00
			120	63	1.1	169 000	400 000	48 000	2 700	4 000	**RNA6917R**	113.5	1	1.20
105	+0.058	+0.036	125	26	1	76 500	147 000	17 300	2 500	3 800	**NK105/26R**	120	1	0.506
			125	35	1.1	116 000	252 000	29 800	2 500	3 800	**RNA4918R**	118.5	1	0.697
			125	36	1	111 000	238 000	28 100	2 500	3 800	**NK105/36R**	120	1	0.713
			125	46	1.1	143 000	310 000	37 000	2 500	3 800	**RNA5918**	118.5	1	1.04
			125	63	1.1	175 000	425 000	50 500	2 500	3 800	**RNA6918R**	118.5	1	1.33
110	+0.058	+0.036	130	30	1.1	97 500	204 000	23 800	2 400	3 600	**NK110/30R**	123.5	1	0.612
			130	35	1.1	118 000	260 000	30 500	2 400	3 600	**RNA4919R**	123.5	1	0.719
			130	40	1.1	129 000	292 000	34 000	2 400	3 600	**NK110/40R**	123.5	1	0.830
			130	46	1.1	149 000	335 000	39 000	2 400	3 600	**RNA5919**	123.5	1	1.13
			130	63	1.1	177 000	440 000	51 000	2 400	3 600	**RNA6919R**	123.5	1	1.46
115	+0.058	+0.036	140	40	1.1	127 000	260 000	29 900	2 300	3 500	**RNA4920**	133.5	1	1.15
			140	54	1.1	182 000	395 000	45 500	2 300	3 500	**RNA5920**	133.5	1	1.76
120	+0.058	+0.036	140	30	1	93 500	210 000	23 900	2 200	3 300	**RNA4822**	135	1	0.670
			140	40	1.1	113 000	268 000	30 500	2 200	3 300	**NK120/40**	133.5	1	0.910
125	+0.068	+0.043	150	40	1.1	131 000	279 000	31 500	2 100	3 200	**RNA4922**	143.5	1	1.24
			150	54	1.1	193 000	440 000	49 500	2 100	3 200	**RNA5922**	143.5	1	1.89
130	+0.068	+0.043	150	30	1	99 500	233 000	25 900	2 100	3 100	**RNA4824**	145	1	0.730
			150	40	1.1	116 000	283 000	31 500	2 100	3 100	**NK130/40**	143.5	1	0.980
135	+0.068	+0.043	165	45	1.1	180 000	380 000	41 500	2 000	3 000	**RNA4924**	158.5	1	1.86
			165	60	1.1	246 000	530 000	57 500	2 000	3 000	**RNA5924**	158.5	1	2.67

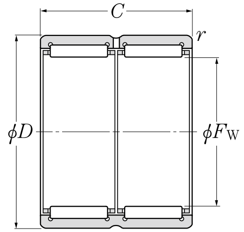
1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.

Machined-ring needle roller bearings without an inner ring

RNA48 type
RNA49 type
RNA59 type
RNA69 type
NK type



RNA48 type
RNA49··R type, RNA49 type
RNA59 type
NK··R type, NK type

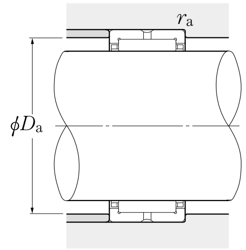


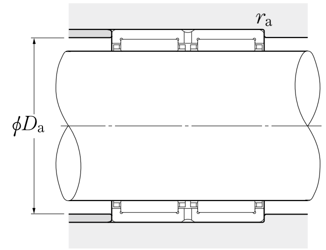
RNA69··R type

F_w 145～245mm

Boundary dimensions mm				Basic load rating N dynamic	static	Fatigue load limit N	Allowable speed min⁻¹		Number	Installation-related dimensions mm		Mass kg
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
$145^{+0.068}_{+0.043}$	165	35	1.1	118 000	305 000	32 500	1 900	2 800	**RNA4826**	158.5	1	0.95
	170	32	1.5	111 000	238 000	25 600	1 900	2 800	**NK145/32**	162.5	1.5	1.12
	170	42	1.5	153 000	360 000	38 500	1 900	2 800	**NK145/42**	162.5	1.5	1.49
$150^{+0.068}_{+0.043}$	180	50	1.5	202 000	455 000	48 000	1 800	2 700	**RNA4926**	172	1.5	2.21
	180	67	1.5	296 000	690 000	73 000	1 800	2 700	**RNA5926**	172	1.5	3.21
$155^{+0.068}_{+0.043}$	175	35	1.1	121 000	315 000	33 500	1 700	2 600	**RNA4828**	168.5	1	1.02
	180	32	1.5	114 000	252 000	26 500	1 700	2 600	**NK155/32**	172	1.5	1.20
	180	42	1.5	156 000	380 000	40 000	1 700	2 600	**NK155/42**	172	1.5	1.59
$160^{+0.068}_{+0.043}$	190	50	1.5	209 000	485 000	50 500	1 700	2 500	**RNA4928**	182	1.5	2.35
	190	67	1.5	315 000	760 000	79 000	1 700	2 500	**RNA5928**	182	1.5	3.48
$165^{+0.068}_{+0.043}$	190	32	1.5	117 000	265 000	27 400	1 600	2 400	**NK165/32**	182	1.5	1.42
	190	40	1.1	152 000	390 000	40 500	1 600	2 400	**RNA4830**	183.5	1	1.60
	190	42	1.5	160 000	400 000	41 000	1 600	2 400	**NK165/42**	182	1.5	1.66
$170^{+0.068}_{+0.043}$	210	60	2	261 000	610 000	62 500	1 600	2 400	**RNA4930**	201	2	2.98
$175^{+0.068}_{+0.043}$	200	40	1.1	160 000	425 000	43 500	1 500	2 300	**RNA4832**	193.5	1	1.70
$180^{+0.068}_{+0.043}$	220	60	2	270 000	650 000	65 500	1 500	2 200	**RNA4932**	211	2	3.10
$185^{+0.079}_{+0.050}$	215	45	1.1	185 000	495 000	49 500	1 500	2 200	**RNA4834**	208.5	1	2.54
$190^{+0.079}_{+0.050}$	230	60	2	279 000	690 000	68 500	1 400	2 100	**RNA4934**	221	2	3.22
$195^{+0.079}_{+0.050}$	225	45	1.1	195 000	540 000	53 500	1 400	2 100	**RNA4836**	218.5	1	2.68
$205^{+0.079}_{+0.050}$	250	69	2	375 000	890 000	86 000	1 300	2 000	**RNA4936**	241	2	4.48
$210^{+0.079}_{+0.050}$	240	50	1.5	227 000	680 000	65 500	1 300	1 900	**RNA4838**	232	1.5	3.21
$215^{+0.079}_{+0.050}$	260	69	2	390 000	945 000	90 500	1 300	1 900	**RNA4938**	251	2	4.53
$220^{+0.079}_{+0.050}$	250	50	1.5	231 000	705 000	67 000	1 200	1 800	**RNA4840**	242	1.5	3.35
$225^{+0.079}_{+0.050}$	280	80	2.1	505 000	1 180 000	111 000	1 200	1 800	**RNA4940**	269	2	7.20
$240^{+0.079}_{+0.050}$	270	50	1.5	244 000	780 000	72 500	1 100	1 700	**RNA4844**	262	1.5	3.62
$245^{+0.079}_{+0.050}$	300	80	2.1	525 000	1 270 000	116 000	1 100	1 600	**RNA4944**	289	2	7.81

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.





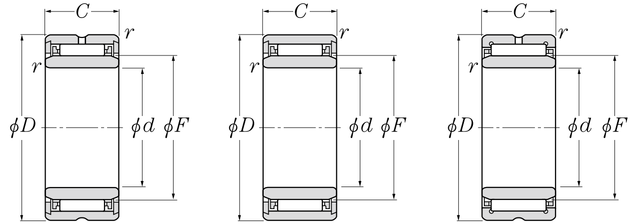
F_w 265～490mm

Boundary dimensions mm				Basic load rating N dynamic	static	Fatigue load limit N	Allowable speed min⁻¹		Number	Installation-related dimensions mm		Mass kg
F_w	D	C	$r_{s\,min}$ 1)	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication		D_a Max.	r_{as} 2) Max.	(approx.)
$265^{+0.088}_{+0.056}$	300	60	2	365 000	1 090 000	98 500	1 000	1 500	**RNA4848**	291	2	5.40
	320	80	2.1	540 000	1 350 000	121 000	1 000	1 500	**RNA4948**	309	2	8.40
$285^{+0.088}_{+0.056}$	320	60	2	375 000	1 170 000	103 000	950	1 400	**RNA4852**	311	2	5.80
$290^{+0.088}_{+0.056}$	360	100	2.1	810 000	1 920 000	166 000	950	1 400	**RNA4952**	349	2	15.9
$305^{+0.088}_{+0.056}$	350	69	2	455 000	1 300 000	112 000	850	1 300	**RNA4856**	341	2	9.30
$310^{+0.088}_{+0.056}$	380	100	2.1	840 000	2 050 000	175 000	850	1 300	**RNA4956**	369	2	16.7
$330^{+0.098}_{+0.062}$	380	80	2.1	625 000	1 770 000	149 000	800	1 200	**RNA4860**	369	2	12.7
$340^{+0.098}_{+0.062}$	420	118	3	1 080 000	2 640 000	219 000	800	1 200	**RNA4960**	407	2.5	24.0
$350^{+0.098}_{+0.062}$	400	80	2.1	640 000	1 850 000	153 000	750	1 100	**RNA4864**	389	2	13.4
$360^{+0.098}_{+0.062}$	440	118	3	1 120 000	2 820 000	230 000	750	1 100	**RNA4964**	427	2.5	25.2
$370^{+0.098}_{+0.062}$	420	80	2.1	655 000	1 940 000	158 000	750	1 100	**RNA4868**	409	2	14.0
$380^{+0.098}_{+0.062}$	460	118	3	1 160 000	3 000 000	242 000	750	1 100	**RNA4968**	447	2.5	26.5
$390^{+0.098}_{+0.062}$	440	80	2.1	665 000	2 020 000	162 000	650	1 000	**RNA4872**	429	2	14.8
$400^{+0.108}_{+0.068}$	480	118	3	1 200 000	3 200 000	253 000	650	1 000	**RNA4972**	467	2.5	28.2
$415^{+0.108}_{+0.068}$	480	100	2.1	1 000 000	2 840 000	223 000	650	950	**RNA4876**	469	2	26.0
$430^{+0.108}_{+0.068}$	520	140	4	1 400 000	3 750 000	292 000	650	950	**RNA4976**	504	3	38.6
$450^{+0.108}_{+0.068}$	540	140	4	1 450 000	4 000 000	306 000	600	900	**RNA4980**	524	3	40.1
$470^{+0.108}_{+0.068}$	560	140	4	1 500 000	4 250 000	320 000	550	850	**RNA4984**	544	3	51.6
$490^{+0.108}_{+0.068}$	600	160	4	1 750 000	4 600 000	342 000	550	800	**RNA4988**	584	3	66.9

1) Smallest allowable dimension for chamfer dimension r.
2) Largest allowable dimension for fillet radius r_a of housing and shaft.

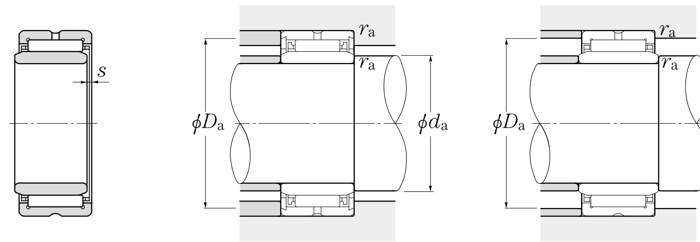
Machined-ring needle roller bearings
with an inner ring

NA49 type
NA59 type
NA69 type
NK+IR type



NA49 type (ϕd≦9mm) NK+IR type (ϕd≦9mm) NA49‥R type (ϕd≧10mm)
NA59 type
NA69‥R type
NK+IR type (ϕd≧10mm)

● Needle Roller Bearings NTN



d 5～17mm

Boundary dimensions (mm) d	D	C	$r_{s\,min}$ 1)	F	s 2)	Basic load rating dynamic (N) C_r	static C_{0r}	Fatigue load limit (N) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Number	Installation-related dimensions (mm) d_a Min.	D_a Max.	r_{as} 3) Max.	Mass kg (approx.)
5	13	10	0.15	7	—	2 670	2 350	287	23 000	34 000	**NA495T2**	6.2	8.5	0.15	0.007
	15	12	0.3	8	1.5	4 000	4 100	500	21 000	32 000	**NK8/12T2＋IR5×8×12**	7	9.5	0.3	0.012
	15	16	0.3	8	2	4 850	5 200	635	21 000	32 000	**NK8/16T2＋IR5×8×16**	7	9.5	0.3	0.016
6	15	10	0.15	8	—	3 150	3 000	365	21 000	32 000	**NA496T2T**	8	9.5	0.15	0.009
	16	12	0.3	9	1.5	4 550	5 000	615	20 000	30 000	**NK9/12T2＋IR6×9×12**	8	10.5	0.3	0.013
	16	16	0.3	9	2	5 500	6 400	780	20 000	30 000	**NK9/16T2＋IR6×9×16**	8	10.5	0.3	0.017
7	17	10	0.15	9	—	3 600	3 650	445	20 000	30 000	**NA497**	9	10.5	0.15	0.010
	17	12	0.3	10	1.5	4 550	5 100	620	19 000	28 000	**NK10/12T2＋IR7×10×12**	9	11.5	0.3	0.014
	17	16	0.3	10	2	5 450	6 450	790	19 000	28 000	**8E-NK10/16CT＋IR7×10×16**	9	11.5	0.3	0.018
8	19	11	0.15	10	—	5 250	5 150	630	19 000	28 000	**NA498CT**	10	12	0.15	0.016
9	19	12	0.3	12	1.5	5 000	6 100	740	17 000	26 000	**NK12/12＋IR9×12×12**	11	13.5	0.3	0.018
	19	16	0.3	12	2	6 000	7 700	940	17 000	26 000	**NK12/16＋IR9×12×16**	11	13.5	0.3	0.022
	20	11	0.3	12	—	4 850	4 900	595	17 000	26 000	**NA499**	11	14	0.3	0.017
10	22	13	0.3	14	0.5	8 600	9 200	1 120	16 000	24 000	**NA4900R**	12	20	0.3	0.024
	22	16	0.3	14	0.5	10 300	11 500	1 400	16 000	24 000	**NK14/16RCT＋IR10×14×16**	12	20	0.3	0.030
	22	20	0.3	14	0.5	13 000	15 600	1 900	16 000	24 000	**NK14/20R＋IR10×14×20**	12	20	0.3	0.038
12	24	13	0.3	16	0.5	9 550	10 900	1 330	15 000	23 000	**NA4901R**	14	22	0.3	0.026
	24	16	0.3	16	0.5	12 200	14 900	1 820	15 000	23 000	**NK16/16R＋IR12×16×16**	14	22	0.3	0.033
	24	20	0.3	16	0.5	14 600	18 800	2 290	15 000	23 000	**NK16/20R＋IR12×16×20**	14	22	0.3	0.042
	24	22	0.3	16	1	15 400	20 000	2 440	15 000	23 000	**NA6901R**	14	22	0.3	0.046
15	27	16	0.3	19	0.5	13 300	17 400	2 120	14 000	21 000	**NK19/16R＋IR15×19×16**	17	25	0.3	0.039
	27	20	0.3	19	0.5	16 000	22 200	2 700	14 000	21 000	**NK19/20R＋IR15×19×20**	17	25	0.3	0.045
	28	13	0.3	20	0.5	10 300	12 800	1 560	13 000	20 000	**NA4902R**	17	26	0.3	0.036
	28	18	0.3	20	0.5	14 100	19 100	2 330	13 000	20 000	**NA5902CT**	17	26	0.3	0.052
	28	23	0.3	20	1	17 600	25 300	3 100	13 000	20 000	**NA6902R**	17	26	0.3	0.064
17	29	16	0.3	21	0.5	13 700	18 700	2 280	13 000	19 000	**NK21/16R＋IR17×21×16**	19	27	0.3	0.042
	29	20	0.3	21	0.5	17 400	25 400	3 100	13 000	19 000	**NK21/20R＋IR17×21×20**	19	27	0.3	0.053
	30	13	0.3	22	0.5	11 200	14 600	1 780	12 000	18 000	**NA4903R**	19	28	0.3	0.037

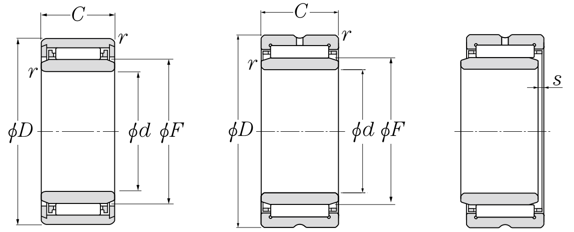
1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

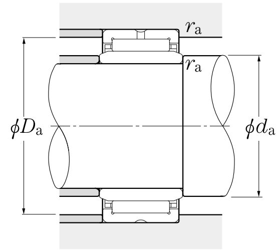
Needle Roller Bearings NTN

Machined-ring needle roller bearings with an inner ring

NA49 type
NA59 type
NA69 type
NK+IR type



NA49··R type
NA59 type
NA69··R type
NK··R+IR type



d 17～32mm

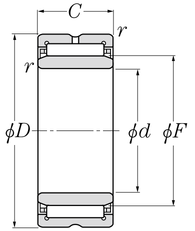
Boundary dimensions (mm)						Basic load rating (N)		Fatigue load limit (N)	Allowable speed (min⁻¹)		Number	Installation-related dimensions (mm)			Mass (kg)
d	D	C	$r_{s\,min}$ 1)	F	s 2)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication		d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
17	30	18	0.3	22	0.5	15 200	21 700	2 650	12 000	18 000	**NA5903**	19	28	0.3	0.056
	30	23	0.3	22	1	18 200	27 200	3 300	12 000	18 000	**NA6903R**	19	28	0.3	0.069
20	32	16	0.3	24	0.5	15 200	22 300	2 720	11 000	17 000	**NK24/16R+IR20×24×16**	22	30	0.3	0.049
	32	20	0.3	24	0.5	18 600	28 800	3 500	11 000	17 000	**NK24/20R+IR20×24×20**	22	30	0.3	0.061
	37	17	0.3	25	0.8	21 300	25 500	3 100	11 000	16 000	**NA4904RCT**	22	35	0.3	0.074
	37	23	0.3	25	0.8	28 400	37 000	4 500	11 000	16 000	**NA5904**	22	35	0.3	0.115
	37	30	0.3	25	1	36 500	50 500	6 150	11 000	16 000	**NA6904R**	22	35	0.3	0.141
22	34	16	0.3	26	0.5	15 600	23 600	2 880	10 000	15 000	**8E-NK26/16RCT+IR22×26×16**	24	32	0.3	0.046
	34	20	0.3	26	0.5	19 100	30 500	3 700	10 000	15 000	**NK26/20R+IR22×26×20**	24	32	0.3	0.064
	39	17	0.3	28	0.8	23 200	29 300	3 600	9 500	14 000	**NA49/22R**	24	37	0.3	0.080
	39	23	0.3	28	0.8	26 400	37 500	4 600	9 500	14 000	**NA59/22**	24	37	0.3	0.134
	39	30	0.3	28	0.5	40 000	58 500	7 150	9 500	14 000	**NA69/22R**	24	37	0.3	0.154
25	38	20	0.3	29	1	22 200	34 000	4 150	9 500	14 000	**NK29/20R+IR25×29×20**	27	36	0.3	0.079
	38	30	0.3	29	1.5	27 500	50 500	6 150	9 500	14 000	**NK29/30R+IR25×29×30**	27	36	0.3	0.123
	42	17	0.3	30	0.8	24 000	31 500	3 800	8 500	13 000	**NA4905R**	27	40	0.3	0.088
	42	23	0.3	30	0.8	30 500	43 000	5 200	8 500	13 000	**NA5905**	27	40	0.3	0.139
	42	30	0.3	30	1	41 500	63 000	7 650	8 500	13 000	**NA6905R**	27	40	0.3	0.162
28	42	20	0.3	32	1	23 500	37 500	4 600	8 500	13 000	**NK32/20R+IR28×32×20**	30	40	0.3	0.096
	42	30	0.3	32	1.5	34 000	60 500	7 350	8 500	13 000	**NK32/30R+IR28×32×30**	30	40	0.3	0.146
	45	17	0.3	32	0.8	24 800	33 500	4 050	8 500	13 000	**NA49/28RCT**	30	43	0.3	0.098
	45	23	0.3	32	0.8	32 000	45 500	5 550	8 500	13 000	**NA59/28**	30	43	0.3	0.142
	45	30	0.3	32	1	43 000	67 000	8 150	8 500	13 000	**NA69/28R**	30	43	0.3	0.179
30	45	20	0.3	35	0.5	24 800	41 500	5 050	7 500	11 000	**NK35/20RCT+IR30×35×20**	32	43	0.3	0.112
	45	30	0.3	35	1	36 000	66 500	8 100	7 500	11 000	**NK35/30R+IR30×35×30**	32	43	0.3	0.171
	47	17	0.3	35	0.8	25 500	35 500	4 300	7 500	11 000	**NA4906R**	32	45	0.3	0.101
	47	23	0.3	35	0.8	32 500	48 500	5 950	7 500	11 000	**NA5906**	32	45	0.3	0.152
	47	30	0.3	35	1	42 500	67 500	8 250	7 500	11 000	**NA6906R**	32	45	0.3	0.185
32	47	20	0.3	37	0.5	25 300	43 500	5 300	7 500	11 000	**NK37/20R+IR32×37×20**	34	45	0.3	0.117
	47	30	0.3	37	1	36 500	69 500	8 500	7 500	11 000	**NK37/30R+IR32×37×30**	34	45	0.3	0.170
	52	20	0.6	40	0.8	31 500	47 500	5 800	6 500	10 000	**NA49/32R**	36	48	0.6	0.157

1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

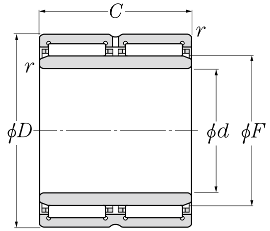
Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

Machined-ring needle roller bearings
with an inner ring

NA49 type
NA59 type
NA69 type
NK+IR type

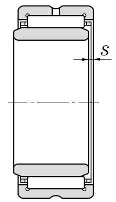


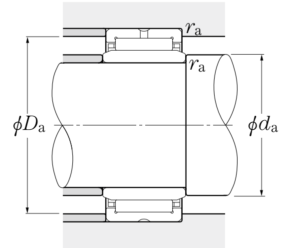
NA49··R type
NA59 type
NA69··R type (ϕd≦30mm)
NK··R+IR type

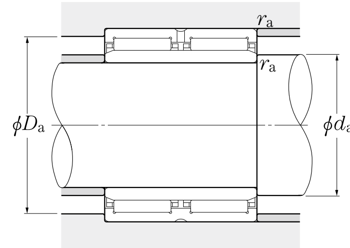


NA69··R type
(ϕd≧32mm)

Needle Roller Bearings NTN







d 32～55mm

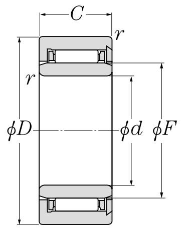
Boundary dimensions mm						Basic load rating N		Fatigue load limit N	Allowable speed min⁻¹		Number	Installation-related dimensions mm			Mass kg
						dynamic	static		Grease lubrication	Oil lubrication					
d	D	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{0r}	C_u				d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
32	52	27	0.6	40	0.8	38 000	61 000	7 450	6 500	10 000	**NA59/32**	36	48	0.6	0.241
	52	36	0.6	40	0.5	47 500	82 000	10 000	6 500	10 000	**NA69/32R**	36	48	0.6	0.286
35	50	20	0.3	40	0.5	26 400	47 000	5 750	6 500	10 000	**NK40/20R＋IR35×40×20**	37	48	0.3	0.130
	50	30	0.3	40	1	38 500	76 000	9 250	6 500	10 000	**NK40/30R＋IR35×40×30**	37	48	0.3	0.193
	55	20	0.6	42	0.8	32 000	50 000	6 100	6 500	9 500	**NA4907R**	39	51	0.6	0.171
	55	27	0.6	42	0.8	39 000	64 500	7 850	6 500	9 500	**NA5907**	39	51	0.6	0.256
	55	36	0.6	42	0.5	49 000	86 500	10 500	6 500	9 500	**NA6907R**	39	51	0.6	0.310
38	53	20	0.3	43	0.5	27 500	51 000	6 200	6 500	9 500	**NK43/20R＋IR38×43×20**	40	51	0.3	0.134
	53	30	0.3	43	1	40 000	82 000	10 000	6 500	9 500	**NK43/30R＋IR38×43×30**	40	51	0.3	0.207
40	55	20	0.3	45	0.5	28 000	52 500	6 450	6 000	9 000	**NK45/20R＋IR40×45×20**	42	53	0.3	0.143
	55	30	0.3	45	1	41 000	85 500	10 400	6 000	9 000	**NK45/30RCT＋IR40×45×30**	42	53	0.3	0.216
	62	22	0.6	48	1	43 500	66 500	8 150	5 500	8 500	**NA4908R**	44	58	0.6	0.232
	62	30	0.6	48	1	53 000	92 500	11 300	5 500	8 500	**NA5908**	44	58	0.6	0.348
	62	40	0.6	48	0.5	67 000	116 000	14 100	5 500	8 500	**NA6908R**	44	58	0.6	0.426
42	57	20	0.3	47	0.5	28 800	55 500	6 800	5 500	8 500	**NK47/20RCT＋IR42×47×20**	44	55	0.3	0.148
	57	30	0.3	47	1	42 500	91 500	11 200	5 500	8 500	**NK47/30R＋IR42×47×30**	44	55	0.3	0.222
45	62	25	0.6	50	1.5	38 500	74 500	9 050	5 500	8 000	**NK50/25RCT＋IR45×50×25**	48	58	0.6	0.229
	62	35	0.6	50	2	51 000	106 000	12 900	5 500	8 000	**NK50/35R＋IR45×50×35**	48	58	0.6	0.322
	68	22	0.6	52	1	46 000	73 000	8 950	5 000	7 500	**NA4909R**	49	64	0.6	0.270
	68	30	0.6	52	1	56 000	101 000	12 300	5 000	7 500	**NA5909**	49	64	0.6	0.396
	68	40	0.6	52	0.5	70 500	127 000	15 500	5 000	7 500	**NA6909R**	49	64	0.6	0.437
50	68	25	0.6	55	1.5	41 000	82 000	10 000	5 000	7 500	**NK55/25R＋IR50×55×25**	53	64	0.6	0.271
	68	35	0.6	55	2	54 000	118 000	14 300	5 000	7 500	**NK55/35R＋IR50×55×35**	53	64	0.6	0.379
	72	22	0.6	58	1	48 000	80 000	9 750	4 700	7 000	**NA4910R**	54	68	0.6	0.276
	72	30	0.6	58	1	58 000	110 000	13 400	4 700	7 000	**NA5910**	54	68	0.6	0.498
	72	40	0.6	58	0.5	74 000	139 000	17 000	4 700	7 000	**NA6910R**	54	68	0.6	0.529
55	72	25	0.6	60	1.5	41 000	85 000	10 400	4 300	6 500	**NK60/25R＋IR55×60×25**	58	68	0.6	0.271
	72	35	0.6	60	2	57 000	130 000	15 800	4 300	6 500	**NK60/35R＋IR55×60×35**	58	68	0.6	0.379
	80	25	1	63	1.5	58 500	99 500	12 100	4 300	6 500	**NA4911R**	60	75	1	0.396

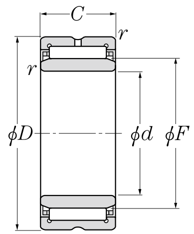
1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

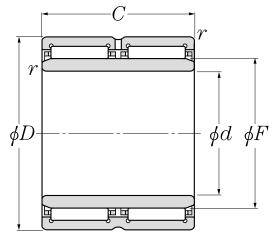
Machined-ring needle roller bearings with an inner ring

NA49 type
NA59 type
NA69 type
NK+IR type

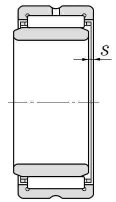


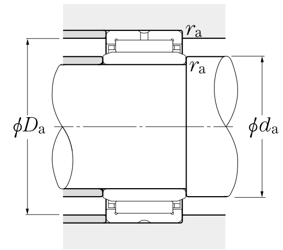


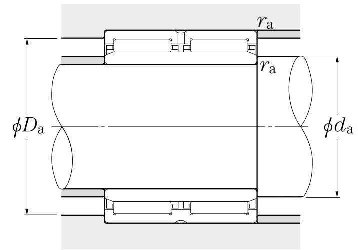
NA49··R type
NA59 type
NK··R+IR type



NA69··R type







d 55～85mm

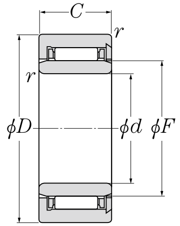
Boundary dimensions mm						Basic load rating N		Fatigue load limit N	Allowable speed min⁻¹		Number	Installation-related dimensions mm			Mass kg
						dynamic	static		Grease lubrication	Oil lubrication					
d	D	C	$r_{s\,min}$ 1)	F	s 2)	C_r	C_{0r}	C_u				d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
55	80	34	1	63	1.5	76 500	140 000	17 100	4 300	6 500	**NA5911**	60	75	1	0.559
	80	45	1	63	1.5	94 000	183 000	22 300	4 300	6 500	**NA6911R**	60	75	1	0.726
60	82	25	1	68	1	44 500	89 000	10 800	4 000	6 000	**NK68/25R+IR60×68×25**	65	77	0.6	0.393
	82	35	0.6	68	1	63 000	139 000	17 000	4 000	6 000	**NK68/35R+IR60×68×35**	64	78	0.6	0.551
	85	25	1	68	1.5	61 500	108 000	13 100	4 000	6 000	**NA4912R**	65	80	1	0.427
	85	34	1	68	1.5	80 500	153 000	18 600	4 000	6 000	**NA5912**	65	80	1	0.614
	85	45	1	68	1.5	95 500	191 000	23 200	4 000	6 000	**NA6912R**	65	80	1	0.758
65	90	25	0.6	73	1	54 000	100 000	12 200	3 700	5 500	**NK73/25R+IR65×73×25**	69	86	0.6	0.466
	90	25	1	72	1.5	62 500	112 000	13 700	3 700	5 500	**NA4913R**	70	85	1	0.454
	90	34	1	72	1.5	84 000	165 000	20 100	3 700	5 500	**NA5913**	70	85	1	0.655
	90	35	0.6	73	1	76 500	156 000	19 100	3 700	5 500	**NK73/35R+IR65×73×35**	69	86	0.6	0.660
	90	45	1	72	1.5	97 000	198 000	24 200	3 700	5 500	**NA6913R**	70	85	1	0.779
70	95	25	1	80	0.8	57 000	119 000	14 500	3 300	5 000	**NK80/25R+IR70×80×25**	75	90	1	0.525
	95	35	1	80	0.8	79 500	184 000	22 400	3 300	5 000	**NK80/35R+IR70×80×35**	75	90	1	0.738
	100	30	1	80	1.5	85 500	156 000	19 000	3 300	5 000	**NA4914R**	75	95	1	0.727
	100	40	1	80	1.5	103 000	187 000	22 800	3 300	5 000	**NA5914**	75	95	1	1.06
	100	54	1	80	1	130 000	267 000	32 500	3 300	5 000	**NA6914R**	75	95	1	1.34
75	105	25	1	85	1	70 500	123 000	15 000	3 100	4 700	**NK85/25R+IR75×85×25**	80	100	1	0.642
	105	30	1	85	1.5	87 000	162 000	19 700	3 100	4 700	**NA4915R**	80	100	1	0.776
	105	35	1	85	1	100 000	193 000	23 600	3 100	4 700	**NK85/35R+IR75×85×35**	80	100	1	0.853
	105	40	1	85	1.5	109 000	205 000	25 000	3 100	4 700	**NA5915**	80	100	1	1.13
	105	54	1	85	1	132 000	277 000	34 000	3 100	4 700	**NA6915R**	80	100	1	1.45
80	110	25	1	90	1	71 500	128 000	15 600	2 900	4 400	**NK90/25R+IR80×90×25**	85	105	1	0.680
	110	30	1	90	1.5	90 500	174 000	21 200	2 900	4 400	**NA4916R**	85	105	1	0.820
	110	35	1	90	1	104 000	208 000	25 400	2 900	4 400	**NK90/35R+IR80×90×35**	85	105	1	0.959
	110	40	1	90	1.5	115 000	223 000	27 200	2 900	4 400	**NA5916**	85	105	1	1.15
	110	54	1	90	1.5	138 000	298 000	36 500	2 900	4 400	**NA6916R**	85	105	1	1.53
85	115	26	1	95	1.5	74 500	137 000	16 600	2 800	4 200	**NK95/26R+IR85×95×26**	90	110	1	0.644
	115	36	1	95	1.5	108 000	223 000	27 000	2 800	4 200	**NK95/36R+IR85×95×36**	90	110	1	1.05

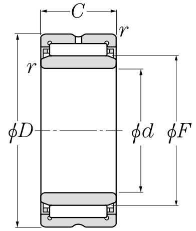
1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

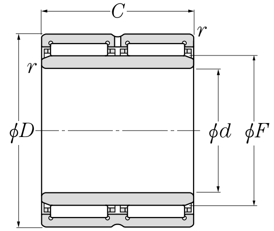
Machined-ring needle roller bearings with an inner ring

NA48 type
NA49 type
NA59 type
NA69 type
NK+IR type



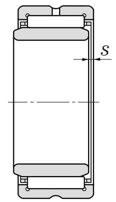


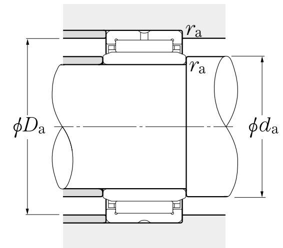
NA49··R type
NA59 type
NK··R+IR type

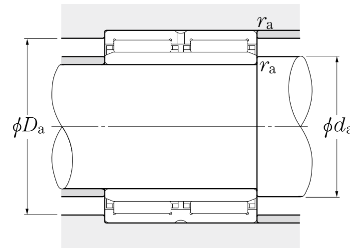


NA69··R type

Needle Roller Bearings NTN







d 85～130mm

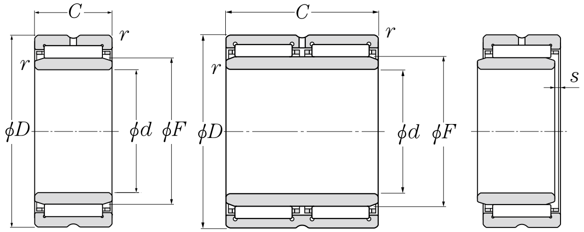
Boundary dimensions (mm)						Basic load rating (N)		Fatigue load limit (N)	Allowable speed (min⁻¹)		Number	Installation-related dimensions (mm)			Mass (kg)
d	D	C	$r_{s\,min}$ 1)	F	s 2)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication		d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
85	120	35	1.1	100	1	112 000	237 000	28 400	2 700	4 000	**NA4917R**	91.5	113.5	1	1.24
	120	46	1.1	100	1.5	137 000	290 000	34 500	2 700	4 000	**NA5917**	91.5	113.5	1	1.76
	120	63	1.1	100	1	169 000	400 000	48 000	2 700	4 000	**NA6917R**	91.5	104	1.1	2.25
90	120	26	1	100	1.5	73 500	137 000	16 400	2 700	4 000	**NK100/26R＋IR90×100×26**	95	115	1	0.781
	120	36	1	100	1.5	107 000	223 000	26 700	2 700	4 000	**NK100/36R＋IR90×100×36**	95	115	1	1.09
	125	35	1.1	105	1	116 000	252 000	29 800	2 500	3 800	**NA4918R**	96.5	118.5	1	1.84
	125	46	1.1	105	1	143 000	310 000	37 000	2 500	3 800	**NA5918**	96.5	118.5	1	2.44
	125	63	1.1	105	1	175 000	425 000	50 500	2 500	3 800	**NA6918R**	96.5	109	1.1	2.37
95	125	26	1	105	1.5	76 500	147 000	17 300	2 500	3 800	**NK105/26R＋IR95×105×26**	100	120	1	0.819
	125	36	1	105	1.5	111 000	238 000	28 100	2 500	3 800	**NK105/36R＋IR95×105×36**	100	120	1	1.15
	130	35	1.1	110	1	118 000	260 000	30 500	2 400	3 600	**NA4919R**	101.5	123.5	1	1.36
	130	46	1.1	110	1	149 000	335 000	39 000	2 400	3 600	**NA5919**	101.5	123.5	1	1.98
	130	63	1.1	110	1	177 000	440 000	51 000	2 400	3 600	**NA6919R**	101.5	123.5	1	2.63
100	130	30	1.1	110	1.5	97 500	204 000	23 800	2 400	3 600	**NK110/30R＋IR100×110×30**	106.5	123.5	1	0.990
	130	40	1.1	110	2	129 000	292 000	34 000	2 400	3 600	**NK110/40R＋IR100×110×40**	106.5	123.5	1	1.34
	140	40	1.1	115	2	127 000	260 000	29 900	2 300	3 500	**NA4920**	106.5	133.5	1	1.93
	140	54	1.1	115	2	182 000	395 000	45 500	2 300	3 500	**NA5920**	106.5	133.5	1	2.85
110	140	30	1	120	0.8	95 000	214 000	24 400	2 200	3 300	**NA4822**	115	135	1	1.11
	140	40	1.1	120	—	114 000	271 000	31 000	2 200	3 300	**NK120/40＋IR110×120×40**	116.5	133.5	1	1.49
	150	40	1.1	125	2	131 000	279 000	31 500	2 100	3 200	**NA4922**	116.5	143.5	1	2.08
	150	54	1.1	125	2	193 000	440 000	49 500	2 100	3 200	**NA5922**	116.5	143.5	1	2.98
120	150	30	1	130	0.8	101 000	237 000	26 400	2 100	3 100	**NA4824**	125	145	1	1.17
	150	40	1.1	130	—	117 000	287 000	32 000	2 100	3 100	**NK130/40＋IR120×130×40**	126.5	143.5	1	1.57
	165	45	1.1	135	2	180 000	380 000	41 500	2 000	3 000	**NA4924**	126.5	158.5	1	2.84
	165	60	1.1	135	2	246 000	530 000	57 500	2 000	3 000	**NA5924**	126.5	158.5	1	3.92
130	165	35	1.1	145	1	120 000	310 000	33 000	1 900	2 800	**NA4826**	136.5	158.5	1	1.60
	170	32	1.5	145	—	111 000	238 000	25 600	1 900	2 800	**NK145/32＋IR130×145×32**	138	162.5	1.5	1.90
	170	42	1.5	145	—	153 000	360 000	38 500	1 900	2 800	**NK145/42＋IR130×145×42**	138	162.5	1.5	2.54
	180	50	1.5	150	1.5	202 000	455 000	48 000	1 800	2 700	**NA4926**	138	172	1.5	3.90
	180	67	1.5	150	1.5	296 000	690 000	73 000	1 800	2 700	**NA5926**	138	172	1.5	5.60

1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

Machined-ring needle roller bearings
with an inner ring

NA48 type
NA49 type
NA59 type
NA69 type
NK+IR type



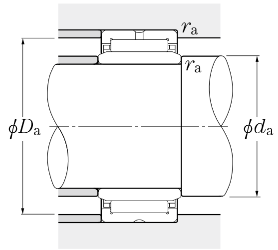
NA48 type
NA49···R type, NA49 type
NA59 type
NK···R+IR type, NK+IR type
NKS+IR type ($\phi d \geqq$ 100mm)

NA69···R type

d 140 ～ 280mm

Boundary dimensions (mm)						Basic load rating (N)		Fatigue load limit (N)	Allowable speed (min⁻¹)		Number
d	D	C	$r_{s\,min}$ 1)	F	s 2)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	
140	175	35	1.1	155	1	121 000	315 000	33 500	1 700	2 600	**NA4828**
	180	32	1.5	155	—	114 000	252 000	26 500	1 700	2 600	**NK155/32＋IR140×155×32**
	180	42	1.5	155	—	156 000	380 000	40 000	1 700	2 600	**NK155/42＋IR140×155×42**
	190	50	1.5	160	1.5	209 000	485 000	50 500	1 700	2 500	**NA4928**
	190	67	1.5	160	1.5	315 000	760 000	79 000	1 700	2 500	**NA5928**
150	190	32	1.5	165	—	117 000	265 000	27 500	1 600	2 400	**NK165/32＋IR150×165×32**
	190	40	1.1	165	1.5	152 000	390 000	40 500	1 600	2 400	**NA4830**
	190	42	1.5	165	—	160 000	400 000	41 000	1 600	2 400	**NK165/42＋IR150×165×42**
	210	60	2	170	1.5	261 000	610 000	62 500	1 600	2 400	**NA4930**
160	200	40	1.1	175	1.5	160 000	425 000	43 500	1 500	2 300	**NA4832**
	220	60	2	180	1.5	270 000	650 000	65 500	1 500	2 200	**NA4932**
170	215	45	1.1	185	1.5	185 000	495 000	49 500	1 500	2 200	**NA4834**
	230	60	2	190	1.5	279 000	690 000	68 500	1 400	2 100	**NA4934**
180	225	45	1.1	195	1.5	195 000	540 000	53 500	1 400	2 100	**NA4836**
	250	69	2	205	1.5	375 000	890 000	86 000	1 300	2 000	**NA4936**
190	240	50	1.5	210	1.5	227 000	680 000	65 500	1 300	1 900	**NA4838**
	260	69	2	215	1.5	390 000	945 000	90 500	1 300	1 900	**NA4938**
200	250	50	1.5	220	1.5	231 000	705 000	67 000	1 200	1 800	**NA4840**
	280	80	2.1	225	1.5	505 000	1 180 000	111 000	1 200	1 800	**NA4940**
220	270	50	1.5	240	1.5	244 000	780 000	72 500	1 100	1 700	**NA4844**
	300	80	2.1	245	1.5	525 000	1 270 000	116 000	1 100	1 600	**NA4944**
240	300	60	2	265	2	365 000	1 090 000	98 500	1 000	1 500	**NA4848**
	320	80	2.1	265	2	540 000	1 350 000	121 000	1 000	1 500	**NA4948**
260	320	60	2	285	2	375 000	1 170 000	103 000	950	1 400	**NA4852**
	360	100	2.1	290	2	810 000	1 920 000	166 000	950	1 400	**NA4952**
280	350	69	2	305	2.5	455 000	1 300 000	112 000	850	1 300	**NA4856**
	380	100	2.1	310	2.5	840 000	2 050 000	175 000	850	1 300	**NA4956**

1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

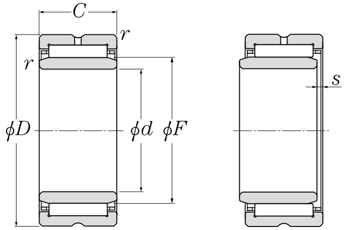


Installation-related dimensions (mm)			Mass (kg)
d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
146.5	168.5	1	1.82
148	172	1.5	2.04
148	172	1.5	2.69
148	182	1.5	4.05
148	182	1.5	6.18
158	182	1.5	2.32
156.5	183.5	1	2.72
158	182	1.5	2.84
159	201	2	5.33
166.5	193.5	1	2.90
169	211	2	5.60
176.5	208.5	1	3.99
179	221	2	5.87
186.5	218.5	1	4.19
189	241	2	8.58
198	232	1.5	5.62
199	251	2	8.68
208	242	1.5	5.84
211	269	2	12.2
228	262	1.5	6.37
231	289	2	13.5
249	291	2	10.0
251	309	2	14.7
269	311	2	10.8
271	349	2	25.9
289	341	2	15.5
291	369	2	27.5

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

Machined-ring needle roller bearings with an inner ring

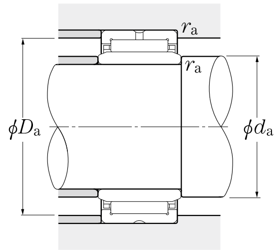
NA48 type
NA49 type
NA59 type
NK+IR type



d 300 ～ 440mm

Boundary dimensions mm						Basic load rating N		Fatigue load limit N	Allowable speed min⁻¹		Number
d	D	C	$r_{s\,min}$ 1)	F	s 2)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	
300	380	80	2.1	330	2	625 000	1 770 000	149 000	800	1 200	**NA4860**
	420	118	3	340	2	1 080 000	2 640 000	219 000	800	1 200	**NA4960**
320	400	80	2.1	350	2	640 000	1 850 000	153 000	750	1 100	**NA4864**
	440	118	3	360	2	1 120 000	2 820 000	230 000	750	1 100	**NA4964**
340	420	80	2.1	370	2	655 000	1 940 000	158 000	750	1 100	**NA4868**
	460	118	3	380	2	1 160 000	3 000 000	242 000	750	1 100	**NA4968**
360	440	80	2.1	390	2	665 000	2 020 000	162 000	650	1 000	**NA4872**
	480	118	3	400	2	1 200 000	3 200 000	253 000	650	1 000	**NA4972**
380	480	100	2.1	415	2	1 000 000	2 840 000	223 000	650	950	**NA4876**
	520	140	4	430	2	1 400 000	3 750 000	292 000	650	950	**NA4976**
400	540	140	4	450	2.5	1 450 000	4 000 000	305 000	600	900	**NA4980**
420	560	140	4	470	2.5	1 500 000	4 250 000	320 000	550	850	**NA4984**
440	600	160	4	490	2.5	1 750 000	4 600 000	340 000	550	800	**NA4988**

1) Smallest allowable dimension for chamfer dimension r.
2) Allowable axial movement amount of the inner ring with respect to the outer ring.
3) Largest allowable dimension for fillet radius r_a of housing and shaft.

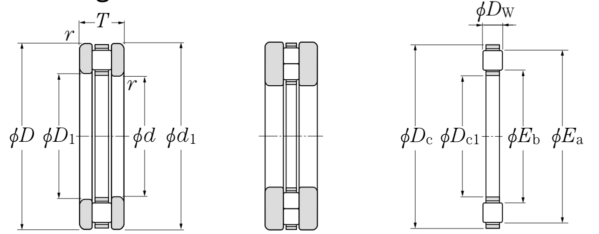


Installation-related dimensions mm			Mass kg
d_a Min.	D_a Max.	r_{as} 3) Max.	(approx.)
311	369	2	22.0
313	407	2.5	42.5
331	389	2	23.2
333	427	2.5	45.2
351	409	2	24.1
353	447	2.5	47.3
371	429	2	25.7
373	467	2.5	49.0
391	469	2	44.5
396	504	3	73.6
416	524	3	76.6
436	544	3	89.8
456	584	3	123

Note: The number of inner rings (IR) is composed of the IR inner diameter dimension × outer diameter dimension × width dimension.

Thrust cylindrical roller bearings

811 type
812 type
893 type



811 type
812 type
(Bearing)

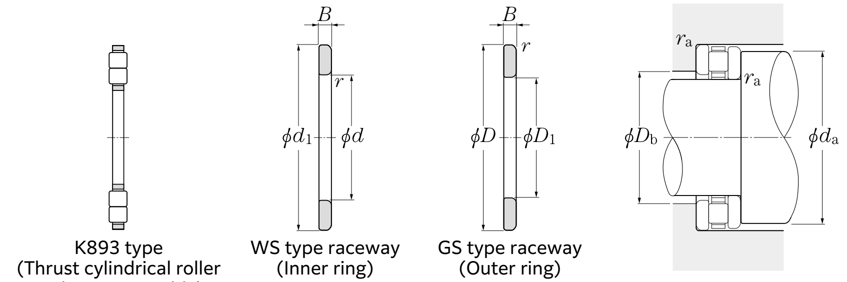
893 type
(Bearing)

K811 type, K812 type
(Thrust cylindrical roller
and cage assembly)

d 10 ～ 60mm

Boundary dimensions (mm)										Basic load rating (N)		Fatigue load limit (N)	Allowable speed (min⁻¹)	
d	D	d_1	D_1	T	D_{c1} 2) E11	D_c a13	D_w 0 / −0.010	B h11	$r_{s\,min}$ 1)	dynamic C_a	static C_{0a}	C_u	Grease lubrication	Oil lubrication
10	24	24	10	9	10	24	3.5	2.75	0.3	10 300	20 100	2 450	3 400	13 000
12	26	26	12	9	12	26	3.5	2.75	0.3	10 900	22 300	2 720	3 000	12 000
15	28	28	16	9	15	28	3.5	2.75	0.3	12 200	26 800	3 250	2 800	11 000
17	30	30	18	9	17	30	3.5	2.75	0.3	12 700	29 000	3 550	2 500	10 000
20	35	35	21	10	20	35	4.5	2.75	0.3	20 200	46 500	5 650	2 100	8 500
25	42	42	26	11	25	42	5	3	0.6	27 300	68 000	8 250	1 800	7 000
30	47	47	32	11	30	47	5	3	0.6	27 800	72 500	8 850	1 500	6 000
	52	52	32	16	30	52	7.5	4.25	0.6	53 000	129 000	15 700	1 500	6 000
	60	60	32	18	30	60	5.5	6.25	1	54 000	166 000	20 200	1 300	5 000
35	52	52	37	12	35	52	5	3.5	0.6	31 000	87 000	10 600	1 400	5 500
	62	62	37	18	35	62	7.5	5.25	1	54 500	139 000	17 000	1 200	4 900
	68	68	37	20	35	68	6	7	1	66 500	214 000	26 100	1 200	4 600
40	60	60	42	13	40	60	6	3.5	0.6	43 000	121 000	14 800	1 200	4 800
	68	68	42	19	40	68	9	5	1	74 500	190 000	23 200	1 100	4 400
	78	78	42	22	40	78	7	7.5	1	85 000	277 000	34 000	1 000	4 000
45	65	65	47	14	45	65	6	4	0.6	45 500	135 000	16 500	1 100	4 400
	73	73	47	20	45	73	9	5.5	1	82 000	222 000	27 000	1 000	4 100
	85	85	47	24	45	85	7.5	8.25	1	102 000	345 000	42 000	900	3 600
50	70	70	52	14	50	70	6	4	0.6	48 500	150 000	18 300	1 000	4 000
	78	78	52	22	50	78	9	6.5	1	85 000	238 000	29 000	950	3 800
	95	95	52	27	50	95	8	9.5	1.1	125 000	445 000	54 000	800	3 200
55	78	78	57	16	55	78	6	5	0.6	62 500	215 000	26 200	900	3 600
	90	90	57	25	55	90	11	7	1	121 000	340 000	41 500	830	3 300
	105	105	57	30	55	105	9	10.5	1.1	158 000	570 000	69 500	730	2 900
60	85	85	62	17	60	85	7.5	4.75	1	69 000	215 000	26 200	830	3 300
	95	95	62	26	60	95	11	7.5	1	126 000	365 000	44 500	780	3 100
	110	110	62	30	60	110	9	10.5	1.1	162 000	600 000	73 500	680	2 700

1) Smallest allowable dimension for chamfer dimension r.
2) The tolerance of bearings with suffix code T2 is E12.



K893 type
(Thrust cylindrical roller
and cage assembly)

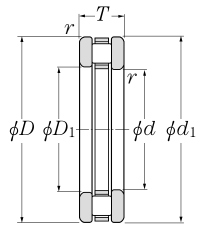
WS type raceway
(Inner ring)

GS type raceway
(Outer ring)

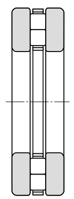
Number				Approx. dimension (mm)		Installation-related dimensions (mm)			Mass kg (approx.)			
Bearing	Thrust cylindrical roller and cage assembly	Inner ring	Outer ring	E_b	E_a	d_a Min.	D_b Max.	r_{as} Max.	811	K811 K812 K893	WS811 WS812 WS893	GS811 GS812 GS893
81100T2	K81100T2	WS81100	GS81100	13.5	21.3	21	14	0.3	0.020	0.0035	0.0081	0.0081
81101T2	K81101T2	WS81101	GS81101	15.5	23.3	23	16	0.3	0.022	0.0040	0.0090	0.0090
81102T2	K81102T2	WS81102	GS81102	17.2	25	25	18	0.3	0.024	0.0060	0.0095	0.0090
81103T2	K81103T2	WS81103	GS81103	19.2	27	27	20	0.3	0.028	0.0080	0.010	0.010
81104T2	K81104T2	WS81104	GS81104	22.4	32.3	32	23	0.3	0.039	0.012	0.014	0.013
81105T2	K81105T2	WS81105	GS81105	27.6	38.7	39	28	0.6	0.059	0.018	0.021	0.020
81106T2	K81106T2	WS81106	GS81106	33.1	43.9	44	33	0.6	0.066	0.020	0.024	0.022
81206T2	K81206T2	WS81206	GS81206	32.8	49	48	33	0.6	0.141	0.050	0.047	0.044
89306	K89306	WS89306	GS89306	34	56.4	56	34	1	0.249	0.046	0.104	0.099
81107T2	K81107T2	WS81107	GS81107	38	48.9	49	38	0.6	0.085	0.024	0.032	0.029
81207T2	K81207T2	WS81207	GS81207	39.8	56	56	41	1	0.230	0.065	0.085	0.080
89307	K89307	WS89307	GS89307	40	64.4	64	40	1	0.351	0.064	0.147	0.140
81108T2	K81108T2	WS81108	GS81108	43.2	56.4	56	44	0.6	0.118	0.035	0.043	0.040
81208T2	K81208T2	WS81208	GS81208	43.7	62.9	63	44	1	0.266	0.085	0.093	0.088
89308	K89308	WS89308	GS89308	46	74.4	74	46	1	0.507	0.100	0.207	0.200
81109T2	K81109T2	WS81109	GS81109	48.4	61.6	61	49	0.6	0.144	0.040	0.054	0.050
81209T2	K81209T2	WS81209	GS81209	48.8	68	68	49	1	0.318	0.100	0.112	0.106
89309	K89309	WS89309	GS89309	50.9	81.3	81	51	1	0.660	0.140	0.264	0.255
81110T2	K81110T2	WS81110	GS81110	53.2	66.4	66	54	0.6	0.158	0.045	0.059	0.054
81210T2	K81210T2	WS81210	GS81210	53.7	73.1	73	54	1	0.384	0.105	0.144	0.135
89310	K89310	WS89310	GS89310	58	90.4	90	58	1	0.932	0.180	0.382	0.370
81111T2	K81111T2	WS81111	GS81111	57.8	75.2	75	58	0.6	0.242	0.060	0.094	0.087
81211T2	K81211T2	WS81211	GS81211	60.1	83.4	83	61	1	0.618	0.190	0.219	0.209
89311	K89311	WS89311	GS89311	63.9	100.3	100	64	1	1.26	0.240	0.518	0.503
81112T2	K81112T2	WS81112	GS81112	63.7	80.1	80	65	1	0.288	0.083	0.106	0.099
81212T2	K81212T2	WS81212	GS81212	64.9	88.4	88	66	1	0.690	0.200	0.251	0.240
89312	K89312	WS89312	GS89312	68.9	105.3	105	69	1	1.33	0.250	0.550	0.534

Thrust cylindrical roller bearings

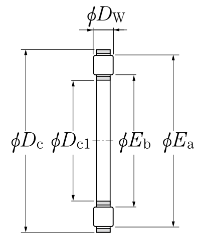
811 type
812 type
893 type



811 type
812 type
(Bearing)



893 type
(Bearing)



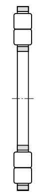
K811 type, K812 type
(Thrust cylindrical roller and cage assembly)

d 65 ～ 130mm

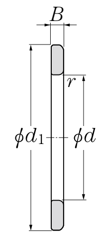
d	*D*	d_1	D_1	*T*	D_{c1}[2]	D_c	D_W	*B*	$r_{s\,min}$[1]	dynamic C_a	static C_{0a}	Fatigue load limit C_u	Allowable speed Grease lubrication	Allowable speed Oil lubrication
Boundary dimensions mm					E11	a13	0 / −0.010	h11		Basic load rating N		N	min⁻¹	
65	90	90	67	18	65	90	7.5	5.25	1	73 000	236 000	28 800	780	3 100
	100	100	67	27	65	100	11	8	1	130 000	385 000	47 000	730	2 900
	115	115	67	30	65	115	9	10.5	1.1	167 000	635 000	77 500	650	2 600
70	95	95	72	18	70	95	7.5	5.25	1	76 500	257 000	31 500	730	2 900
	105	105	72	27	70	105	11	8	1	134 000	410 000	50 000	680	2 700
	125	125	72	34	70	125	10	12	1.1	205 000	790 000	96 500	600	2 400
75	100	100	77	19	75	100	7.5	5.75	1	78 000	268 000	32 500	680	2 700
	110	110	77	27	75	110	11	8	1	138 000	435 000	53 000	650	2 600
	135	135	77	36	75	135	11	12.5	1.5	239 000	920 000	110 000	550	2 200
80	105	105	82	19	80	105	7.5	5.75	1	79 500	279 000	34 000	650	2 600
	115	115	82	28	80	115	11	8.5	1	143 000	460 000	56 000	630	2 500
	140	140	82	36	80	140	11	12.5	1.5	246 000	970 000	114 000	530	2 100
85	110	110	87	19	85	110	7.5	5.75	1	83 000	300 000	36 500	630	2 500
	125	125	88	31	85	125	12	9.5	1	169 000	550 000	66 500	580	2 300
	150	150	88	39	85	150	12	13.5	1.5	281 000	1 100 000	128 000	500	2 000
90	120	120	92	22	90	120	9	6.5	1	112 000	395 000	47 500	580	2 300
	135	135	93	35	90	135	14	10.5	1.1	213 000	680 000	80 000	530	2 100
	155	155	93	39	90	155	12	13.5	1.5	289 000	1 160 000	132 000	480	1 900
100	135	135	102	25	100	135	11	7	1	158 000	555 000	65 000	500	2 000
	150	150	103	38	100	150	15	11.5	1.1	243 000	795 000	91 000	480	1 900
	170	170	103	42	100	170	13	14.5	1.5	335 000	1 370 000	153 000	430	1 700
110	145	145	112	25	110	145	11	7	1	165 000	605 000	68 500	480	1 900
	160	160	113	38	110	160	15	11.5	1.1	258 000	885 000	98 500	450	1 800
	190	190	113	48	110	190	15	16.5	2	430 000	1 770 000	190 000	400	1 600
120	155	155	122	25	120	155	11	7	1	172 000	655 000	72 500	450	1 800
	170	170	123	39	120	170	15	12	1.1	264 000	930 000	101 000	430	1 700
130	170	170	132	30	130	170	12	9	1	197 000	755 000	81 500	400	1 600
	190	187	133	45	130	190	19	13	1.5	360 000	1 210 000	128 000	380	1 500

1) Smallest allowable dimension for chamfer dimension *r*.
2) The tolerance of bearings with suffix code T2 is E12.

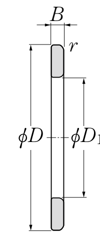
Needle Roller Bearings
NTN



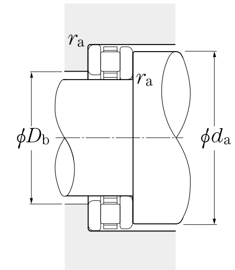
K893 type
(Thrust cylindrical roller and cage assembly)



WS type raceway
(Inner ring)



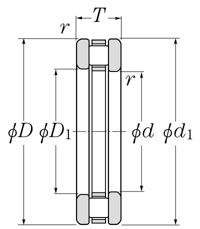
GS type raceway
(Outer ring)



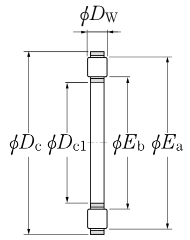
Number: Bearing	Thrust cylindrical roller and cage assembly	Inner ring	Outer ring	Approx. dimension mm E_b	E_a	Installation-related dimensions mm d_a Min.	D_b Max.	r_{as} Max.	Mass kg (approx.) 811	K811 K812 K893	WS811 WS812 WS893	GS811 GS812 GS893
81113T2	**K81113T2**	**WS81113**	**GS81113**	68.8	85.2	85	70	1	0.332	0.090	0.125	0.117
81213T2	**K81213T2**	**WS81213**	**GS81213**	69.9	93.3	93	71	1	0.772	0.215	0.285	0.272
89313	**K89313**	**WS89313**	**GS89313**	73.9	110.3	110	74	1	1.41	0.260	0.583	0.566
81114T2	**K81114T2**	**WS81114**	**GS81114**	73.7	90.1	90	74	1	0.355	0.097	0.134	0.124
81214T2	**K81214T2**	**WS81214**	**GS81214**	75	98.4	98	76	1	0.815	0.225	0.302	0.288
89314	**K89314**	**WS89314**	**GS89314**	79.8	120.2	120	80	1	1.91	0.340	0.793	0.772
81115T2	**K81115T2**	**WS81115**	**GS81115**	78.7	95.1	95	80	1	0.414	0.115	0.155	0.144
81215T2	**K81215T2**	**WS81215**	**GS81215**	80.1	103.7	103	81	1	0.864	0.240	0.319	0.304
89315	**K89315**	**WS89315**	**GS89315**	84.7	129.2	129	85	1.5	2.39	0.470	0.971	0.948
81116T2	**K81116T2**	**WS81116**	**GS81116**	83.7	100.1	100	85	1	0.435	0.119	0.164	0.152
81216T2	**K81216T2**	**WS81216**	**GS81216**	84.8	108.4	106	86	1	0.948	0.250	0.358	0.341
89316	**K89316**	**WS89316**	**GS89316**	89.8	134.2	134	90	1.5	2.50	0.490	1.02	0.992
81117T2	**K81117T2**	**WS81117**	**GS81117**	88.7	105.3	105	89	1	0.458	0.125	0.173	0.161
81217	**K81217**	**WS81217**	**GS81217**	92.2	116.9	116	92	1	1.25	0.300	0.492	0.462
89317	**K89317**	**WS89317**	**GS89317**	95.8	144.2	144	96	1.5	3.09	0.590	1.27	1.23
81118T2	**K81118T2**	**WS81118**	**GS81118**	94.7	114.3	114	95	1	0.660	0.170	0.252	0.238
81218J	**K81218J**	**WS81218**	**GS81218**	97.9	126.7	126	97	1	1.82	0.540	0.655	0.620
89318	**K89318**	**WS89318**	**GS89318**	100.8	149.2	149	101	1.5	3.23	0.620	1.33	1.28
81120T2	**K81120T2**	**WS81120**	**GS81120**	105.1	128.7	128	106	1	0.993	0.300	0.355	0.338
81220	**K81220**	**WS81220**	**GS81220**	109.2	140	139	109	1	2.35	0.620	0.886	0.843
89320	**K89320**	**WS89320**	**GS89320**	110.6	163	163	110	1.5	4.13	0.810	1.69	1.64
81122T2	**K81122T2**	**WS81122**	**GS81122**	115	138.8	138	116	1	1.08	0.325	0.385	0.366
81222	**K81222**	**WS81222**	**GS81222**	119.2	150	149	119	1	2.55	0.685	0.957	0.910
89322	**K89322**	**WS89322**	**GS89322**	122.5	183	183	122	2	5.96	1.15	2.44	2.37
81124T2	**K81124T2**	**WS81124**	**GS81124**	125	148.8	148	126	1	1.15	0.340	0.415	0.395
81224	**K81224**	**WS81224**	**GS81224**	129.2	160	159	129	1	2.82	0.730	1.07	1.02
81126	**K81126**	**WS81126**	**GS81126**	137.7	162.4	162	137	1	1.72	0.415	0.666	0.637
81226	**K81226**	**WS81226**	**GS81226**	140.1	179	178	140	1.5	4.06	1.14	1.45	1.48

Thrust cylindrical roller bearings

811 type
812 type



811 type
812 type
(Bearing)

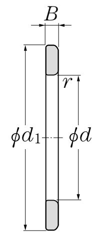


K811 type, K812 type
(Thrust cylindrical roller and cage assembly)

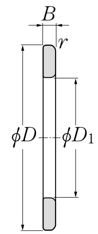
d 140 ～ 160mm

Boundary dimensions (mm)										Basic load rating (N)		Fatigue load limit (N)	Allowable speed (min⁻¹)	
d	D	d_1	D_1	T	D_{c1} E11	D_c a13	D_w 0/−0.010	B h11	$r_{s\,min}$ 1)	dynamic C_a	static C_{0a}	C_u	Grease lubrication	Oil lubrication
140	180	178	142	31	140	180	12	9.5	1	206 000	815 000	86 000	380	1 500
	200	197	143	46	140	200	19	13.5	1.5	370 000	1 280 000	133 000	350	1 400
150	190	188	152	31	150	190	12	9.5	1	214 000	870 000	90 500	350	1 400
160	200	198	162	31	160	200	12	9.5	1	221 000	930 000	95 000	330	1 300

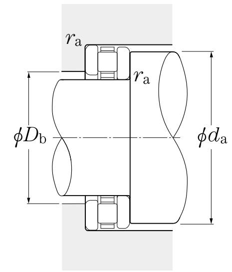
1) Smallest allowable dimension for chamfer dimension *r*.



WS type raceway
(Inner ring)



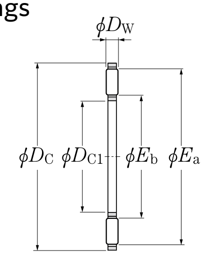
GS type raceway
(Outer ring)



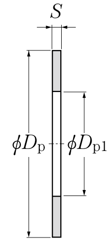
Number				Approx. dimension (mm)		Installation-related dimensions (mm)			Mass kg (approx.)			
Bearing	Thrust cylindrical roller and cage assembly	Inner ring	Outer ring	E_b	E_a	d_a Min.	D_b Max.	r_{as} Max.	811	K811 K812 K893	WS811 WS812 WS893	GS811 GS812 GS893
81128	**K81128**	**WS81128**	**GS81128**	147.8	172.5	172	147	1	1.87	0.450	0.708	0.717
81228	**K81228**	**WS81228**	**GS81228**	150.1	189	188	150	1.5	4.43	1.20	1.60	1.63
81130	**K81130**	**WS81130**	**GS81130**	157.7	182.4	182	157	1	1.98	0.470	0.752	0.761
81132	**K81132**	**WS81132**	**GS81132**	167.8	192.5	192	167	1	2.10	0.500	0.797	0.806

Thrust needle roller bearings

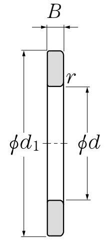
AXK11 type
AS11 type
WS811 type
GS811 type



AXK type
(Thrust needle roller and cage assembly)



AS type raceway
(Washer)



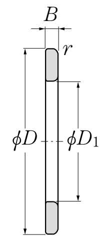
WS type raceway
(Inner ring)

D_{c1} 10～140mm

Boundary dimensions (mm)												Basic load rating (N)		Fatigue load limit (N)
D_{c1} E11	D_c c12	D_w $^{0}_{-0.010}$	D_p e13	D_{p1} E12	S [2] ±0.05	d	d_1	D	D_1	B	$r_{s\,min}$ [1]	dynamic C_a	static C_{0a}	C_u
10	24	2	24	10	1	10	24	24	10	2.75 $^{0}_{-0.060}$	0.3	9 150	25 300	3 100
12	26	2	26	12	1	12	26	26	12	2.75 $^{0}_{-0.060}$	0.3	9 850	28 900	3 500
15	28	2	28	15	1	15	28	28	16	2.75 $^{0}_{-0.060}$	0.3	11 300	36 000	4 400
17	30	2	30	17	1	17	30	30	18	2.75 $^{0}_{-0.060}$	0.3	11 900	39 500	4 800
20	35	2	35	20	1	20	35	35	21	2.75 $^{0}_{-0.060}$	0.3	13 200	46 500	5 650
25	42	2	42	25	1	25	42	42	26	3 $^{0}_{-0.060}$	0.6	14 600	58 000	7 050
30	47	2	47	30	1	30	47	47	32	3 $^{0}_{-0.060}$	0.6	16 300	69 500	8 500
35	52	2	52	35	1	35	52	52	37	3.5 $^{0}_{-0.075}$	0.6	17 800	81 500	9 900
40	60	3	60	40	1	40	60	60	42	3.5 $^{0}_{-0.075}$	0.6	27 400	110 000	13 500
45	65	3	65	45	1	45	65	65	47	4 $^{0}_{-0.075}$	0.6	29 800	128 000	15 600
50	70	3	70	50	1	50	70	70	52	4 $^{0}_{-0.075}$	0.6	31 500	143 000	17 400
55	78	3	78	55	1	55	78	78	57	5 $^{0}_{-0.075}$	0.6	38 000	186 000	22 700
60	85	3	85	60	1	60	85	85	62	4.75 $^{0}_{-0.075}$	1	44 500	234 000	28 600
65	90	3	90	65	1	65	90	90	67	5.25 $^{0}_{-0.075}$	1	46 500	254 000	31 000
70	95	4	95	70	1	70	95	95	72	5.25 $^{0}_{-0.075}$	1	53 500	253 000	31 000
75	100	4	100	75	1	75	100	100	77	5.75 $^{0}_{-0.075}$	1	55 000	266 000	32 500
80	105	4	105	80	1	80	105	105	82	5.75 $^{0}_{-0.075}$	1	56 500	279 000	34 000
85	110	4	110	85	1	85	110	110	87	5.75 $^{0}_{-0.075}$	1	57 500	291 000	35 500
90	120	4	120	90	1	90	120	120	92	6.5 $^{0}_{-0.090}$	1	70 500	390 000	46 500
100	135	4	135	100	1	100	135	135	102	7 $^{0}_{-0.090}$	1	90 000	550 000	64 000
110	145	4	145	110	1	110	145	145	112	7 $^{0}_{-0.090}$	1	93 500	590 000	67 000
120	155	4	155	120	1	120	155	155	122	7 $^{0}_{-0.090}$	1	99 000	650 000	72 000
130	170	5	170	130	1	130	170	170	132	9 $^{0}_{-0.090}$	1	140 000	900 000	97 000
140	180	5	180	140	1	140	178	180	142	9.5 $^{0}_{-0.090}$	1	145 000	960 000	102 000

1) Smallest allowable dimension for chamfer dimension r.
2) The measured thrust load is 2.04 N or above.

● Needle Roller Bearings NTN

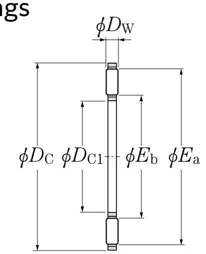


GS type raceway
(Outer ring)

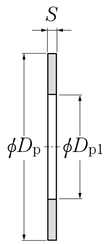
Allowable speed (min^{-1})		Number				Approx. dimension (mm)		Mass kg(approx.)			
Grease lubrication	Oil lubrication	Thrust needle roller and cage assembly	Washer	Inner ring	Outer ring	E_b	E_a	AXK11	AS11	WS811 WS812 WS893	GS811 GS812 GS893
3 500	14 000	**AXK1100**	**AS1100**	**WS81100**	**GS81100**	12.3	21.7	0.0028	0.0029	0.0081	0.0081
3 300	13 000	**AXK1101**	**AS1101**	**WS81101**	**GS81101**	14.3	23.7	0.0030	0.0033	0.0090	0.0090
2 800	11 000	**AXK1102**	**AS1102**	**WS81102**	**GS81102**	17.2	26.5	0.0035	0.0034	0.0095	0.0090
2 500	10 000	**AXK1103**	**AS1103**	**WS81103**	**GS81103**	19.2	28.5	0.0040	0.0038	0.010	0.010
2 100	8 500	**AXK1104**	**AS1104**	**WS81104**	**GS81104**	21.3	31.3	0.0050	0.0051	0.014	0.013
1 800	7 000	**AXK1105**	**AS1105**	**WS81105**	**GS81105**	29.5	39.4	0.0070	0.0070	0.021	0.020
1 500	6 000	**AXK1106**	**AS1106**	**WS81106**	**GS81106**	34.5	44.4	0.0080	0.0081	0.024	0.022
1 400	5 500	**AXK1107**	**AS1107**	**WS81107**	**GS81107**	39.5	49.4	0.010	0.0091	0.032	0.029
1 200	4 700	**AXK1108**	**AS1108**	**WS81108**	**GS81108**	44.2	56.2	0.019	0.012	0.043	0.040
1 100	4 300	**AXK1109**	**AS1109**	**WS81109**	**GS81109**	50.5	62.4	0.021	0.014	0.054	0.050
1 000	3 900	**AXK1110**	**AS1110**	**WS81110**	**GS81110**	55.5	67.4	0.024	0.015	0.059	0.054
900	3 500	**AXK1111**	**AS1111**	**WS81111**	**GS81111**	61.0	74.9	0.031	0.019	0.094	0.087
800	3 200	**AXK1112**	**AS1112**	**WS81112**	**GS81112**	66.0	81.9	0.039	0.022	0.106	0.099
750	3 000	**AXK1113**	**AS1113**	**WS81113**	**GS81113**	71.0	86.9	0.040	0.024	0.125	0.117
750	2 900	**AXK1114**	**AS1114**	**WS81114**	**GS81114**	75.5	91.4	0.060	0.025	0.134	0.124
700	2 700	**AXK1115**	**AS1115**	**WS81115**	**GS81115**	80.5	96.4	0.061	0.027	0.155	0.144
650	2 600	**AXK1116**	**AS1116**	**WS81116**	**GS81116**	84.4	100.3	0.063	0.029	0.164	0.152
600	2 400	**AXK1117**	**AS1117**	**WS81117**	**GS81117**	90.5	106.4	0.067	0.030	0.173	0.161
600	2 300	**AXK1118**	**AS1118**	**WS81118**	**GS81118**	96.5	116.4	0.086	0.039	0.252	0.238
500	2 000	**AXK1120**	**AS1120**	**WS81120**	**GS81120**	107.5	131.4	0.112	0.051	0.355	0.338
480	1 900	**AXK1122**	**AS1122**	**WS81122**	**GS81122**	115.5	139.4	0.122	0.055	0.385	0.366
430	1 700	**AXK1124**	**AS1124**	**WS81124**	**GS81124**	125.5	149.4	0.131	0.059	0.415	0.395
400	1 600	**AXK1126**	**AS1126**	**WS81126**	**GS81126**	136.0	164.0	0.205	0.074	0.666	0.637
380	1 500	**AXK1128**	**AS1128**	**WS81128**	**GS81128**	146.0	174.0	0.219	0.079	0.708	0.717

Thrust needle roller bearings

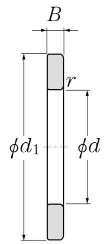
AXK11 type
AS11 type
WS811 type
GS811 type



AXK type
(Thrust needle roller and cage assembly)



AS type raceway
(Washer)

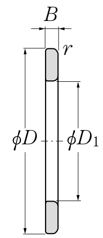


WS type raceway
(Inner ring)

D_{c1} 150 ～ 160mm

Boundary dimensions mm												Basic load rating N		Fatigue load limit N
D_{c1} E11	D_c c12	D_w $^{0}_{-0.010}$	D_p e13	D_{p1} E12	S 2) ±0.05	d	d_1	D	D_1	B	$r_{s\,min}$ 1)	dynamic C_a	static C_{0a}	C_u
150	190	5	190	150	1	150	188	190	152	9.5 $^{0}_{-0.090}$	1	149 000	1 020 000	106 000
160	200	5	200	160	1	160	198	200	162	9.5 $^{0}_{-0.090}$	1	154 000	1 070 000	110 000

1) Smallest allowable dimension for chamfer dimension r.
2) The measured thrust load is 2.04 N or above.

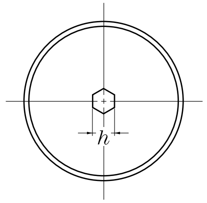


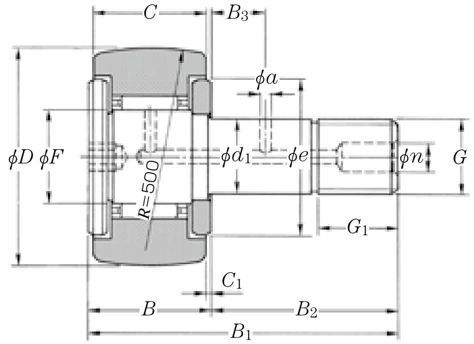
GS type raceway
(Outer ring)

Allowable speed min^{-1}		Number				Approx. dimension mm		Mass kg(approx.)			
Grease lubrication	Oil lubrication	Thrust needle roller and cage assembly	Washer	Inner ring	Outer ring	E_b	E_a	AXK11	AS11	WS811 WS812 WS893	GS811 GS812 GS893
350	1 400	**AXK1130**	**AS1130**	**WS81130**	**GS81130**	156.0	184.2	0.232	0.084	0.752	0.761
330	1 300	**AXK1132**	**AS1132**	**WS81132**	**GS81132**	166.0	194.2	0.246	0.089	0.797	0.806

Cam follower stud type track roller
metric series

KR··H type
KR··XH type
KR··LLH type
KR··XLLH type





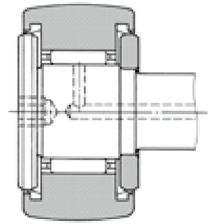
KR··H type
(With cage)

D 10 ～ 90mm

Outer dia.[1) mm D $_{-0.05}^{\ 0}$	Dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u
10	$3_{-0.010}^{\ 0}$	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	1 640	1 270	155
12	$4_{-0.012}^{\ 0}$	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	2 170	1 690	206
13	$5_{-0.012}^{\ 0}$	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	2 650	2 260	276
16	$6_{-0.012}^{\ 0}$	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	4 050	4 200	510
19	$8_{-0.015}^{\ 0}$	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	4 750	5 400	660
22	$10_{-0.015}^{\ 0}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300	6 650	810
26	$10_{-0.015}^{\ 0}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300	6 650	810
30	$12_{-0.018}^{\ 0}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850	9 650	1 180
32	$12_{-0.018}^{\ 0}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850	9 650	1 180
35	$16_{-0.018}^{\ 0}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	12 200	17 900	2 180
40	$18_{-0.018}^{\ 0}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	14 000	22 800	2 790
47	$20_{-0.021}^{\ 0}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700	33 500	4 100
52	$20_{-0.021}^{\ 0}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700	33 500	4 100
62	$24_{-0.021}^{\ 0}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900	55 000	6 700
72	$24_{-0.021}^{\ 0}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900	55 000	6 700
80	$30_{-0.021}^{\ 0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000	88 500	10 800
85	$30_{-0.021}^{\ 0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000	88 500	10 800
90	$30_{-0.021}^{\ 0}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000	88 500	10 800

1) The tolerance of outer ring outer diameter D of KR··XH type and KR··XLLH type having a cylindrical outer diameter surface is JIS 0 class.

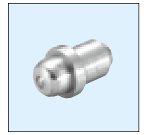
Needle Roller Bearings



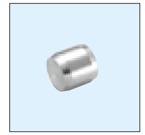
KR··LLH type
(Seal type with cage)

Accessories

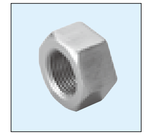
Applied bearing number	Grease nipple number	Plug number	Applied hexagonal nut
10～19	—	—	1M3×0.5～1M8×1.25
22～26	NIP-B4	SEN4	1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5



Grease fitting



Plug



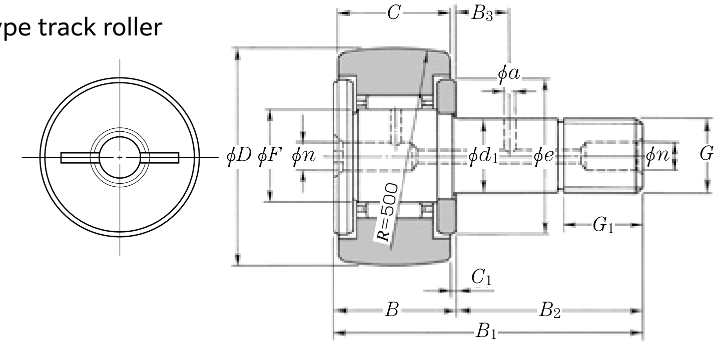
Hexagon nut

Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[2) min⁻¹ Grease lubrication	Oil lubrication	Maximum tightening torque N·m	Number[3) Without seal Spherical outer ring	Without seal Cylindrical outer ring	With seal Spherical outer ring	With seal Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
560	1 360	*27 000	*40 000	0.5	KR10T2H/3AS	KR10XT2H/3AS	KR10T2LLH/3AS	KR10XT2LLH/3AS	0.005	**3**
725	1 790	*25 000	*36 000	1	KR12T2H/3AS	KR12XT2H/3AS	KR12T2LLH/3AS	KR12XT2LLH/3AS	0.008	**4**
805	2 220	*23 000	*33 000	2	KR13T2H/3AS	KR13XT2H/3AS	KR13T2LLH/3AS	KR13XT2LLH/3AS	0.010	**5**
1 080	3 400	*19 000	*25 000	3	KR16FDOH/L588	KR16FXDOH/L588	KR16FLLDOH/L588	KR16FXLLDOH/L588	0.019	**6**
1 380	4 050	*15 000	*20 000	8	KR19FDOH/L588	KR19FXDOH/L588	KR19FLLDOH/L588	KR19FXLLDOH/L588	0.031	**8**
1 690	5 150	*12 000	*16 000	14	KR22FH	KR22FXH	KR22FLLH/3AS	KR22FXLLH/3AS	0.046	**10**
2 120	6 100	*12 000	*16 000	14	KR26FH	KR26FXH	KR26FLLH/3AS	KR26FXLLH/3AS	0.059	**10**
2 620	7 700	10 000	*13 000	20	KR30H	KR30XH	KR30LLH/3AS	KR30XLLH/3AS	0.087	**12**
2 860	8 200	10 000	*13 000	20	KR32H	KR32XH	KR32LLH/3AS	KR32XLLH/3AS	0.097	**12**
3 200	11 900	8 000	*11 000	52	KR35H	KR35XH	KR35LLH/3AS	KR35XLLH/3AS	0.169	**16**
3 850	14 500	7 000	9 000	76	KR40H	KR40XH	KR40LLH/3AS	KR40XLLH/3AS	0.248	**18**
4 700	21 000	6 000	8 000	98	KR47H	KR47XH	KR47LLH/3AS	KR47XLLH/3AS	0.386	**20**
5 550	23 300	6 000	8 000	98	KR52H	KR52XH	KR52LLH/3AS	KR52XLLH/3AS	0.461	**20**
6 950	34 500	5 000	6 500	178	KR62H	KR62XH	KR62LLH/3AS	KR62XLLH/3AS	0.790	**24**
8 050	38 500	5 000	6 500	178	KR72H	KR72XH	KR72LLH/3AS	KR72XLLH/3AS	1.04	**24**
9 800	53 000	4 000	5 500	360	KR80H	KR80XH	KR80LLH/3AS	KR80XLLH/3AS	1.55	**30**
10 400	56 000	4 000	5 500	360	KR85H	KR85XH	KR85LLH/3AS	KR85XLLH/3AS	1.74	**30**
11 400	59 000	4 000	5 500	360	KR90H	KR90XH	KR90LLH/3AS	KR90XLLH/3AS	1.95	**30**

2) The allowable speed of KR··LLH type and KR··XLLH type with a "*" mark seal is about 10 000 min⁻¹.
3) Bearings having T2 after the bearing number have a plastic cage, and the allowable temperature is 120°C and 100°C or below for continuous use.

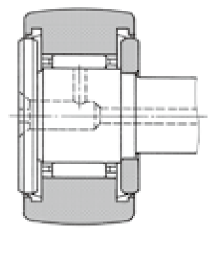
Cam follower stud type track roller
metric series

KR type
KR··X type
KR··LL type
KR··XLL type



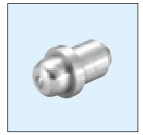
KR type
(With cage)

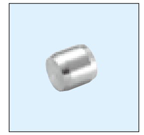
D 16 ～ 90mm

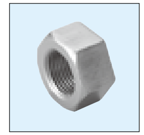

KR··LL type
(Seal type with cage)

Accessories

Applied bearing number	Grease nipple number	Plug number	Applied hexagonal nut
16～26	NIP-B4	SEN4	1M 6×1 ～1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5


Grease fitting


Plug


Hexagon nut

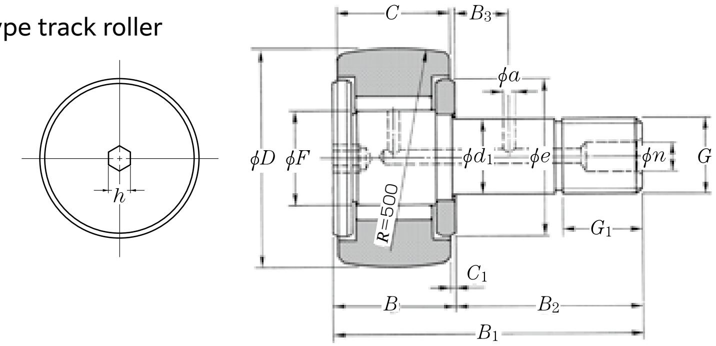
Outer dia.[1] mm D $^{0}_{-0.05}$	Dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u	Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[3] min⁻¹ Grease lubrication	Oil lubrication	Maximum tightening torque N · m	Number Without seal Spherical outer ring	Without seal Cylindrical outer ring	With seal Spherical outer ring	With seal Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	4[2]	—	12	4 050	4 200	510	1 080	3 400	*19 000	*25 000	3	**KR16F**	**KR16FX**	**KR16FLL/3AS**	**KR16FXLL/3AS**	0.019	**6**
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	4[2]	—	14	4 750	5 400	660	1 380	4 050	*15 000	*20 000	8	**KR19F**	**KR19FX**	**KR19FLL/3AS**	**KR19FXLL/3AS**	0.031	**8**
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300	6 650	810	1 690	5 150	*12 000	*16 000	14	**KR22F**	**KR22FX**	**KR22FLL/3AS**	**KR22FXLL/3AS**	0.046	**10**
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300	6 650	810	2 120	6 100	*12 000	*16 000	14	**KR26F**	**KR26FX**	**KR26FLL/3AS**	**KR26FXLL/3AS**	0.059	**10**
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850	9 650	1 180	2 620	7 700	10 000	*13 000	20	**KR30**	**KR30X**	**KR30LL/3AS**	**KR30XLL/3AS**	0.087	**12**
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850	9 650	1 180	2 860	8 200	10 000	*13 000	20	**KR32**	**KR32X**	**KR32LL/3AS**	**KR32XLL/3AS**	0.097	**12**
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	12 200	17 900	2 180	3 200	11 900	8 000	*11 000	52	**KR35**	**KR35X**	**KR35LL/3AS**	**KR35XLL/3AS**	0.169	**16**
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	14 000	22 800	2 780	3 850	14 500	7 000	9 000	76	**KR40**	**KR40X**	**KR40LL/3AS**	**KR40XLL/3AS**	0.248	**18**
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700	33 500	4 100	4 700	21 000	6 000	8 000	98	**KR47**	**KR47X**	**KR47LL/3AS**	**KR47XLL/3AS**	0.386	**20**
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700	33 500	4 100	5 550	23 300	6 000	8 000	98	**KR52**	**KR52X**	**KR52LL/3AS**	**KR52XLL/3AS**	0.461	**20**
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900	55 000	6 700	6 950	34 500	5 000	6 500	178	**KR62**	**KR62X**	**KR62LL/3AS**	**KR62XLL/3AS**	0.790	**24**
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900	55 000	6 700	8 050	38 500	5 000	6 500	178	**KR72**	**KR72X**	**KR72LL/3AS**	**KR72XLL/3AS**	1.04	**24**
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000	88 500	10 800	9 800	53 000	4 000	5 500	360	**KR80**	**KR80X**	**KR80LL/3AS**	**KR80XLL/3AS**	1.55	**30**
85	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000	88 500	10 800	10 400	56 000	4 000	5 500	360	**KR85**	**KR85X**	**KR85LL/3AS**	**KR85XLL/3AS**	1.74	**30**
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000	88 500	10 800	11 400	59 000	4 000	5 500	360	**KR90**	**KR90X**	**KR90LL/3AS**	**KR90XLL/3AS**	1.95	**30**

1) The tolerance of outer ring outer diameter D of KR··X type and KR··XLL type having a cylindrical outer diameter surface is JIS 0 class.
2) A grease filler hole is provided only on the front surface (left side in the above drawing).

3) The allowable speed of KR··LL type and KR··XLL type with a "*" mark seal is about 10 000 min⁻¹.

Cam follower stud type track roller metric series

KRV··H type
KRV··XH type
KRV··LLH type
KRV··XLLH type



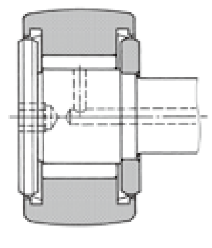
KRV··H type
(Full complement roller type)

D 10 ～ 90mm

Outer dia.[1) mm D $^{0}_{-0.05}$	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	h	Basic load rating N dynamic C_r	static C_{0r}	Fatigue load limit N C_u
10	3 $^{0}_{-0.010}$	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	2 500	2 610	320
12	4 $^{0}_{-0.012}$	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	3 500	3 800	460
13	5 $^{0}_{-0.012}$	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	4 500	5 350	650
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	6 500	9 350	1 140
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	7 450	11 700	1 430
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200	14 000	1 700
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200	14 000	1 700
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000	20 300	2 470
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000	20 300	2 470
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	17 600	34 000	4 150
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	19 400	42 000	5 100
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800	61 000	7 450
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800	61 000	7 450
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500	98 500	12 000
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500	98 500	12 000
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000	147 000	18 000
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000	147 000	18 000

(Dimensions in mm)

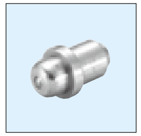
1) The tolerance of outer ring outer diameter D of KRV··XH type and KRV··XLLH type having a cylindrical outer diameter surface is JIS 0 class.



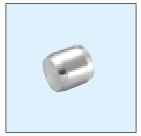
KRV··LLH type
(Full complement roller sealed type)

Accessories

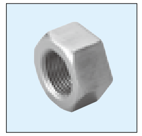
Applied bearing number	Grease nipple number	Plug number	Applied hexagonal nut
10～19	—	—	1M3×0.5～1M8×1.25
22～26	NIP-B4	SEN4	1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5



Grease fitting



Plug



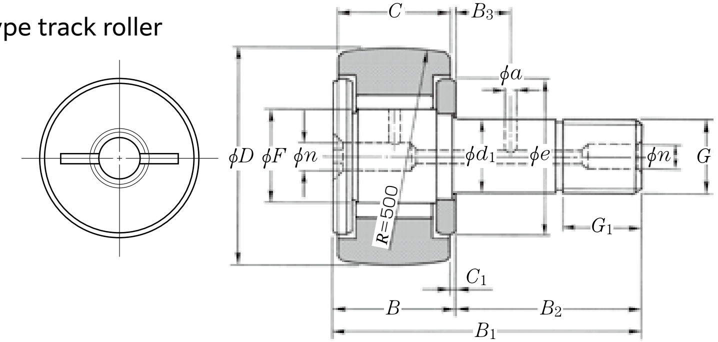
Hexagon nut

Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[2) min⁻¹ Grease lubrication	Oil lubrication	Maximum tightening torque N·m	Number Without seal Spherical outer ring	Without seal Cylindrical outer ring	With seal Spherical outer ring	With seal Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
560	1 360	*25 000	*32 000	0.5	KRV10H/3AS	KRV10XH/3AS	KRV10LLH/3AS	KRV10XLLH/3AS	0.005	3
725	1 790	*20 000	*27 000	1	KRV12H/3AS	KRV12XH/3AS	KRV12LLH/3AS	KRV12XLLH/3AS	0.008	4
805	2 220	*17 000	*22 000	2	KRV13H/3AS	KRV13XH/3AS	KRV13LLH/3AS	KRV13XLLH/3AS	0.011	5
1 080	3 400	*13 000	*16 000	3	KRV16FDOH/L588	KRV16FXDOH/L588	KRV16FLLDOH/L588	KRV16FXLLDOH/L588	0.020	6
1 380	4 050	10 000	*13 000	8	KRV19FDOH/L588	KRV19FXDOH/L588	KRV19FLLDOH/L588	KRV19FXLLDOH/L588	0.032	8
1 690	5 150	8 500	*11 000	14	KRV22FH/3AS	KRV22FXH/3AS	KRV22FLLH/3AS	KRV22FXLLH/3AS	0.047	10
2 120	6 100	8 500	*11 000	14	KRV26FH/3AS	KRV26FXH/3AS	KRV26FLLH/3AS	KRV26FXLLH/3AS	0.061	10
2 620	7 700	6 500	8 500	20	KRV30H/3AS	KRV30XH/3AS	KRV30LLH/3AS	KRV30XLLH/3AS	0.089	12
2 860	8 200	6 500	8 500	20	KRV32H/3AS	KRV32XH/3AS	KRV32LLH/3AS	KRV32XLLH/3AS	0.100	12
3 200	11 900	5 500	7 000	52	KRV35H/3AS	KRV35XH/3AS	KRV35LLH/3AS	KRV35XLLH/3AS	0.172	16
3 850	14 500	4 500	6 000	76	KRV40H/3AS	KRV40XH/3AS	KRV40LLH/3AS	KRV40XLLH/3AS	0.252	18
4 700	21 000	4 000	5 000	98	KRV47H/3AS	KRV47XH/3AS	KRV47LLH/3AS	KRV47XLLH/3AS	0.392	20
5 550	23 300	4 000	5 000	98	KRV52H/3AS	KRV52XH/3AS	KRV52LLH/3AS	KRV52XLLH/3AS	0.465	20
6 950	34 500	3 300	4 500	178	KRV62H/3AS	KRV62XH/3AS	KRV62LLH/3AS	KRV62XLLH/3AS	0.800	24
8 050	38 500	3 300	4 500	178	KRV72H/3AS	KRV72XH/3AS	KRV72LLH/3AS	KRV72XLLH/3AS	1.05	24
9 800	53 000	2 600	3 500	360	KRV80H/3AS	KRV80XH/3AS	KRV80LLH/3AS	KRV80XLLH/3AS	1.56	30
11 400	59 000	2 600	3 500	360	KRV90H/3AS	KRV90XH/3AS	KRV90LLH/3AS	KRV90XLLH/3AS	1.97	30

2) The allowable speed of KRV··LLH type and KRV··XLLH type with a "*" mark seal is about 10 000 min⁻¹.

Cam follower stud type track roller metric series

KRV type
KRV··X type
KRV··LL type
KRV··XLL type



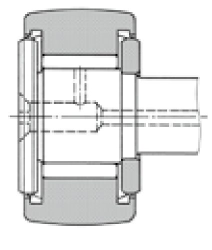
KRV type
(Full complement roller type)

D 16 ～ 90mm

Outer dia.[1)] mm *D* $^{0}_{-0.05}$	Dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	a	e	Basic load rating dynamic N C_r	static C_{0r}	Fatigue load limit N C_u
16	$6\ ^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	—	0.6	4[2)]	—	12	6 500	9 350	1 140
19	$8\ ^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	—	0.6	4[2)]	—	14	7 450	11 700	1 430
22	$10\ ^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200	14 000	1 700
26	$10\ ^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200	14 000	1 700
30	$12\ ^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000	20 300	2 470
32	$12\ ^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000	20 300	2 470
35	$16\ ^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	17 600	34 000	4 150
40	$18\ ^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	19 400	42 000	5 100
47	$20\ ^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800	61 000	7 450
52	$20\ ^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800	61 000	7 450
62	$24\ ^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500	98 500	12 000
72	$24\ ^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500	98 500	12 000
80	$30\ ^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000	147 000	18 000
90	$30\ ^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000	147 000	18 000

1) The tolerance of outer ring outer diameter *D* of KRV··X type and KRV··XLL type having a cylindrical outer diameter surface is JIS 0 class.
2) A grease filler hole is provided only on the front surface (left side in the above drawing).

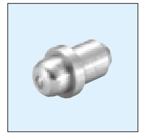
●Needle Roller Bearings NTN



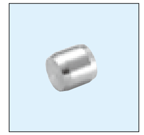
KRV··LL type
(Full complement roller sealed type)

Accessories

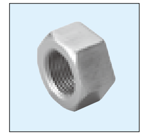
Applied bearing number	Grease nipple number	Plug number	Applied hexagonal nut
16～26	NIP-B4	SEN4	1M 6×1 ～1M10×1.25
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5



Grease fitting



Plug



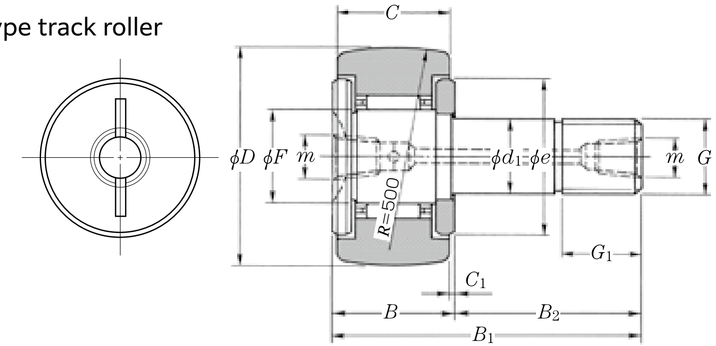
Hexagon nut

Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[3)] min⁻¹ Grease lubrication	Oil lubrication	Maximum tightening torque N · m	Number Without seal Spherical outer ring	Cylindrical outer ring	With seal Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
1 080	3 400	*13 000	*16 000	3	**KRV16F/3AS**	**KRV16FX/3AS**	**KRV16FLL/3AS**	**KRV16FXLL/3AS**	0.020	**6**
1 380	4 050	10 000	*13 000	8	**KRV19F/3AS**	**KRV19FX/3AS**	**KRV19FLL/3AS**	**KRV19FXLL/3AS**	0.032	**8**
1 690	5 150	8 500	*11 000	14	**KRV22F/3AS**	**KRV22FX/3AS**	**KRV22FLL/3AS**	**KRV22FXLL/3AS**	0.047	**10**
2 120	6 100	8 500	*11 000	14	**KRV26F/3AS**	**KRV26FX/3AS**	**KRV26FLL/3AS**	**KRV26FXLL/3AS**	0.061	**10**
2 620	7 700	6 500	8 500	20	**KRV30/3AS**	**KRV30X/3AS**	**KRV30LL/3AS**	**KRV30XLL/3AS**	0.089	**12**
2 860	8 200	6 500	8 500	20	**KRV32/3AS**	**KRV32X/3AS**	**KRV32LL/3AS**	**KRV32XLL/3AS**	0.100	**12**
3 200	11 900	5 500	7 000	52	**KRV35/3AS**	**KRV35X/3AS**	**KRV35LL/3AS**	**KRV35XLL/3AS**	0.172	**16**
3 850	14 500	4 500	6 000	76	**KRV40/3AS**	**KRV40X/3AS**	**KRV40LL/3AS**	**KRV40XLL/3AS**	0.252	**18**
4 700	21 000	4 000	5 000	98	**KRV47/3AS**	**KRV47X/3AS**	**KRV47LL/3AS**	**KRV47XLL/3AS**	0.390	**20**
5 550	23 300	4 000	5 000	98	**KRV52/3AS**	**KRV52X/3AS**	**KRV52LL/3AS**	**KRV52XLL/3AS**	0.465	**20**
6 950	34 500	3 300	4 500	178	**KRV62/3AS**	**KRV62X/3AS**	**KRV62LL/3AS**	**KRV62XLL/3AS**	0.800	**24**
8 050	38 500	3 300	4 500	178	**KRV72/3AS**	**KRV72X/3AS**	**KRV72LL/3AS**	**KRV72XLL/3AS**	1.05	**24**
9 800	53 000	2 600	3 500	360	**KRV80/3AS**	**KRV80X/3AS**	**KRV80LL/3AS**	**KRV80XLL/3AS**	1.56	**30**
11 400	59 000	2 600	3 500	360	**KRV90/3AS**	**KRV90X/3AS**	**KRV90LL/3AS**	**KRV90XLL/3AS**	1.97	**30**

3) The allowable speed of KRV··LL type and KRV··XLL type with a "＊" mark seal is about 10 000 min^{-1}.

Cam follower stud type track roller
metric series

KRT type
KRT··X type
KRT··LL type
KRT··XLL type

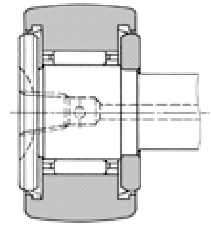


KRT type
(With cage)

D 16 ～ 90mm

Outer dia.[1] mm D $^{0}_{-0.05}$	Dimensions mm											Basic load rating dynamic N	static	Fatigue load limit N
	d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	C_r	C_{0r}	C_u
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	0.6	M4×0.7[2)]	12	4 050	4 200	510
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7[2)]	14	4 750	5 400	660
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300	6 650	810
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300	6 650	810
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850	9 650	1 180
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850	9 650	1 180
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	0.8	Rc 1/8	27	12 200	17 900	2 180
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	0.8	Rc 1/8	32	14 000	22 800	2 785
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	Rc 1/8	37	20 700	33 500	4 100
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	Rc 1/8	37	20 700	33 500	4 100
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	Rc 1/8	44	28 900	55 000	6 700
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	Rc 1/8	44	28 900	55 000	6 700
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	Rc 1/8	53	45 000	88 500	10 800
85	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	Rc 1/8	53	45 000	88 500	10 800
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	Rc 1/8	53	45 000	88 500	10 800

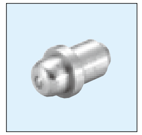
1) The tolerance of outer ring outer diameter D of KRT··X type and KRT··XLL type having a cylindrical outer diameter surface is JIS 0 class.
2) A tapped hole is provided only on the front surface (left side in the above drawing).

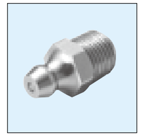


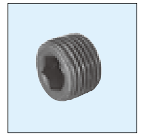
KRT··LL type
(Seal type with cage)

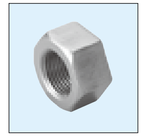
Accessories

Applied Number	Grease nipple number	Number of hex socket screw plug	Applied hexagonal nut Number
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～32	JIS 1 type (A-M6F)	M6×0.75 ×6 ℓ	1M12×1.5
35～90	JIS 2 type (A-PT1/8)	R1/8 (PT1/8) ×7 ℓ	1M16×1.5～1M30×1.5


Grease fitting


Grease fitting


Hex socket screw plug

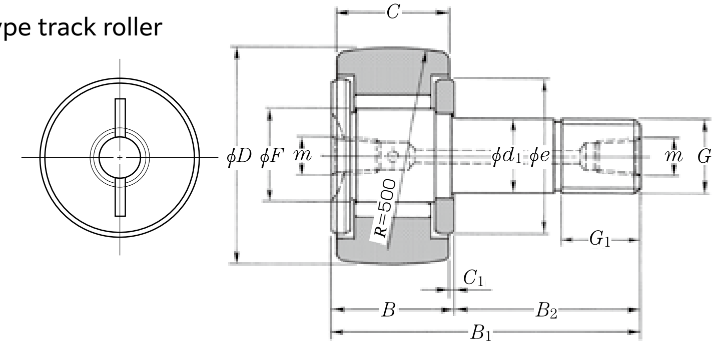

Hexagon nut

Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[3)] min⁻¹ Grease lubrication	Oil lubrication	Maximum tightening torque N · m	Number Without seal Spherical outer ring	Cylindrical outer ring	With seal Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
1 080	3 400	*19 000	*25 000	3	**KRT16**	**KRT16X**	**KRT16LL/3AS**	**KRT16XLL/3AS**	0.019	**6**
1 380	4 050	*15 000	*20 000	8	**KRT19**	**KRT19X**	**KRT19LL/3AS**	**KRT19XLL/3AS**	0.031	**8**
1 690	5 150	*12 000	*16 000	14	**KRT22**	**KRT22X**	**KRT22LL/3AS**	**KRT22XLL/3AS**	0.046	**10**
2 120	6 100	*12 000	*16 000	14	**KRT26**	**KRT26X**	**KRT26LL/3AS**	**KRT26XLL/3AS**	0.059	**10**
2 620	7 700	10 000	*13 000	20	**KRT30**	**KRT30X**	**KRT30LL/3AS**	**KRT30XLL/3AS**	0.087	**12**
2 860	8 200	10 000	*13 000	20	**KRT32**	**KRT32X**	**KRT32LL/3AS**	**KRT32XLL/3AS**	0.097	**12**
3 200	11 900	8 000	*11 000	52	**KRT35**	**KRT35X**	**KRT35LL/3AS**	**KRT35XLL/3AS**	0.169	**16**
3 850	14 500	7 000	9 000	76	**KRT40**	**KRT40X**	**KRT40LL/3AS**	**KRT40XLL/3AS**	0.248	**18**
4 700	21 000	6 000	8 000	98	**KRT47**	**KRT47X**	**KRT47LL/3AS**	**KRT47XLL/3AS**	0.386	**20**
5 550	23 300	6 000	8 000	98	**KRT52**	**KRT52X**	**KRT52LL/3AS**	**KRT52XLL/3AS**	0.461	**20**
6 950	34 500	5 000	6 500	178	**KRT62**	**KRT62X**	**KRT62LL/3AS**	**KRT62XLL/3AS**	0.790	**24**
8 050	38 500	5 000	6 500	178	**KRT72**	**KRT72X**	**KRT72LL/3AS**	**KRT72XLL/3AS**	1.04	**24**
9 800	53 000	4 000	5 500	360	**KRT80**	**KRT80X**	**KRT80LL/3AS**	**KRT80XLL/3AS**	1.55	**30**
10 400	56 000	4 000	5 500	360	**KRT85**	**KRT85X**	**KRT85LL/3AS**	**KRT85XLL/3AS**	1.74	**30**
11 400	59 000	4 000	5 500	360	**KRT90**	**KRT90X**	**KRT90LL/3AS**	**KRT90XLL/3AS**	1.95	**30**

3) The allowable speed of KRT··LL type and KRT··XLL type with a "*" mark seal is about 10 000 min^{-1}.

Cam follower stud type track roller metric series

KRVT type
KRVT··X type
KRVT··LL type
KRVT··XLL type

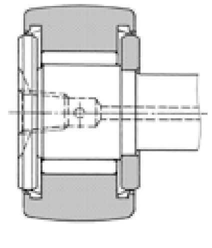


KRVT type
(Full complement roller type)

D 16 ～ 90mm

Outer dia.[1)] mm D $^{0}_{-0.05}$	Dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	Basic load rating dynamic N C_r	static N C_{0r}	Fatigue load limit N C_u
16	6 $^{0}_{-0.012}$	11	8	12	28	16	M6×1	8	0.6	M4×0.7[2)]	12	6 500	9 350	1 140
19	8 $^{0}_{-0.015}$	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7[2)]	14	7 450	11 700	1 430
22	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200	14 000	1 700
26	10 $^{0}_{-0.015}$	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200	14 000	1 700
30	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000	20 300	2 470
32	12 $^{0}_{-0.018}$	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000	20 300	2 470
35	16 $^{0}_{-0.018}$	18	18	19.5	52	32.5	M16×1.5	17	0.8	Rc 1/8	27	17 600	34 000	4 150
40	18 $^{0}_{-0.018}$	20	22	21.5	58	36.5	M18×1.5	19	0.8	Rc 1/8	32	19 400	42 000	5 100
47	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	Rc 1/8	37	28 800	61 000	7 450
52	20 $^{0}_{-0.021}$	24	25	25.5	66	40.5	M20×1.5	21	0.8	Rc 1/8	37	28 800	61 000	7 450
62	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	Rc 1/8	44	39 500	98 500	12 000
72	24 $^{0}_{-0.021}$	29	30	30.5	80	49.5	M24×1.5	25	0.8	Rc 1/8	44	39 500	98 500	12 000
80	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	Rc 1/8	53	58 000	147 000	18 000
90	30 $^{0}_{-0.021}$	35	38	37	100	63	M30×1.5	32	1	Rc 1/8	53	58 000	147 000	18 000

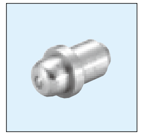
1) The tolerance of outer ring outer diameter *D* of KRVT··X type and KRVT··XLL type having a cylindrical outer diameter surface is JIS 0 class.
2) A tapped hole is provided only on the front surface (left side in the above drawing).

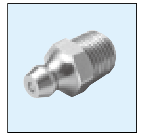


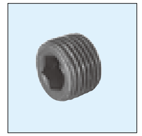
KRVT··LL type
(Full complement roller sealed type)

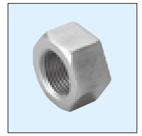
Accessories

Applied Number	Grease nipple number	Number of hex socket screw plug	Applied hexagonal nut Number
16～26	NIP-X30	M4×0.7 ×4 ℓ	1M 6×1 ～1M10×1.25
30～32	JIS 1 type (A-M6F)	M6×0.75 ×6 ℓ	1M12×1.5
35～90	JIS 2 type (A-PT 1/8)	R 1/8 (PT 1/8) ×7 ℓ	1M16×1.5～1M30×1.5


Grease fitting


Grease fitting


Hex socket screw plug

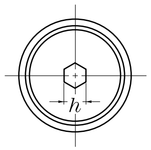

Hexagon nut

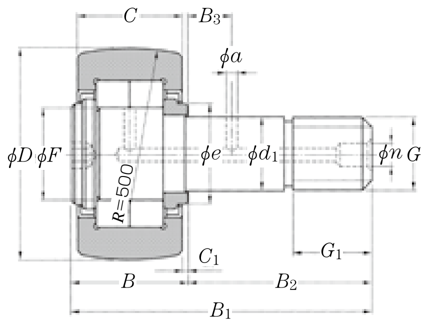
Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed[3)] min^{-1} Grease lubrication	Oil lubrication	Maximum tightening torque N · m	Number Without seal Spherical outer ring	Without seal Cylindrical outer ring	With seal Spherical outer ring	With seal Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
1 080	3 400	*13 000	*16 000	3	KRVT16/3AS	KRVT16X/3AS	KRVT16LL/3AS	KRVT16XLL/3AS	0.020	**6**
1 380	4 050	10 000	*13 000	8	KRVT19/3AS	KRVT19X/3AS	KRVT19LL/3AS	KRVT19XLL/3AS	0.032	**8**
1 690	5 150	8 500	*11 000	14	KRVT22/3AS	KRVT22X/3AS	KRVT22LL/3AS	KRVT22XLL/3AS	0.047	**10**
2 120	6 100	8 500	*11 000	14	KRVT26/3AS	KRVT26X/3AS	KRVT26LL/3AS	KRVT26XLL/3AS	0.061	**10**
2 620	7 700	6 500	8 500	20	KRVT30/3AS	KRVT30X/3AS	KRVT30LL/3AS	KRVT30XLL/3AS	0.089	**12**
2 860	8 200	6 500	8 500	20	KRVT32/3AS	KRVT32X/3AS	KRVT32LL/3AS	KRVT32XLL/3AS	0.100	**12**
3 200	11 900	5 500	7 000	52	KRVT35/3AS	KRVT35X/3AS	KRVT35LL/3AS	KRVT35XLL/3AS	0.172	**16**
3 850	14 500	4 500	6 000	76	KRVT40/3AS	KRVT40X/3AS	KRVT40LL/3AS	KRVT40XLL/3AS	0.252	**18**
4 700	21 000	4 000	5 000	98	KRVT47/3AS	KRVT47X/3AS	KRVT47LL/3AS	KRVT47XLL/3AS	0.390	**20**
5 550	23 300	4 000	5 000	98	KRVT52/3AS	KRVT52X/3AS	KRVT52LL/3AS	KRVT52XLL/3AS	0.465	**20**
6 950	34 500	3 300	4 500	178	KRVT62/3AS	KRVT62X/3AS	KRVT62LL/3AS	KRVT62XLL/3AS	0.800	**24**
8 050	38 500	3 300	4 500	178	KRVT72/3AS	KRVT72X/3AS	KRVT72LL/3AS	KRVT72XLL/3AS	1.05	**24**
9 800	53 000	2 600	3 500	360	KRVT80/3AS	KRVT80X/3AS	KRVT80LL/3AS	KRVT80XLL/3AS	1.56	**30**
11 400	59 000	2 600	3 500	360	KRVT90/3AS	KRVT90X/3AS	KRVT90LL/3AS	KRVT90XLL/3AS	1.97	**30**

3) The allowable speed of KRVT··LL type and KRVT··XLL type with a "∗" mark seal is about 10 000 min^{-1}.

Cam follower stud type track roller metric series

NUKR··H type
NUKR··XH type



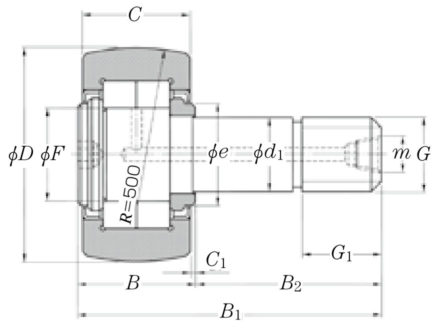


NUKR··H type (D < 100 mm)
(Full complement double-row cylindrical roller bearings with shield)

D 30 ～ 180mm

Outer dia.[1] mm D ($^{0}_{-0.05}$)	Dimensions mm															Fatigue load limit N
	d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	m	a	e	h	C_u
30	12 $^{0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15	6	1 650
35	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21	6	3 150
40	18 $^{0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23	6	3 550
47	20 $^{0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27	8	5 900
52	20 $^{0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31	8	7 000
62	24 $^{0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38	8	8 850
72	24 $^{0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44	8	10 400
80	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8	18 400
90	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8	18 400
100	36 $^{0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	—	Rc 1/8	—	53	14	20 400
120	42 $^{0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	—	Rc 1/8	—	66	14	32 400
140	48 $^{0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	—	1.5	—	Rc 1/8	—	72.5	14	35 900
150	52 $^{0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	—	Rc 1/8	—	85.5	17	46 500
160	56 $^{0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	—	2	—	Rc 1/8	—	89.5	17	49 000
170	60 $^{0}_{-0.030}$	66	86	70	190	120	M60×3	58	—	2	—	Rc 1/8	—	96.5	17	58 000
180	64 $^{0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	—	2	—	Rc 1/8	—	103.5	17	67 500

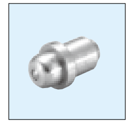
1) The tolerance of outer ring outer diameter D of NUKR··XH type having a cylindrical outer diameter surface is JIS 0 class.

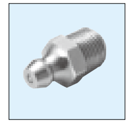


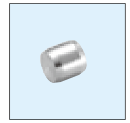
NUKR··H type (D ≧ 100 mm)

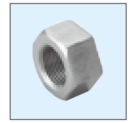
Accessories

Applied Number	Grease nipple number	Plug Number	Applied hexagonal nut
30～40	NIP-B6	SEN3, SEN6	1M12×1.5～1M18×1.5
47～90	NIP-B8	SEN4, SEN8	1M20×1.5～1M30×1.5
100～180	JIS 2 type (A-PT1/8)	—	1M36×1.5～1M64×3


Grease fitting


Grease fitting

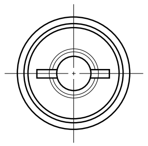

Plug

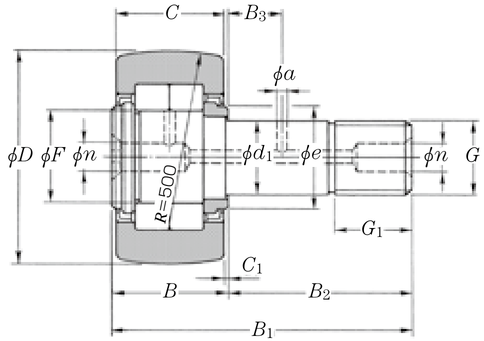

Hexagon nut

Basic load rating N dynamic	static	Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed min⁻¹ Grease lubrication	Maximum tightening torque N · m	Number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
C_r	C_{0r}								
13 300	13 500	2 620	7 700	6 900	20	NUKR30H/3AS	NUKR30XH/3AS	0.088	**12**
22 300	25 700	3 200	11 900	5 500	52	NUKR35H/3AS	NUKR35XH/3AS	0.165	**16**
24 100	29 100	3 850	14 500	4 700	76	NUKR40H/3AS	NUKR40XH/3AS	0.242	**18**
38 500	48 000	4 700	21 000	4 000	98	NUKR47H/3AS	NUKR47XH/3AS	0.380	**20**
42 500	57 500	5 550	23 300	3 300	98	NUKR52H/3AS	NUKR52XH/3AS	0.450	**20**
56 500	72 500	6 950	34 500	2 900	178	NUKR62H/3AS	NUKR62XH/3AS	0.795	**24**
62 000	85 500	8 050	38 500	2 400	178	NUKR72H/3AS	NUKR72XH/3AS	1.01	**24**
101 000	151 000	9 800	53 000	2 100	360	NUKR80H/3AS	NUKR80XH/3AS	1.54	**30**
101 000	151 000	11 400	59 000	2 100	360	NUKR90H/3AS	NUKR90XH/3AS	1.96	**30**
119 000	167 000	13 000	79 000	2 000	630	NUKR100H/3AS	NUKR100XH/3AS	3.08	**36**
172 000	266 000	16 400	113 000	1 700	1 020	NUKR120H/3AS	NUKR120XH/3AS	5.17	**42**
201 000	294 000	20 000	152 000	1 500	1 540	NUKR140H/3AS	NUKR140XH/3AS	7.98	**48**
258 000	380 000	22 000	173 000	1 300	1 950	NUKR150H/3AS	NUKR150XH/3AS	9.70	**52**
274 000	400 000	24 000	194 000	1 200	2 480	NUKR160H/3AS	NUKR160XH/3AS	11.7	**56**
320 000	475 000	26 000	218 000	1 100	3 030	NUKR170H/3AS	NUKR170XH/3AS	13.9	**60**
365 000	555 000	27 900	253 000	1 000	3 670	NUKR180H/3AS	NUKR180XH/3AS	17.0	**64**

Cam follower stud type track roller metric series

NUKR type
NUKR··X type



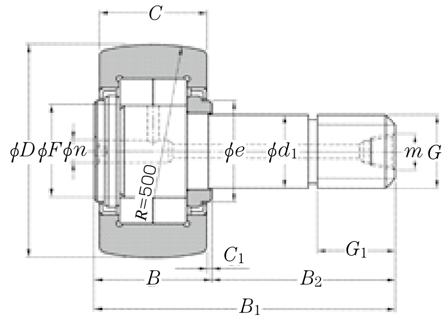


NUKR type (D < 100 mm)
(Full complement double-row cylindrical roller bearings with shield)

D 30 ~ 180mm

Outer dia.[1] mm D $^{0}_{-0.05}$	Dimensions mm d_1	C	F	B	B_1	B_2	G	G_1	B_3	C_1	n	m	a	e	Fatigue load limit N C_u
30	$12^{\ 0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15	1 650
35	$16^{\ 0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21	3 150
40	$18^{\ 0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23	3 550
47	$20^{\ 0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27	5 900
52	$20^{\ 0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31	7 000
62	$24^{\ 0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38	8 850
72	$24^{\ 0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44	10 400
80	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	18 400
90	$30^{\ 0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	18 400
100	$36^{\ 0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	8	Rc 1/8	—	53	20 400
120	$42^{\ 0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	8	Rc 1/8	—	66	32 500
140	$48^{\ 0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	—	1.5	8	Rc 1/8	—	72.5	36 000
150	$52^{\ 0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	8	Rc 1/8	—	85.5	46 500
160	$56^{\ 0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	—	2	8	Rc 1/8	—	89.5	49 000
170	$60^{\ 0}_{-0.030}$	66	86	70	190	120	M60×3	58	—	2	8	Rc 1/8	—	96.5	58 000
180	$64^{\ 0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	—	2	8	Rc 1/8	—	103.5	67 500

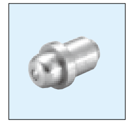
1) The tolerance of outer ring outer diameter D of NUKR··X type having a cylindrical outer diameter surface is JIS 0 class.

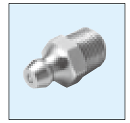


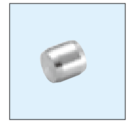
NUKR type (D ≧ 100 mm)

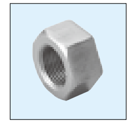
Accessories

Applied Number	Grease nipple number	Plug Number	Applied hexagonal nut
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5
100~180	JIS 2 type (A-PT1/8)	—	1M36×1.5~1M64×3


Grease fitting


Grease fitting

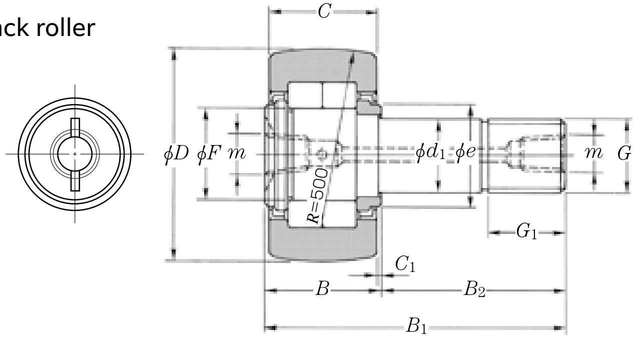

Plug


Hexagon nut

Basic load rating N dynamic C_r	static C_{0r}	Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed min-1 Grease lubrication	Maximum tightening torque N · m	Number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
13 300	13 500	2 620	7 700	6 900	20	**NUKR 30/3AS**	**NUKR 30X/3AS**	0.088	**12**
22 300	25 700	3 200	11 900	5 500	52	**NUKR 35/3AS**	**NUKR 35X/3AS**	0.165	**16**
24 100	29 100	3 850	14 500	4 700	76	**NUKR 40/3AS**	**NUKR 40X/3AS**	0.242	**18**
38 500	48 000	4 700	21 000	4 000	98	**NUKR 47/3AS**	**NUKR 47X/3AS**	0.380	**20**
42 500	57 500	5 550	23 300	3 300	98	**NUKR 52/3AS**	**NUKR 52X/3AS**	0.450	**20**
56 500	72 500	6 950	34 500	2 900	178	**NUKR 62/3AS**	**NUKR 62X/3AS**	0.795	**24**
62 000	85 500	8 050	38 500	2 400	178	**NUKR 72/3AS**	**NUKR 72X/3AS**	1.01	**24**
101 000	151 000	9 800	53 000	2 100	360	**NUKR 80/3AS**	**NUKR 80X/3AS**	1.54	**30**
101 000	151 000	11 400	59 000	2 100	360	**NUKR 90/3AS**	**NUKR 90X/3AS**	1.96	**30**
119 000	167 000	13 000	79 000	2 000	630	**NUKR 100/3AS**	**NUKR 100X/3AS**	3.08	**36**
172 000	266 000	16 400	113 000	1 700	1 020	**NUKR 120/3AS**	**NUKR 120X/3AS**	5.17	**42**
201 000	294 000	20 000	152 000	1 500	1 540	**NUKR 140/3AS**	**NUKR 140X/3AS**	7.98	**48**
258 000	380 000	22 000	173 000	1 300	1 950	**NUKR 150/3AS**	**NUKR 150X/3AS**	9.70	**52**
274 000	400 000	24 000	194 000	1 200	2 480	**NUKR 160/3AS**	**NUKR 160X/3AS**	11.7	**56**
320 000	475 000	26 000	218 000	1 100	3 030	**NUKR 170/3AS**	**NUKR 170X/3AS**	13.9	**60**
365 000	555 000	27 900	253 000	1 000	3 670	**NUKR 180/3AS**	**NUKR 180X/3AS**	17.0	**64**

Cam follower stud type track roller metric series

NUKRT type
NUKRT··X type



NUKRT type
(Full complement double-row cylindrical roller bearings with shield)

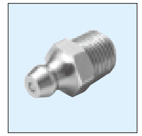
D 30 ～ 180mm

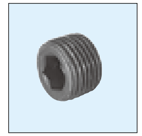
Outer dia.[1) mm D $^{0}_{-0.05}$	Dimensions mm											Basic load rating N dynamic	static	Fatigue load limit N
	d_1	C	F	B	B_1	B_2	G	G_1	C_1	m	e	C_r	C_{0r}	C_u
30	12 $^{0}_{-0.018}$	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	13 300	13 500	1 650
35	16 $^{0}_{-0.018}$	18	19	19.5	52	32.5	M16×1.5	17	0.8	Rc ⅛	21	22 300	25 700	3 150
40	18 $^{0}_{-0.018}$	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	Rc ⅛	23	24 100	29 100	3 550
47	20 $^{0}_{-0.021}$	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	Rc ⅛	27	38 500	48 000	5 900
52	20 $^{0}_{-0.021}$	24	30	25.5	66	40.5	M20×1.5	21	0.8	Rc ⅛	31	42 500	57 500	7 000
62	24 $^{0}_{-0.021}$	29	35	30.5	80	49.5	M24×1.5	25	0.8	Rc ⅛	38	56 500	72 500	8 850
72	24 $^{0}_{-0.021}$	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	Rc ⅛	44	62 000	85 500	10 400
80	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	Rc ⅛	51	101 000	151 000	18 400
90	30 $^{0}_{-0.021}$	35	47.5	37	100	63	M30×1.5	32	1	Rc ⅛	51	101 000	151 000	18 400
100	36 $^{0}_{-0.025}$	43	48.5	46	120	74	M36×1.5	38	1.5	Rc ⅛	53	119 000	167 000	20 400
120	42 $^{0}_{-0.025}$	50	60.5	53	140	87	M42×1.5	44	1.5	Rc ⅛	66	172 000	266 000	32 500
140	48 $^{0}_{-0.025}$	57	65	60	160	100	M48×1.5	52	1.5	Rc ⅛	72.5	201 000	294 000	36 000
150	52 $^{0}_{-0.030}$	60	75.5	63	170	107	M52×1.5	52	1.5	Rc ⅛	85.5	258 000	380 000	46 500
160	56 $^{0}_{-0.030}$	63	80.5	67	180	113	M56×3	58	2	Rc ⅛	89.5	274 000	400 000	49 000
170	60 $^{0}_{-0.030}$	66	86	70	190	120	M60×3	58	2	Rc ⅛	96.5	320 000	475 000	58 000
180	64 $^{0}_{-0.030}$	72	91.5	76	200	124	M64×3	65	2	Rc ⅛	103.5	365 000	555 000	67 500

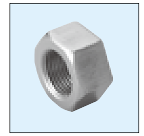
1) The tolerance of outer ring outer diameter D of NUKRT··X type having a cylindrical outer diameter surface is JIS 0 class.

Accessories

Applied Number	Grease nipple number	Number of hex socket screw plug	Applied hexagonal nut
30	JIS 1 type (A-M6F)	M6×0.75×6 ℓ	1M12×1.5
35～180	JIS 2 type (A-PT ⅛)	R⅛(PT ⅛)×7 ℓ	1M16×1.5～1M64×3


Grease fitting

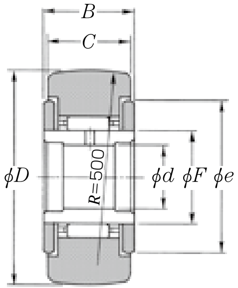

Hex socket screw plug


Hexagon nut

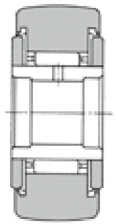
Track load capacity N Spherical outer ring	Cylindrical outer ring	Allowable speed min⁻¹ Grease lubrication	Maximum tightening torque N · m	Number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Stud dia. mm
2 620	7 700	6 900	20	**NUKRT 30/3AS**	**NUKRT 30X/3AS**	0.088	**12**
3 200	11 900	5 500	52	**NUKRT 35/3AS**	**NUKRT 35X/3AS**	0.165	**16**
3 850	14 500	4 700	76	**NUKRT 40/3AS**	**NUKRT 40X/3AS**	0.242	**18**
4 700	21 000	4 000	98	**NUKRT 47/3AS**	**NUKRT 47X/3AS**	0.380	**20**
5 550	23 300	3 300	98	**NUKRT 52/3AS**	**NUKRT 52X/3AS**	0.450	**20**
6 950	34 500	2 900	178	**NUKRT 62/3AS**	**NUKRT 62X/3AS**	0.795	**24**
8 050	38 500	2 400	178	**NUKRT 72/3AS**	**NUKRT 72X/3AS**	1.01	**24**
9 800	53 000	2 100	360	**NUKRT 80/3AS**	**NUKRT 80X/3AS**	1.54	**30**
11 400	59 000	2 100	360	**NUKRT 90/3AS**	**NUKRT 90X/3AS**	1.96	**30**
13 000	79 000	2 000	630	**NUKRT 100/3AS**	**NUKRT 100X/3AS**	3.08	**36**
16 400	113 000	1 700	1 020	**NUKRT 120/3AS**	**NUKRT 120X/3AS**	5.17	**42**
20 000	152 000	1 500	1 540	**NUKRT 140/3AS**	**NUKRT 140X/3AS**	7.98	**48**
22 000	173 000	1 300	1 950	**NUKRT 150/3AS**	**NUKRT 150X/3AS**	9.70	**52**
24 000	194 000	1 200	2 480	**NUKRT 160/3AS**	**NUKRT 160X/3AS**	11.7	**56**
26 000	218 000	1 100	3 030	**NUKRT 170/3AS**	**NUKRT 170X/3AS**	13.9	**60**
27 900	253 000	1 000	3 670	**NUKRT 180/3AS**	**NUKRT 180X/3AS**	17.0	**64**

Roller follower yoke type track roller
metric series

NATR type
NATR··X type
NATR··LL type
NATR··XLL type



NATR type
(With cage)


NATR··LL type
(Seal type with cage)

D 16～90mm

Outer dia.[1) mm] D ($^{0}_{-0.05}$)	Dimensions mm d	B	C	e	F	Basic load rating N dynamic C_r	static C_{0r}	Track load capacity N Spherical outer ring	Cylindrical outer ring	Fatigue load limit N C_u
16	5	12 $^{0}_{-0.180}$	11	12	8	4 050	4 200	1 080	3 400	510
19	6	12 $^{0}_{-0.180}$	11	14	10	4 750	5 400	1 380	4 050	660
24	8	15 $^{0}_{-0.180}$	14	19	12	6 900	7 700	1 900	6 650	940
30	10	15 $^{0}_{-0.180}$	14	23	15	7 850	9 650	2 620	7 700	1 180
32	12	15 $^{0}_{-0.180}$	14	25	17	8 400	10 900	2 860	8 200	1 330
35	15	19 $^{0}_{-0.210}$	18	27	20	13 300	20 800	3 200	11 900	2 530
40	17	21 $^{0}_{-0.210}$	20	32	22	14 000	22 800	3 850	14 500	2 790
47	20	25 $^{0}_{-0.210}$	24	37	25	20 700	33 500	4 700	21 000	4 100
52	25	25 $^{0}_{-0.210}$	24	42	30	22 800	40 500	5 500	23 300	4 950
62	30	29 $^{0}_{-0.210}$	28	51	38	36 000	66 000	6 950	33 000	8 100
72	35	29 $^{0}_{-0.210}$	28	58	44.5	39 000	77 000	8 050	37 000	9 400
80	40	32 $^{0}_{-0.250}$	30	66	50	49 500	92 500	9 800	44 500	11 300
85	45	32 $^{0}_{-0.250}$	30	71	55	51 500	100 000	10 400	47 000	12 200
90	50	32 $^{0}_{-0.250}$	30	76	60	53 000	108 000	11 400	50 000	13 200

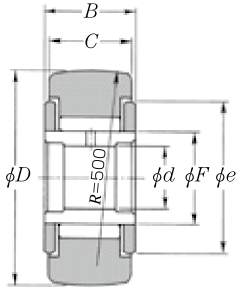
1) The tolerance of outer ring outer diameter *D* of NATR··X type and NATR··XLL type having a cylindrical outer diameter surface is JIS 0 class.

Allowable speed[2)] min⁻¹ Grease lubrication	Oil lubrication	Number Without seal Spherical outer ring	Without seal Cylindrical outer ring	With seal Spherical outer ring	With seal Cylindrical outer ring	Mass kg (approx.)	Outer dia.[1)] mm D ($^{0}_{-0.05}$)
*19 000	*25 000	**NATR5**	**NATR5X**	**NATR5LL/3AS**	**NATR5XLL/3AS**	0.018	**16**
*15 000	*20 000	**NATR6**	**NATR6X**	**NATR6LL/3AS**	**NATR6XLL/3AS**	0.025	**19**
*12 000	*16 000	**NATR8**	**NATR8X**	**NATR8LL/3AS**	**NATR8XLL/3AS**	0.042	**24**
10 000	*13 000	**NATR10**	**NATR10X**	**NATR10LL/3AS**	**NATR10XLL/3AS**	0.061	**30**
9 000	*12 000	**NATR12CT**	**NATR12XCT**	**NATR12CLLT/3AS**	**NATR12CXLLT/3AS**	0.069	**32**
7 500	10 000	**NATR15**	**NATR15X**	**NATR15LL/3AS**	**NATR15XLL/3AS**	0.098	**35**
7 000	9 000	**NATR17**	**NATR17X**	**NATR17LL/3AS**	**NATR17XLL/3AS**	0.140	**40**
6 000	8 000	**NATR20**	**NATR20X**	**NATR20LL/3AS**	**NATR20XLL/3AS**	0.246	**47**
5 000	6 500	**NATR25**	**NATR25X**	**NATR25LL/3AS**	**NATR25XLL/3AS**	0.275	**52**
4 000	5 500	**NATR30**	**NATR30X**	**NATR30LL/3AS**	**NATR30XLL/3AS**	0.470	**62**
3 300	4 500	**NATR35**	**NATR35X**	**NATR35LL/3AS**	**NATR35XLL/3AS**	0.635	**72**
3 000	4 000	**NATR40**	**NATR40X**	**NATR40LL/3AS**	**NATR40XLL/3AS**	0.875	**80**
2 700	3 600	**NATR45**	**NATR45X**	**NATR45LL/3AS**	**NATR45XLL/3AS**	0.910	**85**
2 500	3 300	**NATR50**	**NATR50X**	**NATR50LL/3AS**	**NATR50XLL/3AS**	0.960	**90**

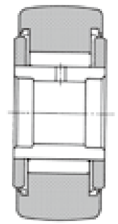
2) The allowable speed of bearings with a "*" mark seal is about 10 000 min^{-1}.

Roller follower yoke type track roller
metric series

NATV type
NATV··X type
NATV··LL type
NATV··XLL type



NATV type
(Full complement roller type)



NATV··LL type
(Full complement roller sealed type)

D 16 ～ 90mm

Outer dia.[1) mm] D $^{0}_{-0.05}$	Dimensions mm d	B	C	e	F	Basic load rating N dynamic C_r	static C_{0r}	Track load capacity N Spherical outer ring	Cylindrical outer ring	Fatigue load limit N C_u
16	5	12 $^{0}_{-0.180}$	11	12	8	6 500	9 350	1 080	3 400	1 140
19	6	12 $^{0}_{-0.180}$	11	14	10	7 450	11 700	1 380	4 050	1 430
24	8	15 $^{0}_{-0.180}$	14	19	12	10 700	16 200	1 900	6 650	1 980
30	10	15 $^{0}_{-0.180}$	14	23	15	12 000	20 300	2 620	7 700	2 470
32	12	15 $^{0}_{-0.180}$	14	25	17	13 000	23 000	2 860	8 200	2 810
35	15	19 $^{0}_{-0.210}$	18	27	20	18 400	38 000	3 200	11 900	4 650
40	17	21 $^{0}_{-0.210}$	20	32	22	19 400	42 000	3 850	14 500	5 100
47	20	25 $^{0}_{-0.210}$	24	37	25	28 800	61 000	4 700	21 000	7 450
52	25	25 $^{0}_{-0.210}$	24	42	30	31 500	73 500	5 500	23 300	8 950
62	30	29 $^{0}_{-0.210}$	28	51	38	47 500	115 000	6 950	33 000	14 000
72	35	29 $^{0}_{-0.210}$	28	58	44.5	52 000	134 000	8 050	37 000	16 300
80	40	32 $^{0}_{-0.250}$	30	66	50	68 500	171 000	9 800	44 500	20 900
90	50	32 $^{0}_{-0.250}$	30	76	60	76 000	205 000	11 400	50 000	25 000

1) The tolerance of outer ring outer diameter *D* of NATV··X type and NATV··XLL type having a cylindrical outer diameter surface is JIS 0 class.

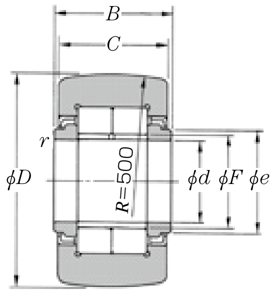
Needle Roller Bearings NTN

Allowable speed[2)] min^{-1} Grease lubrication	Oil lubrication	Number Without seal Spherical outer ring	Cylindrical outer ring	With seal Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Outer dia.[1)] mm D $^{0}_{-0.05}$
*13 000	*16 000	**NATV5/3AS**	**NATV5X/3AS**	**NATV5LL/3AS**	**NATV5XLL/3AS**	0.020	**16**
10 000	*13 000	**NATV6/3AS**	**NATV6X/3AS**	**NATV6LL/3AS**	**NATV6XLL/3AS**	0.027	**19**
8 500	*11 000	**NATV8/3AS**	**NATV8X/3AS**	**NATV8LL/3AS**	**NATV8XLL/3AS**	0.044	**24**
6 500	8 500	**NATV10/3AS**	**NATV10X/3AS**	**NATV10LL/3AS**	**NATV10XLL/3AS**	0.065	**30**
6 000	7 500	**NATV12/3AS**	**NATV12X/3AS**	**NATV12LL/3AS**	**NATV12XLL/3AS**	0.074	**32**
5 000	6 500	**NATV15/3AS**	**NATV15X/3AS**	**NATV15LL/3AS**	**NATV15XLL/3AS**	0.102	**35**
4 500	6 000	**NATV17/3AS**	**NATV17X/3AS**	**NATV17LL/3AS**	**NATV17XLL/3AS**	0.145	**40**
4 000	5 000	**NATV20/3AS**	**NATV20X/3AS**	**NATV20LL/3AS**	**NATV20XLL/3AS**	0.254	**47**
3 300	4 500	**NATV25/3AS**	**NATV25X/3AS**	**NATV25LL/3AS**	**NATV25XLL/3AS**	0.285	**52**
2 600	3 500	**NATV30/3AS**	**NATV30X/3AS**	**NATV30LL/3AS**	**NATV30XLL/3AS**	0.481	**62**
2 200	2 900	**NATV35/3AS**	**NATV35X/3AS**	**NATV35LL/3AS**	**NATV35XLL/3AS**	0.647	**72**
2 000	2 600	**NATV40/3AS**	**NATV40X/3AS**	**NATV40LL/3AS**	**NATV40XLL/3AS**	0.890	**80**
1 600	2 100	**NATV50/3AS**	**NATV50X/3AS**	**NATV50LL/3AS**	**NATV50XLL/3AS**	0.990	**90**

2) The allowable speed of bearings with a "*" mark seal is about 10 000 min^{-1}.

Roller follower yoke type track roller
metric series

NUTR2 type
NUTR2··X type
NUTR3 type
NUTR3··X type



NUTR2 type
NUTR3 type

D 35 ～ 110mm

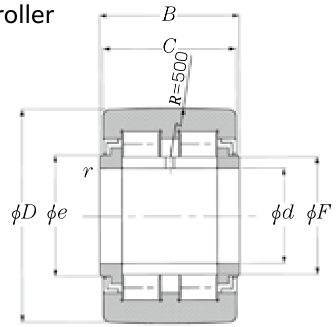
Outer dia.[1] mm D $^{0}_{-0.05}$	Dimensions mm d	B		C	e	F	$r_{s\,min}$[2]	Basic load rating N dynamic C_r	static C_{0r}	Track load capacity N Spherical outer ring	Cylindrical outer ring	Fatigue load limit N C_u
35	15	19	$^{0}_{-0.210}$	18	20	19	0.3	22 300	25 700	3 200	11 900	3 150
40	17	21	$^{0}_{-0.210}$	20	22	21.5	0.3	24 100	29 100	3 850	14 500	3 550
42	15	19	$^{0}_{-0.210}$	18	20	19	0.3	22 300	25 700	4 100	14 300	3 150
47	17	21	$^{0}_{-0.210}$	20	22	21.5	0.3	24 100	29 100	4 700	17 000	3 550
	20	25		24	27	25.5	0.3	38 500	48 000	4 700	21 000	5 900
52	20	25	$^{0}_{-0.210}$	24	27	25.5	0.3	38 500	48 000	5 550	23 300	5 900
	25	25		24	31	30	0.3	42 500	57 500	5 550	23 300	7 000
62	25	25	$^{0}_{-0.210}$	24	31	30	0.3	42 500	57 500	6 950	27 800	7 000
	30	29		28	38	35	0.3	56 500	72 500	6 950	33 000	8 850
72	30	29	$^{0}_{-0.210}$	28	38	35	0.3	56 500	72 500	8 050	38 500	8 850
	35	29		28	44	41.5	0.6	62 000	85 500	8 050	37 000	10 400
80	35	29	$^{0}_{-0.210}$	28	44	41.5	0.6	62 000	85 500	9 800	41 000	10 400
	40	32	$^{0}_{-0.250}$	30	51	47.5	0.6	87 000	125 000	9 800	44 500	15 200
85	45	32	$^{0}_{-0.250}$	30	55	52.5	0.6	92 000	137 000	10 400	47 000	16 700
90	40	32	$^{0}_{-0.250}$	30	51	47.5	0.6	87 000	125 000	11 400	50 000	15 200
	50	32		30	60	57	0.6	96 500	150 000	11 400	50 000	18 300
100	45	32	$^{0}_{-0.250}$	30	55	52.5	0.6	92 000	137 000	13 000	55 500	16 700
110	50	32	$^{0}_{-0.250}$	30	60	57	0.6	96 500	150 000	14 700	61 000	18 300

1) The tolerance of outer ring outer diameter D of NUTR2··X type and NUTR3··X type having a cylindrical outer diameter surface is JIS 0 class.
2) Smallest allowable dimension for chamfer dimension r.

Allowable speed min⁻¹ Grease lubrication	Number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Outer dia.[1] mm D $^{0}_{-0.05}$
5 500	**NUTR202/3AS**	**NUTR202X/3AS**	0.100	**35**
4 700	**NUTR203/3AS**	**NUTR203X/3AS**	0.147	**40**
5 500	**NUTR302/3AS**	**NUTR302X/3AS**	0.160	**42**
4 700	**NUTR303/3AS**	**NUTR303X/3AS**	0.222	**47**
4 000	**NUTR204/3AS**	**NUTR204X/3AS**	0.245	
4 000	**NUTR304/3AS**	**NUTR304X/3AS**	0.321	**52**
3 300	**NUTR205/3AS**	**NUTR205X/3AS**	0.281	
3 300	**NUTR305/3AS**	**NUTR305X/3AS**	0.450	**62**
2 900	**NUTR206/3AS**	**NUTR206X/3AS**	0.466	
2 900	**NUTR306/3AS**	**NUTR306X/3AS**	0.697	**72**
2 400	**NUTR207/3AS**	**NUTR207X/3AS**	0.630	
2 400	**NUTR307/3AS**	**NUTR307X/3AS**	0.840	**80**
2 100	**NUTR208/3AS**	**NUTR208X/3AS**	0.817	
1 900	**NUTR209/3AS**	**NUTR209X/3AS**	0.883	**85**
2 100	**NUTR308/3AS**	**NUTR308X/3AS**	1.13	**90**
1 800	**NUTR210/3AS**	**NUTR210X/3AS**	0.950	
1 900	**NUTR309/3AS**	**NUTR309X/3AS**	1.40	**100**
1 800	**NUTR310/3AS**	**NUTR310X/3AS**	1.69	**110**

Roller follower yoke type track roller
metric series

NUTW2 type
NUTW··X type



NUTW2 type

D 35 ～ 90mm

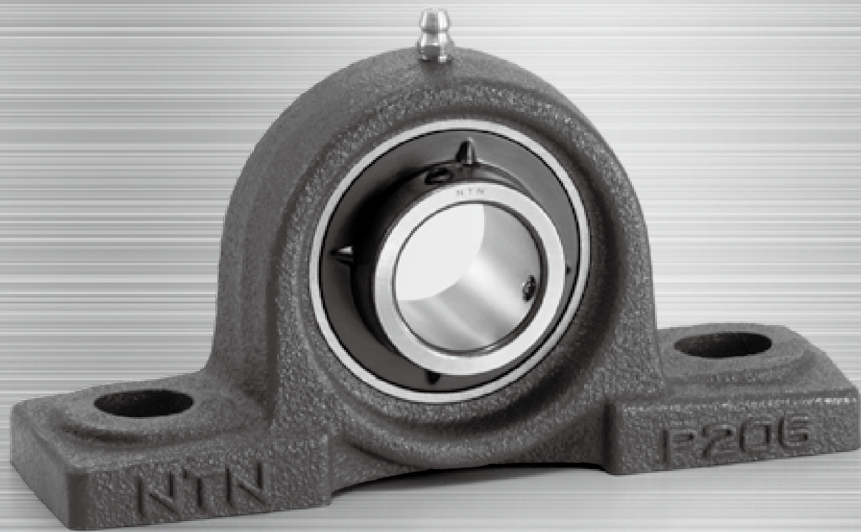
Outer dia.[1] mm D $^{0}_{-0.05}$	Dimensions mm d	B	C	e	F	$r_{s\,min}$[2]	Basic load rating dynamic N C_r	static C_{0r}	Track load capacity N Spherical outer ring	Cylindrical outer ring	Fatigue load limit N C_u	Allowable speed min⁻¹ Grease lubrication	Number Spherical outer ring	Cylindrical outer ring	Mass kg (approx.)	Outer dia.[1] mm D $^{0}_{-0.05}$
35	15	22 $^{0}_{-0.210}$	21	20	19	0.3	24 100	28 300	3 200	14 200	3 450	5 500	**NUTW202/3AS**	**NUTW202X/3AS**	0.115	**35**
40	17	24 $^{0}_{-0.210}$	23	22	21.5	0.3	26 000	32 000	3 850	17 100	3 900	4 700	**NUTW203/3AS**	**NUTW203X/3AS**	0.167	**40**
47	20	29 $^{0}_{-0.210}$	28	27	25.5	0.3	40 500	51 500	4 700	25 100	6 300	4 000	**NUTW204/3AS**	**NUTW204X/3AS**	0.280	**47**
52	25	29 $^{0}_{-0.210}$	28	31	30	0.3	45 000	61 500	5 550	27 700	7 500	3 300	**NUTW205/3AS**	**NUTW205X/3AS**	0.322	**52**
62	30	35 $^{0}_{-0.210}$	34	38	35	0.3	59 500	77 000	6 950	41 000	9 400	2 900	**NUTW206/3AS**	**NUTW206X/3AS**	0.549	**62**
72	35	35 $^{0}_{-0.210}$	34	44	41.5	0.6	65 000	91 000	8 050	46 000	11 100	2 400	**NUTW207/3AS**	**NUTW207X/3AS**	0.747	**72**
80	40	38 $^{0}_{-0.250}$	36	51	47.5	0.6	90 500	131 000	9 800	54 500	16 000	2 100	**NUTW208/3AS**	**NUTW208X/3AS**	0.953	**80**
85	45	38 $^{0}_{-0.250}$	36	55	52.5	0.6	95 500	144 000	10 400	58 000	17 600	1 900	**NUTW209/3AS**	**NUTW209X/3AS**	1.03	**85**
90	50	38 $^{0}_{-0.250}$	36	60	57	0.6	100 000	158 000	11 400	61 500	19 200	1 800	**NUTW210/3AS**	**NUTW210X/3AS**	1.11	**90**

1) For bearings having a cylindrical outer ring surface, code "X" is added after the bearing number. In this case, the tolerance of outer ring outer diameter D of cylindrical bearings is JIS 0 class. Example: NUTW203X
2) Smallest allowable dimension for chamfer dimension r.

Needle Roller Bearings NTN

Bearing Units Contents

Bearing Units



1. Design features and characteristics of bearing unit

The **NTN** bearing unit is a combination of a radial ball bearing with seals and a cast iron or steel housing of various shapes. The bearing outer diameter surface and the housing inner diameter surface are spherical and have a self-aligning design.

The internal construction of the ball bearing for units uses the same steel ball and cage as the bearing series 62 and 63 of the **NTN** deep groove ball bearings. Seals consisting of an oil resistant synthetic rubber, and a **NTN** unique slinger (also referred to as a flinger) is provided on both sides.

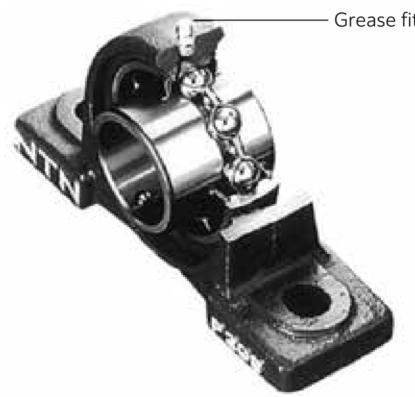
The included bearings for units are factory filled with grease and sealed, but can be re-lubricated from the grease fitting. See section “11. Lubrication” for greases used.

The ball bearings for units have a wide inner ring which depending on the type, fit to the shaft in the following ways:

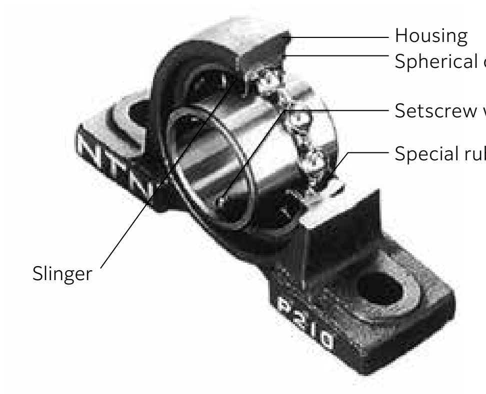
1. The inner ring is fastened to the shaft in two places by ball point setscrews.
2. The inner ring has a tapered bore and is fitted to the shaft by means of an adapter.
3. The inner ring is fastened to the shaft by an eccentric locking collar system by means of eccentric groves on the side of the inner ring and a collar.
4. The inner ring is fastened to the shaft by providing an interference fit.

For the details of **NTN** bearing units, see the special catalog “**Bearing units (CAT. No. 2400/E)**.”

NTN bearing unit with grease fitting



NTN bearing unit without grease fitting



2. Bearing unit types

Table 1 Main types of ball bearings for bearing units

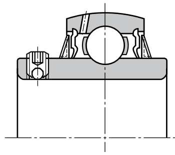
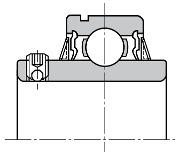
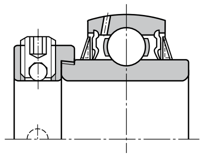
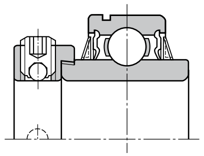
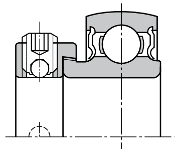
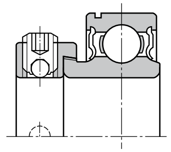
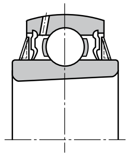
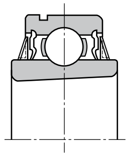
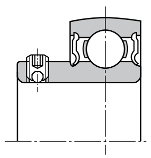
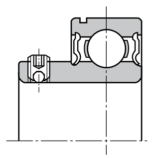
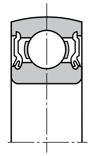
Type		
UC (S) type Cylindrical bore type Setscrew type	 (F-)UC type	 UCS type
UEL (S) type Cylindrical bore type Eccentric collar type	 UEL type	 UELS type
AEL (S) type Cylindrical bore type Eccentric collar type	 AEL type	 AELS type
UK (S) type Tapered bore type Adapter type	 UK type	 UKS type
AS (S) type Cylindrical bore type Setscrew type	 AS type	 ASS type
CS type Cylindrical bore type Tight fit type	 CS···LLU type	

Table 2 (1) List of cast iron pillow bearing unit types

Housing type	Cover	UC	UEL	UK;H	AS	AEL	CS
Cast iron pillow type	None	UCP	UELP	UKP	ASP	AELP	–
	Steel	S(M)-UCP	–	S(M)-UKP	S(M)-ASP	–	–
	Cast iron	C(M)-UCP	C(M)E-UELP	C(M)-UKP	C(M)-ASP	–	–
Cast iron thick pillow type	None	UCIP	UELIP	UKIP	–	–	–
	Steel	S(M)-UCIP	–	S(M)-UKIP	–	–	–
	Cast iron	C(M)-UCIP	C(M)E-UELIP	C(M)-UKIP	–	–	–
Cast iron center height pillow type	None	UCHP	UELHP	UKHP	ASHP	AELHP	–
	Steel	S(M)-UCHP	–	S(M)-UKHP	S(M)-ASHP	–	–
Cast iron narrow width pillow type	None	UCUP	UELUP	UKUP	ASUP	AELUP	–
	Steel	S(M)-UCUP	–	S(M)-UKUP	S(M)-ASUP	–	–
Lightweight cast iron pillow type	None	–	–	–	ASPB	AELPB	CSPB
Cast iron low center height pillow type	None	UCPL	UELPL	UKPL	ASPL	AELPL	–

(Bearing type: UC, UEL, UK;H, AS, AEL, CS)

Note: 1. Type code S- is given for steel covers that open on both sides, and type code SM- is given for steel covers that close on one side.
2. Type code C- is given for cast iron covers that open on both sides, and type code CM- is given for cast iron covers that close on one side. However, in the case of cast iron covers combined with eccentric locking ring bearings, type code CE- is given for covers that open on both sides, and type code CME- is given for covers that close on one side.

Table 2 (2) List of cast iron flange bearing unit types

Housing type	Cover	UC	UEL	UK;H	AS	AEL	CS
Cast iron square flange	None	UCF	UELF	UKF	ASF	AELF	–
	Steel	S(M)-UCF	–	S(M)-UKF	S(M)-ASF	–	–
	Cast iron	C(M)-UCF	C(M)E-UELF	C(M)-UKF	C(M)-ASF	–	–
Square flange with cast iron spigot joint	None	UCFS	UELFS	UKFS	–	–	–
	Cast iron	C(M)-UCFS	C(M)E-UELFS	C(M)-UKFS	–	–	–
Round flange with cast iron spigot joint	None	UCFC	UELFC	UKFC	ASFC	AELFC	–
	Steel	S(M)-UCFC	–	S(M)-UKFC	S(M)-ASFC	–	–
	Cast iron	C(M)-UCFC	C(M)E-UELFC	C(M)-UKFC	C(M)-ASFC	–	–
Cast iron rhombic flange	None	UCFL	UELFL	UKFL	ASFL	AELFL	–
	Steel	S(M)-UCFL	–	S(M)-UKFL	S(M)-ASFL	–	–
	Cast iron	C(M)-UCFL	C(M)E-UELFL	C(M)-UKFL	C(M)-ASFL	–	–
Cast iron square flange	None	UCFU	UELFU	UKFU	ASFU	AELFU	–
Cast iron rhombic flange	None	UCFLU	UELFLU	UKFLU	ASFLU	AELFLU	–
Cast iron deformed rhombic flange	None	UCFA	UELFA	UKFA	ASFA	AELFA	–
	Steel	S(M)-UCFA	–	S(M)-UKFA	S(M)-ASFA	–	–
Lightweight cast iron rhombic flange	None	–	–	–	ASFB	AELFB	CSFB
Lightweight cast iron rhombic flange	None	–	–	–	ASFD	AELFD	–
Cast iron deformed flange	None	UCFH	UELFH	UKFH	ASFH	AELFH	–

(Bearing type: UC, UEL, UK;H, AS, AEL, CS)

Note: 1. Type code S- is given for steel opening covers, and type code SM- is given for steel closing covers.
2. Type code C- is given for cast iron opening covers, and type code CM- is given for cast iron closing covers. However, in the case of cast iron covers combined with eccentric locking ring bearings, type code CE- is given for covers that open on both sides, and type code CME- is given for covers that close on one side.
3. The housing type of F and FU types, FL and FLU types, and FB and FD types are the same but have different attachment part dimensions.

Table 2 (3) List of other cast iron bearing unit types

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Cast iron take-up type	None	UCT	UELT	UKT	AST	AELT	—
	Steel	S(M)-UCT	—	S(M)-UKT	S(M)-AST	—	—
	Cast iron	C(M)-UCT	C(M)E-UELT	C(M)-UKT	C(M)-AST	—	—
Cast iron cartridge type	None	UCC	UELC	UKC	ASC	AELC	—
Cast iron hanger type	None	UCHB	UELHB	UKHB	ASHB	AELHB	—

Note: 1. Type code S- is given for steel covers that open on both sides, and type code SM- is given for steel covers that close on one side.
2. Type code C- is given for cast iron covers that open on both sides, and type code CM- is given for cast iron covers that close on one side. However, in the case of cast iron covers combined with eccentric locking ring bearings, type code CE- is given for covers that open on both sides, and type code CME- is given for covers that close on one side.

Table 2 (4) List of spherical graphite cast iron bearing unit types (ductile series)

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Spherical graphite cast iron pillow type	None	UCPE	UELPE	UKPE	ASPE	AELPE	—
Spherical graphite cast iron rhombic flange	None	UCFE	UELFE	UKFE	ASFE	AELFE	—

Table 2 (5) List of structural rolled steel bearing unit types (steel series)

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Structural rolled steel pillow type	None	UCPG	UELPG	UKPG	ASPG	AELPG	—
	Steel	S(M)-UCPG	—	S(M)-UKPG	S(M)-ASPG	—	—
	Cast iron	C(M)-UCPG	C(M)E-UELPG	C(M)-UKPG	C(M)-ASPG	—	—
Structural rolled steel thick pillow type	None	UCIPG	UELIPG	UKIPG	—	—	—
	Steel	S(M)-UCIPG	—	S(M)-UKIPG	—	—	—
	Cast iron	C(M)-UCIPG	C(M)E-UELIPG	C(M)-UKIPG	—	—	—
Structural rolled steel square flange	None	UCFG	UELFG	UKFG	ASFG	AELFG	—
	Steel	S(M)-UCFG	—	S(M)-UKFG	S(M)-ASFG	—	—
	Cast iron	C(M)-UCFG	C(M)E-UELFG	C(M)-UKFG	C(M)-ASFG	—	—
Structural rolled steel square flange with spigot joint	None	UCFSG	UELFSG	UKFSG	—	—	—
	Cast iron	C(M)-UCFSG	C(M)E-UELFSG	C(M)-UKFSG	—	—	—
Structural rolled steel round flange with spigot joint	None	UCFCG	UELFCG	UKFCG	ASFCG	AELFCG	—
	Steel	S(M)-UCFCG	—	S(M)-UKFCG	S(M)-ASFCG	—	—
	Cast iron	C(M)-UCFCG	C(M)E-UELFCG	C(M)-UKFCG	C(M)-ASFCG	—	—
Structural rolled steel rhombic flange	None	UCFLG	UELFLG	UKFLG	ASFLG	AELFLG	—
	Steel	S(M)-UCFLG	—	S(M)-UKFLG	S(M)-ASFLG	—	—
	Cast iron	C(M)-UCFLG	C(M)E-UELFLG	C(M)-UKFLG	C(M)-ASFLG	—	—
Structural rolled steel take-up type	None	UCTG	UELTG	UKTG	ASTG	AELTG	—
	Steel	S(M)-UCTG	—	S(M)-UKTG	S(M)-ASTG	—	—
	Cast iron	C(M)-UCTG	C(M)E-UELTG	C(M)-UKTG	C(M)-ASTG	—	—

Note: 1. Type code S- is given for steel covers that open on both sides, and type code SM- is given for steel covers that close on one side.
2. Type code C- is given for cast iron covers that open on both sides, and type code CM- is given for cast iron covers that close on one side. However, in the case of cast iron covers combined with eccentric locking ring bearings, type code CE- is given for covers that open on both sides, and type code CME- is given for covers that close on one side.

Table 2 (6) List of stainless steel bearing unit types (stainless steel series)

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Cast iron take-up type	None	F-UCPM	—	—	—	—	—
	Stainless steel	F-FS(M)-UCPM	—	—	—	—	—
Stainless steel cast iron square flange	None	F-UCQFM	—	—	—	—	—
	Stainless steel	F-FS(M)-UCQFM	—	—	—	—	—
Stainless steel cast iron rhombic flange	None	F-UCFM	—	—	—	—	—
	Stainless steel	F-FS(M)-UCFM	—	—	—	—	—

Note: Type code F- FSM- is given for stainless steel covers that close on one side.

Table 2 (7) List of glass-fiber reinforced resin bearing unit types (plastic series)

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Glass-fiber reinforced resin pillow type	None	F-UCPR	—	—	—	—	—
	Resin	F-RM-UCPR	—	—	—	—	—
Glass-fiber reinforced resin rhombic flange	None	F-UCFLR	—	—	—	—	—
	Resin	F-RM-UCFLR	—	—	—	—	—

Note: The resin cover is only on one side.

Table 2 (8) List of steel bearing unit types

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL	CS
Steel pillow type	None	—	—	—	ASPP	AELPP	CSPP
Steel pillow type with rubber ring	None	—	—	—	ASRPP	AELRPP	CSRPP
Steel round flange type	None	—	—	—	ASPF	AELPF	CSPF
Steel round flange type with rubber ring	None	—	—	—	ASRPF	AELRPF	CSRPF
Steel rhombic flange	None	—	—	—	ASPFL	AELPFL	CSPFL
Steel rhombic flange type with rubber ring	None	—	—	—	ASRPFL	AELRPFL	CSRPFL

Table 2 (9) List of stretcher® unit types

Housing type	Cover	Bearing type UC	UEL	UK;H	AS	AEL
Stretcher steel mini type	None	—	—	—	ASPT	AELPT
Stretcher protrusion steel frame	None	UCT-00	UELT-00	UKT-00	AST-00	AELT-00
	Steel	S(M)-UCT-00	—	S(M)-UKT-00	S(M)-AST-00	—
	Cast iron	C(M)-UCT-00	C(M)E-UELT-00	C(M)-UKT-00	C(M)-AST-00	—
Stretcher light groove steel frame	None	UCL-00	UELL-00	UKL-00	ASL-00	AELL-00
	Steel	S(M)-UCL-00	—	S(M)-UKL-00	S(M)-ASL-00	—
	Cast iron	C(M)-UCL-00	C(M)E-UELL-00	C(M)-UKL-00	C(M)-ASL-00	—
Stretcher groove steel frame	None	UCM-00	UELM-00	UKM-00	ASM-00	AELM-00
	Steel	S(M)-UCM-00	—	S(M)-UKM-00	S(M)-ASM-00	—
	Cast iron	C(M)-UCM-00	C(M)E-UELM-00	C(M)-UKM-00	C(M)-ASM-00	—

Note: 1. Type code S- is given for steel covers that open on both sides, and type code SM- is given for steel covers that close on one side.
2. Type code C- is given for cast iron covers that open on both sides, and type code CM- is given for cast iron covers that close on one side. However, in the case of cast iron covers combined with eccentric locking ring bearings, type code CE- is given for covers that open on both sides, and type code CME- is given for covers that close on one side.

3. Accuracy

The accuracy of **NTN** bearing units conform to JIS B1558 (Roller bearings: insert bearings and eccentric locking rings) and JIS B1559 (Roller bearings: insert bearings and steel housings).

3.1 Accuracy of ball bearings for units

Tables 3 and **4** show the accuracy of ball bearings for units.

Table 3 Tolerance values for inner rings

Unit: μm

Nominal bearing bore diameter d mm		Cylindrical bore bearings: Bearing bore diameter, All models except CS type: Mean bore diameter deviation Δ_{dmp}		Bore diameter variation V_{dsp}	CS type: Mean bore diameter deviation Δ_{dmp}		Dimensional tolerance of eccentricity amount of eccentric surface of eccentric collar type bearings Δ_{Hs}		Dimensional tolerance of inner ring width Δ_{Bs} (approx.)		Radial runout K_{ia} (approx.)
Over	Incl.	Upper	Lower	Max.	Upper	Lower	Upper	Lower	Upper	Lower	Max.
10	18	+15	0	10	0	− 8	+100	−100	0	−120	15
18 1)	31.75	+18	0	12	0	−10	+100	−100	0	−120	18
31.75	50.8	+21	0	14	0	−12	+100	−100	0	−120	20
50.8	80	+24	0	16	0	−15	+100	−100	0	−150	25
80	120	+28	0	19	0	−20	+100	−100	0	−200	30
120	180	+33	0	22	0	−25	+100	−100	0	−250	35

1) 10 mm is included in this dimensional division.
2) See the section of "6. Bearing tolerance" for the tolerance and tolerance values for tapered bores.

Table 4 Tolerance values for outer rings

Unit: μm

Nominal bearing outer diameter D mm		Mean outside diameter deviation Δ_{Dm} 1)		Radial runout K_{ea} (approx.)
Over	Incl.	Upper	Lower	Max.
30	50	0	−11	20
50	80	0	−13	25
80	120	0	−15	35
120	150	0	−18	40
150	180	0	−25	45
180	250	0	−30	50
250	315	0	−35	60

1) The lower value of the dimensional tolerance of the average outer diameter specified in the table does not apply to the distance of 1/4 of the width dimension of the outer ring side surface to the outer ring.

3.2 Accuracy of housings for units

Table 5 shows the spherical bearing seating (spherical surface inner diameter) of housings for units. For other dimensional accuracy, see the special catalog "**Bearing units (CAT. No. 2400/E)**."

Table 5 Dimensional tolerance of inner diameter of cast iron housings

Unit: μm

Nominal bore diameter of spherical bearing seating D_a (mm)		Dimensional tolerance of average inner diameter within the plane of spherical bearing seating Δ_{Dam}: Tolerance class H7		Tolerance class J7		Tolerance class K7	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower
30	50	+25	0	+14	−11	+7	−18
50	80	+30	0	+18	−12	+9	−21
80	120	+35	0	+22	−13	—	—
120	180	+40	0	+26	−14	—	—
180	250	+46	0	+30	−16	—	—
250	315	+52	0	+36	−16	—	—

Spherical bearing seatings with an inner diameter of 52 mm or below is finished in the tolerance class K7, 53 mm to 180 mm is finished in the tolerance class J7, and 181 mm or above is finished in the tolerance class H7.
The casting indication of "J" is being abolished since 2000.

3.3 Bearing internal clearance

The standard internal clearance of ball bearings used in bearing units is CN (see Technical Explanation 8 **Table 8.8**). However, for the values of CN clearance of tapered bore type bearings, the values of C3 clearance of deep groove ball bearings is applied.

4. Allowable speed

The allowable speed of bearings for units that allows safe long operation is restricted by the bearing dimensions, loads, and circumferential speed of the seal contact lip. **Fig. 1** shows the allowable speed that considers these factors. When higher speed is necessary, use a bearing unit that uses a non-contact type shield. Consult with **NTN** Engineering for additional details.

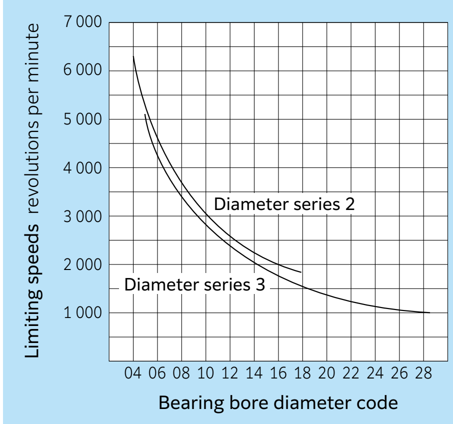


Fig. 1 Allowable speed of ball bearings for units

5. Lubrication

NTN bearing units are factory filled with an appropriate amount of grease.

The grease amount necessary for lubrication is very small in general, and the grease amount of **NTN** bearing units is about 1/2 to 1/3 of the bearing internal free space.

The grease must be filled until a small amount of grease is discharged to the entire circumference between the bearing outer ring inner diameter and the slinger outer diameter.

Rough standard of the amount of pressure required to insert grease: 1 to 3 MPa

6. Housing strength

The static breaking strength of housings for units differs depending on the housing type and load characteristics. The pillow block type unit is originally designed based on the use of a downward load. For other types of loading, please consult **NTN** Engineering.

Table 6 and **Figs. 2** and **3** show approximate values of average static breaking loads by the load direction of pillow unit housings. Consult **NTN** Engineering for the strength of other types of housings.

The allowable load of unit housings can be obtained from the static breaking load and the safety factor S_0 shown in **Table 7** from the formula below.

$$P_0 = \frac{P_{st}}{S_0}$$

P_0 : Allowable load of housing, N

P_{st} : Static breaking strength of housing, N

S_0 : Safety factor

Table 6 Static breaking load of pillow type housing

Number	Downward load kN	Number	Downward load kN
P203	75	P305	160
P204	80	P306	180
P205	95	P307	200
P206	130	P308	220
P207	160	P309	270
P208	170	P310	340
P209	180	P311	360
P210	200	P312	320
P211	210	P313	370
P212	280	P314	400
P213	290	P315	430
P214	320	P316	490
P215	330	P317	500
P216	360	P318	550
P217	450	P319	600
P218	480	P320	700
PE203	90	P321	700
PE204	100	P322	830
PE205	118	P324	900
PE206	137	P326	1 150
PE207	160	P328	1 200
PE208	186		
PE209	215		
PE210	255		
PE211	350		
PE212	400		

Table 7 Safety factor of housing

Material		Static load	Repeated load		Impact load
			Pulsating	Alternating	
SS400	Structural steel	3	5	8	12
FC200	Gray cast iron	4	6	10	15
FCD450	Ductile cast iron	4	6	10	15

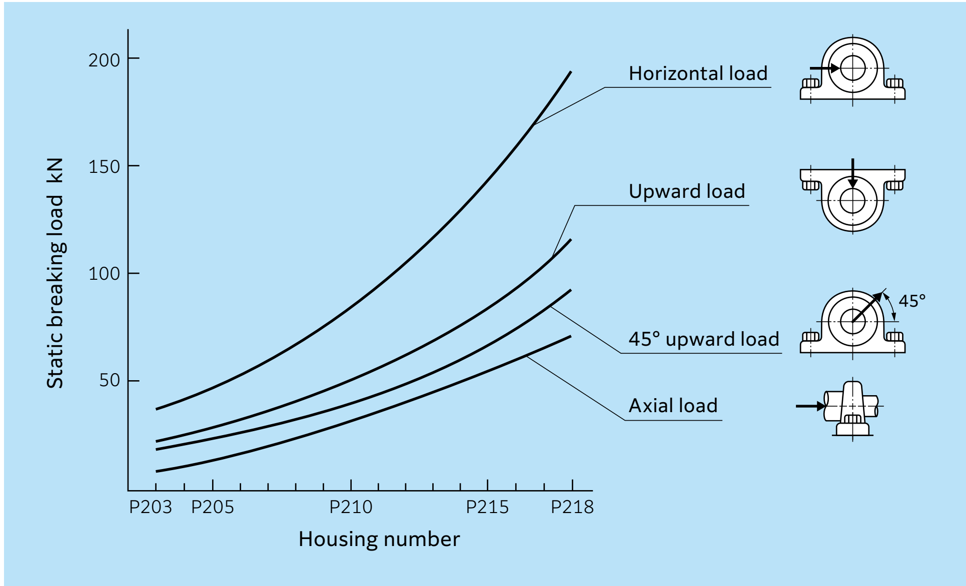


Fig. 2 Static breaking load of P2 type

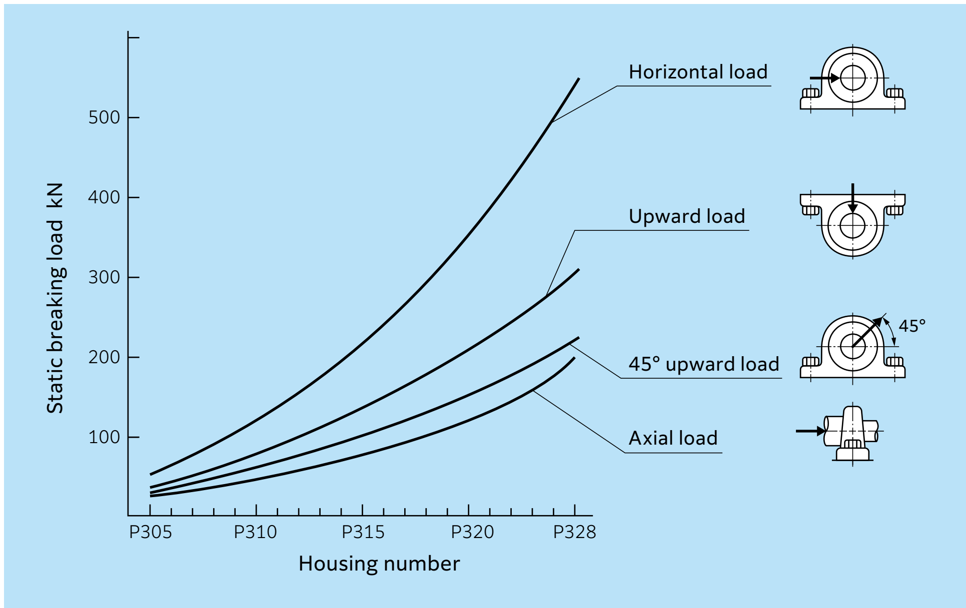


Fig. 3 Static breaking load of P3 type

7. Alignment allowance

The alignment allowance between the housing attachment surface and the shaft must be within 1/30 (1/60 for the narrow width outer ring type) due to grease channel alignment considerations. The alignment allowance of units with a cover differs depending on the cover seal, so please consult **NTN** Engineering.

8. Recommended bearing fits

Shafts used for **NTN** bearing units are not required to be highly precise, but it is desirable that the shaft is not bent or damaged.

When a bearing unit of a set screw type is to be used under a general use condition, the fitting between the inner ring and the shaft normally should be a loose fit for the assembly convenience. The appropriate values of the dimensional tolerance of the shaft are shown in **Fig. 4**.

In the case of the adapter sleeve type, since the shaft is fastened with a sleeve, the dimensional tolerance of the shaft can be h9 under a general use condition.

As with the set screw type, for the eccentric color type under a general use condition, a loose fit is generally used for the fitting between the inner ring and the shaft for the assembly convenience. For the dimensional tolerance of the shaft, values indicated in **Fig. 5** are appropriate.

According to the use condition, when a tight fit is to be adopted, proper installation methods shall be used and the inner ring side face shall not be struck directly to facilitate installation.

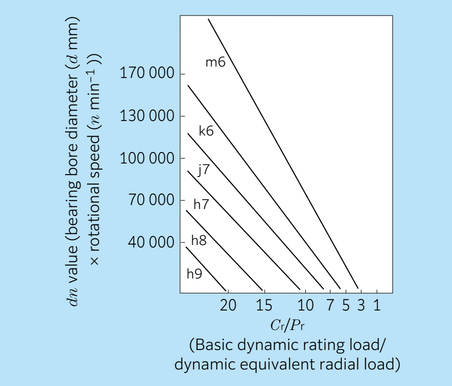


Fig. 4 Dimensional tolerance of setscrew type shaft

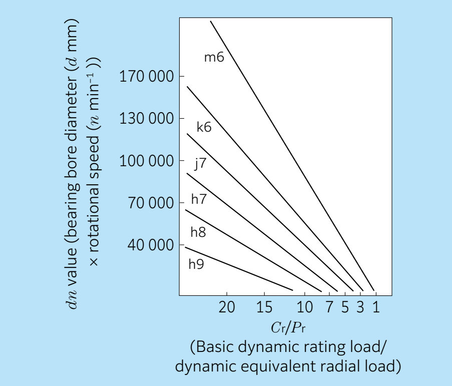


Fig. 5 Dimensional tolerance of eccentric collar type shaft

9. Recommended torque of setscrew

When bearing units of the set screw type or a eccentric collar type are to be attached to a shaft, the fastening torque shown in **Tables 8** and **9** is used as a rough standard. For fastening, the two setscrews are alternately and uniformly fastened. For the details of unit attachment, see the special catalog "**Bearing units (CAT. No. 2400/E)**."

Table 8 Recommended fastening torque of setscrews

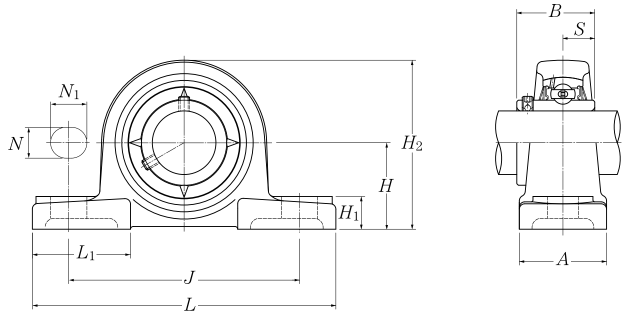
Applied unit bearing number			Setscrew nominal dimension		Recommended setscrew fastening torque N·m
			Inner diameter milli series	Inner diameter inch series	
AS201~203	—	—	MSS5	S8W4.826×32×7	3.4
UC201~205 AS204~205	—	—	MSS5	S8W4.826×32×7	3.9
UC206 AS206	—	UC305~306	MSS6	S8W1/4×28×8	4.9
UC207 AS207	UCX05	—	MSS6	S8W1/4×28×8	5.8
UC208~210 AS208~210	—	—	MSS8	S8W5/16×24×10	7.8
UC211	UCX06~X08	UC307	MSS8	S8W5/16×24×10	9.8
UC212	UCX09	—	MSS10	S8W3/8×24×12	16.6
UC213~215	—	UC308~309	MSS10	S8W3/8×24×12	19.6
UC216	UCX10	—	MSS10	S8W3/8×24×12	22.5
—	UCX11~X12	—	MSS10	S8W3/8×24×12	24.5
UC217~218	UCX13~X15	UC310~314	MSS12	S8W1/2×20×13	29.4
—	UCX16~X17	—	MSS12	S8W1/2×20×13	34.3
—	UCX18	UC315~316	MSS14	S8W9/16×18×15	34.3
—	UCX20	UC317~319	MSS16	S8W5/8×18×18	53.9
—	—	UC320~324	MSS18	S8W3/4×16×25	58.8
—	—	UC326~328	MSS20	—	78.4

Note: Fastening setscrews excessively may cause inner ring cracks. Loose fastening may cause the shaft to slide.

Table 9 Recommended fastening torque of eccentric collar setscrews

Applied unit bearing number		Setscrew nominal dimension		Recommended setscrew fastening torque N·m
		Inner diameter milli series	Inner diameter inch series	
UEL204~205 AEL201~205	—	MSS6	S8W1/4×28×8	7.8
UEL206 AEL206	UEL305~307	MSS8	S8W5/16×24×10	9.8
UEL207 AEL207	—	MSS10	S8W3/8×24×12	11.7
UEL208~210 AEL208~210	—	MSS10	S8W3/8×24×12	15.6
UEL211 AEL211	—	MSS10	S8W3/8×24×12	19.6
UEL212~215 AEL212	UEL308~312	MSS10	S8W3/8×24×12	29.4
—	UEL313~314	MSS12	S8W1/2×20×13	34.3
—	UEL315~317	MSS16	S8W5/8×18×18	53.9
—	UEL318~322	MSS20	S8W3/4×16×25	78.4

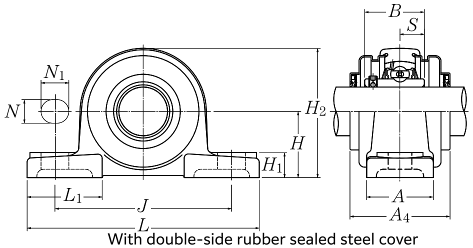
Cast iron pillow blocks UCP type / cylindrical bore type, setscrew type



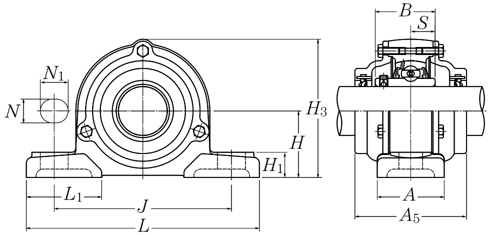
Shaft diameter: 12 to 50 mm

Shaft dia. mm	Unit number [1)2)]	Dimensions mm											Fixing bolt	Bearing			
														Number	Basic load rating dynamic kN	static kN	Fatigue load limit kN
		H	L	J	A	N	N_1	H_1	H_2	L_1	B	S			C_r	C_{0r}	C_u
12	**UCP201**	30.2	127	95	38	13	16	14	62	42	31	12.7	M10	UC201D1	14.2	6.65	0.505
15	**UCP202**	30.2	127	95	38	13	16	14	62	42	31	12.7	M10	UC202D1	14.2	6.65	0.505
17	**UCP203**	30.2	127	95	38	13	16	14	62	42	31	12.7	M10	UC203D1	14.2	6.65	0.505
20	**UCP204**	33.3	127	95	38	13	16	14	65	42	31	12.7	M10	UC204D1	14.2	6.65	0.505
25	**UCP205**	36.5	140	105	38	13	16	15	71	42	34.1	14.3	M10	UC205D1	15.5	7.85	0.55
	UCPX05	44.4	159	119	51	17	20	18	85	50	38.1	15.9	M14	UCX05D1	21.6	11.3	0.795
	UCP305	45	175	132	45	17	20	15	85	54	38	15	M14	UC305D1	23.5	10.9	0.855
30	**UCP206**	42.9	165	121	48	17	20	17	83	54	38.1	15.9	M14	UC206D1	21.6	11.3	0.795
	UCPX06	47.6	175	127	57	17	20	20	93	54	42.9	17.5	M14	UCX06D1	28.4	15.3	1.09
	UCP306	50	180	140	50	17	20	18	95	54	43	17	M14	UC306D1	29.5	15.0	1.14
35	**UCP207**	47.6	167	127	48	17	20	18	93	54	42.9	17.5	M14	UC207D1	28.4	15.3	1.09
	UCPX07	54	203	144	57	17	20	21	105	60	49.2	19	M14	UCX07D1	32.5	17.8	1.24
	UCP307	56	210	160	56	17	25	20	106	60	48	19	M14	UC307D1	37.0	19.1	1.47
40	**UCP208**	49.2	184	137	54	17	20	18	98	52	49.2	19	M14	UC208D1	32.5	17.8	1.24
	UCPX08	58.7	222	156	67	20	23	26	111	65	49.2	19	M16	UCX08D1	36.0	20.4	1.60
	UCP308	60	220	170	60	17	27	22	116	60	52	19	M14	UC308D1	45.0	24.0	1.83
45	**UCP209**	54	190	146	54	17	20	20	106	60	49.2	19	M14	UC209D1	36.0	20.4	1.60
	UCPX09	58.7	222	156	67	20	23	26	116	65	51.6	19	M16	UCX09D1	39.0	23.2	1.82
	UCP309	67	245	190	67	20	30	24	129	65	57	22	M16	UC309D1	58.5	32.0	2.50
50	**UCP210**	57.2	206	159	60	20	23	21	114	65	51.6	19	M16	UC210D1	39.0	23.2	1.82
	UCPX10	63.5	241	171	73	20	23	27	126	70	55.6	22.2	M16	UCX10D1	48.0	29.2	2.29
	UCP310	75	275	212	75	20	35	27	143	75	61	22	M16	UC310D1	68.5	38.5	2.99

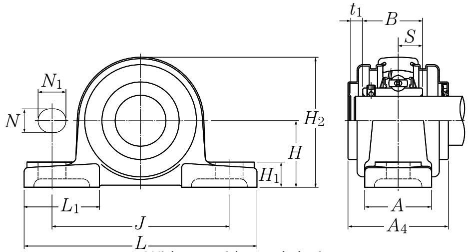
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example:** UCP320N1
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.



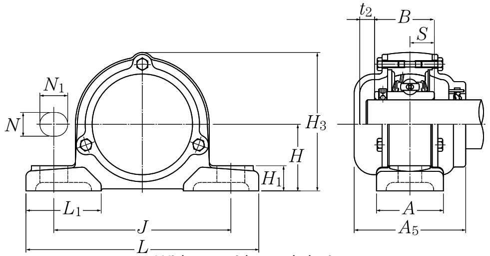
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



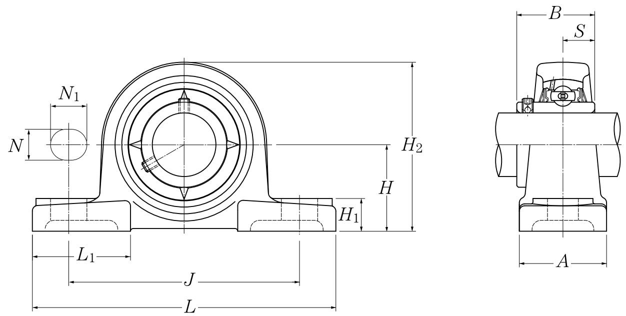
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover		Number of unit with cast iron cover		Dimensions mm					Unit mass (approx.) kg		
	Double-side rubber sealed cover	One-side closing cover	Double-side rubber sealed cover	One-side closing cover	t_1	t_2	A_4	H_3	A_5	Standard	With steel cover	With cast iron cover
P203	**S-UCP201**	**SM-UCP201**	**C-UCP201**	**CM-UCP201**	5	8	51	67	62	0.7	0.7	0.9
P203	**S-UCP202**	**SM-UCP202**	**C-UCP202**	**CM-UCP202**	5	8	51	67	62	0.7	0.7	0.9
P203	**S-UCP203**	**SM-UCP203**	**C-UCP203**	**CM-UCP203**	5	8	51	67	62	0.7	0.7	0.9
P204	**S-UCP204**	**SM-UCP204**	**C-UCP204**	**CM-UCP204**	5	8	51	70	62	0.7	0.7	0.9
P205	**S-UCP205**	**SM-UCP205**	**C-UCP205**	**CM-UCP205**	7	11	57	76	70	0.8	0.9	1.1
PX05	**S-UCPX05**	**SM-UCPX05**	**C-UCPX05**	**CM-UCPX05**	7	11	62	89	75	1.4	1.5	1.8
P305	–	–	**C-UCP305**	**CM-UCP305**	–	12	–	91	80	1.4	–	1.8
P206	**S-UCP206**	**SM-UCP206**	**C-UCP206**	**CM-UCP206**	7	11	62	88	75	1.4	1.4	1.7
PX06	**S-UCPX06**	**SM-UCPX06**	**C-UCPX06**	**CM-UCPX06**	8	10	72	99	80	1.8	2	2.4
P306	–	–	**C-UCP306**	**CM-UCP306**	–	11	–	105	85	1.8	–	2.5
P207	**S-UCP207**	**SM-UCP207**	**C-UCP207**	**CM-UCP207**	8	10	72	99	80	1.6	1.7	2
PX07	**S-UCPX07**	**SM-UCPX07**	**C-UCPX07**	**CM-UCPX07**	8	9	82	110	90	2.4	2.6	3.3
P307	–	–	**C-UCP307**	**CM-UCP307**	–	13	–	115	95	2.5	–	3.2
P208	**S-UCP208**	**SM-UCP208**	**C-UCP208**	**CM-UCP208**	8	9	82	105	90	1.9	2.1	2.7
PX08	**S-UCPX08**	**SM-UCPX08**	**C-UCPX08**	**CM-UCPX08**	8	12	82	118	95	2.9	3.1	3.8
P308	–	–	**C-UCP308**	**CM-UCP308**	–	13	–	125	105	3	–	4.1
P209	**S-UCP209**	**SM-UCP209**	**C-UCP209**	**CM-UCP209**	8	12	82	113	95	2.2	2.4	3
PX09	**S-UCPX09**	**SM-UCPX09**	**C-UCPX09**	**CM-UCPX09**	8	12	87	120	100	3.2	3.5	4.2
P309	–	–	**C-UCP309**	**CM-UCP309**	–	14	–	140	110	4.1	–	5.5
P210	**S-UCP210**	**SM-UCP210**	**C-UCP210**	**CM-UCP210**	8	12	87	119	100	2.7	2.8	3.6
PX10	**S-UCPX10**	**SM-UCPX10**	**C-UCPX10**	**CM-UCPX10**	10	11	92	130	100	4.1	4.5	5.4
P310	–	–	**C-UCP310**	**CM-UCP310**	–	15	–	156	120	5.6	–	7.1

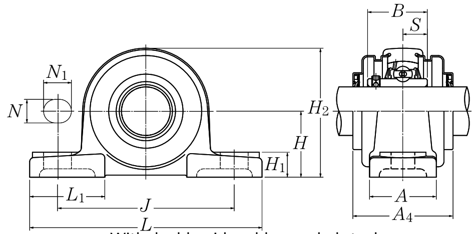
Cast iron pillow blocks UCP type / cylindrical bore type, setscrew type



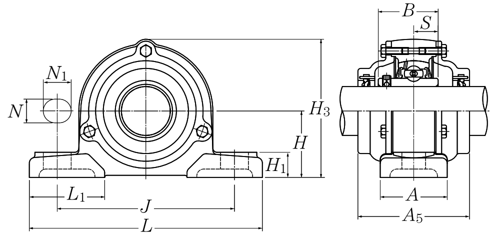
Shaft diameter: 55 to 90 mm

Shaft dia. mm	Unit number [1) 2)]	Dimensions mm H	L	J	A	N	N_1	H_1	H_2	L_1	B	S	Fixing bolt	Bearing Number	Basic load rating dynamic C_r kN	Basic load rating static C_{0r} kN	Fatigue load limit C_u kN
55	**UCP211**	63.5	219	171	60	20	23	23	126	65	55.6	22.2	M16	UC211D1	48.0	29.2	2.29
	UCPX11	69.8	260	184	79	25	28	30	137	75	65.1	25.4	M20	UCX11D1	58.0	36.0	2.83
	UCP311	80	310	236	80	20	38	30	154	85	66	25	M16	UC311D1	79.5	45.0	3.50
60	**UCP212**	69.8	241	184	70	20	23	25	138	70	65.1	25.4	M16	UC212D1	58.0	36.0	2.83
	UCPX12	76.2	286	203	83	25	28	33	151	80	65.1	25.4	M20	UCX12D1	63.5	40.0	3.15
	UCP312	85	330	250	85	25	38	32	165	95	71	26	M20	UC312D1	90.5	52.0	4.10
65	**UCP213**	76.2	265	203	70	25	28	27	151	77	65.1	25.4	M20	UC213D1	63.5	40.0	3.15
	UCPX13	76.2	286	203	83	25	28	33	154	80	74.6	30.2	M20	UCX13D1	69.0	44.0	3.45
	UCP313	90	340	260	90	25	38	33	176	105	75	30	M20	UC313D1	103	60.0	4.60
70	**UCP214**	79.4	266	210	72	25	28	27	157	77	74.6	30.2	M20	UC214D1	69.0	44.0	3.45
	UCPX14	88.9	330	229	89	27	30	35	170	95	77.8	33.3	M22	UCX14D1	73.5	49.5	3.80
	UCP314	95	360	280	90	27	40	35	187	105	78	33	M22	UC314D1	115	68.0	5.10
75	**UCP215**	82.6	275	217	74	25	28	28	163	80	77.8	33.3	M20	UC215D1	73.5	49.5	3.80
	UCPX15	88.9	330	229	89	27	30	35	175	95	82.6	33.3	M22	UCX15D1	80.5	53.0	3.95
	UCP315	100	380	290	100	27	40	35	198	110	82	32	M22	UC315D1	126	77.0	5.55
80	**UCP216**	88.9	292	232	78	25	28	30	175	85	82.6	33.3	M20	UC216D1	80.5	53.0	3.95
	UCPX16	101.6	381	283	102	27	30	40	194	110	85.7	34.1	M22	UCX16D1	92.0	64.0	4.60
	UCP316	106	400	300	110	27	40	40	210	110	86	34	M22	UC316D1	136	86.5	6.05
85	**UCP217**	95.2	310	247	83	25	28	32	187	85	85.7	34.1	M20	UC217D1	92.0	64.0	4.60
	UCPX17	101.6	381	283	102	27	30	40	200	110	96	39.7	M22	UCX17D1	106	71.5	5.00
	UCP317	112	420	320	110	33	45	40	220	120	96	40	M27	UC317D1	147	97.0	6.55
90	**UCP218**	101.6	327	262	88	27	30	33	200	90	96	39.7	M22	UC218D1	106	71.5	5.00
	UCPX18	101.6	381	283	111	27	30	40	206	110	104	42.9	M22	UCX18D1	121	82.0	5.55
	UCP318	118	430	330	110	33	45	45	235	120	96	40	M27	UC318D1	158	107	7.10

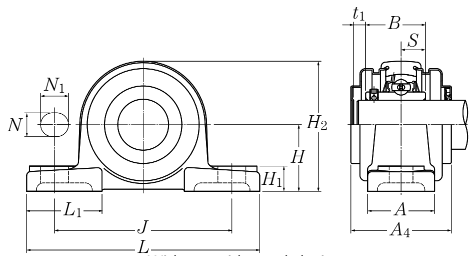
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "**N1**" is added after the unit number. **Example: UCP320N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "**D1**" is added after the number for the oil feeding type.



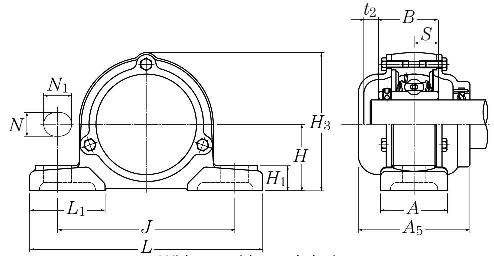
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



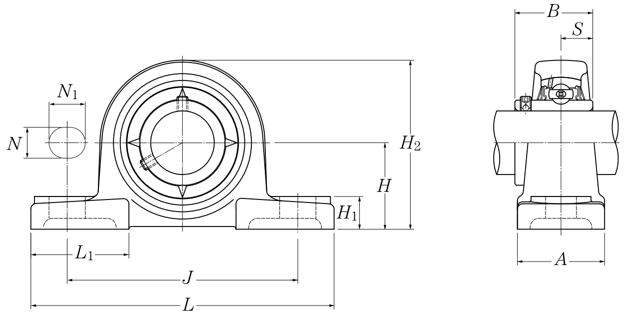
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	Number of unit with steel cover: One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	Number of unit with cast iron cover: One-side closing cover	Dimensions mm t_1	t_2	A_4	H_3	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
P211	**S-UCP211**	**SM-UCP211**	**C-UCP211**	**CM-UCP211**	10	11	92	130	100	3.4	3.6	4.4
PX11	**S-UCPX11**	**SM-UCPX11**	**C-UCPX11**	**CM-UCPX11**	8	12	102	144	115	5.4	5.8	6.9
P311	–	–	**C-UCP311**	**CM-UCP311**	–	15	–	166	125	7.3	–	8.9
P212	**S-UCP212**	**SM-UCP212**	**C-UCP212**	**CM-UCP212**	8	12	102	143	115	4.7	5	6
PX12	**S-UCPX12**	**SM-UCPX12**	**C-UCPX12**	**CM-UCPX12**	11	15	107	155	120	6.8	7.3	8.6
P312	–	–	**C-UCP312**	**CM-UCP312**	–	16	–	179	135	9.4	–	11
P213	**S-UCP213**	**SM-UCP213**	**C-UCP213**	**CM-UCP213**	11	15	107	155	120	5.6	5.8	7.2
PX13	–	–	**C-UCPX13**	**CM-UCPX13**	–	17	–	159	135	7.1	–	9.4
P313	–	–	**C-UCP313**	**CM-UCP313**	–	19	–	190	140	10	–	13
P214	–	–	**C-UCP214**	**CM-UCP214**	–	17	–	162	135	6.5	–	8.4
PX14	–	–	**C-UCPX14**	**CM-UCPX14**	–	17	–	175	135	9.3	–	12
P314	–	–	**C-UCP314**	**CM-UCP314**	–	19	–	200	140	12	–	14
P215	–	–	**C-UCP215**	**CM-UCP215**	–	17	–	168	135	7.2	–	9.3
PX15	–	–	**C-UCPX15**	**CM-UCPX15**	–	17	–	181	145	10	–	13
P315	–	–	**C-UCP315**	**CM-UCP315**	–	19	–	210	150	14	–	17
P216	–	–	**C-UCP216**	**CM-UCP216**	–	17	–	181	145	8.7	–	11
PX16	–	–	**C-UCPX16**	**CM-UCPX16**	–	19	–	198	155	14	–	17
P316	–	–	**C-UCP316**	**CM-UCP316**	–	18	–	221	155	17	–	21
P217	–	–	**C-UCP217**	**CM-UCP217**	–	19	–	191	155	11	–	13
PX17	–	–	**C-UCPX17**	**CM-UCPX17**	–	20	–	204	165	15	–	19
P317	–	–	**C-UCP317**	**CM-UCP317**	–	21	–	235	170	19	–	24
P218	–	–	**C-UCP218**	**CM-UCP218**	–	20	–	204	165	13	–	16
PX18	–	–	**C-UCPX18**	**CM-UCPX18**	–	22	–	208	180	16	–	21
P318	–	–	**C-UCP318**	**CM-UCP318**	–	21	–	246	170	22	–	27

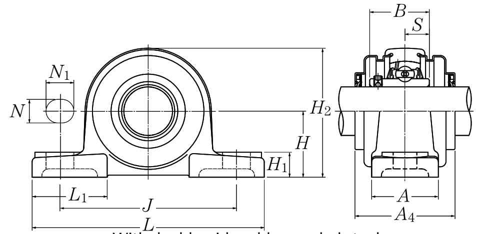
Cast iron pillow blocks UCP type / cylindrical bore type, setscrew type



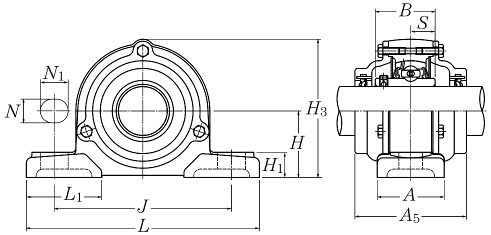
Shaft diameter: 95 to 140 mm

Shaft dia. mm	Unit number 1) 2)	Dimensions mm H	L	J	A	N	N_1	H_1	H_2	L_1	B	S	Fixing bolt	Bearing Number	Basic load rating kN dynamic C_r	static C_{0r}	Fatigue load limit C_u
95	**UCP319**	125	470	360	120	36	50	45	250	125	103	41	M30	UC319D1	169	119	7.65
100	**UCP320**	140	490	380	120	36	50	50	275	130	108	42	M30	UC320D1	192	141	8.75
	UCPX20	127	432	337	121	33	36	45	244	125	117.5	49.2	M27	UCX20D1	147	105	6.75
105	**UCP321**	140	490	380	120	36	50	50	280	130	112	44	M30	UC321D1	204	153	9.35
110	**UCP322**	150	520	400	140	40	55	55	300	135	117	46	M33	UC322D1	227	179	10.5
120	**UCP324**	160	570	450	140	40	55	65	320	140	126	51	M33	UC324D1	229	185	10.5
130	**UCP326**	180	600	480	140	40	55	75	355	140	135	54	M33	UC326D1	254	214	11.7
140	**UCP328**	200	620	500	140	40	55	75	390	140	145	59	M33	UC328D1	280	246	13.0

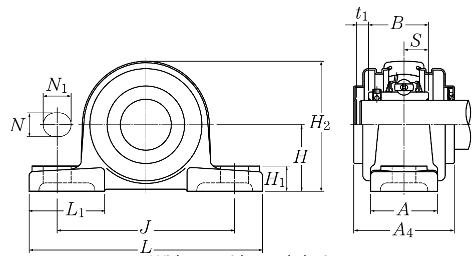
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example:** UCP320N1
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.



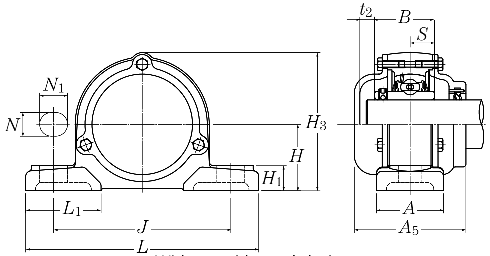
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



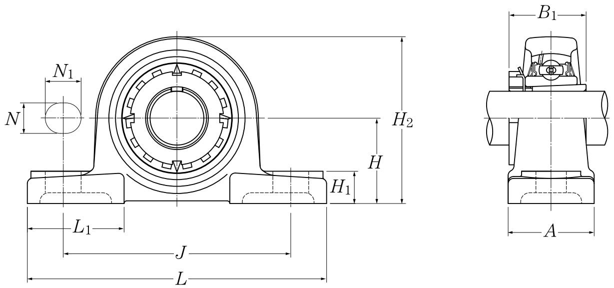
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	One-side closing cover	Dimensions mm t_1	t_2	A_4	H_3	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
P319	–	–	**C-UCP319**	**CM-UCP319**	–	20	–	258	180	26	–	32
P320	–	–	**C-UCP320**	**CM-UCP320**	–	20	–	283	190	33	–	39
PX20	–	–	**C-UCPX20**	**CM-UCPX20**	–	23	–	244	195	25	–	29
P321	–	–	**C-UCP321**	**CM-UCP321**	–	20	–	290	195	35	–	42
P322	–	–	**C-UCP322**	**CM-UCP322**	–	20	–	313	200	43	–	52
P324	–	–	**C-UCP324**	**CM-UCP324**	–	22	–	335	215	50	–	67
P326	–	–	**C-UCP326**	**CM-UCP326**	–	21	–	375	225	69	–	85
P328	–	–	**C-UCP328**	**CM-UCP328**	–	21	–	407	235	84	–	100

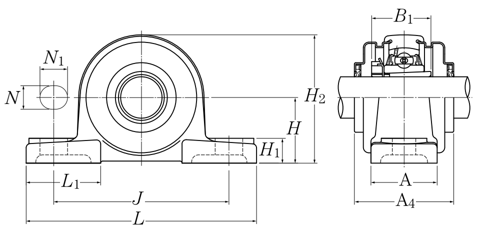
Cast iron pillow blocks UKP type / tapered bore type, adapter type



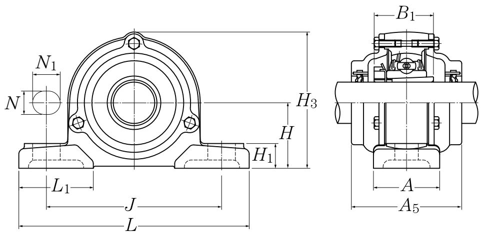
Shaft diameter: 20 to 55 mm

Shaft dia. mm	Unit number 1) 2) 3)	Dimensions mm H	L	J	A	N	N_1	H_1	H_2	B_1	L_1	Fixing bolt	Bearing Number	Basic load rating dynamic kN C_r	static kN C_{0r}	Fatigue load limit kN C_u
20	UKP205;H2305X	36.5	140	105	38	13	16	15	71	35	42	M10	UK205D1;H2305X	15.5	7.85	0.55
	UKPX05;H2305X	44.4	159	119	51	17	20	18	85	35	50	M14	UKX05D1;H2305X	21.6	11.3	0.795
	UKP305;H2305X	45	175	132	45	17	20	15	85	35	54	M14	UK305D1;H2305X	23.5	10.9	0.855
25	UKP206;H2306X	42.9	165	121	48	17	20	17	83	38	54	M14	UK206D1;H2306X	21.6	11.3	0.795
	UKPX06;H2306X	47.6	175	127	57	17	20	20	93	38	54	M14	UKX06D1;H2306X	28.4	15.3	1.09
	UKP306;H2306X	50	180	140	50	17	20	18	95	38	54	M14	UK306D1;H2306X	29.5	15.0	1.14
30	UKP207;H2307X	47.6	167	127	48	17	20	18	93	43	54	M14	UK207D1;H2307X	28.4	15.3	1.09
	UKPX07;H2307X	54	203	144	57	17	20	21	105	43	60	M14	UKX07D1;H2307X	32.5	17.8	1.24
	UKP307;H2307X	56	210	160	56	17	25	20	106	43	60	M14	UK307D1;H2307X	37.0	19.1	1.47
35	UKP208;H2308X	49.2	184	137	54	17	20	18	98	46	52	M14	UK208D1;H2308X	32.5	17.8	1.24
	UKPX08;H2308X	58.7	222	156	67	20	23	26	111	46	65	M16	UKX08D1;H2308X	36.0	20.4	1.60
	UKP308;H2308X	60	220	170	60	17	27	22	116	46	60	M14	UK308D1;H2308X	45.0	24.0	1.83
40	UKP209;H2309X	54	190	146	54	17	20	20	106	50	60	M14	UK209D1;H2309X	36.0	20.4	1.60
	UKPX09;H2309X	58.7	222	156	67	20	23	26	116	50	65	M16	UKX09D1;H2309X	39.0	23.2	1.82
	UKP309;H2309X	67	245	190	67	20	30	24	129	50	65	M16	UK309D1;H2309X	58.5	32.0	2.50
45	UKP210;H2310X	57.2	206	159	60	20	23	21	114	55	65	M16	UK210D1;H2310X	39.0	23.2	1.82
	UKPX10;H2310X	63.5	241	171	73	20	23	27	126	55	70	M16	UKX10D1;H2310X	48.0	29.2	2.29
	UKP310;H2310X	75	275	212	75	20	35	27	143	55	75	M16	UK310D1;H2310X	68.5	38.5	2.99
50	UKP211;H2311X	63.5	219	171	60	20	23	23	126	59	65	M16	UK211D1;H2311X	48.0	29.2	2.29
	UKPX11;H2311X	69.8	260	184	79	25	28	30	137	59	75	M20	UKX11D1;H2311X	58.0	36.0	2.83
	UKP311;H2311X	80	310	236	80	20	38	30	154	59	85	M16	UK311D1;H2311X	79.5	45.0	3.50
55	UKP212;H2312X	69.8	241	184	70	20	23	25	138	62	70	M16	UK212D1;H2312X	58.0	36.0	2.83
	UKPX12;H2312X	76.2	286	203	83	25	28	33	151	62	80	M20	UKX12D1;H2312X	63.5	40.0	3.15
	UKP312;H2312X	85	330	250	85	25	38	32	165	62	95	M20	UK312D1;H2312X	90.5	52.0	4.10

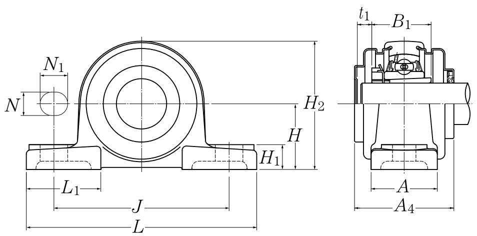
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UKP310N1; H2310X**
2) Unit numbers with the suffix "X" signify narrow slit type adapters, and use washers with straight inner tabs.



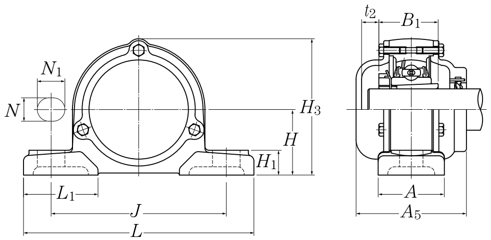
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



With one-side steel closing cover

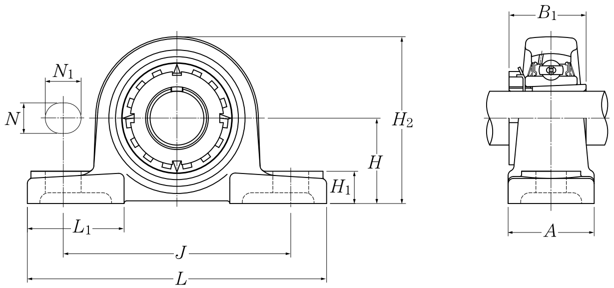


With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	Number of unit with steel cover: One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	Number of unit with cast iron cover: One-side closing cover	Dimensions mm t_1	t_2	A_4	H_3	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
P205	S-UKP205;H2305X	SM-UKP205;H2305X	C-UKP205;H2305X	CM-UKP205;H2305X	7	11	57	76	70	0.8	0.9	1.2
PX05	–	–	C-UKPX05;H2305X	CM-UKPX05;H2305X	–	12	–	89	75	1.4	–	1.8
P305	–	–	C-UKP305;H2305X	CM-UKP305;H2305X	–	14	–	91	80	1.4	–	1.8
P206	S-UKP206;H2306X	SM-UKP206;H2306X	C-UKP206;H2306X	CM-UKP206;H2306X	8	12	62	88	75	1.4	1.4	1.8
PX06	–	–	C-UKPX06;H2306X	CM-UKPX06;H2306X	–	13	–	99	80	1.7	–	2.2
P306	–	–	C-UKP306;H2306X	CM-UKP306;H2306X	–	15	–	105	85	1.8	–	2.6
P207	S-UKP207;H2307X	SM-UKP207;H2307X	C-UKP207;H2307X	CM-UKP207;H2307X	10	12	72	99	80	1.7	1.8	2.1
PX07	–	–	C-UKPX07;H2307X	CM-UKPX07;H2307X	–	15	–	110	90	2.4	–	3.3
P307	–	–	C-UKP307;H2307X	CM-UKP307;H2307X	–	17	–	115	95	2.6	–	3.2
P208	S-UKP208;H2308X	SM-UKP208;H2308X	C-UKP208;H2308X	CM-UKP208;H2308X	13	14	82	105	90	2	2.2	2.8
PX08	–	–	C-UKPX08;H2308X	CM-UKPX08;H2308X	–	17	–	118	95	3.2	–	4.1
P308	–	–	C-UKP308;H2308X	CM-UKP308;H2308X	–	19	–	125	105	3.1	–	4.2
P209	S-UKP209;H2309X	SM-UKP209;H2309X	C-UKP209;H2309X	CM-UKP209;H2309X	12	16	82	113	95	2.3	2.5	3.2
PX09	–	–	C-UKPX09;H2309X	CM-UKPX09;H2309X	–	18	–	120	100	3.2	–	4.3
P309	–	–	C-UKP309;H2309X	CM-UKP309;H2309X	–	19	–	140	110	4.1	–	5.5
P210	S-UKP210;H2310X	SM-UKP210;H2310X	C-UKP210;H2310X	CM-UKP210;H2310X	13	17	87	119	100	2.9	3	3.8
PX10	–	–	C-UKPX10;H2310X	CM-UKPX10;H2310X	–	15	–	130	100	4.2	–	5.4
P310	–	–	C-UKP310;H2310X	CM-UKP310;H2310X	–	21	–	156	120	5.6	–	7.2
P211	S-UKP211;H2311X	SM-UKP211;H2311X	C-UKP211;H2311X	CM-UKP211;H2311X	14	15	92	130	100	3.6	3.7	4.7
PX11	–	–	C-UKPX11;H2311X	CM-UKPX11;H2311X	–	21	–	144	115	5.3	–	6.8
P311	–	–	C-UKP311;H2311X	CM-UKP311;H2311X	–	22	–	166	125	7.3	–	9
P212	S-UKP212;H2312X	SM-UKP212;H2312X	C-UKP212;H2312X	CM-UKP212;H2312X	16	20	102	143	115	4.7	5.1	6.1
PX12	–	–	C-UKPX12;H2312X	CM-UKPX12;H2312X	–	22	–	155	120	6.8	–	8.6
P312	–	–	C-UKP312;H2312X	CM-UKP312;H2312X	–	25	–	179	135	9.3	–	11

3) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.

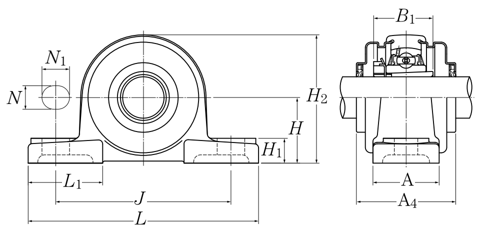
Cast iron pillow blocks UKP type / tapered bore type, adapter type



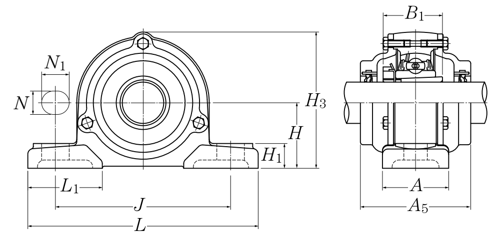
Shaft diameter: 60 to 125 mm

Shaft dia. mm	Unit number 1) 2) 3)	Dimensions mm H	L	J	A	N	N_1	H_1	H_2	B_1	L_1	Fixing bolt	Bearing Number	Basic load rating dynamic C_r (kN)	static C_{0r} (kN)	Fatigue load limit C_u (kN)
60	**UKP213;H2313X**	76.2	265	203	70	25	28	27	151	65	77	M20	UK213D1;H2313X	63.5	40.0	3.15
	UKPX13;H2313X	76.2	286	203	83	25	28	33	154	65	80	M20	UKX13D1;H2313X	69.0	44.0	3.45
	UKP313;H2313X	90	340	260	90	25	38	33	176	65	105	M20	UK313D1;H2313X	103	60.0	4.60
65	**UKP215;H2315X**	82.6	275	217	74	25	28	28	163	73	80	M20	UK215D1;H2315X	73.5	49.5	3.80
	UKPX15;H2315X	88.9	330	229	89	27	30	35	175	73	95	M22	UKX15D1;H2315X	80.5	53.0	3.95
	UKP315;H2315X	100	380	290	100	27	40	35	198	73	110	M22	UK315D1;H2315X	126	77.0	5.55
70	**UKP216;H2316X**	88.9	292	232	78	25	28	30	175	78	85	M20	UK216D1;H2316X	80.5	53.0	3.95
	UKPX16;H2316X	101.6	381	283	102	27	30	40	194	78	110	M22	UKX16D1;H2316X	92.0	64.0	4.60
	UKP316;H2316X	106	400	300	110	27	40	40	210	78	110	M22	UK316D1;H2316X	136	86.5	6.05
75	**UKP217;H2317X**	95.2	310	247	83	25	28	32	187	82	85	M20	UK217D1;H2317X	92.0	64.0	4.60
	UKPX17;H2317X	101.6	381	283	102	27	30	40	200	82	110	M22	UKX17D1;H2317X	106	71.5	5.00
	UKP317;H2317X	112	420	320	110	33	45	40	220	82	120	M27	UK317D1;H2317X	147	97.0	6.55
80	**UKP218;H2318X**	101.6	327	262	88	27	30	33	200	86	90	M22	UK218D1;H2318X	106	71.5	5.00
	UKPX18;H2318X	101.6	381	283	111	27	30	40	206	86	110	M22	UKX18D1;H2318X	121	82.0	5.55
	UKP318;H2318X	118	430	330	110	33	45	45	235	86	120	M27	UK318D1;H2318X	158	107	7.10
85	**UKP319;H2319X**	125	470	360	120	36	50	45	250	90	125	M30	UK319D1;H2319X	169	119	7.65
90	**UKPX20;H2320X**	127	432	337	121	33	36	45	244	97	125	M27	UKX20D1;H2320X	147	105	6.75
	UKP320;H2320X	140	490	380	120	36	50	50	275	97	130	M30	UK320D1;H2320X	192	141	8.75
100	**UKP322;H2322X**	150	520	400	140	40	55	55	300	105	135	M33	UK322D1;H2322X	227	179	10.5
110	**UKP324;H2324X**	160	570	450	140	40	55	65	320	112	140	M33	UK324D1;H2324X	229	185	10.5
115	**UKP326;H2326**	180	600	480	140	40	55	75	355	121	140	M33	UK326D1;H2326	254	214	11.7
125	**UKP328;H2328**	200	620	500	140	40	55	75	390	131	140	M33	UK328D1;H2328	280	246	13.0

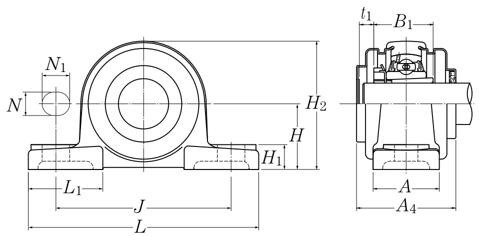
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UKP310N1; H2310X**



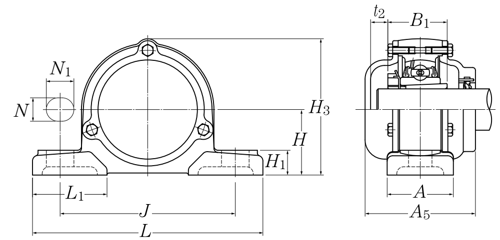
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



With one-side steel closing cover

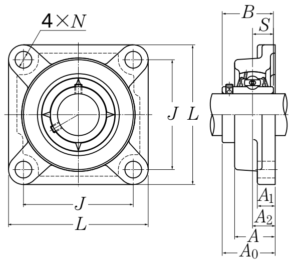


With one-side steel closing cover

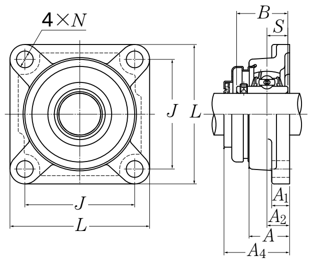
Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	Number of unit with steel cover: One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	Number of unit with cast iron cover: One-side closing cover	Dimensions mm t_1	t_2	A_4	H_3	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
P213	**S-UKP213;H2313X**	**SM-UKP213;H2313X**	**C-UKP213;H2313X**	**CM-UKP213;H2313X**	17	21	107	155	120	5.6	5.9	7.4
PX13	–	–	**C-UKPX13;H2313X**	**CM-UKPX13;H2313X**	–	26	–	159	135	7	–	9.2
P313	–	–	**C-UKP313;H2313X**	**CM-UKP313;H2313X**	–	25	–	190	140	10	–	13
P215	–	–	**C-UKP215;H2315X**	**CM-UKP215;H2315X**	–	24	–	168	135	7.6	–	9.9
PX15	–	–	**C-UKPX15;H2315X**	**CM-UKPX15;H2315X**	–	29	–	181	145	10	–	13
P315	–	–	**C-UKP315;H2315X**	**CM-UKP315;H2315X**	–	26	–	210	150	14	–	18
P216	–	–	**C-UKP216;H2316X**	**CM-UKP216;H2316X**	–	27	–	181	145	9.2	–	12
PX16	–	–	**C-UKPX16;H2316X**	**CM-UKPX16;H2316X**	–	31	–	198	155	14	–	17
P316	–	–	**C-UKP316;H2316X**	**CM-UKP316;H2316X**	–	24	–	221	155	17	–	21
P217	–	–	**C-UKP217;H2317X**	**CM-UKP217;H2317X**	–	30	–	191	155	11	–	14
PX17	–	–	**C-UKPX17;H2317X**	**CM-UKPX17;H2317X**	–	35	–	204	165	15	–	18
P317	–	–	**C-UKP317;H2317X**	**CM-UKP317;H2317X**	–	29	–	235	170	19	–	24
P218	–	–	**C-UKP218;H2318X**	**CM-UKP218;H2318X**	–	35	–	204	165	13	–	16
PX18	–	–	**C-UKPX18;H2318X**	**CM-UKPX18;H2318X**	–	41	–	208	180	16	–	20
P318	–	–	**C-UKP318;H2318X**	**CM-UKP318;H2318X**	–	27	–	246	170	22	–	28
P319	–	–	**C-UKP319;H2319X**	**CM-UKP319;H2319X**	–	29	–	258	180	27	–	33
PX20	–	–	**C-UKPX20;H2320X**	**CM-UKPX20;H2320X**	–	43	–	244	195	24	–	28
P320	–	–	**C-UKP320;H2320X**	**CM-UKP320;H2320X**	–	29	–	283	190	33	–	39
P322	–	–	**C-UKP322;H2322X**	**CM-UKP322;H2322X**	–	30	–	313	200	43	–	54
P324	–	–	**C-UKP324;H2324X**	**CM-UKP324;H2324X**	–	32	–	335	215	50	–	67
P326	–	–	**C-UKP326;H2326**	**CM-UKP326;H2326**	–	34	–	375	225	69	–	86
P328	–	–	**C-UKP328;H2328**	**CM-UKP328;H2328**	–	36	–	407	235	84	–	101

2) Unit numbers with the suffix "X" signify narrow slit type adapters, and use washers with straight inner tabs.
3) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.

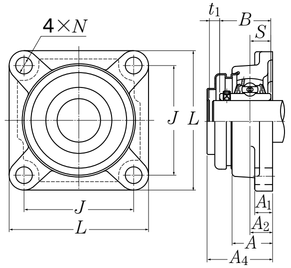
Cast iron square flanged unit UCF type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover



With steel closing cover

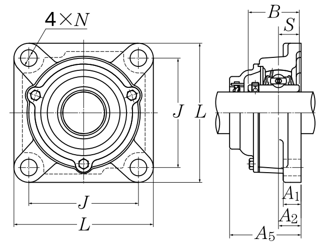
Shaft diameter: 12 to 60 mm

Shaft dia. mm	Unit number[1) 2)]	Dimensions mm									Fixing bolt	Bearing Number	Basic load rating dynamic kN	static kN	Fatigue load limit kN
		L	J	A_2	A_1	A	N	A_0	B	S			C_r	C_{0r}	C_u
12	UCF201	86	64	15	11	25.5	12	33.3	31	12.7	M10	UC201D1	14.2	6.65	0.505
15	UCF202	86	64	15	11	25.5	12	33.3	31	12.7	M10	UC202D1	14.2	6.65	0.505
17	UCF203	86	64	15	11	25.5	12	33.3	31	12.7	M10	UC203D1	14.2	6.65	0.505
20	UCF204	86	64	15	11	25.5	12	33.3	31	12.7	M10	UC204D1	14.2	6.65	0.505
25	UCF205	95	70	16	13	27	12	35.8	34.1	14.3	M10	UC205D1	15.5	7.85	0.55
	UCFX05	108	83	18	13	30	12	40.2	38.1	15.9	M10	UCX05D1	21.6	11.3	0.795
	UCF305	110	80	16	13	29	16	39	38	15	M14	UC305D1	23.5	10.9	0.855
30	UCF206	108	83	18	13	31	12	40.2	38.1	15.9	M10	UC206D1	21.6	11.3	0.795
	UCFX06	117	92	19	14	34	16	44.4	42.9	17.5	M14	UCX06D1	28.4	15.3	1.09
	UCF306	125	95	18	15	32	16	44	43	17	M14	UC306D1	29.5	15.0	1.14
35	UCF207	117	92	19	15	34	14	44.4	42.9	17.5	M12	UC207D1	28.4	15.3	1.09
	UCFX07	130	102	21	14	38	16	51.2	49.2	19	M14	UCX07D1	32.5	17.8	1.24
	UCF307	135	100	20	16	36	19	49	48	19	M16	UC307D1	37.0	19.1	1.47
40	UCF208	130	102	21	15	36	16	51.2	49.2	19	M14	UC208D1	32.5	17.8	1.24
	UCFX08	137	105	22	14	40	19	52.2	49.2	19	M16	UCX08D1	36.0	20.4	1.60
	UCF308	150	112	23	17	40	19	56	52	19	M16	UC308D1	45.0	24.0	1.83
45	UCF209	137	105	22	16	38	16	52.2	49.2	19	M14	UC209D1	36.0	20.4	1.60
	UCFX09	143	111	23	14	40	19	55.6	51.6	19	M16	UCX09D1	39.0	23.2	1.82
	UCF309	160	125	25	18	44	19	60	57	22	M16	UC309D1	58.5	32.0	2.50
50	UCF210	143	111	22	16	40	16	54.6	51.6	19	M14	UC210D1	39.0	23.2	1.82
	UCFX10	162	130	26	20	44	19	59.4	55.6	22.2	M16	UCX10D1	48.0	29.2	2.29
	UCF310	175	132	28	19	48	23	67	61	22	M20	UC310D1	68.5	38.5	2.99
55	UCF211	162	130	25	18	43	19	58.4	55.6	22.2	M16	UC211D1	48.0	29.2	2.29
	UCFX11	175	143	29	20	49	19	68.7	65.1	25.4	M16	UCX11D1	58.0	36.0	2.83
	UCF311	185	140	30	20	52	23	71	66	25	M20	UC311D1	79.5	45.0	3.50
60	UCF212	175	143	29	18	48	19	68.7	65.1	25.4	M16	UC212D1	58.0	36.0	2.83
	UCFX12	187	149	34	21	59	19	73.7	65.1	25.4	M16	UCX12D1	63.5	40.0	3.15
	UCF312	195	150	33	22	56	23	78	71	26	M20	UC312D1	90.5	52.0	4.10

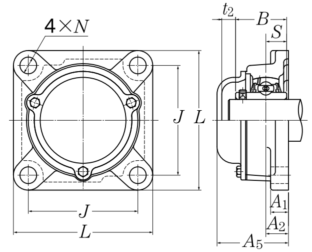
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UCF210N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.

Bearing Units

NTN



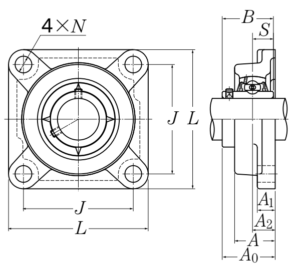
With rubber sealed cast iron cover



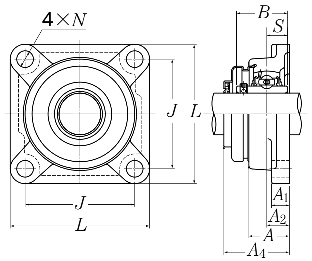
With cast iron closing cover

Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm				Unit mass (approx.) kg		
					t_1	t_2	A_4	A_5	Standard	With steel cover	With cast iron cover
F204	S-UCF201	SM-UCF201	C-UCF201	CM-UCF201	5	8	40.5	46	0.6	0.6	0.8
F204	S-UCF202	SM-UCF202	C-UCF202	CM-UCF202	5	8	40.5	46	0.6	0.6	0.8
F204	S-UCF203	SM-UCF203	C-UCF203	CM-UCF203	5	8	40.5	46	0.6	0.6	0.8
F204	S-UCF204	SM-UCF204	C-UCF204	CM-UCF204	5	8	40.5	46	0.6	0.6	0.7
F205	S-UCF205	SM-UCF205	C-UCF205	CM-UCF205	7	11	44.5	51	0.8	0.8	0.9
FX05	–	–	C-UCFX05	CM-UCFX05	7	11	49	56	1.1	1.2	1.3
F305	–	–	C-UCF305	CM-UCF305	–	12	–	56	1.1	–	1.4
F206	S-UCF206	SM-UCF206	C-UCF206	CM-UCF206	7	11	49	56	1.1	1.1	1.3
FX06	–	–	C-UCFX06	CM-UCFX06	8	10	55	59	1.6	1.8	1.9
F306	–	–	C-UCF306	CM-UCF306	–	11	–	60	1.6	–	2.1
F207	S-UCF207	SM-UCF207	C-UCF207	CM-UCF207	8	10	55	59	1.5	1.5	1.8
FX07	S-UCFX07	SM-UCFX07	C-UCFX07	CM-UCFX07	8	9	62	66	2.1	2.2	2.5
F307	–	–	C-UCF307	CM-UCF307	–	14	–	68	2.1	–	2.6
F208	S-UCF208	SM-UCF208	C-UCF208	CM-UCF208	8	9	62	66	1.7	1.8	2.2
FX08	S-UCFX08	SM-UCFX08	C-UCFX08	CM-UCFX08	8	12	63	70	2.3	2.4	2.7
F308	–	–	C-UCF308	CM-UCF308	–	14	–	76	2.7	–	3.4
F209	S-UCF209	SM-UCF209	C-UCF209	CM-UCF209	8	12	63	70	2.1	2.2	2.6
FX09	S-UCFX09	SM-UCFX09	C-UCFX09	CM-UCFX09	7	12	65.5	73	2.5	2.6	3
F309	–	–	C-UCF309	CM-UCF309	–	14	–	80	3.4	–	4.3
F210	S-UCF210	SM-UCF210	C-UCF210	CM-UCF210	8	12	65.5	72	2.5	2.5	3
FX10	S-UCFX10	SM-UCFX10	C-UCFX10	CM-UCFX10	9	11	71	76	3.8	3.9	4.3
F310	–	–	C-UCF310	CM-UCF310	–	15	–	88	4.5	–	5.8
F211	S-UCF211	SM-UCF211	C-UCF211	CM-UCF211	10	11	71	75	3.3	3.4	4
FX11	S-UCFX11	SM-UCFX11	C-UCFX11	CM-UCFX11	8	12	80	86	4.8	5	5.5
F311	–	–	C-UCF311	CM-UCF311	–	15	–	92	5.3	–	6.7
F212	S-UCF212	SM-UCF212	C-UCF212	CM-UCF212	8	12	80	86	3.9	4.1	4.8
FX12	S-UCFX12	SM-UCFX12	C-UCFX12	CM-UCFX12	7	15	83.5	94	6.4	6.6	7.3
F312	–	–	C-UCF312	CM-UCF312	–	16	–	100	6.3	–	7.8

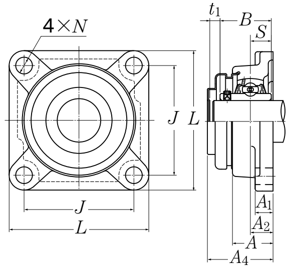
Cast iron square flanged unit UCF type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover

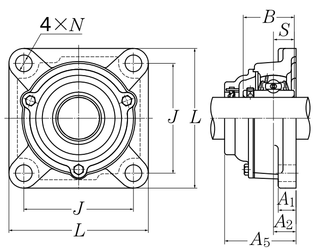


With steel closing cover

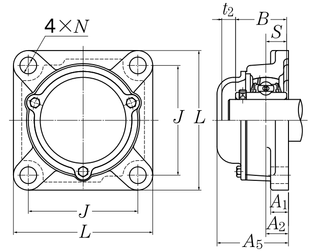
Shaft diameter: 65 to 140 mm

Shaft dia. mm	Unit number[1) 2)]	Dimensions mm L	J	A_2	A_1	A	N	A_0	B	S	Fixing bolt	Bearing Number	Basic load rating dynamic C_r kN	static C_{0r} kN	Fatigue load limit C_u kN
65	UCF213	187	149	30	22	50	19	69.7	65.1	25.4	M16	UC213D1	63.5	40.0	3.15
	UCFX13	187	149	34	21	59	19	78.4	74.6	30.2	M16	UCX13D1	69.0	44.0	3.45
	UCF313	208	166	33	22	58	23	78	75	30	M20	UC313D1	103	60.0	4.60
70	UCF214	193	152	31	22	54	19	75.4	74.6	30.2	M16	UC214D1	69.0	44.0	3.45
	UCFX14	197	152	37	24	60	23	81.5	77.8	33.3	M20	UCX14D1	73.5	49.5	3.80
	UCF314	226	178	36	25	61	25	81	78	33	M22	UC314D1	115	68.0	5.10
75	UCF215	200	159	34	22	56	19	78.5	77.8	33.3	M16	UC215D1	73.5	49.5	3.80
	UCFX15	197	152	40	24	68	23	89.3	82.6	33.3	M20	UCX15D1	80.5	53.0	3.95
	UCF315	236	184	39	25	66	25	89	82	32	M22	UC315D1	126	77.0	5.55
80	UCF216	208	165	34	22	58	23	83.3	82.6	33.3	M20	UC216D1	80.5	53.0	3.95
	UCFX16	214	171	40	24	70	23	91.6	85.7	34.1	M20	UCX16D1	92.0	64.0	4.60
	UCF316	250	196	38	27	68	31	90	86	34	M27	UC316D1	136	86.5	6.05
85	UCF217	220	175	36	24	63	23	87.6	85.7	34.1	M20	UC217D1	92.0	64.0	4.60
	UCFX17	214	171	40	24	70	23	96.3	96	39.7	M20	UCX17D1	106	71.5	5.00
	UCF317	260	204	44	27	74	31	100	96	40	M27	UC317D1	147	97.0	6.55
90	UCF218	235	187	40	24	68	23	96.3	96	39.7	M20	UC218D1	106	71.5	5.00
	UCFX18	214	171	45	24	76	23	106.1	104	42.9	M20	UCX18D1	121	82.0	5.55
	UCF318	280	216	44	30	76	35	100	96	40	M30	UC318D1	158	107	7.10
95	UCF319	290	228	59	30	94	35	121	103	41	M30	UC319D1	169	119	7.65
100	UCFX20	268	211	59[3)]	31	97	31	127.3	117.5	49.2	M27	UCX20D1	147	105	6.75
	UCF320	310	242	59	32	94	38	125	108	42	M33	UC320D1	192	141	8.75
105	UCF321	310	242	59	32	94	38	127	112	44	M33	UC321D1	204	153	9.35
110	UCF322	340	266	60	35	96	41	131	117	46	M36	UC322D1	227	179	10.5
120	UCF324	370	290	65	40	110	41	140	126	51	M36	UC324D1	229	185	10.5
130	UCF326	410	320	65	45	115	41	146	135	54	M36	UC326D1	254	214	11.7
140	UCF328	450	350	75	55	125	41	161	145	59	M36	UC328D1	280	246	13.0

1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UCF320N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.
3) Dimension A_2 becomes **49** in the case of a unit with a cast iron cover.



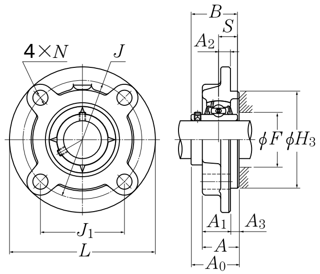
With rubber sealed cast iron cover



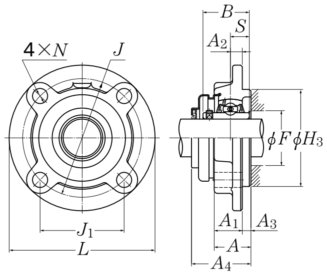
With cast iron closing cover

Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm t_1	t_2	A_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
F213	S-UCF213	SM-UCF213	C-UCF213	CM-UCF213	11	15	83.5	90	5.5	5.6	6.4
FX13	–	–	C-UCFX13	CM-UCFX13	–	16	–	101	6.6	–	7.8
F313	–	–	C-UCF313	CM-UCF313	–	19	–	103	8	–	9.7
F214	–	–	C-UCF214	CM-UCF214	–	16	–	98	6.3	–	7.4
FX14	–	–	C-UCFX14	CM-UCFX14	–	17	–	105	7.1	–	8.3
F314	–	–	C-UCF314	CM-UCF314	–	19	–	106	9.4	–	11
F215	–	–	C-UCF215	CM-UCF215	–	17	–	102	6.6	–	7.8
FX15	–	–	C-UCFX15	CM-UCFX15	–	16	–	112	8.6	–	9.9
F315	–	–	C-UCF315	CM-UCF315	–	19	–	114	11	–	13
F216	–	–	C-UCF216	CM-UCF216	–	16	–	106	7.9	–	9.2
FX16	–	–	C-UCFX16	CM-UCFX16	–	20	–	118	11	–	12
F316	–	–	C-UCF316	CM-UCF316	–	19	–	116	14	–	16
F217	–	–	C-UCF217	CM-UCF217	–	20	–	114	9.8	–	12
FX17	–	–	C-UCFX17	CM-UCFX17	–	19	–	122	12	–	14
F317	–	–	C-UCF317	CM-UCF317	–	21	–	129	15	–	19
F218	–	–	C-UCF218	CM-UCF218	–	19	–	122	12	–	13
FX18	–	–	C-UCFX18	CM-UCFX18	–	22	–	135	13	–	15
F318	–	–	C-UCF318	CM-UCF318	–	21	–	129	19	–	23
F319	–	–	C-UCF319	CM-UCF319	–	20	–	149	22	–	25
FX20	–	–	C-UCFX20	CM-UCFX20	–	23	–	146.5	21	–	23
F320	–	–	C-UCF320	CM-UCF320	–	20	–	154	27	–	32
F321	–	–	C-UCF321	CM-UCF321	–	20	–	156	26	–	32
F322	–	–	C-UCF322	CM-UCF322	–	20	–	160	34	–	40
F324	–	–	C-UCF324	CM-UCF324	–	22	–	172	48	–	56
F326	–	–	C-UCF326	CM-UCF326	–	22	–	178	63	–	73
F328	–	–	C-UCF328	CM-UCF328	–	21	–	192	90	–	100

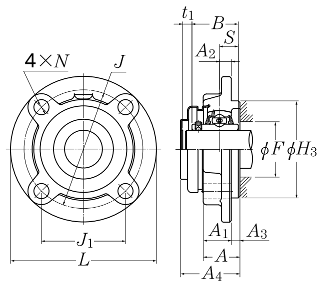
Round flange with cast iron spigot joint UCFC type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover

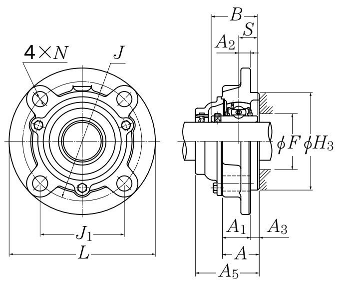


With steel closing cover

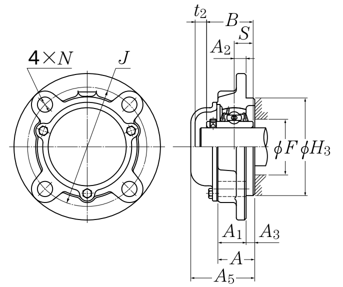
Shaft diameter: 12 to 70 mm

Shaft dia. mm	Unit number[1)2)]	Dimensions mm L	J	(J_1)	A_2	N	A_3	A_1 Standard, With steel cover	A_1 With cast iron cover	A	H_3	A_0	B	S	F (Min.)	Fixing bolt	Bearing Number	Basic load ratings dynamic kN C_r	Basic load ratings static kN C_{0r}	Fatigue load limit kN C_u
12	UCFC201	100	78	55.2	10	12	5	20.5	20.5	25.5	62	33.3	31	12.7	–	M10	UC201D1	14.2	6.65	0.505
15	UCFC202	100	78	55.2	10	12	5	20.5	20.5	25.5	62	33.3	31	12.7	–	M10	UC202D1	14.2	6.65	0.505
17	UCFC203	100	78	55.2	10	12	5	20.5	20.5	25.5	62	33.3	31	12.7	–	M10	UC203D1	14.2	6.65	0.505
20	UCFC204	100	78	55.2	10	12	5	20.5	20.5	25.5	62	33.3	31	12.7	–	M10	UC204D1	14.2	6.65	0.505
25	UCFC205	115	90	63.6	10	12	6	21	22	27	70	35.8	34.1	14.3	–	M10	UC205D1	15.5	7.85	0.55
	UCFCX05	111	92	65.1	10	9.5	6	24	–	30	76	38.2	38.1	15.9	46	M 8	UCX05D1	21.6	11.3	0.795
30	UCFC206	125	100	70.7	10	12	8	23	24.5	31	80	40.2	38.1	15.9	–	M10	UC206D1	21.6	11.3	0.795
	UCFCX06	127	105	74.2	8	12	9.5	22.5	–	32	85	42.9	42.9	17.5	52	M10	UCX06D1	28.4	15.3	1.09
35	UCFC207	135	110	77.8	11	14	8	26	26	34	90	44.4	42.9	17.5	–	M12	UC207D1	28.4	15.3	1.09
	UCFCX07	133	111	78.5	9	12	11	26	–	37	92	50.2	49.2	19	59	M10	UCX07D1	32.5	17.8	1.24
40	UCFC208	145	120	84.9	11	14	10	26	27.5	36	100	51.2	49.2	19	–	M12	UC208D1	32.5	17.8	1.24
	UCFCX08	133	111	78.5	9	12	11	26	–	37	92	50.2	49.2	19	63	M10	UCX08D1	36.0	20.4	1.60
45	UCFC209	160	132	93.3	10	16	12	26	28	38	105	52.2	49.2	19	–	M14	UC209D1	36.0	20.4	1.60
	UCFCX09	155	130	91.9	8	14	12	25	–	37	108	52.6	51.6	19	68	M12	UCX09D1	39.0	23.2	1.82
50	UCFC210	165	138	97.6	10	16	12	28	29	40	110	54.6	51.6	19	–	M14	UC210D1	39.0	23.2	1.82
	UCFCX10	162	136	96.2	7	14	16	25	–	41	118	56.4	55.6	22.2	75	M12	UCX10D1	48.0	29.2	2.29
55	UCFC211	185	150	106.1	13	19	12	31	32.5	43	125	58.4	55.6	22.2	–	M16	UC211D1	48.0	29.2	2.29
	UCFCX11	180	152	107.5	4	16	22	26	–	48	127	65.7	65.1	25.4	83	M14	UCX11D1	58.0	36.0	2.83
60	UCFC212	195	160	113.1	17	19	12	36	38	48	135	68.7	65.1	25.4	–	M16	UC212D1	58.0	36.0	2.83
	UCFCX12	194	165	116.7	11	16	20	33	–	53	140	70.7	65.1	25.4	–	M14	UCX12D1	63.5	40.0	3.15
65	UCFC213	205	170	120.2	16	19	14	36	38	50	145	69.7	65.1	25.4	–	M16	UC213D1	63.5	40.0	3.15
	UCFCX13	194	165	116.7	11	16	20	33	–	53	140	75.4	74.6	30.2	94	M14	UCX13D1	69.0	44.0	3.45
70	UCFC214	215	177	125.2	17	19	14	40	39.5	54	150	75.4	74.6	30.2	94	M16	UC214D1	69.0	44.0	3.45
	UCFCX14	222	190	134.4	14	19	20	36	–	56	164	78.5	77.8	33.3	100	M16	UCX14D1	73.5	49.5	3.80

1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UCFC210N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.



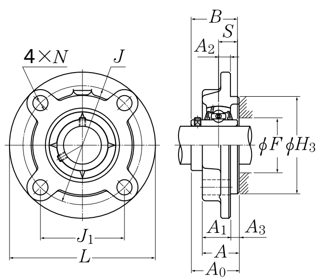
With rubber sealed cast iron cover



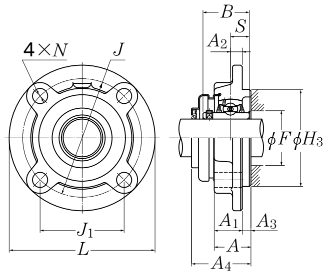
With cast iron closing cover

Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm t_1	t_2	A_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
FC204	S-UCFC201	SM-UCFC201	C-UCFC201	CM-UCFC201	5	8	40.5	46	0.8	0.8	0.9
FC204	S-UCFC202	SM-UCFC202	C-UCFC202	CM-UCFC202	5	8	40.5	46	0.8	0.8	0.9
FC204	S-UCFC203	SM-UCFC203	C-UCFC203	CM-UCFC203	5	8	40.5	46	0.8	0.8	0.9
FC204	S-UCFC204	SM-UCFC204	C-UCFC204	CM-UCFC204	5	8	40.5	46	0.7	0.7	0.9
FC205	S-UCFC205	SM-UCFC205	C-UCFC205	CM-UCFC205	7	11	44.5	51	1	1	1.2
FCX05	–	–	–	–	–	–	–	–	1.2	–	–
FC206	S-UCFC206	SM-UCFC206	C-UCFC206	CM-UCFC206	7	11	49	56	1.3	1.4	1.6
FCX06	–	–	–	–	–	–	–	–	1.5	–	–
FC207	S-UCFC207	SM-UCFC207	C-UCFC207	CM-UCFC207	8	10	55	59	1.6	1.7	1.9
FCX07	–	–	–	–	–	–	–	–	1.9	–	–
FC208	S-UCFC208	SM-UCFC208	C-UCFC208	CM-UCFC208	8	9	62	66	2	2.1	2.4
FCX08	–	–	–	–	–	–	–	–	2	–	–
FC209	S-UCFC209	SM-UCFC209	C-UCFC209	CM-UCFC209	8	12	63	70	2.7	2.7	3.2
FCX09	–	–	–	–	–	–	–	–	2.6	–	–
FC210	S-UCFC210	SM-UCFC210	C-UCFC210	CM-UCFC210	8	12	65.5	72	3	3.1	3.6
FCX10	–	–	–	–	–	–	–	–	3.1	–	–
FC211	S-UCFC211	SM-UCFC211	C-UCFC211	CM-UCFC211	10	11	71	75	4	4.2	4.8
FCX11	–	–	–	–	–	–	–	–	4.2	–	–
FC212	S-UCFC212	SM-UCFC212	C-UCFC212	CM-UCFC212	8	12	80	86	4.9	5.1	5.9
FCX12	–	–	–	–	–	–	–	–	5.5	–	–
FC213	S-UCFC213	SM-UCFC213	C-UCFC213	CM-UCFC213	11	14	83.5	89.5	5.8	6	6.8
FCX13	–	–	–	–	–	–	–	–	5.7	–	–
FC214	–	–	C-UCFC214	CM-UCFC214	–	16	–	98	7	–	8
FCX14	–	–	–	–	–	–	–	–	7.3	–	–

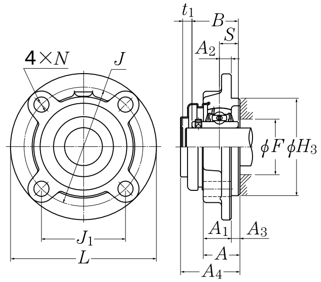
Round flange with cast iron spigot joint UCFC type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover

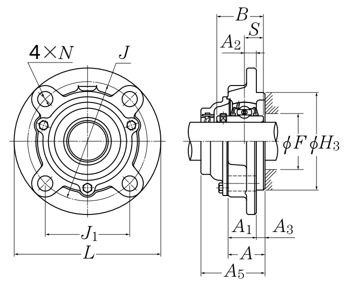


With steel closing cover

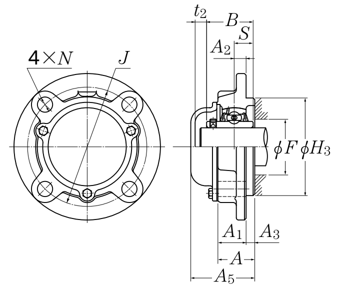
Shaft diameter: 75 to 100 mm

Shaft dia. mm	Unit number[1)2)]	Dimensions mm L	J	(J_1)	A_2	N	A_3	A_1 (Standared, With steel cover)	A_1 (With cast iron cover)	A	H_3	A_0	B	S	F (Min.)	Fixing bolt	Bearing Number	Basic load ratings dynamic kN C_r	static kN C_{0r}	Fatigue load limit kN C_u
75	**UCFC215**	220	184	130.1	18	19	16	40	43	56	160	78.5	77.8	33.3	100	M16	UC215D1	73.5	49.5	3.80
	UCFCX15	222	190	134.4	12	19	22	35	–	57	164	83.3	82.6	33.3	105	M16	UCX15D1	80.5	53.0	3.95
80	**UCFC216**	240	200	141.4	18	23	16	42	43	58	170	83.3	82.6	33.3	105	M20	UC216D1	80.5	53.0	3.95
	UCFCX16	260	219	154.9	10	23	25	36	–	61	186	86.6	85.7	34.1	113	M20	UCX16D1	92.0	64.0	4.60
85	**UCFC217**	250	208	147.1	18	23	18	45	45.5	63	180	87.6	85.7	34.1	113	M20	UC217D1	92.0	64.0	4.60
	UCFCX17	260	219	154.9	10	23	25	36	–	61	186	91.3	96	39.7	119	M20	UCX17D1	106	71.5	5.00
90	**UCFC218**	265	220	155.6	22	23	18	50	50	68	190	96.3	96	39.7	119	M20	UC218D1	106	71.5	5.00
	UCFCX18	260	219	154.9	12	23	28	43	–	71	186	101.1	104	42.9	126	M20	UCX18D1	121	82.0	5.55
100	**UCFCX20**	276	238	168.3	22	23	28	66	–	94	206	118.3	117.5	49.2	139	M20	UCX20D1	147	105	6.75

1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. Example: UCFC218N1
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.



With rubber sealed cast iron cover

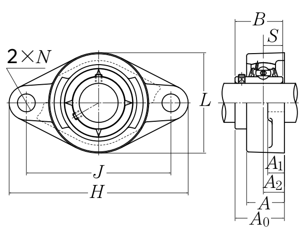


With cast iron closing cover

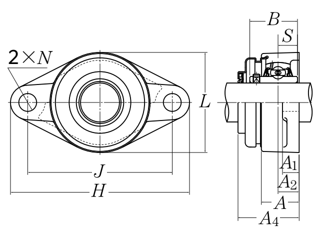
Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm t_1	t_2	A_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
FC215	–	–	**C-UCFC215**	**CM-UCFC215**	–	17	–	102	7.4	–	8.8
FCX15	–	–	–	–	–	–	–	–	8	–	–
FC216	–	–	**C-UCFC216**	**CM-UCFC216**	–	16	–	106	9.1	–	10
FCX16	–	–	–	–	–	–	–	–	12	–	–
FC217	–	–	**C-UCFC217**	**CM-UCFC217**	–	20	–	114	11	–	12
FCX17	–	–	–	–	–	–	–	–	12	–	–
FC218	–	–	**C-UCFC218**	**CM-UCFC218**	–	19	–	122	13	–	15
FCX18	–	–	–	–	–	–	–	–	12	–	–
FCX20	–	–	–	–	–	–	–	–	18	–	–

NTN

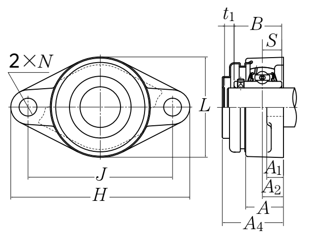
Cast iron rhombus flanged unit UCFL type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover



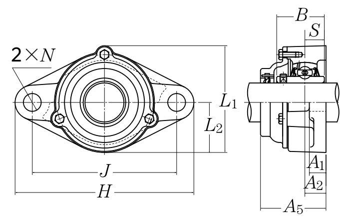
With steel closing cover

Shaft diameter: 12 to 60 mm

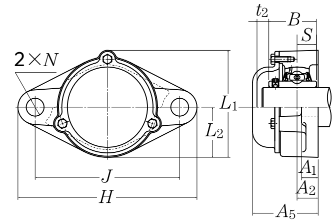
Shaft dia. mm	Unit number[1) 2)]	Dimensions mm										Fixing bolt	Bearing Number	Basic load ratings dynamic kN	static kN	Fatigue load limit kN
		H	J	A_2	A_1	A	N	L	A_0	B	S			C_r	C_{0r}	C_u
12	UCFL201	113	90	15	11	25.5	12	60	33.3	31	12.7	M10	UC201D1	14.2	6.65	0.505
15	UCFL202	113	90	15	11	25.5	12	60	33.3	31	12.7	M10	UC202D1	14.2	6.65	0.505
17	UCFL203	113	90	15	11	25.5	12	60	33.3	31	12.7	M10	UC203D1	14.2	6.65	0.505
20	UCFL204	113	90	15	11	25.5	12	60	33.3	31	12.7	M10	UC204D1	14.2	6.65	0.505
25	UCFL205	130	99	16	13	27	16	68	35.8	34.1	14.3	M14	UC205D1	15.5	7.85	0.55
	UCFLX05	141	117	18	13	30	12	83	40.2	38.1	15.9	M10	UCX05D1	21.6	11.3	0.795
	UCFL305	150	113	16	13	29	19	80	39	38	15	M16	UC305D1	23.5	10.9	0.855
30	UCFL206	148	117	18	13	31	16	80	40.2	38.1	15.9	M14	UC206D1	21.6	11.3	0.795
	UCFLX06	156	130	19	15	34	16	95	44.4	42.9	17.5	M14	UCX06D1	28.4	15.3	1.09
	UCFL306	180	134	18	15	32	23	90	44	43	17	M20	UC306D1	29.5	15.0	1.14
35	UCFL207	161	130	19	15	34	16	90	44.4	42.9	17.5	M14	UC207D1	28.4	15.3	1.09
	UCFLX07	171	144	21	16	38	16	105	51.2	49.2	19	M14	UCX07D1	32.5	17.8	1.24
	UCFL307	185	141	20	16	36	23	100	49	48	19	M20	UC307D1	37.0	19.1	1.47
40	UCFL208	175	144	21	15	36	16	100	51.2	49.2	19	M14	UC208D1	32.5	17.8	1.24
	UCFLX08	179	148	22	16	40	16	111	52.2	49.2	19	M14	UCX08D1	36.0	20.4	1.60
	UCFL308	200	158	23	17	40	23	112	56	52	19	M20	UC308D1	45.0	24.0	1.83
45	UCFL209	188	148	22	16	38	19	108	52.2	49.2	19	M16	UC209D1	36.0	20.4	1.60
	UCFLX09	189	157	23	16	40	16	116	55.6	51.6	19	M14	UCX09D1	39.0	23.2	1.82
	UCFL309	230	177	25	18	44	25	125	60	57	22	M22	UC309D1	58.5	32.0	2.50
50	UCFL210	197	157	22	16	40	19	115	54.6	51.6	19	M16	UC210D1	39.0	23.2	1.82
	UCFLX10	216	184	26	18	44	19	133	59.4	55.6	22.2	M16	UCX10D1	48.0	29.2	2.29
	UCFL310	240	187	28	19	48	25	140	67	61	22	M22	UC310D1	68.5	38.5	2.99
55	UCFL211	224	184	25	18	43	19	130	58.4	55.6	22.2	M16	UC211D1	48.0	29.2	2.29
	UCFL311	250	198	30	20	52	25	150	71	66	25	M22	UC311D1	79.5	45.0	3.50
60	UCFL212	250	202	29	18	48	23	140	68.7	65.1	25.4	M20	UC212D1	58.0	36.0	2.83
	UCFL312	270	212	33	22	56	31	160	78	71	26	M27	UC312D1	90.5	52.0	4.10

1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UCFL210N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.

NTN



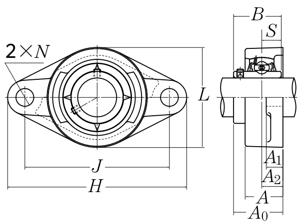
With rubber sealed cast iron cover



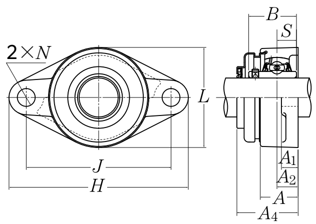
With cast iron closing cover

Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm						Unit mass (approx.) kg		
					t_1	t_2	A_4	A_5	L_1	L_2	Standard	With steel cover	With cast iron cover
FL204	S-UCFL201	SM-UCFL201	C-UCFL201	CM-UCFL201	5	8	40.5	46	67	30	0.5	0.5	0.6
FL204	S-UCFL202	SM-UCFL202	C-UCFL202	CM-UCFL202	5	8	40.5	46	67	30	0.5	0.5	0.6
FL204	S-UCFL203	SM-UCFL203	C-UCFL203	CM-UCFL203	5	8	40.5	46	67	30	0.5	0.5	0.6
FL204	S-UCFL204	SM-UCFL204	C-UCFL204	CM-UCFL204	5	8	40.5	46	67	30	0.4	0.4	0.6
FL205	S-UCFL205	SM-UCFL205	C-UCFL205	CM-UCFL205	7	11	44.5	51	74	34	0.6	0.6	0.8
FLX05	S-UCFLX05	SM-UCFLX05	C-UCFLX05	CM-UCFLX05	7	11	49	56	86	41.5	1	1	1.2
FL305	–	–	C-UCFL305	CM-UCFL305	–	12	–	56	86	40	0.9	–	1.2
FL206	S-UCFL206	SM-UCFL206	C-UCFL206	CM-UCFL206	7	11	49	56	85	40	0.8	0.9	1.2
FLX06	S-UCFLX06	SM-UCFLX06	C-UCFLX06	CM-UCFLX06	8	10	55	59	98.5	47.5	1.4	1.6	1.8
FL306	–	–	C-UCFL306	CM-UCFL306	–	11	–	60	101	45	1.4	–	1.7
FL207	S-UCFL207	SM-UCFL207	C-UCFL207	CM-UCFL207	8	10	55	59	97	45	1.2	1.2	1.4
FLX07	S-UCFLX07	SM-UCFLX07	C-UCFLX07	CM-UCFLX07	8	9	62	66	108.5	52.5	1.8	1.9	2.2
FL307	–	–	C-UCFL307	CM-UCFL307	–	14	–	68	110	50	1.7	–	2.1
FL208	S-UCFL208	SM-UCFL208	C-UCFL208	CM-UCFL208	8	9	62	66	106	50	1.5	1.5	1.9
FLX08	S-UCFLX08	SM-UCFLX08	C-UCFLX08	CM-UCFLX08	8	12	63	70	114.5	55.5	2	2.1	2.4
FL308	–	–	C-UCFL308	CM-UCFL308	–	14	–	76	122	56	2.2	–	2.9
FL209	S-UCFL209	SM-UCFL209	C-UCFL209	CM-UCFL209	8	12	63	70	113	54	1.8	1.9	2.3
FLX09	S-UCFLX09	SM-UCFLX09	C-UCFLX09	CM-UCFLX09	7	12	65.5	73	119.5	58	2.2	2.3	2.7
FL309	–	–	C-UCFL309	CM-UCFL309	–	14	–	80	135	62	3	–	3.8
FL210	S-UCFL210	SM-UCFL210	C-UCFL210	CM-UCFL210	8	12	65.5	72	120	58	2	2.1	2.7
FLX10	S-UCFLX10	SM-UCFLX10	C-UCFLX10	CM-UCFLX10	9	11	71	76	133.5	66.5	3	3.2	3.6
FL310	–	–	C-UCFL310	CM-UCFL310	–	15	–	88	152	70	4.1	–	5
FL211	S-UCFL211	SM-UCFL211	C-UCFL211	CM-UCFL211	10	11	71	75	133	65	2.9	3	3.4
FL311	–	–	C-UCFL311	CM-UCFL311	–	15	–	92	162	75	4.6	–	5.9
FL212	S-UCFL212	SM-UCFL212	C-UCFL212	CM-UCFL212	8	12	80	86	144	70	3.8	4	4.6
FL312	–	–	C-UCFL312	CM-UCFL312	–	16	–	100	175	80	5.7	–	7.7

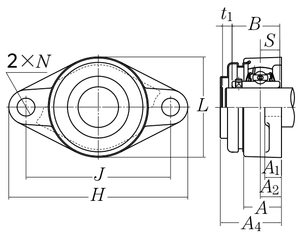
Cast iron rhombus flanged unit UCFL type / cylindrical bore type, setscrew type



Standard



With rubber sealed steel cover

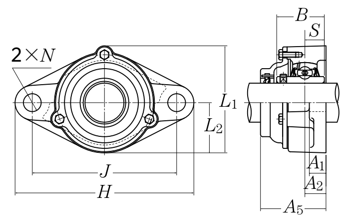


With steel closing cover

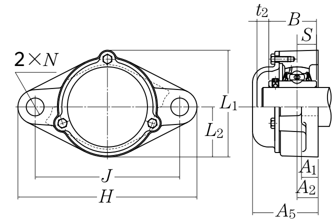
Shaft diameter: 65 to 140 mm

Shaft dia. mm	Unit number[1) 2)]	Dimensions mm H	J	A_2	A_1	A	N	L	A_0	B	S	Fixing bolt	Bearing Number	Basic load ratings dynamic kN C_r	static kN C_{0r}	Fatigue load limit kN C_u
65	**UCFL213**	258	210	30	22	50	23	155	69.7	65.1	25.4	M20	UC213D1	63.5	40.0	3.15
	UCFL313	295	240	33	25	58	31	175	78	75	30	M27	UC313D1	103	60.0	4.60
70	**UCFL214**	265	216	31	22	54	23	160	75.4	74.6	30.2	M20	UC214D1	69.0	44.0	3.45
	UCFL314	315	250	36	28	61	35	185	81	78	33	M30	UC314D1	115	68.0	5.10
75	**UCFL215**	275	225	34	22	56	23	165	78.5	77.8	33.3	M20	UC215D1	73.5	49.5	3.80
	UCFL315	320	260	39	30	66	35	195	89	82	32	M30	UC315D1	126	77.0	5.55
80	**UCFL216**	290	233	34	22	58	25	180	83.3	82.6	33.3	M22	UC216D1	80.5	53.0	3.95
	UCFL316	355	285	38	32	68	38	210	90	86	34	M33	UC316D1	136	86.5	6.05
85	**UCFL217**	305	248	36	24	63	25	190	87.6	85.7	34.1	M22	UC217D1	92.0	64.0	4.60
	UCFL317	370	300	44	32	74	38	220	100	96	40	M33	UC317D1	147	97.0	6.55
90	**UCFL218**	320	265	40	24	68	25	205	96.3	96	39.7	M22	UC218D1	106	71.5	5.00
	UCFL318	385	315	44	36	76	38	235	100	96	40	M33	UC318D1	158	107	7.10
95	**UCFL319**	405	330	59	40	94	41	250	121	103	41	M36	UC319D1	169	119	7.65
100	**UCFL320**	440	360	59	40	94	44	270	125	108	42	M39	UC320D1	192	141	8.75
105	**UCFL321**	440	360	59	40	94	44	270	127	112	44	M39	UC321D1	204	153	9.35
110	**UCFL322**	470	390	60	42	96	44	300	131	117	46	M39	UC322D1	227	179	10.5
120	**UCFL324**	520	430	65	48	110	47	330	140	126	51	M42	UC324D1	229	185	10.5
130	**UCFL326**	550	460	65	50	115	47	360	146	135	54	M42	UC326D1	254	214	11.7
140	**UCFL328**	600	500	75	60	125	51	400	161	145	59	M45	UC328D1	280	246	13.0

1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. **Example: UCFL215N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "**D1**" is added after the number for the oil feeding type.



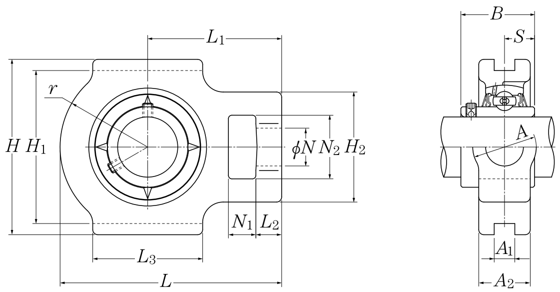
With rubber sealed cast iron cover



With cast iron closing cover

Standard housing number	Number of unit with steel cover: Rubber sealed cover	Number of unit with steel cover: Closing cover	Number of unit with cast iron cover: Rubber sealed cover	Number of unit with cast iron cover: Closing cover	Dimensions mm t_1	t_2	A_4	A_5	L_1	L_2	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
FL213	**S-UCFL213**	**SM-UCFL213**	**C-UCFL213**	**CM-UCFL213**	11	15	83.5	90	157	78	4.8	4.9	5.8
FL313	–	–	**C-UCFL313**	**CM-UCFL313**	–	19	–	103	189	88	7.5	–	9.9
FL214	–	–	**C-UCFL214**	**CM-UCFL214**	–	16	–	98	164	80	5.4	–	7.7
FL314	–	–	**C-UCFL314**	**CM-UCFL314**	–	19	–	106	198	92	8.6	–	11
FL215	–	–	**C-UCFL215**	**CM-UCFL215**	–	17	–	102	169	82	6	–	7.1
FL315	–	–	**C-UCFL315**	**CM-UCFL315**	–	19	–	114	210	98	9.8	–	12
FL216	–	–	**C-UCFL216**	**CM-UCFL216**	–	16	–	106	183	90	7.4	–	8.6
FL316	–	–	**C-UCFL316**	**CM-UCFL316**	–	19	–	116	222	105	13	–	16
FL217	–	–	**C-UCFL217**	**CM-UCFL217**	–	20	–	114	192	95	8.8	–	10
FL317	–	–	**C-UCFL317**	**CM-UCFL317**	–	19	–	127	234	110	15	–	17
FL218	–	–	**C-UCFL218**	**CM-UCFL218**	–	19	–	122	205	102	11	–	13
FL318	–	–	**C-UCFL318**	**CM-UCFL318**	–	21	–	129	247	118	17	–	21
FL319	–	–	**C-UCFL319**	**CM-UCFL319**	–	20	–	149	260	125	23	–	26
FL320	–	–	**C-UCFL320**	**CM-UCFL320**	–	20	–	154	280	135	26	–	31
FL321	–	–	**C-UCFL321**	**CM-UCFL321**	–	20	–	156	287	135	27	–	32
FL322	–	–	**C-UCFL322**	**CM-UCFL322**	–	20	–	160	315	150	34	–	39
FL324	–	–	**C-UCFL324**	**CM-UCFL324**	–	22	–	172	342	165	48	–	52
FL326	–	–	**C-UCFL326**	**CM-UCFL326**	–	22	–	178	376	180	58	–	67
FL328	–	–	**C-UCFL328**	**CM-UCFL328**	–	21	–	192	410	200	81	–	90

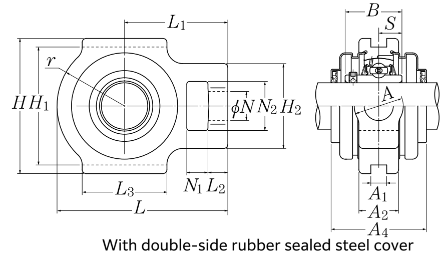
Cast iron take-up unit UCT type / cylindrical bore type, setscrew type



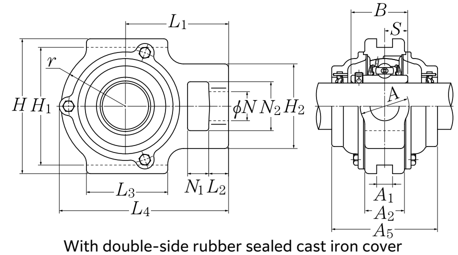
Shaft diameter: 12 to 50 mm

Shaft dia. mm	Unit number[1)2)]	Dimensions mm N_1	L_2	H_2	N_2	N	L_3	A_1	H_1	H	L	A_2	A	r	L_1	B	S	Bearing Number	Basic load ratings dynamic kN C_r	static kN C_{0r}	Fatigue load limit kN C_u
12	**UCT201**	16	12	51	32	19	51	12	76	89	94	21	32	33	61	31	12.7	UC201D1	14.2	6.65	0.505
15	**UCT202**	16	12	51	32	19	51	12	76	89	94	21	32	33	61	31	12.7	UC202D1	14.2	6.65	0.505
17	**UCT203**	16	12	51	32	19	51	12	76	89	94	21	32	33	61	31	12.7	UC203D1	14.2	6.65	0.505
20	**UCT204**	16	12	51	32	19	51	12	76	89	94	21	32	33	61	31	12.7	UC204D1	14.2	6.65	0.505
25	**UCT205**	16	12	51	32	19	51	12	76	89	97	24	32	35	62	34.1	14.3	UC205D1	15.5	7.85	0.55
	UCTX05	16	12	56	37	22	57	12	89	102	113	28	37	43	70	38.1	15.9	UCX05D1	21.6	11.3	0.795
	UCT305	16	14	62	36	26	65	12	80	89	122	26	36	46	76	38	15	UC305D1	23.5	10.9	0.855
30	**UCT206**	16	12	56	37	22	57	12	89	102	113	28	37	43	70	38.1	15.9	UC206D1	21.6	11.3	0.795
	UCTX06	16	15	64	37	22	64	12	89	102	129	30	37	51	78	42.9	17.5	UCX06D1	28.4	15.3	1.09
	UCT306	18	16	70	41	28	74	16	90	100	137	28	41	52	85	43	17	UC306D1	29.5	15.0	1.14
35	**UCT207**	16	15	64	37	22	64	12	89	102	129	30	37	51	78	42.9	17.5	UC207D1	28.4	15.3	1.09
	UCTX07	19	17	83	49	29	83	16	102	114	144	36	49	56	88	49.2	19	UCX07D1	32.5	17.8	1.24
	UCT307	20	17	75	45	30	80	16	100	111	150	32	45	56	94	48	19	UC307D1	37.0	19.1	1.47
40	**UCT208**	19	18	83	49	29	83	16	102	114	144	33	49	56	88	49.2	19	UC208D1	32.5	17.8	1.24
	UCTX08	19	17	83	49	29	83	16	102	117	144	36	49	57	87	49.2	19	UCX08D1	36.0	20.4	1.60
	UCT308	22	19	83	50	32	89	18	112	124	162	34	50	62	100	52	19	UC308D1	45.0	24.0	1.83
45	**UCT209**	19	18	83	49	29	83	16	102	117	145	35	49	57	88	49.2	19	UC209D1	36.0	20.4	1.60
	UCTX09	19	18	83	49	29	86	16	102	117	151	38	49	59	92	51.6	19	UCX09D1	39.0	23.2	1.82
	UCT309	24	20	90	55	34	97	18	125	138	178	38	55	68	110	57	22	UC309D1	58.5	32.0	2.50
50	**UCT210**	19	18	83	49	29	86	16	102	117	151	37	49	59	92	51.6	19	UC210D1	39.0	23.2	1.82
	UCTX10	25	21	102	64	35	95	22	130	146	171	42	64	65	106	55.6	22.2	UCX10D1	48.0	29.2	2.29
	UCT310	27	22	98	61	37	106	20	140	151	192	40	61	74	118	61	22	UC310D1	68.5	38.5	2.99

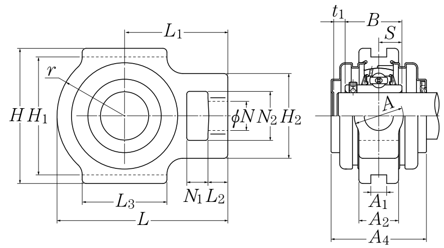
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "**N1**" is added after the number. **Example:** UCT210N1
2) The unit numbers indicate the oil-free type, and supplementary suffix "**D1**" is added after the number for the oil feeding type.



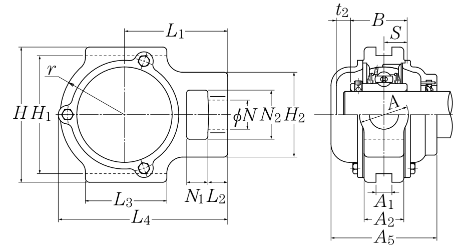
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



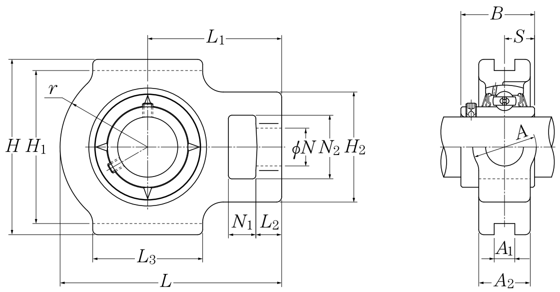
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	Number of unit with steel cover: One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	Number of unit with cast iron cover: One-side closing cover	Dimensions mm t_1	t_2	A_4	L_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
T204	**S-UCT201**	**SM-UCT201**	**C-UCT201**	**CM-UCT201**	5	8	51	97	62	0.6	0.8	1.1
T204	**S-UCT202**	**SM-UCT202**	**C-UCT202**	**CM-UCT202**	5	8	51	97	62	0.6	0.8	1
T204	**S-UCT203**	**SM-UCT203**	**C-UCT203**	**CM-UCT203**	5	8	51	97	62	0.6	0.8	1
T204	**S-UCT204**	**SM-UCT204**	**C-UCT204**	**CM-UCT204**	5	8	51	97	62	0.6	0.8	1
T205	**S-UCT205**	**SM-UCT205**	**C-UCT205**	**CM-UCT205**	7	11	57	100.5	70	0.8	0.9	1.1
TX05	**S-UCTX05**	**SM-UCTX05**	**C-UCTX05**	**CM-UCTX05**	7	11	62	113.5	75	1.3	1.5	1.8
T305	–	–	**C-UCT305**	**CM-UCT305**	–	12	–	122	80	1.4	–	1.7
T206	**S-UCT206**	**SM-UCT206**	**C-UCT206**	**CM-UCT206**	7	11	62	113.5	75	1.3	1.3	1.7
TX06	**S-UCTX06**	**SM-UCTX06**	**C-UCTX06**	**CM-UCTX06**	8	10	72	129	80	1.7	2	2.3
T306	–	–	**C-UCT306**	**CM-UCT306**	–	11	–	139	85	1.8	–	2.4
T207	**S-UCT207**	**SM-UCT207**	**C-UCT207**	**CM-UCT207**	8	10	72	129	80	1.6	1.7	2.1
TX07	**S-UCTX07**	**SM-UCTX07**	**C-UCTX07**	**CM-UCTX07**	8	9	82	144	90	2.6	2.8	3.5
T307	–	–	**C-UCT307**	**CM-UCT307**	–	13	–	152	95	2.3	–	3.2
T208	**S-UCT208**	**SM-UCT208**	**C-UCT208**	**CM-UCT208**	8	9	82	144	90	2.4	2.5	3.1
TX08	**S-UCTX08**	**SM-UCTX08**	**C-UCTX08**	**CM-UCTX08**	8	12	82	144.5	95	2.6	2.8	3.5
T308	–	–	**C-UCT308**	**CM-UCT308**	–	13	–	164	105	3	–	4.2
T209	**S-UCT209**	**SM-UCT209**	**C-UCT209**	**CM-UCT209**	8	12	82	145.5	95	2.4	2.5	3.2
TX09	**S-UCTX09**	**SM-UCTX09**	**C-UCTX09**	**CM-UCTX09**	8	12	87	152	100	2.7	3	3.7
T309	–	–	**C-UCT309**	**CM-UCT309**	–	14	–	181	110	4	–	5.5
T210	**S-UCT210**	**SM-UCT210**	**C-UCT210**	**CM-UCT210**	8	12	87	152	100	2.6	2.7	3.6
TX10	**S-UCTX10**	**SM-UCTX10**	**C-UCTX10**	**CM-UCTX10**	10	11	92	171.5	100	4.2	4.6	5.4
T310	–	–	**C-UCT310**	**CM-UCT310**	–	15	–	197	120	5	–	7.1

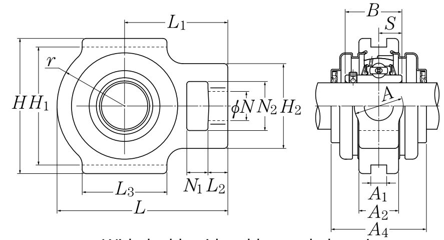
Cast iron take-up unit UCT type / cylindrical bore type, setscrew type



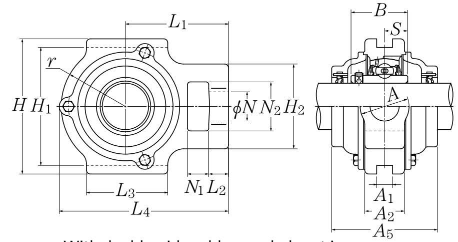
Shaft diameter: 55 to 95 mm

Shaft dia. mm	Unit number[1)2)]	Dimensions mm N_1	L_2	H_2	N_2	N	L_3	A_1	H_1	H	L	A_2	A	r	L_1	B	S	Bearing Number	Basic load ratings dynamic C_r kN	static C_{0r} kN	Fatigue load limit C_u kN
55	**UCT211**	25	21	102	64	35	95	22	130	146	171	38	64	65	106	55.6	22.2	UC211D1	48.0	29.2	2.29
	UCTX11	32	21	102	64	35	102	22	130	146	194	44	64	75	119	65.1	25.4	UCX11D1	58.0	36.0	2.83
	UCT311	29	23	105	66	39	115	22	150	163	207	44	66	80	127	66	25	UC311D1	79.5	45.0	3.50
60	**UCT212**	32	21	102	64	35	102	22	130	146	194	42	64	75	119	65.1	25.4	UC212D1	58.0	36.0	2.83
	UCTX12	32	23	111	70	41	121	26	151	167	224	48	70	87	137	65.1	25.4	UCX12D1	63.5	40.0	3.15
	UCT312	31	25	113	71	41	123	22	160	178	220	46	71	85	135	71	26	UC312D1	90.5	52.0	4.10
65	**UCT213**	32	23	111	70	41	121	26	151	167	224	44	70	87	137	65.1	25.4	UC213D1	63.5	40.0	3.15
	UCTX13	32	23	111	70	41	121	26	151	167	224	48	70	87	137	74.6	30.2	UCX13D1	69.0	44.0	3.45
	UCT313	32	27	116	70	43	134	26	170	190	238	50	80	92	146	75	30	UC313D1	103	60.0	4.60
70	**UCT214**	32	23	111	70	41	121	26	151	167	224	46	70	87	137	74.6	30.2	UC214D1	69.0	44.0	3.45
	UCTX14	32	23	111	70	41	121	26	151	167	232	48	70	92	140	77.8	33.3	UCX14D1	73.5	49.5	3.80
	UCT314	36	27	130	85	46	140	26	180	202	252	52	90	97	155	78	33	UC314D1	115	68.0	5.10
75	**UCT215**	32	23	111	70	41	121	26	151	167	232	48	70	92	140	77.8	33.3	UC215D1	73.5	49.5	3.80
	UCTX15	32	23	111	70	41	121	28	165	184	235	48	70	95	140	82.6	33.3	UCX15D1	80.5	53.0	3.95
	UCT315	36	27	132	85	46	150	26	192	216	262	55	90	102	160	82	32	UC315D1	126	77.0	5.55
80	**UCT216**	32	23	111	70	41	121	26	165	184	235	51	70	95	140	82.6	33.3	UC216D1	80.5	53.0	3.95
	UCTX16	38	30	124	73	48	157	28	173	198	260	54	73	98	162	85.7	34.1	UCX16D1	92.0	64.0	4.60
	UCT316	42	30	150	98	53	160	30	204	230	282	60	102	108	174	86	34	UC316D1	136	86.5	6.05
85	**UCT217**	38	31	124	73	48	157	30	173	198	260	54	73	98	162	85.7	34.1	UC217D1	92.0	64.0	4.60
	UCTX17	38	30	124	73	48	157	28	173	198	260	54	73	98	162	96	39.7	UCX17D1	106	71.5	5.00
	UCT317	42	32	152	98	53	170	32	214	240	298	64	102	115	183	96	40	UC317D1	147	97.0	6.55
90	**UCT318**	46	32	160	106	57	175	32	228	255	312	66	110	120	192	96	40	UC318D1	158	107	7.10
95	**UCT319**	46	33	165	106	57	180	35	240	270	322	72	110	125	197	103	41	UC319D1	169	119	7.65

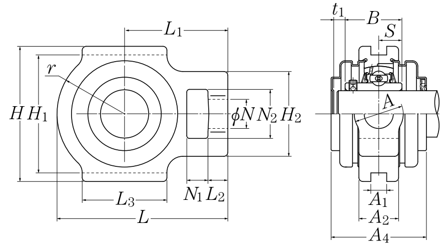
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "**N1**" is added after the unit number. **Example: UCT320N1**
2) The unit numbers indicate the oil-free type, and supplementary suffix "**D1**" is added after the number for the oil feeding type.



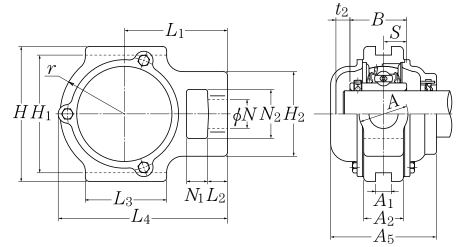
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



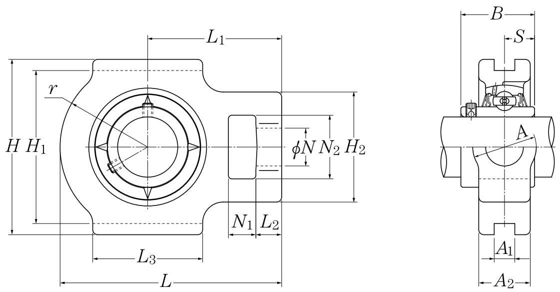
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	Number of unit with steel cover: One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	Number of unit with cast iron cover: One-side closing cover	Dimensions mm t_1	t_2	A_4	L_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
T211	**S-UCT211**	**SM-UCT211**	**C-UCT211**	**CM-UCT211**	10	11	92	171.5	100	3.9	4.1	5
TX11	**S-UCTX11**	**SM-UCTX11**	**C-UCTX11**	**CM-UCTX11**	8	12	102	194	115	5.2	5.6	6.7
T311	–	–	**C-UCT311**	**CM-UCT311**	–	15	–	211	125	6.3	–	8.5
T212	**S-UCT212**	**SM-UCT212**	**C-UCT212**	**CM-UCT212**	8	12	102	194	115	4.8	5.1	6.1
TX12	**S-UCTX12**	**SM-UCTX12**	**C-UCTX12**	**CM-UCTX12**	11	15	107	224	120	7.2	7.7	9
T312	–	–	**C-UCT312**	**CM-UCT312**	–	16	–	227	135	7.6	–	10
T213	**S-UCT213**	**SM-UCT213**	**C-UCT213**	**CM-UCT213**	11	15	107	224	120	7	7.3	8.4
TX13	–	–	**C-UCTX13**	**CM-UCTX13**	–	17	–	224	135	7.4	–	9.8
T313	–	–	**C-UCT313**	**CM-UCT313**	–	19	–	244	140	9.3	–	12
T214	–	–	**C-UCT214**	**CM-UCT214**	–	17	–	224	135	7	–	9.2
TX14	–	–	**C-UCTX14**	**CM-UCTX14**	–	17	–	232	135	7.7	–	10
T314	–	–	**C-UCT314**	**CM-UCT314**	–	19	–	258	140	11	–	14
T215	–	–	**C-UCT215**	**CM-UCT215**	–	17	–	232	135	7.4	–	9.8
TX15	–	–	**C-UCTX15**	**CM-UCTX15**	–	17	–	235	145	8.3	–	11
T315	–	–	**C-UCT315**	**CM-UCT315**	–	19	–	268	150	13	–	17
T216	–	–	**C-UCT216**	**CM-UCT216**	–	17	–	235	145	8.2	–	11
TX16	–	–	**C-UCTX16**	**CM-UCTX16**	–	19	–	260	155	11	–	14
T316	–	–	**C-UCT316**	**CM-UCT316**	–	18	–	287	155	16	–	20
T217	–	–	**C-UCT217**	**CM-UCT217**	–	19	–	260	155	11	–	14
TX17	–	–	**C-UCTX17**	**CM-UCTX17**	–	20	–	262	165	11	–	15
T317	–	–	**C-UCT317**	**CM-UCT317**	–	21	–	303	170	19	–	25
T318	–	–	**C-UCT318**	**CM-UCT318**	–	21	–	317	170	21	–	27
T319	–	–	**C-UCT319**	**CM-UCT319**	–	20	–	327	180	24	–	31

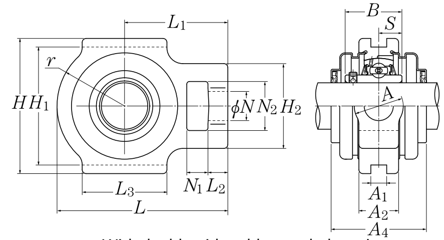
Cast iron take-up unit UCT type / cylindrical bore type, setscrew type



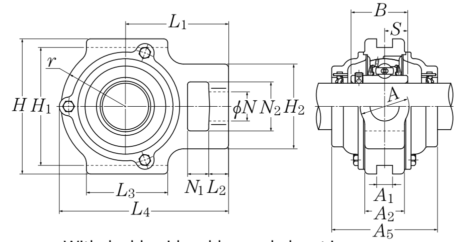
Shaft diameter: 100 to 140 mm

Shaft dia. mm	Unit number[1)2)]	Dimensions mm																Bearing Number	Basic load ratings dynamic kN	static	Fatigue load limit
		N_1	L_2	H_2	N_2	N	L_3	A_1	H_1	H	L	A_2	A	r	L_1	B	S		C_r	C_{0r}	C_u
100	**UCT320**	48	34	175	115	59	200	35	260	290	345	75	120	135	210	108	42	UC320D1	192	141	8.75
105	**UCT321**	48	34	175	115	59	200	35	260	290	347	75	120	135	212	112	44	UC321D1	204	153	9.35
110	**UCT322**	52	40	185	125	65	215	38	285	320	385	80	130	150	235	117	46	UC322D1	227	179	10.5
120	**UCT324**	60	44	210	140	70	230	45	320	355	432	90	140	165	267	126	51	UC324D1	229	185	10.5
130	**UCT326**	65	47	220	150	75	240	50	350	385	465	100	150	180	285	135	54	UC326D1	254	214	11.7
140	**UCT328**	70	52	230	160	80	255	50	380	415	515	100	155	200	315	145	59	UC328D1	280	246	13.0

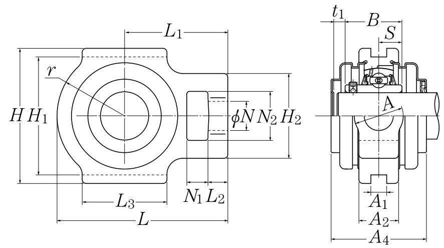
1) Spherical graphite cast iron bearings are also available based on request. In this case, a supplementary suffix "N1" is added after the unit number. Example: UCT320N1
2) The unit numbers indicate the oil-free type, and supplementary suffix "D1" is added after the number for the oil feeding type.



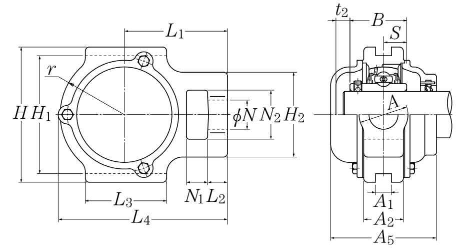
With double-side rubber sealed steel cover



With double-side rubber sealed cast iron cover



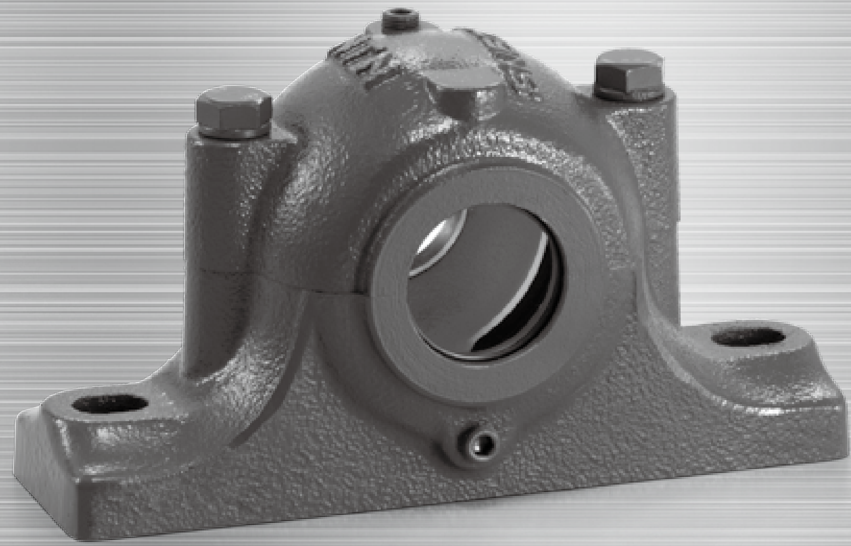
With one-side steel closing cover



With one-side steel closing cover

Standard housing number	Number of unit with steel cover: Double-side rubber sealed cover	One-side closing cover	Number of unit with cast iron cover: Double-side rubber sealed cover	One-side closing cover	Dimensions mm t_1	t_2	A_4	L_4	A_5	Unit mass (approx.) kg Standard	With steel cover	With cast iron cover
T320	–	–	**C-UCT320**	**CM-UCT320**	–	20	–	350	190	30	–	38
T321	–	–	**C-UCT321**	**CM-UCT321**	–	20	–	359	195	30	–	40
T322	–	–	**C-UCT322**	**CM-UCT322**	–	20	–	395	200	39	–	50
T324	–	–	**C-UCT324**	**CM-UCT324**	–	22	–	439	215	43	–	69
T326	–	–	**C-UCT326**	**CM-UCT326**	–	21	–	476	225	69	–	84
T328	–	–	**C-UCT328**	**CM-UCT328**	–	21	–	519	235	88	–	106

Plummer Blocks



Plummer Blocks Contents

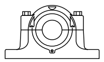
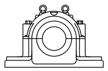
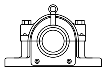
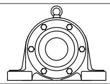
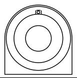
1. Design features and characteristics

The **NTN** plummer blocks are housings for spherical roller bearings and self-aligning ball bearings. The standard housing is gray cast iron, while spheroidal graphite cast iron (ductile cast iron) and cast steel, are also available depending on the application.

The housings can incorporate rubber seals, felt seals, or labyrinth seals depending on the application. Grease and oil are both available for lubrication.

This catalog includes dimension tables of representative shapes indicated by blue characters in “2. Plummer block types and characteristics.”

For the details on **NTN** plummer blocks, see the special catalog “**Plummer blocks (CAT. No. 2500/E)**.”

Plummer block types			Shaft diameter mm	Page of bearing dimension table
Split type	SN type		25～140	G-14～25, G-30～31
	SD type		150～300	G-26～29, G-32～35
	SBG type		55～180	—
Single type	SV type		20～300	G-36～43
	VA type		50～100	—

2. Type

Type — Split type

SN type (standard type)

SN5 SN2
SN6 SN3
S6 S3
SN30
SN31

Lubricant: grease
Seal: rubber seal

- SN5 and SN6 are the most general types that are specified in JIS, ISO, and DIN, and widely used in the world.
- SN30 and SN31 are a medium size and can be applied when the bearing diameter is large.
- A tapered bore bearing (with adapter) is used.

SNZ type (stepped bore type)

SNZ2
SNZ3
SZ3

Lubricant: grease
Seal: rubber seal

- This type of plummer block is SN5, SN6, and S6 types having a large aperture on one side.
- Cylindrical bore bearings are attached with nuts and washers.

SN type (high strength type)

SN5··F SN2··F
SNZ2··F
SN6··F SN3··F

Lubricant: grease
Seal: rubber seal

- The recess at the bottom part is made small to increase the strength of the plummer block.
- The plummer block has same dimensions as SN5, SN6, and S6 types except the bottom shape.
- A tapered bore bearing (with adapter) is used.
- There is no mounting bolt hole.

SD type (standard type and large bore type)

SD5··(G) SD2··D(G)
SD6··(G) SD3··D(G)
SD30··(G)
SD31··(G)
SD33··(G)
SD34··(G)

Lubricant: grease or oil
Seal: double rubber seal

- Used for heavy loads with large self-aligning roller bearings.
- There are types for the floating side and the fixed side (G).
- A tapered bore bearing (with adapter) is used.
- There are four mounting bolt holes.

SD type (stepped bore type)

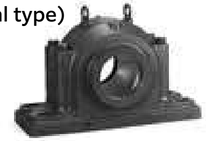
SD2··(G)
SD3··(G)
SD35··(G)
SD36··(G)

Lubricant: grease or oil
Seal: double rubber seal

- Used for heavy loads with large self-aligning roller bearings.
- This type of plummer block is SD5(G) and SD6 (G) types having a large aperture on one side.
- Cylindrical bore bearings are attached with nuts and washers.

Type — Split type

SD type (labyrinth seal type)



SD31··TS(G)
SD32··TS(G)

Lubricant: grease or oil
Seal: Labyrinth seal

- Used for heavy loads with large self-aligning roller bearings.
- Suitable for high speed rotation because the sealing device for labyrinth seals is adopted.
- Used for both oil lubrication and grease lubrication because an oil sump is provided in the housing.

Type — Single type

SV type (standard type)

SV5
SV6
SV30

Lubricant: grease
Seal: rubber seal

- The plummer block main body is a single type and has higher accuracy compared with the divided type.
- Applied to tapered bore bearings.

SV type (stepped bore type)

SV2
SV3
SV35

Lubricant: grease
Seal: rubber seal

- This type of plummer block is SN5 and SN6 types having a large aperture on one side.
- Cylindrical bore bearings are attached with nuts and washers.

VA type (narrow attachment width type)

VA5

Lubricant: grease
Seal: oil seal

- Applied to tapered bore bearings.
- Mounting bolt holes are provided at the bottom.

3. Plummer block numbers

A plummer block number indicates the type, structure, and consists of basic numbers followed by supplementary codes.

SD 5 34 B4 M3 D3 N L5

Basic number

1) Plummer block type codes
- SN (S) : divided, standard type
- SNZ : divided, standard type, different aperture type
- SD : divided, for heavy loads, with double seal
- SV : single type

2) Plummer block dimension array codes
- 5, 6, 30, 31, 33, 34 : Tapered bore bearing
- 2, 3, 35, 36 : Cylindrical bore bearing

3) Bore diameter code
- Bore no. of bearing used: 05…22…

Supplementary codes

4) Dimensions of bottom shape and mounting bolt hole
- F: small bottom recess without bolt hole
- B1…Bn: different shape and dimension from standard

5) Shaft end shape
- M3: one aperture part is embedded into the seal part
- M2: one aperture part has an iron plate attached to the end surface

6) Aperture part
- Dn: different shape and dimension from standard

7) Housing material
- N : cast steel
- N1: spheroidal graphite cast iron (ductile cast iron)

8) Lubrication
- L5: standard oil filler plug and oil drain plug are attached
- L1: standard grease nipple and oil drain plug are attached

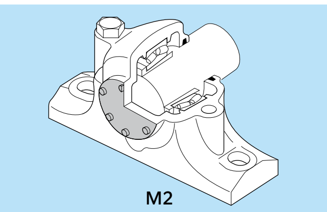
For order

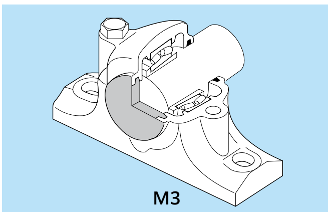
The plummer block numbers do not include additional parts. Therefore, please order any necessary parts with their numbers.
(Example)

SN506	1206K	H206X	SR62×7	ZF6
Plummer blocks	Rolling bearings	Adapter	Positioning wheel (fixed side only)	Rubber seal

Article

For shaft ends, a plummer block having a non-penetrating aperture on the shaft end side (outer side) is generally used.
There are two types shown below.


M2


M3

4. Accuracy

4.1 Accuracy

Regarding the accuracy of **NTN** plummer blocks, the divided types conform to JIS B 1551 and the single types to The Japan Bearing Industrial Association (BAS) 188. The dimensional tolerances are shown in the table below.

Table 1: dimensional tolerances of bearing seating bore diameter, width, and center height
Table 2: dimensional tolerances of length of castings (cast parts such as bases and bolt holes)

Table 1 Dimensional tolerance of plummer blocks

Unit: mm

<table>
<tr><th colspan="4">Divided type</th><th colspan="6">Single type</th></tr>
<tr><th>Plummer block series</th><th>Bearing seating bore dia. Δ_{Ds}</th><th>Bearing seating bore width Δ_{gs}</th><th>Center height Δ_{Hs}</th><th>Plummer block series</th><th>Bearing seating bore dia. Δ_{Ds}</th><th>Center height Δ_{Hs}</th><th>Main body width l_1</th><th>Cover dimension l_2</th><th>Cover inlet width l_3</th></tr>
<tr><td>SN5, SN5F
SN(S)6, SN(S)6F
SN2, SNZ2, SN30
SN(S)3, SNZ(SZ)3, SN31
SBG5</td><td>H8</td><td>H13</td><td>h13</td><td rowspan="2">SV5
SV6
SV2
SV3
SV30
SV35
VA5</td><td rowspan="2">H7</td><td rowspan="2">h11</td><td rowspan="2">+0.2
0</td><td rowspan="2">±1</td><td rowspan="2">0
−0.2</td></tr>
<tr><td>SD30, SD31
SD33
SD34, SD35
SD36
SD2, SD3
SD5, SD6
SD31TS, SD32TS</td><td>H8</td><td>±0.2</td><td>h13</td></tr>
</table>

Table 2 Dimensional tolerance of length of castings

Unit: mm

Size of castings (mm)				
120 or below	121 to 250	251 to 400	401 to 800	801 to 1600
±1.5	±2.0	±3.0	±4.0	±6.0

4.2 Machining accuracy of mounting bolt seating end surface

When a large horizontal load is to be applied on a plummer block, the fastening force of the mounting bolts cannot reliably secure the plumber block alone; therefore, the housing base should abut a fixed surface. In this case, it is effective to use a plummer block with a machined vertical face that comes in contact with the fixed abutment surface.

Seating length L of a plummer block having a machined mounting bolt seating end surface is smaller than the standard dimension by the machining allowance shown in **Table 3** and becomes L' (see **Fig. 1**). **Table 4** shows the dimensional tolerance of L'.

Table 3 Machining allowance Unit: mm

Plummer block nominal dimension	Machining allowance $L-L'$	Surface finish roughness
All types All sizes	5	12.5*Ra*

Table 4 Tolerance of dimension L' after machining of mounting bolt seating end surface Unit: mm

Dimension after machining L'	31 to 120	121 to 315	316 to 1 000	1 001 to 2 000
Tolerance	±0.8	±1.2	±2.0	±3.0

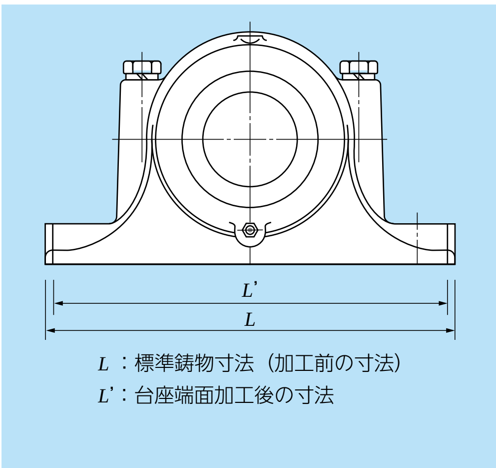


Fig. 1 Seating surface length dimension of plummer block

5. Combination with bearings

Tables 5 (1) and (2) show the combinations of plummer blocks and bearings.

Table 5 (1) Plummer blocks and applied bearings

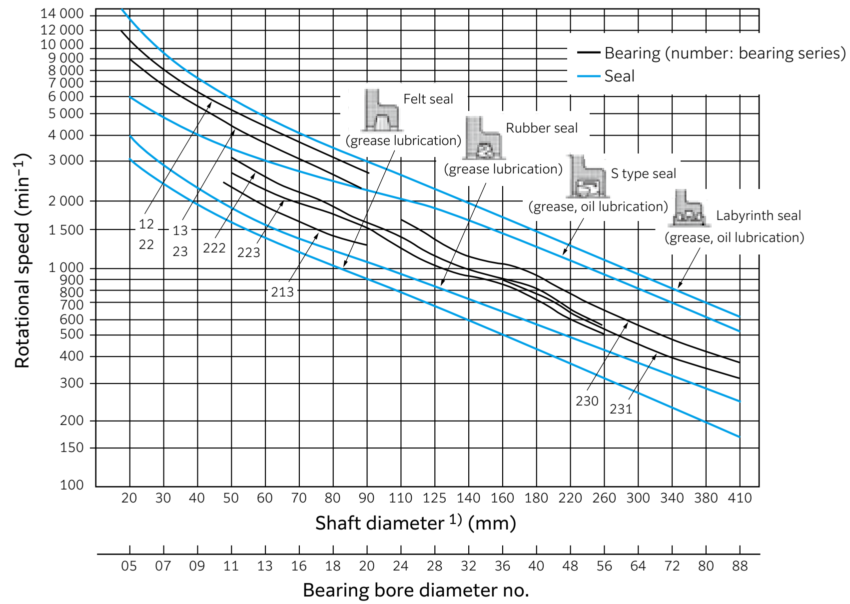
Plummer block series \ Applied bearing series	12	22	13	23	230	231	222	232	213	223
SN5 SN5 ··F	06SK ~22SK	06SK ~22SK					06EAK ~32EAK	18EMK, 20EMK ~32EMK		
SN2 SN2··F	06S ~22S	06S ~22S					06EA ~32EA	18EM, 20EM ~32EM		
SNZ2 SNZ2··F	06S ~22S	06S ~22S					06EA ~32EA	18EM, 20EM ~32EM		
SD5 SD5··G							34EMK ~64EMK			
SD2··D SD2··DG							34EM ~64EM			
SD2 SD2··G							34EM ~64EM			
SN(S)6 SN(S)6··F			06SK ~22SK	06SK ~22SK					08CK~10CK 11K~22K	08EAK~28EAK 30EMK~32EMK
SN(S)3 SN(S)3··F			06S ~22S	06S ~22S					08C~10C 11~22	08EA~28EA 30EM~32EM
SNZ(SZ)3 SNZ(SZ)3··F			06S ~22S	06S ~22S					08C~10C 11~22	08EA~28EA 30EM~32EM
SD6 SD6··G										34EMK ~56EMK
SD3··D SD3··DG										34EM ~56EM
SD3 SD3 ··G										34EM ~56EM
SN30					24EAK ~38EAK					
SD30 SD30··G					34EAK ~38EAK					
SD33 SD33··G					40EMK ~76EMK					
SD35 SD35··G					40EM ~76EM					
SN31						22EAK~36EAK 38EMK				
SD31 SD31··G						34EAK~36EAK 38EMK~68EMK 72BK~84BK				
SD34 SD34··G						40EMK ~68EMK				
SD36 SD36··G						40EM ~68EM				

Table 5 (2) Plummer blocks and applied bearings

Plummer block series \ Applied bearing series	12	22	13	23	230	231	222	232	213	223
SD31··TS SD31··TSG						34EAK～36EAK 38EMK～68EMK 72BK～89BK				
SD32··TS SD32··TSG								34EMK～64EMK 68BK～80BK		
SBG5							12EAK～32EAK 34EMK～40EMK			
SV5	05SK ～22SK	05SK ～22SK					05EAK ～32EAK	18EMK, 20EMK～64EMK		
SV2	05S ～22S	05S ～22S					05EA～32EA	18EM, 20EM～38EM		
SV6			05SK ～22SK	05SK ～22SK					08CK～10CK 11K～22K	08EAK～28EAK 30EMK～58EMK
SV3			05S ～22S	05S ～22S					08C～10C 11～22	08EA～28EA 30EM～58EM
SV30					22EAK～38EAK 40EMK～72EMK					
SV35					22EA～38EA 40EM～72EM					
VA5							11EAK ～22EAK			
TV5							11EAK ～32EAK			

6. Allowable speed

The allowable speed of plummer blocks differ by seal types. In the case of a contact seal, the allowable speed is restricted by the allowable peripheral speed of the seal. **Fig. 2** shows a rough standard for selecting the peripheral speed of seals.



1) The allowable speed of the seal of cylindrical bore bearings is obtained by the shaft diameter of the seal contact part. The allowable speed of seals is indicated by the rotational speed of shafts.

Fig. 2 Allowable speed of bearings and seals

7. Sealing device

External seals have two main functions: to prevent lubrication from leaking out and to prevent dust, water, and other contaminants from entering the bearing.

The sealing device must be selected with the following in consideration: the type of lubricant (oil or grease) and seal peripheral speed.

A rubber seal or a felt seal is used for the contact type, and a labyrinth seal is used for the non-contact type. There are also special seals suitable for other conditions including heavy contamination.

7.1 Contact seal

(1) Rubber seal (Fig. 3)

Since rubber seals are mainly used for grease lubrication, a rough standard for the peripheral speed is 5 to 6 m/s.

Nitrile rubber is generally used for the rubber seal material, and materials shown in **Table 6** are used depending on the ambient temperature.

(2) Felt seal (Fig. 4)

Felt seals are interchangeable with rubber seals, but the use is limited to grease lubrication.

Felt seals are unsuitable for environments with a large amount of dust or high humidity, and a rough standard for the peripheral speed is 4 m/s. The seal is also convenient because it can be cut and embedded separately into the seal grooves at the upper and lower parts of a plummer block.

(3) S type seal (Fig. 5)

The S type seal has excellent sealing performance and can be used for grease and oil lubrications. Plummer blocks with special specifications are used.

A rough standard for the peripheral speed of S type seals is 10 to 12 m/s. The shaft roughness and hardness of the seal contact area especially needs attention.

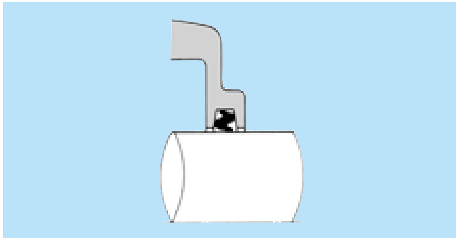


Fig. 3 Rubber seal

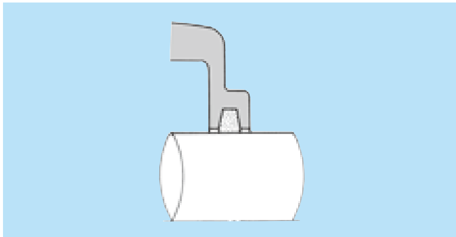


Fig. 4 Felt seal

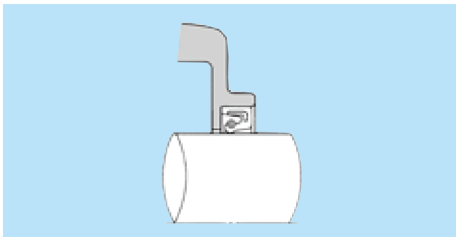


Fig. 5 S type seal

Plummer Blocks NTN

Table 6 Rubber seal types and characteristics

Seal material	Abrasion resistance	Oil resistance	Acid resistance	Alkali resistance	Water resistance	Allowable temp rough standard (°C)	Characteristics
Nitrile rubber (NBR)	◎	◎	○	○	○	−25 100	The material has resistance to most oils and has good abrasion resistance; therefore, it is the most used oil seal material. The material can be used for most conditions of general machines.
Acrylic rubber (ACM)	◎	◎	△	×	△	−15 130	The material has good heat resistance and oil resistance but poor alkali resistance and water resistance; therefore, the application is limited.
Silicone rubber (VMQ)	○	○	△	×	○	−50 220	The material has good heat resistance and cold resistance but cannot be used for spindle oil and oil containing an extreme pressure additive.
Fluorinated rubber (FKM)	◎	◎	◎	△	○	−10 220	The material is not affected by most oils and chemicals. The material has well-balanced characteristics and can be used in a wide range of applications; therefore, it is the best oil seal material.

◎ : Good, ○ : Fair, △: Slightly poor, × : Poor (cannot be used)

7.2 Non-contact seal

(1) Labyrinth seal (Fig. 6)
The labyrinth seal is a seal type that uses a labyrinth ring at the aperture part of a plummer block.

The labyrinth ring is used with a shaft loose fit (h9) and attached with an O ring to allow easy attachment and allow for expansion and contraction of the shaft.

The labyrinth seal has excellent sealing performance and can be used for grease and oil lubrications.

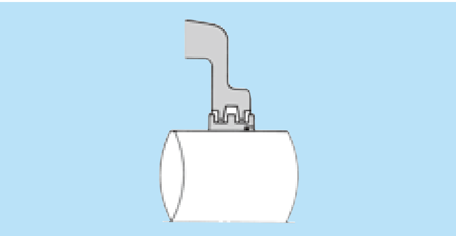


Fig. 6 Labyrinth seal

(2) Special labyrinth seal (Fig. 7)
The special labyrinth seal shown in the figure is especially effective for environments with a large amount of contamination such as dirt and sand.

Plummer blocks using this seal have special specifications, so consult with **NTN** Engineering.

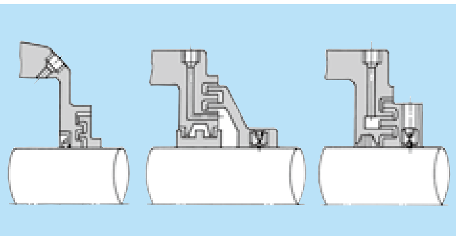


Fig. 7 Special labyrinth seal

(3) Shaft design criteria for seal attachment part (Table 7)
The hardness and roughness of shafts to be attached with seal significantly influences the sealing performance; therefore, the design criteria shown in the table must be followed.

Table 7 Shaft design criteria

Item	Design criteria	Article
Hardness	30 to 40 HRC	
Roughness *Ra*	0.8	It is preferable to grind the finish surface without feeding.
End surface chamfer	The shaft end to be inserted with a seal must be tapered, and the corner part must be rounded.	15~30° Round the corner.

7.3 Combination seal (Fig. 8)

The combination seal is a sealing device having a rubber seal and a labyrinth seal combined to the aperture part of a plummer block. It is used for environments with a large amount of dirt and foreign materials.

Filling the labyrinth voids with grease further improves the sealing effect.

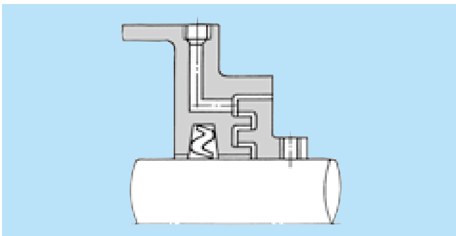


Fig. 8 Combination seal

8. Strength

The breaking strength of plummer blocks differ by the plummer block type, the characteristic and direction of the load to be applied, and is influenced by the flatness of the mounting surfaces. **Fig. 9** and **Fig. 10** shows the general fracture loads of static breaking strength of SN5 and SN6 (S6) series gray cast iron plummer blocks.

The downward breaking strength is about twice the horizontal breaking strength, and the axial breaking strength is about half of the horizontal breaking strength.

When selecting plummer blocks, consider the safety factor shown in **Table 8**. The surface to be attached with a plummer block must be flat without backlash.

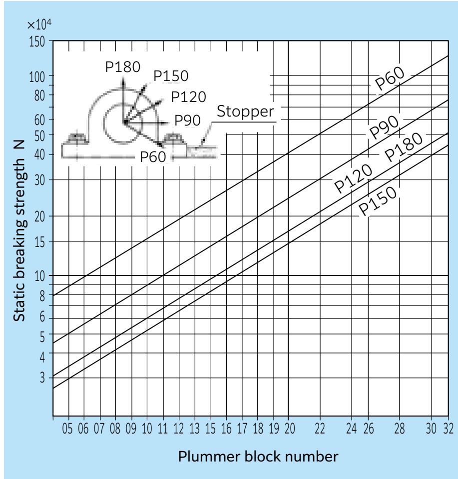


Fig. 9 Static breaking strength of SN5 series

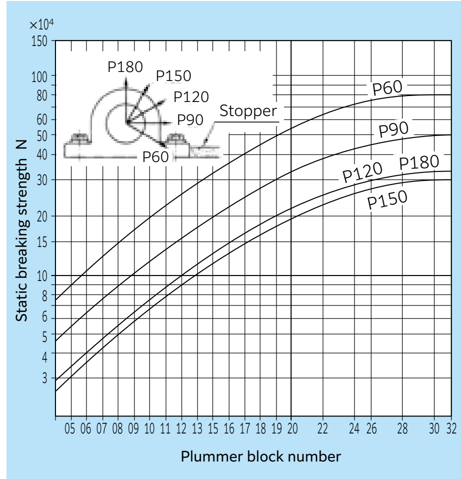


Fig. 10 Static breaking strength of SN6 series

Table 8 Safety factor of casting plummer block

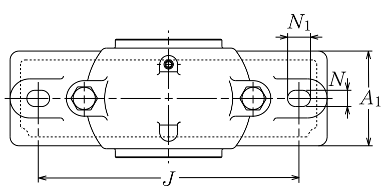
Types of load	Static load	Repeated load	Alternating load	Impact load
Safety factor	4	6	10	15

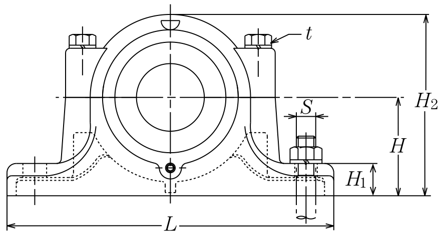
For horizontal and axial loads, the base end surface needs to abut a fixed surface.

For places with especially large impact loads or when plummer block damage may result in serious accidents, plummer blocks made of materials other than gray cast iron such as cast steel or spheroidal graphite cast iron are available. Please consult **NTN** Engineering.

Plummer Blocks

Plummer block series SN5 (standard type / for bearings with adapter assembly)



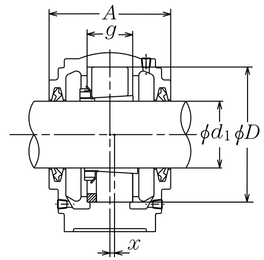


d_1 25 ～ 140mm

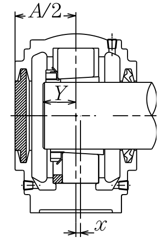
Shaft dia. mm d_1	Plummer block number	Dimensions mm D	H	J	N	N_1	A	L	A_1	H_1	H_2	g	t Nominal no.	Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)
25	**SN506**	62	50	150	15	20	77	185	52	22	90	30	M8	R1/8	M12	1.7
30	**SN507**	72	50	150	15	20	82	185	52	22	95	33	M10	R1/8	M12	2.2
35	**SN508**	80	60	170	15	20	85	205	60	25	110	33	M10	R1/8	M12	2.6
40	**SN509**	85	60	170	15	20	85	205	60	25	112	31	M10	R1/8	M12	2.8
45	**SN510**	90	60	170	15	20	90	205	60	25	115	33	M10	R1/8	M12	3
50	**SN511**	100	70	210	18	23	95	255	70	28	130	33	M12	R1/8	M16	4
55	**SN512**	110	70	210	18	23	105	255	70	30	135	38	M12	R1/8	M16	4.5
60	**SN513**	120	80	230	18	23	110	275	80	30	150	43	M12	R1/8	M16	5.6
65	**SN515**	130	80	230	18	23	115	280	80	30	155	41	M12	R1/8	M16	6
70	**SN516**	140	95	260	22	27	120	315	90	32	175	43	M16	R1/8	M20	9
75	**SN517**	150	95	260	22	27	125	320	90	32	185	46	M16	R1/8	M20	9.3
80	**SN518**	160	100	290	22	27	145	345	100	35	195	62.4	M16	R1/8	M20	12
85	**SN519**	170	112	290	22	27	140	345	100	35	210	53	M16	R1/8	M20	14
90	**SN520**	180	112	320	26	32	160	380	110	40	218	70.3	M20	R1/8	M24	17
100	**SN522**	200	125	350	26	32	175	410	120	45	240	80	M20	R1/4	M24	20
110	**SN524**	215	140	350	26	32	185	410	120	45	270	86	M20	R1/4	M24	23
115	**SN526**	230	150	380	28	36	190	445	130	50	290	90	M24	R1/4	M24	29
125	**SN528**	250	150	420	33	42	205	500	150	50	305	98	M24	R1/4	M30	37
135	**SN530**	270	160	450	33	42	220	530	160	60	325	106	M24	R1/4	M30	42
140	**SN532**	290	170	470	33	42	235	550	160	60	345	114	M24	R1/4	M30	48

1) The stabilizing ring indicates the outer diameter and width dimension.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.
Note: 1. **SN524** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks



Shaft penetration type



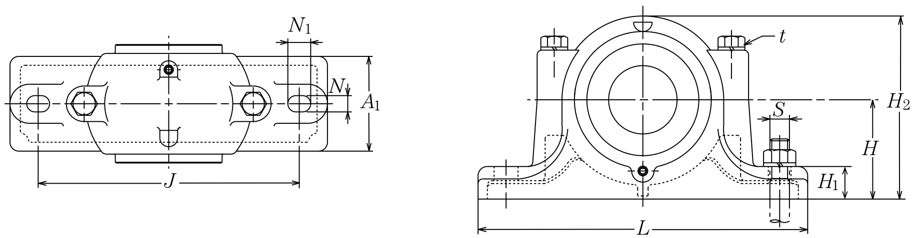
Shaft end type

Applied part: Combination of self-aligning ball bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Combination of spherical roller bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Reference dimension mm Y 2)	Rubber seal number	End cover number	Shaft dia. mm d_1
1206SK 2206SK	H206X H306X	SR62×7 SR62×10	2 1	– 22206EAKW33	– H306X	– SR 62×10	– 1	18 20	ZF6	MF6	**25**
1207SK 2207SK	H207X H307X	SR72×8 SR72×10	2 1	– 22207EAKW33	– H307X	– SR 72×10	– 1	19 22	ZF7	MF7	**30**
1208SK 2208SK	H208X H308X	SR80×7.5 SR80×10	2 1	– 22208EAKD1	– H308X	– SR 80×10	– 1	21 23	ZF8	MF8	**35**
1209SK 2209SK	H209X H309X	SR85×6 SR85×8	2 1	– 22209EAKD1	– H309X	– SR 85×8	– 1	22 24	ZF9	MF9	**40**
1210SK 2210SK	H210X H310X	SR90×6.5 SR90×10	2 1	– 22210EAKD1	– H310X	– SR 90×10	– 1	24 25	ZF10	MF10	**45**
1211SK 2211SK	H211X H311X	SR100×6 SR100×8	2 1	– 22211EAKD1	– H311X	– SR100×8	– 1	25 27	ZF11	MF11	**50**
1212SK 2212SK	H212X H312X	SR110×8 SR110×10	2 1	– 22212EAKD1	– H312X	– SR110×10	– 1	26 29	ZF12	MF12	**55**
1213SK 2213SK	H213X H313X	SR120×10 SR120×12	2 1	– 22213EAKD1	– H313X	– SR120×12	– 1	28 32	ZF13	MF13	**60**
1215SK 2215SK	H215X H315X	SR130×8 SR130×10	2 1	– 22215EAKD1	– H315X	– SR130×10	– 1	30 33	ZF15	MF15	**65**
1216SK 2216SK	H216X H316X	SR140×8.5 SR140×10	2 1	– 22216EAKD1	– H316X	– SR140×10	– 1	32 36	ZF16	MF16	**70**
1217SK 2217SK	H217X H317X	SR150×9 SR150×10	2 1	– 22217EAKD1	– H317X	– SR150×10	– 1	34 38	ZF17	MF17	**75**
1218SK 2218SK –	H218X H318X –	SR160×16.2 SR160×11.2 –	2 2 –	– 22218EAKD1 23218EMKD1	– H318X H2318X	– SR160×11.2 SR160×10	– 2 1	35 40 46	ZF18	MF18	**80**
1219SK 2219SK	H219X H319X	SR170×10.5 SR170×10	2 1	– 22219EAKD1	– H319X	– SR170×10	– 1	37 43	ZF19	MF19	**85**
1220SK 2220SK –	H220X H320X –	SR180×18.1 SR180×12.1 –	2 2 –	– 22220EAKD1 23220EMKD1	– H320X H2320X	– SR180×12.1 SR180×10	– 2 1	39 45 52	ZF20	MF20	**90**
1222SK 2222SK –	H222X H322X –	SR200×21 SR200×13.5 –	2 2 –	– 22222EAKD1 23222EMKD1	– H322X H2322X	– SR200×13.5 SR200×10	– 2 1	42 50 58	ZF22	MF22	**100**
–	–	–	–	22224EAKD1 23224EMKD1	H3124X H2324X	SR215×14 SR215×10	2 1	53 62	ZF24	MF24	**110**
–	–	–	–	22226EAKD1 23226EMKD1	H3126 H2326	SR230×13 SR230×10	2 1	57 65	ZF26	MF26	**115**
–	–	–	–	22228EAKD1 23228EMKD1	H3128 H2328	SR250×15 SR250×10	2 1	60 70	ZF28	MF28	**125**
–	–	–	–	22230EAKD1 23230EMKD1	H3130 H2330	SR270×16.5 SR270×10	2 1	65 76	ZF30	MF30	**135**
–	–	–	–	22232EAKD1 23232EMKD1	H3132 H2332	SR290×17 SR290×10	2 1	71 83	ZF32	MF32	**140**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.
3. Adapters for series 12 bearings can also be used with **H2** and **H3** series bearings.

Plummer Blocks

Plummer block series SN2
(large bore type / for cylindrical bore bearings)

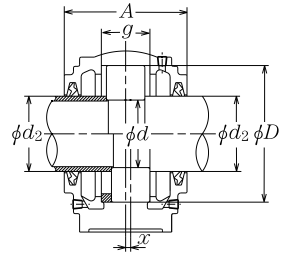


d 30 ～ 160mm

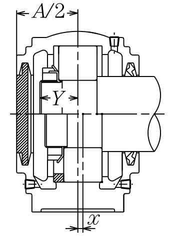
Shaft diameter mm *d*	d_2	Plummer block number	Dimensions mm *D*	*H*	*J*	*N*	N_1	*A*	*L*	A_1	H_1	H_2	*g*	*t* Nominal no.	Oil filler / drain plug size	Reference dimension *S* Nominal dimension	Mass kg (approx.)
30	35	**SN206**	62	50	150	15	20	77	185	52	22	90	30	M8	R1/8	M12	1.7
35	45	**SN207**	72	50	150	15	20	82	185	52	22	95	33	M10	R1/8	M12	2.1
40	50	**SN208**	80	60	170	15	20	85	205	60	25	110	33	M10	R1/8	M12	2.7
45	55	**SN209**	85	60	170	15	20	85	205	60	25	112	31	M10	R1/8	M12	3
50	60	**SN210**	90	60	170	15	20	90	205	60	25	115	33	M10	R1/8	M12	3.2
55	65	**SN211**	100	70	210	18	23	95	255	70	28	130	33	M12	R1/8	M16	4.3
60	70	**SN212**	110	70	210	18	23	105	255	70	30	135	38	M12	R1/8	M16	5.2
65	75	**SN213**	120	80	230	18	23	110	275	80	30	150	43	M12	R1/8	M16	5.9
70	80	**SN214**	125	80	230	18	23	115	275	80	30	155	44	M12	R1/8	M16	5.7
75	85	**SN215**	130	80	230	18	23	115	280	80	30	155	41	M12	R1/8	M16	7.2
80	90	**SN216**	140	95	260	22	27	120	315	90	32	175	43	M16	R1/8	M20	8.9
85	95	**SN217**	150	95	260	22	27	125	320	90	32	185	46	M16	R1/8	M20	9.9
90	100	**SN218**	160	100	290	22	27	145	345	100	35	195	62.4	M16	R1/8	M20	12
95	110	**SN219**	170	112	290	22	27	140	345	100	35	210	53	M16	R1/8	M20	13
100	115	**SN220**	180	112	320	26	32	160	380	110	40	218	70.3	M20	R1/8	M24	17
110	125	**SN222**	200	125	350	26	32	175	410	120	45	240	80	M20	R1/4	M24	22
120	135	**SN224**	215	140	350	26	32	185	410	120	45	270	86	M20	R1/4	M24	23
130	145	**SN226**	230	150	380	28	36	190	445	130	50	290	90	M24	R1/4	M24	28
140	155	**SN228**	250	150	420	33	42	205	500	150	50	305	98	M24	R1/4	M30	36
150	165	**SN230**	270	160	450	33	42	220	530	160	60	325	106	M24	R1/4	M30	43
160	175	**SN232**	290	170	470	33	42	235	550	160	60	345	114	M24	R1/4	M30	50

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension *Y* indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **SN224** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks NTN



Shaft penetration type



Shaft end type

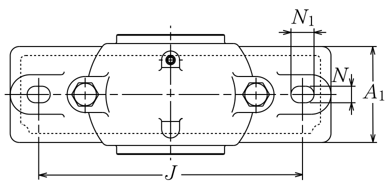
Applied part: Combination of self-aligning ball bearings – Bearing number	Stabilizing ring Number [1]	Quantity	Combination of spherical roller bearings – Bearing number	Stabilizing ring Number [1]	Quantity	Reference dimension mm Y [2]	Rubber seal number	End cover number	Shaft dia. mm *d*
1206S 2206S	SR62×7 SR62×10	2 1	– 22206EAW33	– SR62×10	– 1	18 20	ZF8	MF8	**30**
1207S 2207S	SR72×8 SR72×10	2 1	– 22207EAW33	– SR72×10	– 1	19 22	ZF10	MF10	**35**
1208S 2208S	SR80×7.5 SR80×10	2 1	– 22208EAD1	– SR80×10	– 1	21 23	ZF11	MF11	**40**
1209S 2209S	SR85×6 SR85×8	2 1	– 22209EAD1	– SR85×8	– 1	22 24	ZF12	MF12	**45**
1210S 2210S	SR90×6.5 SR90×10	2 1	– 22210EAD1	– SR90×10	– 1	24 25	ZF13	MF13	**50**
1211S 2211S	SR100×6 SR100×8	2 1	– 22211EAD1	– SR100×8	– 1	25 27	ZF15	MF15	**55**
1212S 2212S	SR110×8 SR110×10	2 1	– 22212EAD1	– SR110×10	– 1	26 29	ZF16	MF16	**60**
1213S 2213S	SR120×10 SR120×12	2 1	– 22213EAD1	– SR120×12	– 1	28 32	ZF17	MF17	**65**
1214S 2214S	SR125×10 SR125×13	2 1	– 22214EAD1	– SR125×13	– 1	28 32	ZF18	MF18	**70**
1215S 2215S	SR130×8 SR130×10	2 1	– 22215EAD1	– SR130×10	– 1	30 33	ZF19	MF19	**75**
1216S 2216S	SR140×8.5 SR140×10	2 1	– 22216EAD1	– SR140×10	– 1	32 36	ZF20	MF20	**80**
1217S 2217S	SR150×9 SR150×10	2 1	– 22217EAD1	– SR150×10	– 1	34 38	ZF21	MF21	**85**
1218S 2218S –	SR160×16.2 SR160×11.2 –	2 2 –	– 22218EAD1 23218EMD1	– SR160×11.2 SR160×10	– 2 1	35 40 46	ZF22	MF22	**90**
1219S 2219S	SR170×10.5 SR170×10	2 1	– 22219EAD1	– SR170×10	– 1	37 43	ZF24	MF24	**95**
1220S 2220S –	SR180×18.1 SR180×12.1 –	2 2 –	– 22220EAD1 23220EMD1	– SR180×12.1 SR180×10	– 2 1	39 45 52	ZF26	MF26	**100**
1222S 2222S –	SR200×21 SR200×13.5 –	2 2 –	– 22222EAD1 23222EMD1	– SR200×13.5 SR200×10	– 2 1	42 50 58	ZF28	MF28	**110**
–	–	–	22224EAD1 23224EMD1	SR215×14 SR215×10	2 1	53 62	ZF30	MF30	**120**
–	–	–	22226EAD1 23226EMD1	SR230×13 SR230×10	2 1	57 65	GS33	MF33	**130**
–	–	–	22228EAD1 23228EMD1	SR250×15 SR250×10	2 1	60 70	GS35	MF35	**140**
–	–	–	22230EAD1 23230EMD1	SR270×16.5 SR270×10	2 1	65 75	GS37	MF37	**150**
–	–	–	22232EAD1 23232EMD1	SR290×17 SR290×10	2 1	71 83	GS39	MF39	**160**

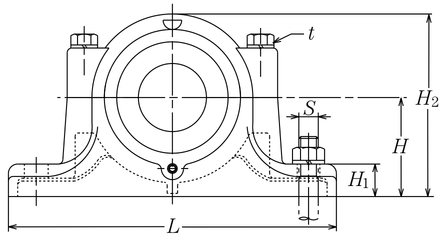
Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer Blocks

NTN

Plummer block series SNZ2
(stepped bore type / for cylindrical bore bearings)





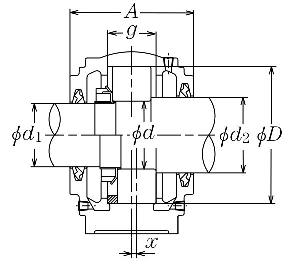
d 30 ～ 160mm

Shaft diameter mm			Plummer block number	Dimensions mm												Oil filler / drain plug size	Reference dimension	Mass kg
															t Nominal no.		S Nominal dimension	
d	d_1	d_2		D	H	J	N	N_1	A	L	A_1	H_1	H_2	g				(approx.)
30	25	35	**SNZ206**	62	50	150	15	20	77	185	52	22	90	30	M 8	R1/8	M12	1.8
35	30	45	**SNZ207**	72	50	150	15	20	82	185	52	22	95	33	M10	R1/8	M12	2.2
40	35	50	**SNZ208**	80	60	170	15	20	85	205	60	25	110	33	M10	R1/8	M12	2.9
45	40	55	**SNZ209**	85	60	170	15	20	85	205	60	25	112	31	M10	R1/8	M12	3.2
50	45	60	**SNZ210**	90	60	170	15	20	90	205	60	25	115	33	M10	R1/8	M12	3.4
55	50	65	**SNZ211**	100	70	210	18	23	95	255	70	28	130	33	M12	R1/8	M16	4.5
60	55	70	**SNZ212**	110	70	210	18	23	105	255	70	30	135	38	M12	R1/8	M16	5.4
65	60	75	**SNZ213**	120	80	230	18	23	110	275	80	30	150	43	M12	R1/8	M16	6.2
70	60	80	**SNZ214**	125	80	230	18	23	115	275	80	30	155	44	M12	R1/8	M16	6.7
75	65	85	**SNZ215**	130	80	230	18	23	115	280	80	30	155	41	M12	R1/8	M16	7.6
80	70	90	**SNZ216**	140	95	260	22	27	120	315	90	32	175	43	M16	R1/8	M20	9.4
85	75	95	**SNZ217**	150	95	260	22	27	125	320	90	32	185	46	M16	R1/8	M20	10
90	80	100	**SNZ218**	160	100	290	22	27	145	345	100	35	195	62.4	M16	R1/8	M20	13
95	85	110	**SNZ219**	170	112	290	22	27	140	345	100	35	210	53	M16	R1/8	M20	16
100	90	115	**SNZ220**	180	112	320	26	32	160	380	110	40	218	70.3	M20	R1/8	M24	18
110	100	125	**SNZ222**	200	125	350	26	32	175	410	120	45	240	80	M20	R1/4	M24	23
120	110	135	**SNZ224**	215	140	350	26	32	185	410	120	45	270	86	M20	R1/4	M24	25
130	115	145	**SNZ226**	230	150	380	28	36	190	445	130	50	290	90	M24	R1/4	M24	32
140	125	155	**SNZ228**	250	150	420	33	42	205	500	150	50	305	98	M24	R1/4	M30	41
150	135	165	**SNZ230**	270	160	450	33	42	220	530	160	60	325	106	M24	R1/4	M30	49
160	140	175	**SNZ232**	290	170	470	33	42	235	550	160	60	345	114	M24	R1/4	M30	57

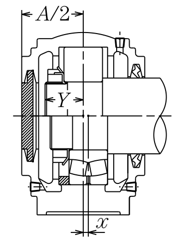
1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **SNZ224** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks

NTN



Shaft penetration type

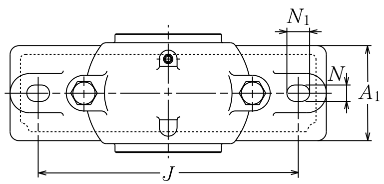


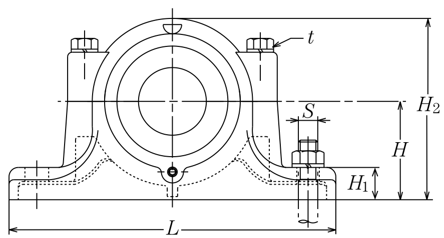
Shaft end type

Applied part								Reference dimension mm	Rubber seal number		End cover number	Shaft dia. mm
Combination of self-aligning ball bearings			Combination of spherical roller bearings			Nut number	Washer number					
Bearing number	Stabilizing ring Number 1)	Quantity	Bearing number	Stabilizing ring Number 1)	Quantity			Y 2)	d_1 side	d_2 side		d
1206S 2206S	SR62×7 SR62×10	2 1	– 22206EAW33	– SR62×10	– 1	AN06	AW06X	18 20	ZF6	ZF8	MF6	**30**
1207S 2207S	SR72×8 SR72×10	2 1	– 22207EAW33	– SR72×10	– 1	AN07	AW07X	19 22	ZF7	ZF10	MF7	**35**
1208S 2208S	SR80×7.5 SR80×10	2 1	– 22208EAD1	– SR80×10	– 1	AN08	AW08X	21 23	ZF8	ZF11	MF8	**40**
1209S 2209S	SR85×6 SR85×8	2 1	– 22209EAD1	– SR85×8	– 1	AN09	AW09X	22 24	ZF9	ZF12	MF9	**45**
1210S 2210S	SR90×6.5 SR90×10	2 1	– 22210EAD1	– SR90×10	– 1	AN10	AW10X	24 25	ZF10	ZF13	MF10	**50**
1211S 2211S	SR100×6 SR100×8	2 1	– 22211EAD1	– SR100×8	– 1	AN11	AW11X	25 27	ZF11	ZF15	MF11	**55**
1212S 2212S	SR110×8 SR110×10	2 1	– 22212EAD1	– SR110×10	– 1	AN12	AW12X	26 29	ZF12	ZF16	MF12	**60**
1213S 2213S	SR120×10 SR120×12	2 1	– 22213EAD1	– SR120×12	– 1	AN13	AW13X	28 32	ZF13	ZF17	MF13	**65**
1214S 2214S	SR125×10 SR125×13	2 1	– 22214EAD1	– SR125×13	– 1	AN14	AW14X	28 32	ZF13	ZF18	MF13	**70**
1215S 2215S	SR130×8 SR130×10	2 1	– 22215EAD1	– SR130×10	– 1	AN15	AW15X	30 33	ZF15	ZF19	MF15	**75**
1216S 2216S	SR140×8.5 SR140×10	2 1	– 22216EAD1	– SR140×10	– 1	AN16	AW16X	32 36	ZF16	ZF20	MF16	**80**
1217S 2217S	SR150×9 SR150×10	2 1	– 22217EAD1	– SR150×10	– 1	AN17	AW17X	34 38	ZF17	ZF21	MF17	**85**
1218S 2218S –	SR160×16.2 SR160×11.2 –	2 2 –	– 22218EAD1 23218EMD1	– SR160×11.2 SR160×10	– 2 1	AN18	AW18X	35 40 46	ZF18	ZF22	MF18	**90**
1219S 2219S	SR170×10.5 SR170×10	2 1	– 22219EAD1	– SR170×10	– 1	AN19	AW19X	37 43	ZF19	ZF24	MF19	**95**
1220S 2220S –	SR180×18.1 SR180×12.1 –	2 2 –	– 22220EAD1 23220EMD1	– SR180×12.1 SR180×10	– 2 1	AN20	AW20X	39 45 52	ZF20	ZF26	MF20	**100**
1222S 2222S –	SR200×21 SR200×13.5 –	2 2 –	– 22222EAD1 23222EMD1	– SR200×13.5 SR200×10	– 2 1	AN22	AW22X	42 50 58	ZF22	ZF28	MF22	**110**
–	–	–	22224EAD1 23224EMD1	SR215×14 SR215×10	2 1	AN24	AW24X	53 62	ZF24	ZF30	MF24	**120**
–	–	–	22226EAD1 23226EMD1	SR230×13 SR230×10	2 1	AN26	AW26	57 65	ZF26	GS33	MF26	**130**
–	–	–	22228EAD1 23228EMD1	SR250×15 SR250×10	2 1	AN28	AW28	60 70	ZF28	GS35	MF28	**140**
–	–	–	22230EAD1 23230EMD1	SR270×16.5 SR270×10	2 1	AN30	AW30	65 76	ZF30	GS37	MF30	**150**
–	–	–	22232EAD1 23232EMD1	SR290×17 SR290×10	2 1	AN32	AW32	71 83	ZF32	GS39	MF32	**160**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer block series SN6 / S6
(standard type / for bearings with adapter)

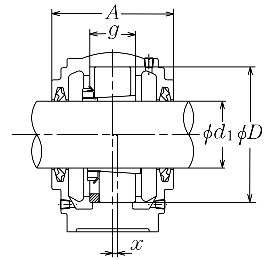




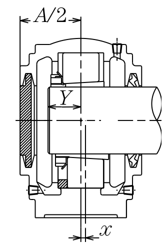
d_1 25～140mm

Shaft dia. mm d_1	Plummer block number	D	H	J	N	N_1	A	L	A_1	H_1	H_2	g	t Nominal no.	Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)
25	SN606	72	50	150	15	20	82	185	52	22	95	37	M10	R1/8	M12	2.3
30	SN607	80	60	170	15	20	90	205	60	25	110	41	M10	R1/8	M12	3
35	SN608	90	60	170	15	20	95	205	60	25	115	43	M10	R1/8	M12	3.1
40	SN609	100	70	210	18	23	105	255	70	28	130	46	M12	R1/8	M16	4.4
45	SN610	110	70	210	18	23	115	255	70	30	135	50	M12	R1/8	M16	5
50	SN611	120	80	230	18	23	120	275	80	30	150	53	M12	R1/8	M16	5.8
55	SN612	130	80	230	18	23	125	280	80	30	155	56	M12	R1/8	M16	7.7
60	SN613	140	95	260	22	27	130	315	90	32	175	58	M16	R1/8	M20	9.8
65	SN615	160	100	290	22	27	140	345	100	35	195	65	M16	R1/8	M20	12
70	SN616	170	112	290	22	27	145	345	100	35	212	68	M16	R1/8	M20	15
75	SN617	180	112	320	26	32	155	380	110	40	218	70	M20	R1/8	M24	17
80	S618	190	112	320	26	35	160	400	110	33	230	74	M20	R1/4	M24	21
85	S619	200	125	350	26	35	170	420	120	36	245	77	M20	R1/4	M24	24
90	S620	215	140	350	26	35	175	420	120	38	280	83	M20	R1/4	M24	29
100	S622	240	150	390	28	38	190	460	130	40	300	90	M24	R1/4	M24	38
110	S624	260	160	450	33	42	205	540	160	50	325	96	M24	R1/4	M30	47
115	S626	280	170	470	33	42	215	560	160	50	350	103	M24	R1/4	M30	54
125	S628	300	180	520	35	45	235	630	170	55	375	112	M30	R1/4	M30	70
135	S630	320	190	560	35	45	245	680	180	55	395	118	M30	R1/4	M30	75
140	S632	340	200	580	42	52	255	710	190	60	415	124	M30	R1/4	M36	80

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **S618** or larger plummer blocks are provided with a lifting eye bolt.



Shaft penetration type



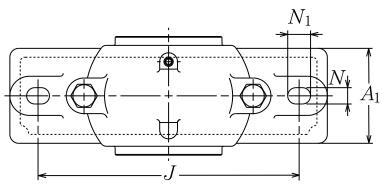
Shaft end type

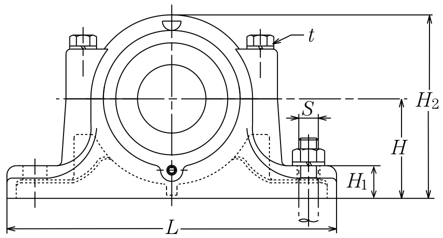
Combination of self-aligning ball bearings: Bearing number	Adapter number	Stabilizing ring Number [1]	Quantity	Combination of spherical roller bearings: Bearing number	Adapter number	Stabilizing ring Number [1]	Quantity	Reference dimension mm Y [2]	Rubber seal number	End cover number	Shaft dia. mm d_1
1306SK 2306SK	H306X H2306X	SR72×9 SR72×10	2 1	–	–	–	–	19 23	ZF6	MF6	25
1307SK 2307SK	H307X H2307X	SR80×10 SR80×10	2 1	–	–	–	–	21 26	ZF7	MF7	30
1308SK 2308SK	H308X H2308X	SR90×10 SR90×10	2 1	21308CK 22308EAKD1	H308X H2308X	SR90×10 SR90×10	2 1	23 28	ZF8	MF8	35
1309SK 2309SK	H309X H2309X	SR100×10.5 SR100×10	2 1	21309CK 22309EAKD1	H309X H2309X	SR100×10.5 SR100×10	2 1	25 31	ZF9	MF9	40
1310SK 2310SK	H310X H2310X	SR110×11.5 SR110×10	2 1	21310CK 22310EAKD1	H310X H2310X	SR110×11.5 SR110×10	2 1	27 34	ZF10	MF10	45
1311SK 2311SK	H311X H2311X	SR120×12 SR120×10	2 1	21311K 22311EAKD1	H311X H2311X	SR120×12 SR120×10	2 1	29 36	ZF11	MF11	50
1312SK 2312SK	H312X H2312X	SR130×12.5 SR130×10	2 1	21312K 22312EAKD1	H312X H2312X	SR130×12.5 SR130×10	2 1	31 39	ZF12	MF12	55
1313SK 2313SK	H313X H2313X	SR140×12.5 SR140×10	2 1	21313K 22313EAKD1	H313X H2313X	SR140×12.5 SR140×10	2 1	33 40	ZF13	MF13	60
1315SK 2315SK	H315X H2315X	SR160×14 SR160×10	2 1	21315K 22315EAKD1	H315X H2315X	SR160×14 SR160×10	2 1	36 45	ZF15	MF15	65
1316SK 2316SK	H316X H2316X	SR170×14.5 SR170×10	2 1	21316K 22316EAKD1	H316X H2316X	SR170×14.5 SR170×10	2 1	39 48	ZF16	MF16	70
1317SK 2317SK	H317X H2317X	SR180×14.5 SR180×10	2 1	21317K 22317EAKD1	H317X H2317X	SR180×14.5 SR180×10	2 1	41 50	ZF17	MF17	75
1318SK 2318SK	H318X H2318X	SR190×15.3 SR190×9.5	2 1	21318K 22318EAKD1	H318X H2318X	SR190×15.3 SR190×9.5	2 1	42 52	ZF18	MF18	80
1319SK 2319SK	H319X H2319X	SR200×15.8 SR200×9.5	2 1	21319K 22319EAKD1	H319X H2319X	SR200×15.8 SR200×9.5	2 1	44 55	ZF19	MF19	85
1320SK 2320SK	H320X H2320X	SR215×17.8 SR215×9.5	2 1	21320K 22320EAKD1	H320X H2320X	SR215×17.8 SR215×9.5	2 1	46 59	ZF20	MF20	90
1322SK 2322SK	H322X H2322X	SR240×19.8 SR240×9.5	2 1	21322K 22322EAKD1	H322X H2322X	SR240×19.8 SR240×9.5	2 1	48 63	ZF22	MF22	100
–	–	–	–	22324EAKD1	H2324X	SR260×9.5	1	67	ZF24	MF24	110
–	–	–	–	22326EAKD1	H2326	SR280×9.5	1	72	ZF26	MF26	115
–	–	–	–	22328EAKD1	H2328	SR300×9.5	1	77	ZF28	MF28	125
–	–	–	–	22330EMKD1	H2330	SR320×9.5	1	82	ZF30	MF30	135
–	–	–	–	22332EMKD1	H2332	SR340×9.5	1	88	ZF32	MF32	140

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer Blocks

Plummer block series SN3 / S3
(large bore type / for cylindrical bore bearings)



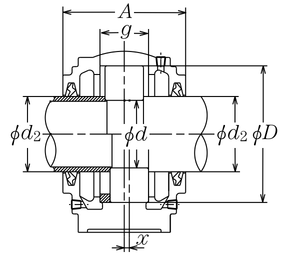


d 30 ~ 160mm

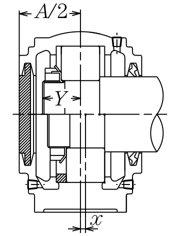
Shaft diameter mm d	d_2	Plummer block number	Dimensions mm D	H	J	N	N_1	A	L	A_1	H_1	H_2	g	t Nominal no.	Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)
30	35	**SN306**	72	50	150	15	20	82	185	52	22	95	37	M10	R1/8	M12	1.8
30	40	**SN306X**	72	50	150	15	20	82	185	52	22	95	37	M10	R1/8	M12	1.8
35	45	**SN307**	80	60	170	15	20	90	205	60	25	110	41	M10	R1/8	M12	2.6
40	50	**SN308**	90	60	170	15	20	95	205	60	25	115	43	M10	R1/8	M12	2.9
45	55	**SN309**	100	70	210	18	23	105	255	70	28	130	46	M12	R1/8	M16	4.1
50	60	**SN310**	110	70	210	18	23	115	255	70	30	135	50	M12	R1/8	M16	4.7
55	65	**SN311**	120	80	230	18	23	120	275	80	30	150	53	M12	R1/8	M16	5.8
60	70	**SN312**	130	80	230	18	23	125	280	80	30	155	56	M12	R1/8	M16	6.5
65	75	**SN313**	140	95	260	22	27	130	315	90	32	175	58	M16	R1/8	M20	8.7
70	80	**SN314**	150	95	260	22	27	130	320	90	32	185	61	M16	R1/8	M20	10
75	85	**SN315**	160	100	290	22	27	140	345	100	35	195	65	M16	R1/8	M20	11
80	90	**SN316**	170	112	290	22	27	145	345	100	35	212	68	M16	R1/8	M20	13
85	95	**SN317**	180	112	320	26	32	155	380	110	40	218	70	M20	R1/8	M24	15
85	100	**SN317X**	180	112	320	26	32	155	380	110	40	218	70	M20	R1/8	M24	15
90	100	**S318**	190	112	320	26	35	160	400	110	33	230	74	M20	R1/4	M24	22
90	105	**S318X**	190	112	320	26	35	160	400	110	33	230	74	M20	R1/4	M24	22
95	110	**S319**	200	125	350	26	35	170	420	120	36	245	77	M20	R1/4	M24	26
100	115	**S320**	215	140	350	26	35	175	420	120	38	280	83	M20	R1/4	M24	32
110	125	**S322**	240	150	390	28	38	190	460	130	40	300	90	M24	R1/4	M24	42
120	135	**S324**	260	160	450	33	42	205	540	160	50	325	96	M24	R1/4	M30	61
130	150	**S326**	280	170	470	33	42	215	560	160	50	350	103	M24	R1/4	M30	68
140	160	**S328**	300	180	520	35	45	235	630	170	55	375	112	M30	R1/4	M30	95
150	170	**S330**	320	190	560	35	45	245	680	180	55	395	118	M30	R1/4	M30	110
160	180	**S332**	340	200	580	42	52	255	710	190	60	415	124	M30	R1/4	M36	130

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **S318** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks



Shaft penetration type



Shaft end type

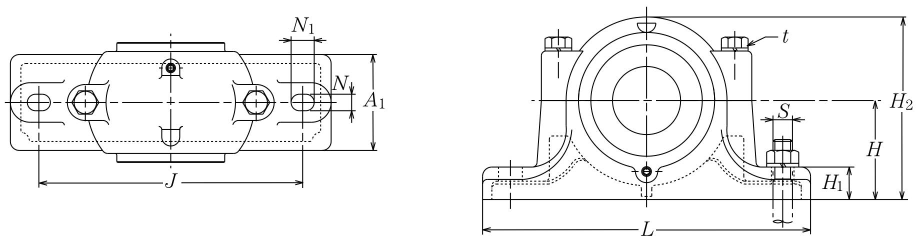
Applied part: Combination of self-aligning ball bearings — Bearing number	Stabilizing ring Number [1]	Quantity	Combination of spherical roller bearings — Bearing number	Stabilizing ring Number [1]	Quantity	Reference dimension mm Y [2]	Rubber seal number	End cover number	Shaft dia. mm d
1306S 2306S	SR72×9 SR72×10	2 1	–	–	–	19 23	ZF8	MF8	**30**
1306S 2306S	SR72×9 SR72×10	2 1	–	–	–	19 23	ZF9	MF9	**30**
1307S 2307S	SR80×10 SR80×10	2 1	–	–	–	21 26	ZF10	MF10	**35**
1308S 2308S	SR90×10 SR90×10	2 1	21308C 22308EAD1	SR90×10 SR90×10	2 1	23 28	ZF11	MF11	**40**
1309S 2309S	SR100×10.5 SR100×10	2 1	21309C 22309EAD1	SR100×10.5 SR100×10	2 1	25 31	ZF12	MF12	**45**
1310S 2310S	SR110×11.5 SR110×10	2 1	21310C 22310EAD1	SR110×11.5 SR110×10	2 1	27 34	ZF13	MF13	**50**
1311S 2311S	SR120×12 SR120×10	2 1	21311 22311EAD1	SR120×12 SR120×10	2 1	29 36	ZF15	MF15	**55**
1312S 2312S	SR130×12.5 SR130×10	2 1	21312 22312EAD1	SR130×12.5 SR130×10	2 1	31 39	ZF16	MF16	**60**
1313S 2313S	SR140×12.5 SR140×10	2 1	21313 22313EAD1	SR140×12.5 SR140×10	2 1	33 40	ZF17	MF17	**65**
1314S 2314S	SR150×13 SR150×10	2 1	21314 22314EAD1	SR150×13 SR150×10	2 1	34 42	ZF18	MF18	**70**
1315S 2315S	SR160×14 SR160×10	2 1	21315 22315EAD1	SR160×14 SR160×10	2 1	36 45	ZF19	MF19	**75**
1316S 2316S	SR170×14.5 SR170×10	2 1	21316 22316EAD1	SR170×14.5 SR170×10	2 1	39 48	ZF20	MF20	**80**
1317S 2317S	SR180×14.5 SR180×10	2 1	21317 22317EAD1	SR180×14.5 SR180×10	2 1	41 50	ZF21	MF21	**85**
1317S 2317S	SR180×14.5 SR180×10	2 1	21317 22317EAD1	SR180×14.5 SR180×10	2 1	41 50	ZF22	MF22	**85**
1318S 2318S	SR190×15.3 SR190×9.5	2 1	21318 22318EAD1	SR190×15.3 SR190×9.5	2 1	42 52	ZF22	MF22	**90**
1318S 2318S	SR190×15.3 SR190×9.5	2 1	21318 22318EAD1	SR190×15.3 SR190×9.5	2 1	42 52	ZF23	MF23	**90**
1319S 2319S	SR200×15.8 SR200×9.5	2 1	21319 22319EAD1	SR200×15.8 SR200×9.5	2 1	44 55	ZF24	MF24	**95**
1320S 2320S	SR215×17.8 SR215×9.5	2 1	21320 22320EAD1	SR215×17.8 SR215×9.5	2 1	46 59	ZF26	MF26	**100**
1322S 2322S	SR240×19.8 SR240×9.5	2 1	21322 22322EAD1	SR240×19.8 SR240×9.5	2 1	48 63	ZF28	MF28	**110**
–	–	–	22324EAD1	SR260×9.5	1	67	ZF30	MF30	**120**
–	–	–	22326EAD1	SR280×9.5	1	72	ZF34	MF34	**130**
–	–	–	22328EAD1	SR300×9.5	1	77	ZF36	MF36	**140**
–	–	–	22330EMD1	SR320×9.5	1	82	ZF38	MF38	**150**
–	–	–	22332EMD1	SR340×9.5	1	88	ZF40	MF40	**160**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer Blocks

NTN

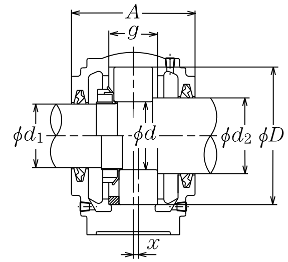
Plummer block series SNZ3 / SZ3
(stepped bore type / for cylindrical bore bearings)



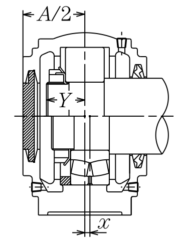
d 30 ～ 160mm

Shaft diameter mm d	d_1	d_2	Plummer block number	Dimensions mm D	H	J	N	N_1	A	L	A_1	H_1	H_2	g	t Nominal no.	Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)
30	25	35	**SNZ306**	72	50	150	15	20	82	185	52	22	95	37	M10	R1/8	M12	2.1
30	25	40	**SNZ306X**	72	50	150	15	20	82	185	52	22	95	37	M10	R1/8	M12	2.1
35	30	45	**SNZ307**	80	60	170	15	20	90	205	60	25	110	41	M10	R1/8	M12	3.1
40	35	50	**SNZ308**	90	60	170	15	20	95	205	60	25	115	43	M10	R1/8	M12	3.5
45	40	55	**SNZ309**	100	70	210	18	23	105	255	70	28	130	46	M12	R1/8	M16	4.8
50	45	60	**SNZ310**	110	70	210	18	23	115	255	70	30	135	50	M12	R1/8	M16	5.6
55	50	65	**SNZ311**	120	80	230	18	23	120	275	80	30	150	53	M12	R1/8	M16	6.6
60	55	70	**SNZ312**	130	80	230	18	23	125	280	80	30	155	56	M12	R1/8	M16	7.9
65	60	75	**SNZ313**	140	95	260	22	27	130	315	90	32	175	58	M16	R1/8	M20	11
70	60	80	**SNZ314**	150	95	260	22	27	130	320	90	32	185	61	M16	R1/8	M20	12
75	65	85	**SNZ315**	160	100	290	22	27	140	345	100	35	195	65	M16	R1/8	M20	13
80	70	90	**SNZ316**	170	112	290	22	27	145	345	100	35	212	68	M16	R1/8	M20	16
85	75	95	**SNZ317**	180	112	320	26	32	155	380	110	40	218	70	M20	R1/8	M24	18
85	75	100	**SNZ317X**	180	112	320	26	32	155	380	110	40	218	70	M20	R1/8	M24	18
90	80	100	**SZ318**	190	112	320	26	35	160	400	110	33	230	74	M20	R1/4	M24	21
90	80	105	**SZ318X**	190	112	320	26	35	160	400	110	33	230	74	M20	R1/4	M24	21
95	85	110	**SZ319**	200	125	350	26	35	170	420	120	36	245	77	M20	R1/4	M24	23
100	90	115	**SZ320**	215	140	350	26	35	175	420	120	38	280	83	M20	R1/4	M24	32
110	100	125	**SZ322**	240	150	390	28	38	190	460	130	40	300	90	M24	R1/4	M24	42
120	110	135	**SZ324**	260	160	450	33	42	205	540	160	50	325	96	M24	R1/4	M30	61
130	115	150	**SZ326**	280	170	470	33	42	215	560	160	50	350	103	M24	R1/4	M30	68
140	125	160	**SZ328**	300	180	520	35	45	235	630	170	55	375	112	M30	R1/4	M30	95
150	135	170	**SZ330**	320	190	560	35	45	245	680	180	55	395	118	M30	R1/4	M30	110
160	140	180	**SZ332**	340	200	580	42	52	255	710	190	60	415	124	M30	R1/4	M36	130

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **SZ318** or larger plummer blocks are provided with a lifting eye bolt.



Shaft penetration type



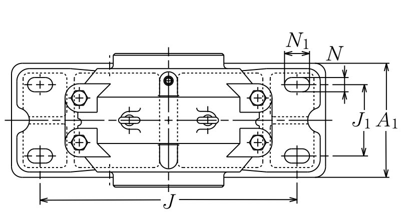
Shaft end type

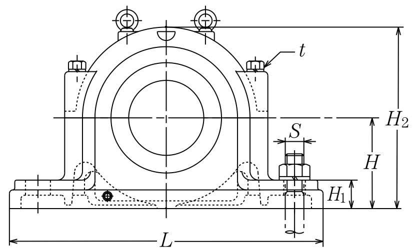
Applied part: Combination of self-aligning ball bearings – Bearing number	Stabilizing ring Number 1)	Quantity	Combination of spherical roller bearings – Bearing number	Stabilizing ring Number 1)	Quantity	Nut number	Washer number	Reference dimension mm Y 2)	Rubber seal number d_1 side	d_2 side	End cover number	Shaft dia. mm d
1306S 2306S	SR72×9 SR72×10	2 1	–	–	–	AN06	AW06X	19 23	ZF6	ZF8	MF6	**30**
1306S 2306S	SR72×9 SR72×10	2 1	–	–	–	AN06	AW06X	19 23	ZF6	ZF9	MF6	**30**
1307S 2307S	SR80×10 SR80×10	2 1	–	–	–	AN07	AW07X	21 26	ZF7	ZF10	MF7	**35**
1308S 2308S	SR90×10 SR90×10	2 1	21308C 22308EAD1	SR90×10 SR90×10	2 1	AN08	AW08X	23 28	ZF8	ZF11	MF8	**40**
1309S 2309S	SR100×10.5 SR100×10	2 1	21309C 22309EAD1	SR100×10.5 SR100×10	2 1	AN09	AW09X	25 31	ZF9	ZF12	MF9	**45**
1310S 2310S	SR110×11.5 SR110×10	2 1	21310C 22310EAD1	SR110×11.5 SR110×10	2 1	AN10	AW10X	27 34	ZF10	ZF13	MF10	**50**
1311S 2311S	SR120×12 SR120×10	2 1	21311 22311EAD1	SR120×12 SR120×10	2 1	AN11	AW11X	29 36	ZF11	ZF15	MF11	**55**
1312S 2312S	SR130×12.5 SR130×10	2 1	21312 22312EAD1	SR130×12.5 SR130×10	2 1	AN12	AW12X	31 39	ZF12	ZF16	MF12	**60**
1313S 2313S	SR140×12.5 SR140×10	2 1	21313 22313EAD1	SR140×12.5 SR140×10	2 1	AN13	AW13X	33 40	ZF13	ZF17	MF13	**65**
1314S 2314S	SR150×13 SR150×10	2 1	21314 22314EAD1	SR150×13 SR150×10	2 1	AN14	AW14X	34 42	ZF13	ZF18	MF13	**70**
1315S 2315S	SR160×14 SR160×10	2 1	21315 22315EAD1	SR160×14 SR160×10	2 1	AN15	AW15X	36 45	ZF15	ZF19	MF15	**75**
1316S 2316S	SR170×14.5 SR170×10	2 1	21316 22316EAD1	SR170×14.5 SR170×10	2 1	AN16	AW16X	39 48	ZF16	ZF20	MF16	**80**
1317S 2317S	SR180×14.5 SR180×10	2 1	21317 22317EAD1	SR180×14.5 SR180×10	2 1	AN17	AW17X	41 50	ZF17	ZF21	MF17	**85**
1317S 2317S	SR180×14.5 SR180×10	2 1	21317 22317EAD1	SR180×14.5 SR180×10	2 1	AN17	AW17X	41 50	ZF17	ZF22	MF17	**85**
1318S 2318S	SR190×15.3 SR190×9.5	2 1	21318 22318EAD1	SR190×15.3 SR190×9.5	2 1	AN18	AW18X	42 52	ZF18	ZF22	MF18	**90**
1318S 2318S	SR190×15.3 SR190×9.5	2 1	21318 22318EAD1	SR190×15.3 SR190×9.5	2 1	AN18	AW18X	42 52	ZF18	ZF23	MF18	**90**
1319S 2319S	SR200×15.8 SR200×9.5	2 1	21319 22319EAD1	SR200×15.8 SR200×9.5	2 1	AN19	AW19X	44 55	ZF19	ZF24	MF19	**95**
1320S 2320S	SR215×17.8 SR215×9.5	2 1	21320 22320EAD1	SR215×17.8 SR215×9.5	2 1	AN20	AW20X	46 59	ZF20	ZF26	MF20	**100**
1322S 2322S	SR240×19.8 SR240×9.5	2 1	21322 22322EAD1	SR240×19.8 SR240×9.5	2 1	AN22	AW22X	48 63	ZF22	ZF28	MF22	**110**
–	–	–	22324EAD1	SR260×9.5	1	AN24	AW24X	67	ZF24	ZF30	MF24	**120**
–	–	–	22326EAD1	SR280×9.5	1	AN26	AW26	72	ZF26	ZF34	MF26	**130**
–	–	–	22328EAD1	SR300×9.5	1	AN28	AW28	77	ZF28	ZF36	MF28	**140**
–	–	–	22330EMD1	SR320×9.5	1	AN30	AW30	82	ZF30	ZF38	MF30	**150**
–	–	–	22332EMD1	SR340×9.5	1	AN32	AW32	88	ZF32	ZF40	MF32	**160**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer Blocks

Plummer block series SD5 / SD5G / SD6 / SD6G
(for heavy loads, double seal type / for bearings with adapters)



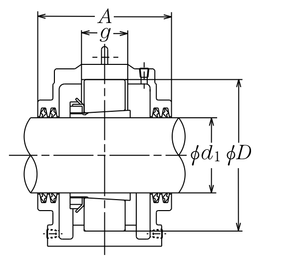


d_1 150 ～ 300mm

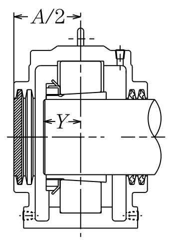
Shaft dia. mm d_1	Plummer block number Floating side	Fixed side	D	H	J	J_1	N	N_1	A	L	A_1	H_1	H_2	g 1)	t Nominal no.
150	**SD534**	**SD534G**	310	180	510	140	32	52	270	620	230	60	360	96	M24
160	**SD536**	**SD536G**	320	190	540	150	32	52	280	650	240	60	380	96	M24
170	**SD538**	**SD538G**	340	200	570	160	35	55	290	700	260	65	400	102	M30
180	**SD540**	**SD540G**	360	210	610	170	35	55	300	740	270	65	420	108	M30
200	**SD544**	**SD544G**	400	240	680	190	40	60	330	820	300	70	475	118	M30
220	**SD548**	**SD548G**	440	260	740	200	42	62	340	880	310	85	515	130	M36
240	**SD552**	**SD552G**	480	280	790	210	42	62	370	940	340	85	560	140	M36
260	**SD556**	**SD556G**	500	300	830	230	50	70	390	990	370	100	590	140	M36
280	**SD560**	**SD560G**	540	325	890	250	50	70	410	1 060	390	100	640	150	M36
300	**SD564**	**SD564G**	580	355	930	270	57	77	440	1 110	420	110	690	160	M42
150	**SD634**	**SD634G**	360	210	610	170	35	55	300	740	270	65	420	130	M30
160	**SD636**	**SD636G**	380	225	640	180	40	60	320	780	290	70	450	136	M30
170	**SD638**	**SD638G**	400	240	680	190	40	60	330	820	300	70	475	142	M30
180	**SD640**	**SD640G**	420	250	710	200	42	62	350	860	320	85	500	148	M36
200	**SD644**	**SD644G**	460	280	770	210	42	62	360	920	330	85	550	155	M36
220	**SD648**	**SD648G**	500	300	830	230	50	70	390	990	370	100	590	165	M36
240	**SD652**	**SD652G**	540	325	890	250	50	70	410	1 060	390	100	640	175	M36
260	**SD656**	**SD656G**	580	355	930	270	57	77	440	1 110	420	110	690	185	M42

1) Dimension g indicates the bearing width dimension of the floating side. The fixed side (code **G**) is larger than the bearing width dimension by 0.5 mm.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.

Plummer Blocks



Shaft penetration type

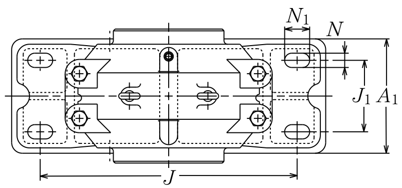


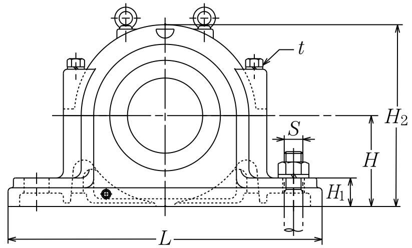
Shaft end type

Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)	Applied part Combination of spherical roller bearings Bearing number	Adapter number	Reference dimension mm Y 2)	Rubber seal number	End cover number	Shaft dia. mm d_1
R3/8	M30	95	22234EMKD1	H3134	75	ZF34	MF34	**150**
R3/8	M30	110	22236EMKD1	H3136	76	ZF36	MF36	**160**
R3/8	M30	130	22238EMKD1	H3138	80	ZF38	MF38	**170**
R3/8	M30	150	22240EMKD1	H3140	84	ZF40	MF40	**180**
R3/8	M36	210	22244EMKD1	H3144	90	ZF44	MF44	**200**
R3/8	M36	240	22248EMKD1	H3148	98	ZF48	MF48	**220**
R3/8	M36	320	22252EMKD1	H3152	105	ZF52	MF52	**240**
R3/8	M42	370	22256EMKD1	H3156	107	ZF56	MF56	**260**
R3/8	M42	460	22260EMKD1	H3160	114	ZF60	MF60	**280**
R3/8	M48	560	22264EMKD1	H3164	122	ZF64	MF64	**300**
R3/8	M30	150	22334EMKD1	H2334	92	ZF34	MF34	**150**
R3/8	M36	180	22336EMKD1	H2336	96	ZF36	MF36	**160**
R3/8	M36	210	22338EMKD1	H2338	100	ZF38	MF38	**170**
R3/8	M36	240	22340EMKD1	H2340	104	ZF40	MF40	**180**
R3/8	M36	300	22344EMKD1	H2344	109	ZF44	MF44	**200**
R3/8	M42	370	22348EMKD1	H2348	116	ZF48	MF48	**220**
R3/8	M42	460	22352EMKD1	H2352	123	ZF52	MF52	**240**
R3/8	M48	560	22356EMKD1	H2356	130	ZF56	MF56	**260**

Plummer Blocks

Plummer block series SD2 / SD2G / SD3 / SD3G
(for heavy loads, stepped bore type / for cylindrical bore bearings)



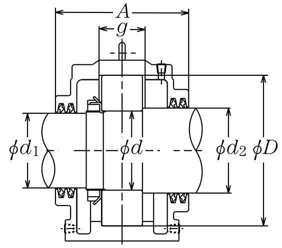


d 170 ～ 320mm

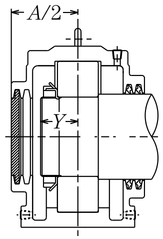
Shaft diameter mm			Plummer block number		Dimensions mm												
d	d_1	d_2	Floating side	Fixed side	D	H	J	J_1	N	N_1	A	L	A_1	H_1	H_2	g 1)	t Nominal no.
170	160	190	**SD234**	**SD234G**	310	180	510	140	32	52	270	620	230	60	360	96	M24
180	170	200	**SD236**	**SD236G**	320	190	540	150	32	52	280	650	240	60	380	96	M24
190	180	210	**SD238**	**SD238G**	340	200	570	160	35	55	290	700	260	65	400	102	M30
200	190	220	**SD240**	**SD240G**	360	210	610	170	35	55	300	740	270	65	420	108	M30
220	210	240	**SD244**	**SD244G**	400	240	680	190	40	60	330	820	300	70	475	118	M30
240	230	260	**SD248**	**SD248G**	440	260	740	200	42	62	340	880	310	85	515	130	M36
260	250	280	**SD252**	**SD252G**	480	280	790	210	42	62	370	940	340	85	560	140	M36
280	260	300	**SD256**	**SD256G**	500	300	830	230	50	70	390	990	370	100	590	140	M36
300	280	320	**SD260**	**SD260G**	540	325	890	250	50	70	410	1 060	390	100	640	150	M36
320	300	340	**SD264**	**SD264G**	580	355	930	270	57	77	440	1 110	420	110	690	160	M42
170	160	190	**SD334**	**SD334G**	360	210	610	170	35	55	300	740	270	65	420	130	M30
180	170	200	**SD336**	**SD336G**	380	225	640	180	40	60	320	780	290	70	450	136	M30
190	180	210	**SD338**	**SD338G**	400	240	680	190	40	60	330	820	300	70	475	142	M30
200	190	220	**SD340**	**SD340G**	420	250	710	200	42	62	350	860	320	85	500	148	M36
220	210	240	**SD344**	**SD344G**	460	280	770	210	42	62	360	920	330	85	550	155	M36
240	230	260	**SD348**	**SD348G**	500	300	830	230	50	70	390	990	370	100	590	165	M36
260	250	280	**SD352**	**SD352G**	540	325	890	250	50	70	410	1 060	390	100	640	175	M36
280	260	300	**SD356**	**SD356G**	580	355	930	270	57	77	440	1 110	420	110	690	185	M42

1) Dimension g indicates the bearing width dimension of the floating side. The fixed side (code **G**) is larger than the bearing width dimension by 0.5 mm.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.

Plummer Blocks



Shaft penetration type

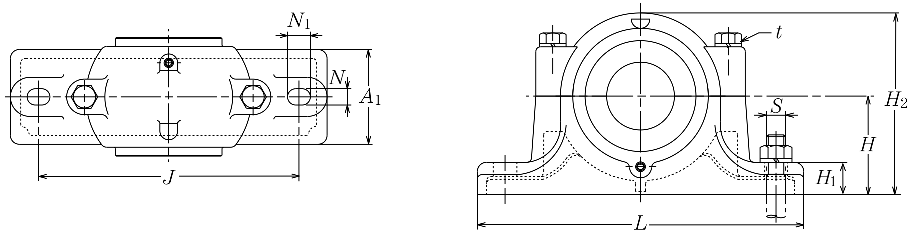


Shaft end type

Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)	Applied part Combination of spherical roller bearings			Reference dimension mm Y 2)	Rubber seal number		End cover number	Shaft dia. mm
			Bearing number	Adapter number	Washer / lock plate number		(d_1 side)	(d_2 side)		d
R3/8	M30	95	22234EMD1	AN34	AW34	75	ZF36	ZF42	MF36	**170**
R3/8	M30	110	22236EMD1	AN36	AW36	76	ZF38	ZF44	MF38	**180**
R3/8	M30	130	22238EMD1	AN38	AW38	80	ZF40	ZF46	MF40	**190**
R3/8	M30	150	22240EMD1	AN40	AW40	84	ZF42	ZF48	MF42	**200**
R3/8	M36	210	22244EMD1	AN44	AL44	90	ZF46	ZF52	MF46	**220**
R3/8	M36	240	22248EMD1	AN48	AL44	98	GS50S	ZF56	MF50	**240**
R3/8	M36	320	22252EMD1	AN52	AL52	105	ZF54	ZF60	MF54	**260**
R3/8	M42	370	22256EMD1	AN56	AL52	107	ZF56	ZF64	MF56	**280**
R3/8	M42	460	22260EMD1	AN60	AL60	114	ZF60	ZF68	MF60	**300**
R3/8	M48	560	22264EMD1	AN64	AL64	122	ZF64	GS72	MF64	**320**
R3/8	M30	150	22334EMD1	AN34	AW34	92	ZF36	ZF42	MF36	**170**
R3/8	M36	180	22336EMD1	AN36	AW36	96	ZF38	ZF44	MF38	**180**
R3/8	M36	210	22338EMD1	AN38	AW38	100	ZF40	ZF46	MF40	**190**
R3/8	M36	240	22340EMD1	AN40	AW40	104	ZF42	ZF48	MF42	**200**
R3/8	M36	300	22344EMD1	AN44	AL44	109	ZF46	ZF52	MF46	**220**
R3/8	M42	370	22348EMD1	AN48	AL44	116	GS50S	ZF56	MF50	**240**
R3/8	M42	460	22352EMD1	AN52	AL52	123	ZF54	ZF60	MF54	**260**
R3/8	M48	560	22356EMD1	AN56	AL52	130	ZF56	ZF64	MF56	**280**

Plummer Blocks

Plummer block series SN30 / SN31
(standard type / for bearings with adapter)

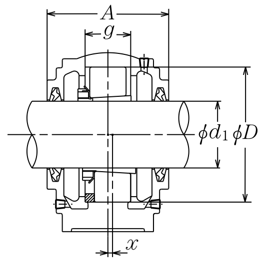


d_1 100～170mm

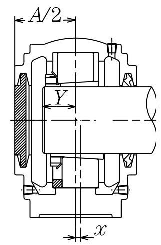
Shaft dia. mm d_1	Plummer block number	Dimensions mm D	H	J	N	N_1	A	L	A_1	H_1	H_2	g	t Nominal no.	Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)
110	SN3024	180	112	320	26	32	150	380	110	40	217	56	M20	R1/4	M24	17
115	SN3026	200	125	350	26	32	160	410	120	45	240	62	M20	R1/4	M24	20
125	SN3028	210	140	350	26	32	170	410	120	45	260	63	M20	R1/4	M24	25
135	SN3030	225	150	380	28	36	175	445	130	50	283	66	M24	R1/4	M24	30
140	SN3032	240	150	390	28	36	190	460	130	50	290	70	M24	R1/4	M24	33
150	SN3034	260	160	450	33	42	200	530	160	60	310	77	M24	R1/4	M30	46
160	SN3036	280	170	470	33	42	210	550	160	60	330	84	M24	R1/4	M30	52
170	SN3038	290	170	470	33	42	210	550	160	60	335	85	M24	R1/4	M30	52
100	SN3122	180	112	320	26	32	155	380	110	40	217	66	M20	R1/4	M24	18
110	SN3124	200	125	350	26	32	165	410	120	45	240	72	M20	R1/4	M24	21
115	SN3126	210	140	350	26	32	170	410	120	45	260	74	M20	R1/4	M24	26
125	SN3128	225	150	380	28	36	180	445	130	50	283	78	M24	R1/4	M24	32
135	SN3130	250	150	420	33	42	200	500	150	50	295	90	M24	R1/4	M30	40
140	SN3132	270	160	450	33	42	215	530	160	60	315	96	M24	R1/4	M30	45
150	SN3134	280	170	470	33	42	220	550	160	60	330	98	M24	R1/4	M30	51
160	SN3136	300	180	520	33	42	230	610	170	70	355	106	M30	R1/4	M30	63
170	SN3138	320	190	560	33	42	240	650	180	70	375	114	M30	R1/4	M30	76

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.
Note: 1. SN3028 or larger and SN3126 or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks



Shaft penetration type



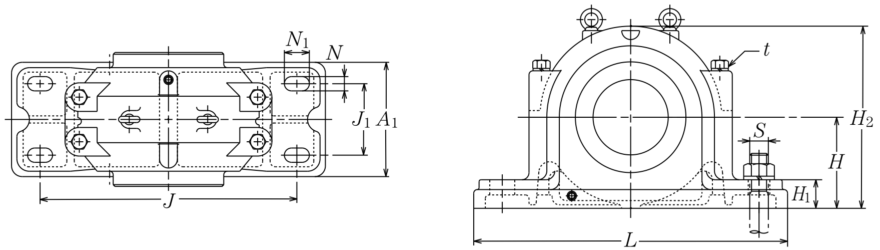
Shaft end type

Applied part: Combination of spherical roller bearings — Bearing number	Adapter / Plummer block number	Stabilizing ring / Plummer block number 1)	Stabilizing ring Quantity	Reference dimension mm Y 2)	Rubber seal number	End cover number	Shaft dia. mm d_1
23024EAKD1	H3024X	SR180×10	1	47	ZF24	MF24	110
23026EAKD1	H3026	SR200×10	1	51	ZF26	MF26	115
23028EAKD1	H3028	SR210×10	1	53	ZF28	MF28	125
23030EAKD1	H3030	SR225×10	1	56	ZF30	MF30	135
23032EAKD1	H3032	SR240×10	1	61	ZF32	MF32	140
23034EAKD1	H3034	SR260×10	1	66	ZF34	MF34	150
23036EAKD1	H3036	SR280×10	1	70	ZF36	MF36	160
23038EAKD1	H3038	SR290×10	1	72	ZF38	MF38	170
23122EAKD1	H3122X	SR180×10	1	51	ZF22	MF22	100
23124EAKD1	H3124X	SR200×10	1	55	ZF24	MF24	110
23126EAKD1	H3126	SR210×10	1	57	ZF26	MF26	115
23128EAKD1	H3128	SR225×10	1	60	ZF28	MF28	125
23130EAKD1	H3130	SR250×10	1	68	ZF30	MF30	135
23132EAKD1	H3132	SR270×10	1	74	ZF32	MF32	140
23134EAKD1	H3134	SR280×10	1	76	ZF34	MF34	150
23136EAKD1	H3136	SR300×10	1	81	ZF36	MF36	160
23138EMKD1	H3138	SR320×10	1	86	ZF38	MF38	170

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer Blocks

Plummer block series SD30/SD30G
(for heavy loads, double seal type / for bearings with adapters)

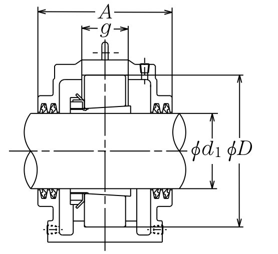


d_1 150 ～ 400mm

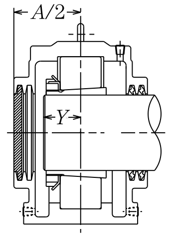
Shaft dia. mm d_1	Plummer block number[1] Floating side	Fixed side	Dimensions mm D	H	J	J_1	N	N_1	A	L	A_1	H_1	H_2	g[2]	t Nominal no.
150	SD3034	SD3034G	260	160	450	110	32	42	230	540	200	50	320	77	M24
160	SD3036	SD3036G	280	170	470	120	32	42	250	560	220	50	340	84	M24
170	SD3038	SD3038G	290	170	470	120	32	42	250	560	220	50	345	85	M24
180	SD3040	SD3040G	310	180	510	140	32	52	270	620	250	60	360	92	M24
200	SD3044	SD3044G	340	200	570	160	35	55	290	700	280	65	400	100	M30
220	SD3048	SD3048G	360	210	610	170	35	55	300	740	290	65	420	102	M30
240	SD3052	SD3052G	400	240	680	190	40	60	340	820	320	70	475	114	M30
260	SD3056	SD3056G	420	250	710	200	42	62	350	860	340	85	500	116	M36
280	SD3060	SD3060G	460	280	770	210	42	62	360	920	350	85	550	128	M36
300	SD3064	SD3064G	480	280	790	210	42	62	380	940	360	85	560	131	M36
380	SD3080	SD3080G	600	365	960	270	57	77	430	1 140	420	120	710	158	M42
400	SD3084	SD3084G	620	375	980	270	57	77	430	1 160	420	120	735	160	M42

1) SD3068, SD3072, and SD3076 have the same dimensions as SD3368, SD3372, and SD3376. Therefore, when these models are necessary, select "SD3368, SD3372, and SD3376."
2) Dimension g indicates the bearing width dimension of the floating side. The fixed side (code G) is larger than the bearing width dimension by 0.5 mm.
3) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.

Plummer Blocks



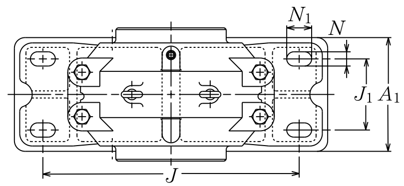
Shaft penetration type

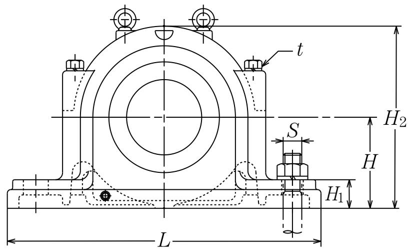


Shaft end type

Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)	Applied part: Combination of spherical roller bearings — Bearing number	Adapter number	Reference dimension mm Y[3]	Rubber seal number	End cover number	Shaft dia. mm d_1
R3/8	M30	70	23034EAKD1	H3034	66	ZF34	MF34	150
R3/8	M30	80	23036EAKD1	H3036	70	ZF36	MF36	160
R3/8	M30	85	23038EAKD1	H3038	72	ZF38	MF38	170
R3/8	M30	100	23040EMKD1	H3040	76	ZF40	MF40	180
R3/8	M30	130	23044EMKD1	H3044	79	ZF44	MF44	200
R3/8	M30	150	23048EMKD1	H3048	84	ZF48	MF48	220
R3/8	M36	210	23052EMKD1	H3052	90	ZF52	MF52	240
R3/8	M36	240	23056EMKD1	H3056	95	ZF56	MF56	260
R3/8	M36	300	23060EMKD1	H3060	105	ZF60	MF60	280
R3/8	M36	320	23064EMKD1	H3064	108	ZF64	MF64	300
R3/8	M48	620	23080BK	H3080	131	GS80	MF80	380
R3/8	M48	690	23084BK	H3084	132	GS84	MF84	400

Plummer block series SD31/SD31G
(for heavy loads, double seal type / for bearings with adapters)

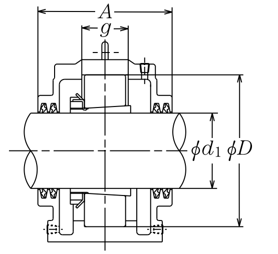




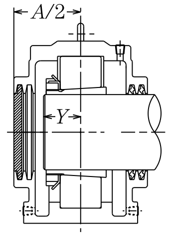
d_1 150 ～ 400mm

Shaft dia. mm d_1	Plummer block number 1) Floating side	Fixed side	Dimensions mm D	H	J	J_1	N	N_1	A	L	A_1	H_1	H_2	g 2)	t Nominal no.
150	**SD3134**	**SD3134G**	280	170	470	120	35	42	250	560	220	50	340	98	M24
160	**SD3136**	**SD3136G**	300	180	520	140	35	52	270	630	250	55	365	106	M30
170	**SD3138**	**SD3138G**	320	190	560	140	35	55	310	680	270	55	385	114	M30
180	**SD3140**	**SD3140G**	340	200	570	160	35	55	310	700	280	65	400	122	M30
200	**SD3144**	**SD3144G**	370	225	640	180	40	60	320	780	310	70	450	130	M30
220	**SD3148**	**SD3148G**	400	240	680	190	40	60	330	820	320	70	475	138	M30
240	**SD3152**	**SD3152G**	440	260	740	200	42	62	360	880	350	85	515	154	M36
260	**SD3156**	**SD3156G**	460	280	770	210	42	62	360	920	350	85	550	156	M36
280	**SD3160**	**SD3160G**	500	300	830	230	50	70	390	990	380	100	590	170	M36
300	**SD3164**	**SD3164G**	540	325	890	250	50	70	430	1 060	400	100	640	186	M36
340	**SD3172**	**SD3172G**	600	365	960	310	57	77	470	1 140	460	120	710	202	M42
360	**SD3176**	**SD3176G**	620	375	980	320	57	77	500	1 160	490	120	735	204	M42
380	**SD3180**	**SD3180G**	650	390	1 040	340	57	77	520	1 220	510	125	770	210	M42
400	**SD3184**	**SD3184G**	700	420	1 070	380	57	77	560	1 250	550	135	820	234	M42

1) SD3168 has the same dimensions as SD3468. Therefore, when this model is necessary, select "SD3468."
2) Dimension g indicates the bearing width dimension of the floating side. The fixed side (code G) is larger than the bearing width dimension by 0.5 mm.
3) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.



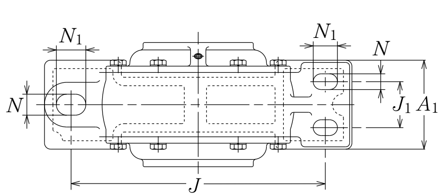
Shaft penetration type

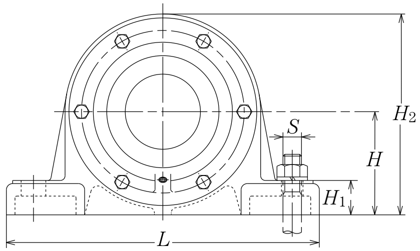


Shaft end type

Oil filler / drain plug size	Reference dimension S Nominal dimension	Mass kg (approx.)	Applied part Combination of spherical roller bearings Bearing number	Adapter number	Reference dimension mm Y 3)	Rubber seal number	End cover number	Shaft dia. mm d_1
R3/8	M30	75	23134EAD1	H3134	76	ZF34	MF34	**150**
R3/8	M30	94	23136EAKD1	H3136	81	ZF36	MF36	**160**
R3/8	M30	110	23138EMKD1	H3138	86	ZF38	MF38	**170**
R3/8	M30	130	23140EMKD1	H3140	91	ZF40	MF40	**180**
R3/8	M36	180	23144EMKD1	H3144	96	ZF44	MF44	**200**
R3/8	M36	210	23148EMKD1	H3148	102	ZF48	MF48	**220**
R3/8	M36	240	23152EMKD1	H3152	112	ZF52	MF52	**240**
R3/8	M36	310	23156EMKD1	H3156	115	ZF56	MF56	**260**
R3/8	M42	400	23160EMKD1	H3160	124	ZF60	MF60	**280**
R3/8	M42	480	23164EMKD1	H3164	135	ZF64	MF64	**300**
R3/8	M48	630	23172BK	H3172	159	GS72	MF72	**340**
R3/8	M48	850	23176BK	H3176	162	GS76	MF76	**360**
R3/8	M48	960	23180BK	H3180	167	GS80	MF80	**380**
R3/8	M48	1 080	23184BK	H3184	187	GS84	MF84	**400**

Plummer block series SV5
(unit standard type / for bearings with adapter assembly)

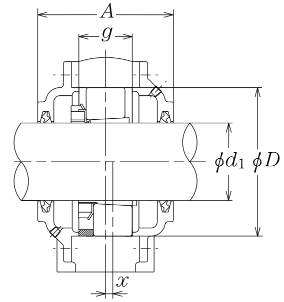




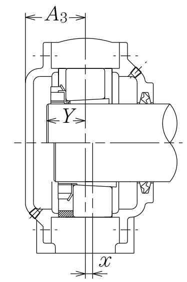
d_1 20 ～ 135mm

Shaft dia. mm d_1	Plummer block number	Dimensions mm D	H	J	J_1	N	N_1	L	A	A_1	g	A_3	H_1	H_2	Oil filler / drain plug size	Reference dimension S Nominal dimension	Quantity	Mass kg (approx.)
20	SV505	52	45	130	–	16	20	165	73	46	27	31	22	85	R1/8	M14	2	2.1
25	SV506	62	50	150	–	16	20	185	80	52	30	34	22	95	R1/8	M14	2	2.7
30	SV507	72	56	150	–	16	20	185	85	52	33	37.5	22	106	R1/8	M14	2	3.3
35	SV508	80	60	170	–	16	20	205	95	60	37	40.5	25	118	R1/8	M14	2	4.5
40	SV509	85	63	170	–	16	23	205	98	60	39	42.5	25	125	R1/8	M14	2	4.5
45	SV510	90	67	170	–	16	23	205	100	60	39	42.5	25	128	R1/8	M14	2	4.8
50	SV511	100	71	210	–	16	23	255	106	70	42	47	28	140	R1/8	M14	2	5.8
55	SV512	110	80	210	–	21	25	255	112	70	46	47	30	155	R1/8	M18	2	6.8
60	SV513	120	85	230	–	21	25	275	118	80	49	50	30	165	R1/8	M18	2	9.5
65	SV515	130	90	230	–	21	25	280	118	80	50	50	30	175	R1/8	M18	2	10
70	SV516	140	100	260	–	25	30	315	136	90	56	58	32	195	R1/8	M22	2	14
75	SV517	150	100	260	–	25	30	315	140	90	56	60	32	195	R1/8	M22	2	15
80	SV518	160	112	290	–	25	30	345	150	100	62	65	35	224	R1/8	M22	2	20
85	SV519	170	112	290	–	25	30	345	165	100	62	72.5	35	224	R1/8	M22	2	20
90	SV520	180	125	320	56	23	32	380	170	110	70	75	40	243	R1/8	M20	4	26
100	SV522	200	132	350	60	23	32	410	190	120	82	82	45	265	R1/4	M20	4	30
110	SV524	215	140	350	60	23	32	410	190	120	82	82	45	280	R1/4	M20	4	36
115	SV526	230	150	380	65	23	32	450	200	130	86	87	50	300	R1/4	M20	4	45
125	SV528	250	160	420	80	23	32	500	218	150	94	96	50	315	R1/4	M20	4	53
135	SV530	270	170	450	92	29	42	540	236	160	103	105	60	335	R1/4	M24	4	63

1) The stabilizing ring indicates the outer diameter and width dimension.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.
Note: 1. SV520 or larger plummer blocks are provided with a lifting eye bolt.



Shaft penetration type



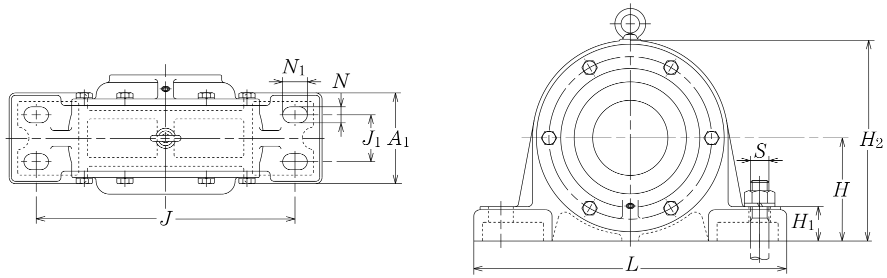
Shaft end type

Applied part: Combination of self-aligning ball bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Combination of spherical roller bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Reference dimension mm Y 2)	Rubber seal number	Shaft dia. mm d_1
1205SK 2205SK	H205X H305X	SR52×6 SR52×9	2 1	– 22205EAKD1	– H305X	– SR52×9	– 1	17 19	ZF5	20
1206SK 2206SK	H206X H306X	SR62×7 SR62×10	2 1	– 22206EAKD1	– H306X	– SR62×10	– 1	18 20	ZF6	25
1207SK 2207SK	H207X H307X	SR72×8 SR72×10	2 1	– 22207EAKD1	– H307X	– SR72×10	– 1	19 22	ZF7	30
1208SK 2208SK	H208X H308X	SR80×9.5 SR80×7	2 2	– 22208EAKD1	– H308X	– SR80×7	– 2	21 23	ZF8	35
1209SK 2209SK	H209X H309X	SR85×10 SR85×8	2 2	– 22209EAKD1	– H309X	– SR85×8	– 2	22 24	ZF9	40
1210SK 2210SK	H210X H310X	SR90×9.5 SR90×8	2 2	– 22210EAKD1	– H310X	– SR90×8	– 2	24 25	ZF10	45
1211SK 2211SK	H211X H311X	SR100×10.5 SR100×8.5	2 2	– 22211EAKD1	– H311X	– SR100×8.5	– 2	25 27	ZF11	50
1212SK 2212SK	H212X H312X	SR110×12 SR110×9	2 2	– 22212EAKD1	– H312X	– SR110×9	– 2	26 29	ZF12	55
1213SK 2213SK	H213X H313X	SR120×13 SR120×9	2 2	– 22213EAKD1	– H313X	– SR120×9	– 2	28 32	ZF13	60
1215SK 2215SK	H215X H315X	SR130×12.5 SR130×9.5	2 2	– 22215EAKD1	– H315X	– SR130×9.5	– 2	30 33	ZF15	65
1216SK 2216SK	H216X H316X	SR140×15 SR140×11.5	2 2	– 22216EAKD1	– H316X	– SR140×11.5	– 2	32 36	ZF16	70
1217SK 2217SK	H217X H317X	SR150×14 SR150×10	2 2	– 22217EAKD1	– H317X	– SR150×10	– 2	34 38	ZF17	75
1218SK 2218SK –	H218X H318X –	SR160×16 SR160×11 –	2 2 –	– 22218EAKD1 23218EMKD1	– H318X H2318X	– SR160×11 SR160×9.6	– 2 1	35 40 46	ZF18	80
1219SK 2219SK	H219X H319X	SR170×15 SR170×9.5	2 2	– 22219EAKD1	– H319X	– SR170×9.5	– 2	37 43	ZF19	85
1220SK 2220SK –	H220X H320X –	SR160×18 SR180×12 –	2 2 –	– 22220EAKD1 23220EMKD1	– H320X H2320X	– SR180×12 SR180×9.7	– 2 1	39 45 52	ZF20	90
1222SK 2222SK –	H222X H322X –	SR200×22 SR200×14.5 –	2 2 –	– 22222EAKD1 23222EMKD1	– H322X H2322X	– SR200×14.5 SR200×12.2	– 2 1	42 50 58	ZF22	100
– –	– –	– –	– –	22224EAKD1 23224EMKD1	H3124X H2324X	SR215×12 SR215×6	2 1	53 62	ZF24	110
– –	– –	– –	– –	22226EAKD1 23226EMKD1	H3126 H2326	SR230×11 SR230×6	2 1	57 65	ZF26	115
– –	– –	– –	– –	22228EAKD1 23228EMKD1	H3128 H2328	SR250×13 SR250×6	2 1	60 70	ZF28	125
– –	– –	– –	– –	22230EAKD1 23230EMKD1	H3130 H2330	SR270×15 SR270×7	2 1	65 76	ZF30	135

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.
3. Adapters for series 12 bearings can also be used with H2 and H3 series bearings.

Plummer Blocks

Plummer block series SV5
(unit single standard type / for bearings with adapter assembly)

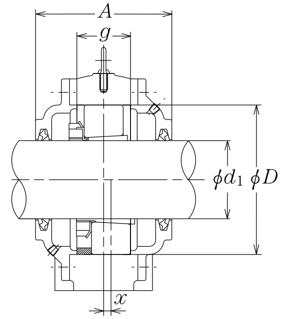


d_1 140 ～ 300mm

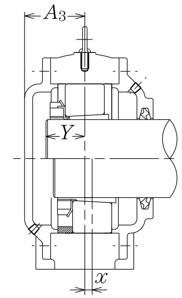
Shaft dia. mm d_1	Plummer block number	Dimensions mm D	H	J	J_1	N	N_1	L	A	A_1	g	A_3	H_1	H_2	Oil filler / drain plug size	Reference dimension S Nominal dimension	Quantity	Mass kg (approx.)
140	**SV532**	290	190	470	92	29	50	560	250	170	113	112	60	375	R1/4	M24	4	76
150	**SV534**	310	200	560	92	29	50	660	258	180	122	116	65	405	R1/4	M24	4	89
160	**SV536**	320	200	560	92	29	50	660	258	180	122	116	65	405	R1/4	M24	4	100
170	**SV538**	340	212	580	104	33	54	680	300	190	130	137	65	425	R1/4	M27	4	110
180	**SV540**	360	224	610	130	33	54	740	300	224	138	136	85	450	R1/4	M27	4	130
200	**SV544**	400	250	680	148	36	60	820	330	250	154	151	95	500	R1/4	M30	4	196
220	**SV548**	440	280	740	166	40	66	880	340	280	170	156	100	560	R1/4	M33	4	260
240	**SV552**	480	300	790	180	43	72	940	370	300	184	173	105	600	R1/4	M36	4	318
260	**SV556**	500	315	830	190	43	72	990	390	315	186	185	110	630	R1/4	M36	4	336
280	**SV560**	540	335	890	200	46	78	1 060	410	335	202	196	115	670	R1/4	M39	4	433
300	**SV564**	580	355	930	215	49	84	1 110	440	355	218	211	120	710	R1/4	M42	4	507

1) The stabilizing ring indicates the outer diameter and width dimension.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.
Note: 1. **SV520** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks



Shaft penetration type

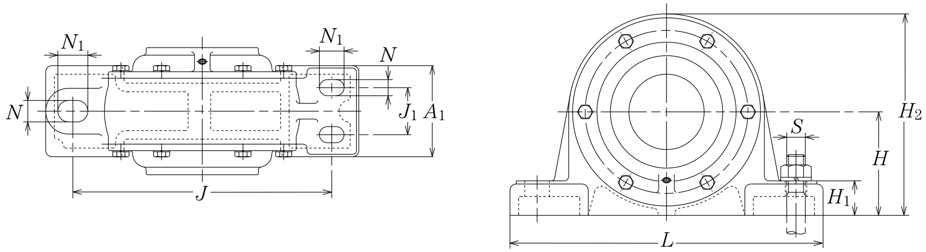


Shaft end type

Applied part: Combination of self-aligning ball bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Combination of spherical roller bearings — Bearing number	Adapter number	Stabilizing ring Number 1)	Quantity	Reference dimension mm Y 2)	Rubber seal number	Shaft dia. mm d_1
–	–	–	–	22232EAKD1	H3132	SR290×16.5	2	71	ZF32	**140**
–	–	–	–	23232EMKD1	H2332	SR290×9	1	83		
–	–	–	–	22234EMKD1	H3134	SR310×18	2	75	ZF34	**150**
–	–	–	–	23234EMKD1	H2334	SR310×12	1	87		
–	–	–	–	22236EMKD1	H3136	SR320×18	2	76	ZF36	**160**
–	–	–	–	23236EMKD1	H2336	SR320×10	1	89		
–	–	–	–	22238EMKD1	H3138	SR340×19	2	80	ZF38	**170**
–	–	–	–	23238EMKD1	H2338	SR340×10	1	94		
–	–	–	–	22240EMKD1	H3140	SR360×20	2	84	ZF40	**180**
–	–	–	–	23240EMKD1	H2340	SR360×10	1	99		
–	–	–	–	22244EMKD1	H3144	SR400×23	2	90	ZF44	**200**
–	–	–	–	23244EMKD1	H2344	SR400×10	1	108		
–	–	–	–	22248EMKD1	H3148	SR440×25	2	98	ZF48	**220**
–	–	–	–	23248EMKD1	H2348	SR440×10	1	118		
–	–	–	–	22252EMKD1	H3152	SR480×27	2	105	ZF52	**240**
–	–	–	–	23252EMKD1	H2352	SR480×10	1	127		
–	–	–	–	22256EMKD1	H3156	SR500×28	2	107	ZF56	**260**
–	–	–	–	23256EMKD1	H2356	SR500×10	1	130		
–	–	–	–	22260EMKD1	H3160	SR540×31	2	114	ZF60	**280**
–	–	–	–	23260EMKD1	H2360	SR540×10	1	160		
–	–	–	–	22264EMKD1	H3164	SR580×34	2	122	ZF64	**300**
–	–	–	–	23264EMKD1	H2364	SR580×10	1	151		

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.
3. Adapters for series 12 bearings can also be used with H2 and H3 series bearings.

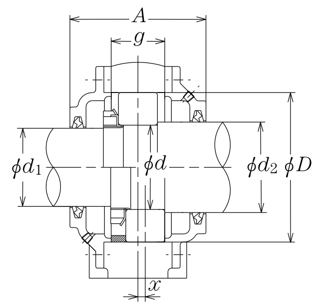
Plummer block series SV2
(unit and stepped bore type / for cylindrical bore bearings)



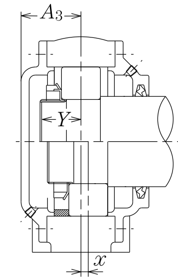
d 25 ~ 140mm

Shaft diameter mm			Plummer block number	Dimensions mm													Oil filler / drain plug size	Reference dimension S		Mass kg
d	d_1	d_2		D	H	J	J_1	N	N_1	L	A	A_1	g	A_3	H_1	H_2		Nominal dimension	Quantity	(approx.)
25	20	30	**SV205**	52	45	130	–	16	20	165	73	46	27	31	22	85	R1/8	M14	2	2.0
30	25	35	**SV206**	62	50	150	–	16	20	185	80	52	30	34	22	95	R1/8	M14	2	2.6
35	30	45	**SV207**	72	56	150	–	16	20	185	85	52	33	37.5	22	106	R1/8	M14	2	3.1
40	35	50	**SV208**	80	60	170	–	16	20	205	95	60	37	40.5	25	118	R1/8	M14	2	4.3
45	40	55	**SV209**	85	63	170	–	16	23	205	98	60	39	42.5	25	125	R1/8	M14	2	4.3
50	45	60	**SV210**	90	67	170	–	16	23	205	100	60	39	42.5	25	128	R1/8	M14	2	4.6
55	50	65	**SV211**	100	71	210	–	16	23	255	106	70	42	47	28	140	R1/8	M14	2	5.5
60	55	70	**SV212**	110	80	210	–	21	25	255	112	70	46	47	30	155	R1/8	M18	2	6.5
65	60	75	**SV213**	120	85	230	–	21	25	275	118	80	49	50	30	165	R1/8	M18	2	9.5
70	60	80	**SV214**	125	90	230	–	21	25	280	118	80	50	50	30	175	R1/8	M18	2	10
75	65	85	**SV215**	130	90	230	–	21	25	280	118	80	50	50	30	175	R1/8	M18	2	10
80	70	90	**SV216**	140	100	260	–	25	30	315	136	90	56	58	32	195	R1/8	M22	2	14
85	75	95	**SV217**	150	100	260	–	25	30	315	140	90	56	60	32	195	R1/8	M22	2	15
90	80	100	**SV218**	160	112	290	–	25	30	345	150	100	62	65	35	224	R1/8	M22	2	20
95	85	110	**SV219**	170	112	290	–	25	30	345	165	100	62	72.5	35	224	R1/8	M22	2	20
100	90	115	**SV220**	180	125	320	56	23	32	380	170	110	70	75	40	243	R1/8	M20	4	26
110	100	125	**SV222**	200	132	350	60	23	32	410	190	120	82	82	45	265	R1/4	M20	4	30
120	110	135	**SV224**	215	140	350	60	23	32	410	190	120	82	82	45	280	R1/4	M20	4	36
130	115	145	**SV226**	230	150	380	65	23	32	450	200	130	86	87	50	300	R1/4	M20	4	44
140	125	155	**SV228**	250	160	420	80	23	32	500	218	150	94	96	50	315	R1/4	M20	4	52

1) The stabilizing ring indicates the outer diameter and width dimension.
2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape.
Note: 1. SV220 or larger plummer blocks are provided with a lifting eye bolt.



Shaft penetration type

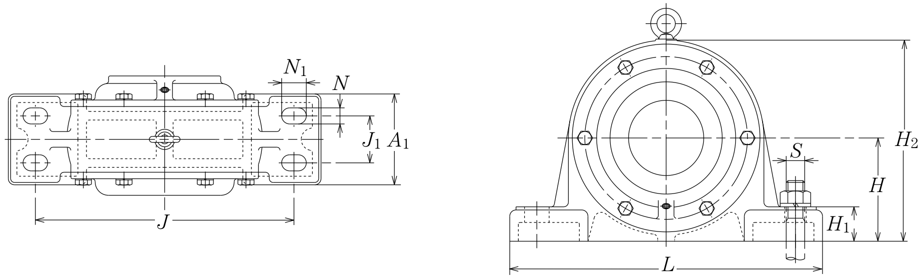


Shaft end type

Applied part: Combination of self-aligning ball bearings			Applied part: Combination of spherical roller bearings			Nut number	Washer number	Reference dimension mm	Rubber seal number		Shaft dia. mm
Bearing number	Stabilizing ring Number 1)	Quantity	Bearing number	Stabilizing ring Number 1)	Quantity			Y 2)	(d_1 side)	(d_2 side)	d_1
1205S 2205S	SR52×6 SR52×9	2 1	– 22205EAD1	– SR52×9	– 1	AN05	AW05X	17 19	ZF5	ZF7	**25**
1206S 2206S	SR62×7 SR62×10	2 1	– 22206EAD1	– SR62×10	– 1	AN06	AW06X	18 20	ZF6	ZF8	**30**
1207S 2207S	SR72×8 SR72×10	2 1	– 22207EAD1	– SR72×10	– 1	AN07	AW07X	19 22	ZF7	ZF10	**35**
1208S 2208S	SR80×9.5 SR80×7	2 2	– 22208EAD1	– SR80×7	– 2	AN08	AW08X	21 23	ZF8	ZF11	**40**
1209S 2209S	SR85×10 SR85×8	2 2	– 22209EAD1	– SR85×8	– 2	AN09	AW09X	22 24	ZF9	ZF12	**45**
1210S 2210S	SR90×9.5 SR90×8	2 2	– 22210EAD1	– SR90×8	– 2	AN10	AW10X	24 25	ZF10	ZF13	**50**
1211S 2211S	SR100×10.5 SR100×8.5	2 2	– 22211EAD1	– SR100×8.5	– 2	AN11	AW11X	25 27	ZF11	ZF15	**55**
1212S 2212S	SR110×12 SR110×9	2 2	– 22212EAD1	– SR110×9	– 2	AN12	AW12X	26 29	ZF12	ZF16	**60**
1213S 2213S	SR120×13 SR120×9	2 2	– 22213EAD1	– SR120×9	– 2	AN13	AW13X	28 32	ZF13	ZF17	**65**
1214S 2214S	SR125×13 SR125×9.5	2 2	– 22214EAD1	– SR125×9.5	– 2	AN14	AW14X	28 32	ZF13	ZF18	**70**
1215S 2215S	SR130×12.5 SR130×9.5	2 2	– 22215EAD1	– SR130×9.5	– 2	AN15	AW15X	30 33	ZF15	ZF19	**75**
1216S 2216S	SR140×15 SR140×11.5	2 2	– 22216EAD1	– SR140×11.5	– 2	AN16	AW16X	32 36	ZF16	ZF20	**80**
1217S 2217S	SR150×14 SR150×10	2 2	– 22217EAD1	– SR150×10	– 2	AN17	AW17X	34 38	ZF17	ZF21	**85**
1218S 2218S –	SR160×15 SR160×11 –	2 2 –	– 22218EAD1 23218EMD1	– SR160×11 SR160×9.6	– 2 1	AN18	AW18X	35 40 46	ZF18	ZF22	**90**
1219S 2219S	SR170×15 SR170×9.5	2 2	– 22219EAD1	– SR170×9.5	– 2	AN19	AW19X	37 43	ZF19	ZF24	**95**
1220S 2220S –	SR180×18 SR180×12 –	2 2 –	– 22220EAD1 23220EMD1	– SR180×12 SR180×9.7	– 2 1	AN20	AW20X	39 45 52	ZF20	ZF26	**100**
1222S 2222S –	SR200×22 SR200×14.5 –	2 2 –	– 22222EAD1 23222EMD1	– SR200×14.5 SR200×12.2	– 2 1	AN22	AW22X	42 50 58	ZF22	ZF28	**110**
–	–	–	22224EAD1 23224EMD1	SR215×12 SR215×6	2 1	AN24	AW24X	53 62	ZF24	ZF30	**120**
–	–	–	22226EAD1 23226EMD1	SR230×11 SR230×6	2 1	AN26	AW26	57 65	ZF26	GS33	**130**
–	–	–	22228EAD1 23228EMD1	SR250×13 SR250×6	2 1	AN28	AW28	60 70	ZF28	GS35	**140**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Plummer block series SV2
(single and different aperture type / for cylindrical bore bearings)

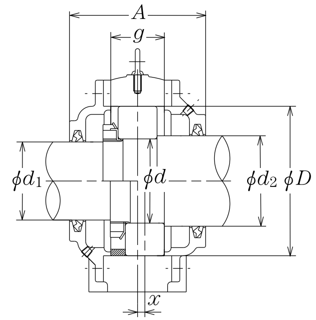


d 150 ～ 320mm

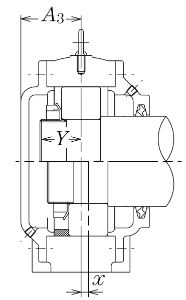
Shaft diameter mm			Plummer block number	Dimensions mm														Oil filler / drain plug size	Reference dimension S		Mass kg
d	d_1	d_2		D	H	J	J_1	N	N_1	L	A	A_1	g	A_3	H_1	H_2		Nominal dimension	Quantity	(approx.)
150	135	165	**SV230**	270	170	450	92	29	42	540	236	160	103	105	60	335	R1/4	M24	4	62
160	140	175	**SV232**	290	190	470	92	29	50	560	250	170	113	112	60	375	R1/4	M24	4	75
170	150	190	**SV234**	310	200	560	92	29	50	660	258	180	122	116	65	405	R1/4	M24	4	87
180	160	200	**SV236**	320	200	560	92	29	50	660	258	180	122	116	65	405	R1/4	M24	4	98
190	170	210	**SV238**	340	212	580	104	33	54	680	300	190	130	137	65	425	R1/4	M27	4	110
200	180	230	**SV240**	360	224	610	130	33	54	740	300	224	138	136	85	450	R1/4	M27	4	130
220	200	250	**SV244**	400	250	680	148	36	60	820	330	250	154	151	95	500	R1/4	M30	4	196
240	220	260	**SV248**	440	280	740	166	40	66	880	340	280	170	156	100	560	R1/4	M33	4	260
260	240	280	**SV252**	480	300	790	180	43	72	940	370	300	184	173	105	600	R1/4	M36	4	318
280	260	300	**SV256**	500	315	830	190	43	72	990	390	315	186	185	110	630	R1/4	M36	4	336
300	280	320	**SV260**	540	335	890	200	46	78	1 060	410	335	202	196	115	670	R1/4	M39	4	433
320	300	340	**SV264**	580	355	930	215	49	84	1 110	440	355	218	211	120	710	R1/4	M42	4	507

1) The stabilizing ring indicates the outer diameter and width dimension. 2) Dimension Y indicates the reference dimension from the shaft center to the end in the case of the shaft end shape. Note: 1. **SV220** or larger plummer blocks are provided with a lifting eye bolt.

Plummer Blocks
NTN



Shaft penetration type



Shaft end type

Applied part								Reference dimension mm	Rubber seal number		Shaft dia. mm
Combination of self-aligning ball bearings			Combination of spherical roller bearings			Nut number	Washer number				
Bearing number	Stabilizing ring Number [1]	Quantity	Bearing number	Stabilizing ring Number [1]	Quantity			Y [2]	(d_1 side)	(d_2 side)	d_1
–	–	–	2220EAD1 23230EMD1	SR270×15 SR270×7	2 1	AN30	AW30	65 76	ZF30	GS37	**150**
–	–	–	22232EAD1 23232EMD1	SR290×16.5 SR290×9	2 1	AN32	AW32	71 83	ZF32	GS39	**160**
–	–	–	22234EMD1 23234EMD1	SR310×18 SR310×12	2 1	AN34	AW34	75 87	ZF34	ZF42	**170**
–	–	–	22236EMD1 23236EMD1	SR320×18 SR320×10	2 1	AN36	AW36	76 89	ZF36	ZF44	**180**
–	–	–	22238EMD1 23238EMD1	SR340×19 SR340×10	2 1	AN38	AW38	80 94	ZF38	ZF46	**190**
–	–	–	22240EMD1	SR360×20	2	AN40	AW40	84	ZF40	GS50S	**200**
–	–	–	22244EMD1	SR400×23	2	AN44	AL44	90	ZF44	ZF54	**220**
–	–	–	22248EMD1	SR440×25	2	AN48	AL44	98	ZF48	ZF56	**240**
–	–	–	22252EMD1	SR480×27	2	AN52	AL52	105	ZF52	ZF60	**260**
–	–	–	22256EMD1	SR500×28	2	AN56	AL52	107	ZF56	ZF64	**280**
–	–	–	22260EMD1	SR540×31	2	AN60	AL60	114	ZF60	ZF68	**300**
–	–	–	22264EMD1	SR580×34	2	AN64	AL64	122	ZF64	GS72	**320**

Note: 2. Dimension x applies to plummer block numbers using one stabilizing ring and indicates the value of deviation from the bearing center to the plummer block center. The value is ½ of the width dimension of the stabilizing ring.

Contents of Introduction of Catalogs and Technical Review

Introduction of Catalogs and Technical Reviews

Introduction of Catalogs and Technical Reviews

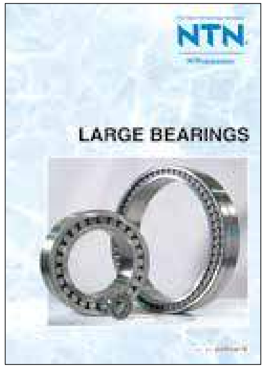
Catalogs and technical reviews issued by **NTN** are as follows.
Please refer to the **NTN** website (https://www.ntnglobal.com) for the latest information.

1. Introduction of catalogs

Catalogs related to rolling bearings

LARGE BEARINGS

CAT.No.2250/E

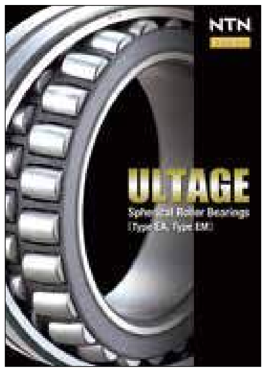


Precision Rolling Bearings

CAT.No.2260/E

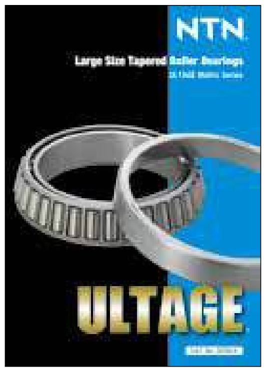
ULTAGE series
Spherical Roller Bearings with High-strength Cage [EMA Type]

CAT.No.3033/E



ULTAGE series
Large Size Tapered Roller Bearings

CAT.No.3035/E

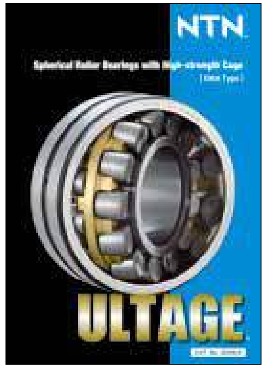


Introduction of Catalogs and Technical Reviews

Catalogs related to rolling bearings

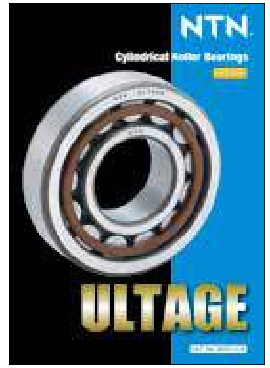
ULTAGE series
Spherical Roller Bearings
with High-strength Cage [EMA Type]

CAT.No.3036/E



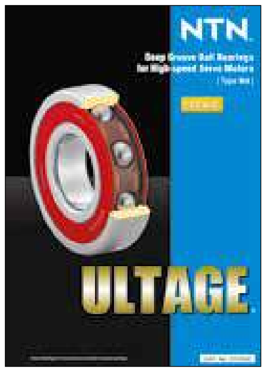
ULTAGE series
Cylindrical Roller Bearings

CAT.No.3037/E



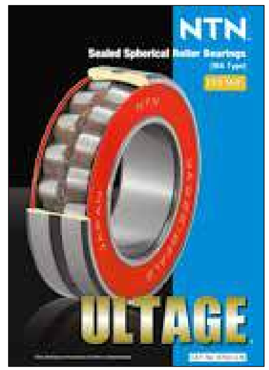
ULTAGE series
Deep Groove Ball Bearings
for High-speed Servo Motors [Type MA]

CAT.No.3103/E



ULTAGE series
Sealed Spherical Roller Bearings [WA Type]

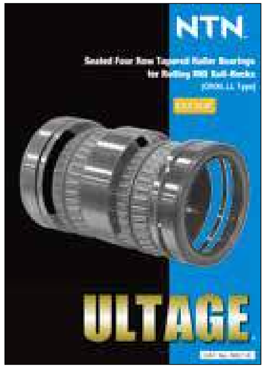
CAT.No.3703/E



Catalogs related to rolling bearings

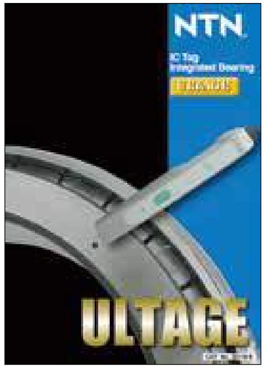
ULTAGE series
Sealed Four Row Tapered Roller Bearings
for Rolling Mill Roll-Necks [CROU...LL type]

CAT.No.3801/E



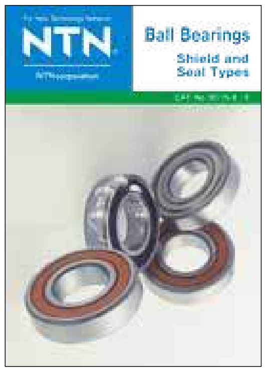
ULTAGE series
IC Tag Integrated Bearing

CAT.No.3019/E



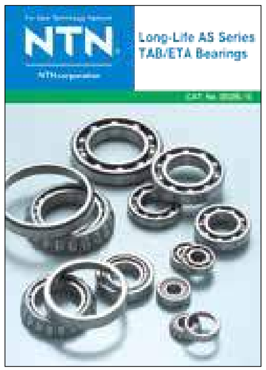
Ball Bearings
Shield and Seal Types

CAT.No.3015/E



Long-Life AS Series
TAB/ETA Bearings

CAT.No.3025/E

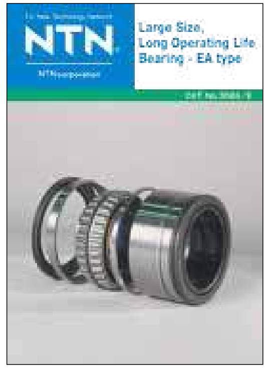


Introduction of Catalogs and Technical Reviews NTN

Catalogs related to rolling bearings

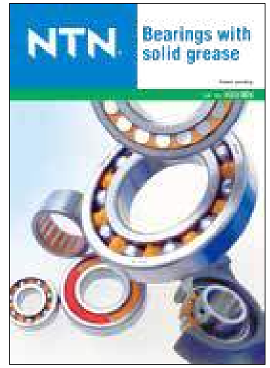
Large Size, Long Operating Life Bearing - EA type

CAT.No.3024/E



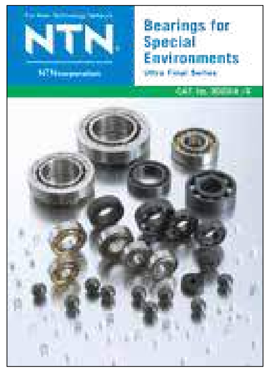
Bearings with solid grease

CAT.No.3022/E



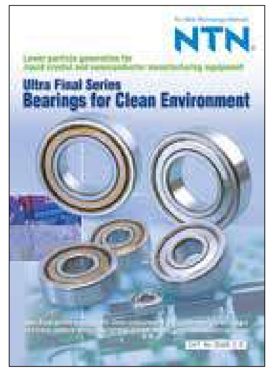
Bearings for Special Environments
Ultra Final Series

CAT.No.3023/E



Ultra Final Series
Bearings for Clean Environment

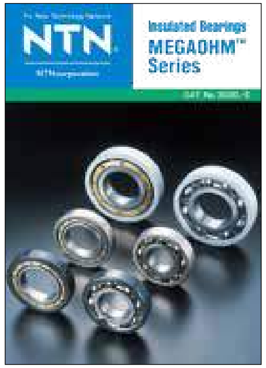
CAT.No.3028/E



●Catalogs related to rolling bearings

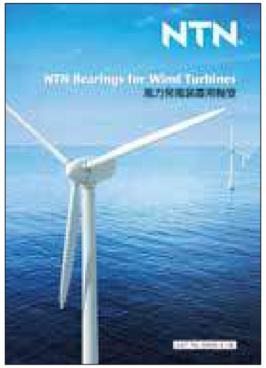
**Insulated Bearings
MEGAOHM™ Series**

CAT.No.3030/E



NTN Bearings for Wind Turbines

CAT.No.8405/JE

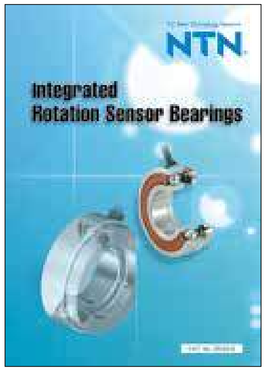


**Asymmetrical Spherical
Roller Bearings
for Wind Turbine Main Shafts**

CAT.No.3038/E

Integrated Rotation Sensor Bearings

CAT.No.3032/E

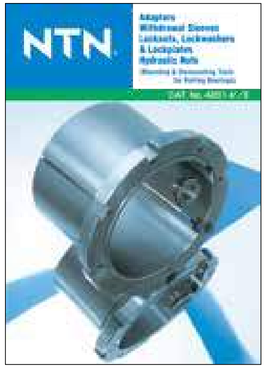


Introduction of Catalogs and Technical Reviews NTN

●Catalogs related to rolling bearings

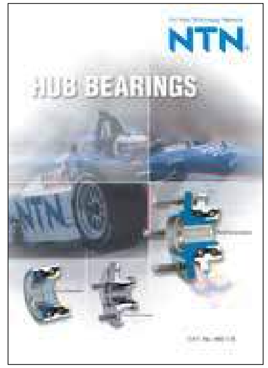
**Adapters, Withdrawal Sleeves,
Locknuts, Lockwashers
& Lockplates, Hydraulic Nuts**

CAT.No.4201/E



HUB BEARINGS

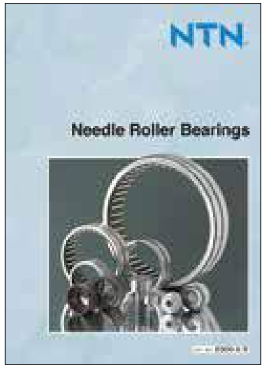
CAT.No.4601/E



Catalogs related to needle roller bearings

Needle Roller Bearings

CAT.No.2300/E



HK-F Type Drawn Cup Needle Roller Bearings

CAT.No.3029/JE

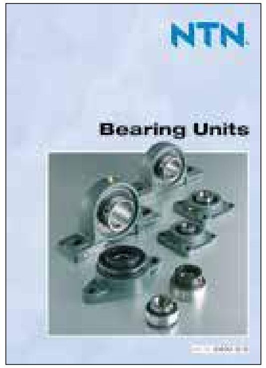
Cam Followers & Roller Followers

CAT.No.3604/JE

Catalogs related to bearing units

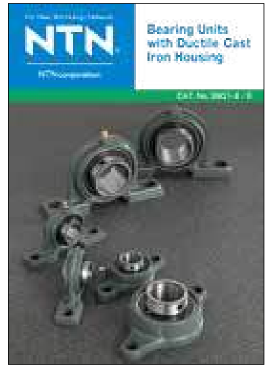
Bearing Units

CAT.No.2400/E



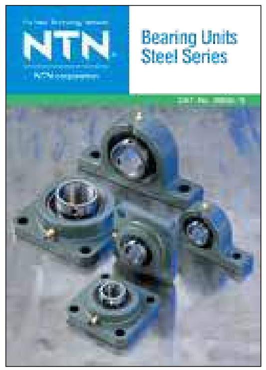
Bearing Units with Ductile Cast Iron Housing

CAT.No.3901/E



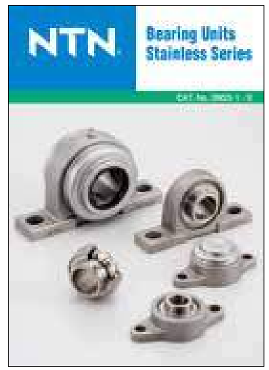
Bearing Units Steel Series

CAT.No.3902/E



Bearing Units Stainless Series

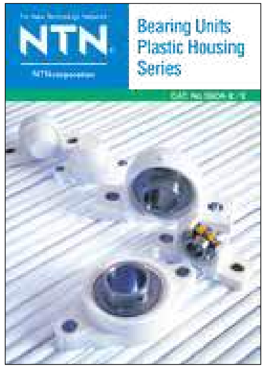
CAT.No.3903/E



Catalogs related to bearing units

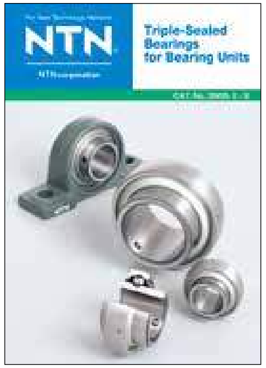
Bearing Units Plastic Housing Series

CAT.No.3904/E



Triple-Sealed Bearings for Bearing Units

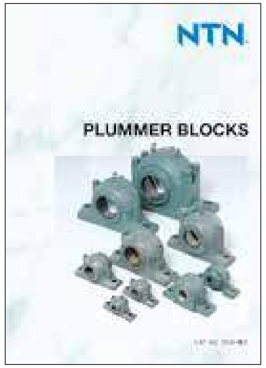
CAT.No.3905/E



Catalogs related to plummer blocks

PLUMMER BLOCKS

CAT.No.2500/E



Introduction of Catalogs and Technical Reviews
NTN

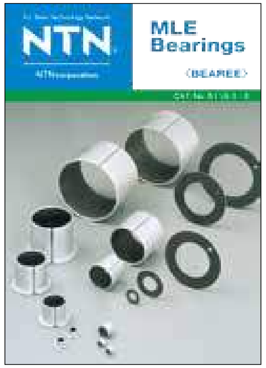
Catalogs related to sliding bearings

BEAREE

CAT.No.5100/JE

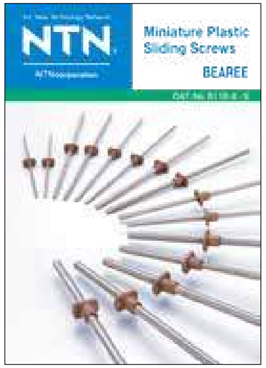
MLE Bearings <BEAREE>

CAT.No.5116/E



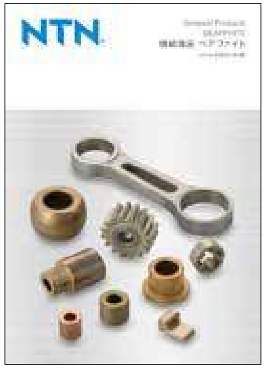
Miniature Plastic Sliding Screws BEAREE

CAT.No.5112/E



Sintered Products BEARPHITE

CAT.No.5202/JE

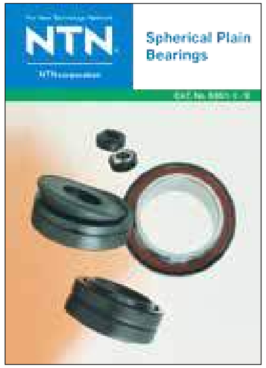


Introduction of Catalogs and Technical Reviews

Catalogs related to sliding bearings

Spherical Plain Bearings

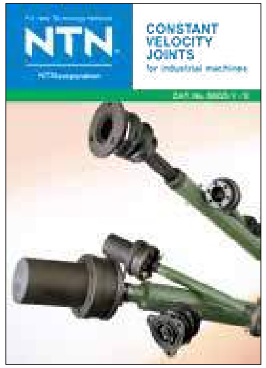
CAT.No.5301/E



Catalogs related to constant velocity joints

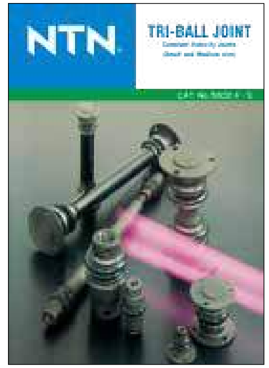
CONSTANT VELOCITY JOINTS for industrial machines

CAT.No.5603/E



TRI-BALL JOINT

CAT.No.5602/E



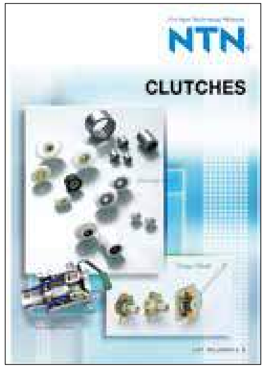
Constant Velocity Joints for Industrial Machines: Application Examples

CAT.No.5604/E

● Catalogs related to clutches

CLUTCHES

CAT.No.2900/E



● Electric motors and actuators

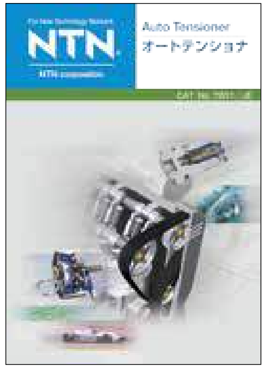
Electric Motor and Actuator

CAT.No.7202/JE

● Auto tensioners

Auto Tensioner

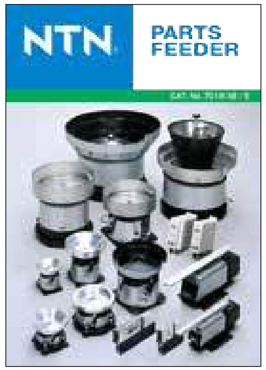
CAT.No.7201/JE



● Catalogs related to parts feeders

PARTS FEEDER

CAT.No.7018/E



Catalogs related to precision machinery / robots

Wrist Joint Module i-WRIST™

CAT.No.6511/E

Multi Track Magnetic Ring

CAT.No.6512/JE

Introduction of Catalogs and Technical Reviews NTN

Catalogs related to maintenance

Condition Monitoring System for Wind Turbines

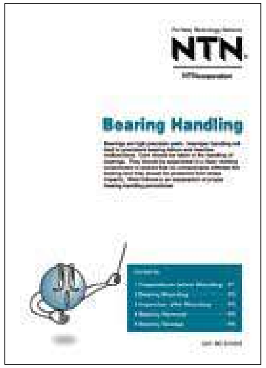
CAT.No.8406/E

Care and Maintenance of Bearings

CAT.No.3017/E

Bearing Handling

CAT.No.9103/E



Catalogs related to natural energy products

NTN Green Power Station

CAT.No.8407/E

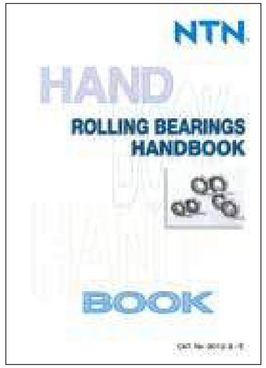
NTN Micro Hydro Turbine

CAT.No.8409/E

Handbooks

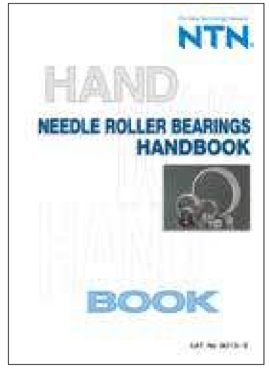
ROLLING BEARINGS HANDBOOK

CAT.No.9012/E



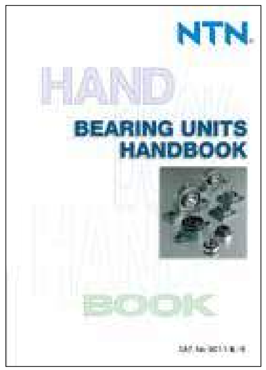
NEEDLE ROLLER BEARINGS HANDBOOK

CAT.No.9013/E



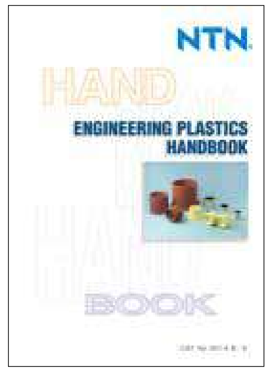
BEARING UNITS HANDBOOK

CAT.No.9011/E



ENGINEERING PLASTICS HANDBOOK

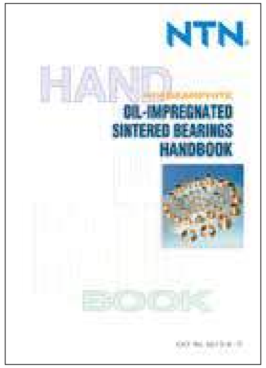
CAT.No.9014/E



Handbooks

OIL-IMPREGNATED SINTERED BEARINGS HANDBOOK

CAT.No.9015/E



Guide book for each industrial field

AUTOMOTIVE PRODUCTS GUIDE BOOK

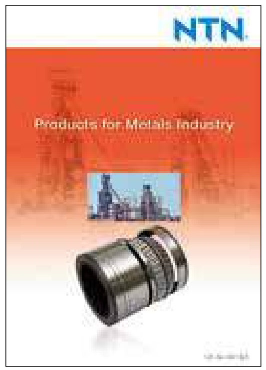
CAT.No.8024/JE

AEROSPACE BEARINGS GUIDE BOOK

CAT.No.8025/JE

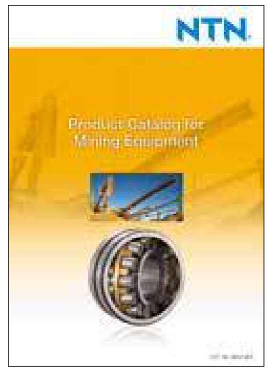
Products for Metals Industry

CAT.No.8301/E



Product Catalog for Mining Equipment

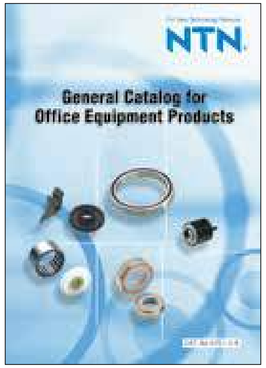
CAT.No.8602/E



Guide book for each industrial field

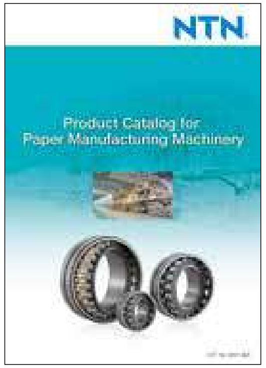
General Catalog for Office Equipment Products

CAT.No.8701/E



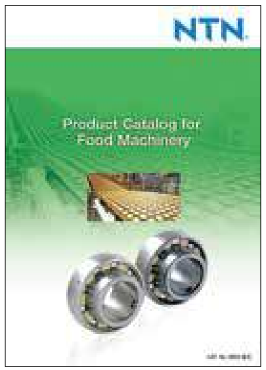
Product Catalog for Paper Manufacturing Machinery

CAT.No.8901/E



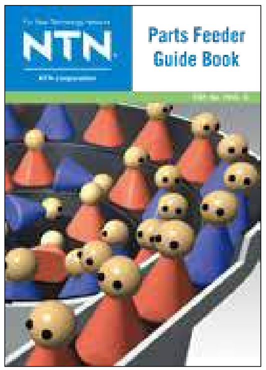
Product Catalog for Food Machinery

CAT.No.8902/E



Parts Feeder Guide Book

CAT.No.7019/E



Introduction of Catalogs and Technical Reviews NTN

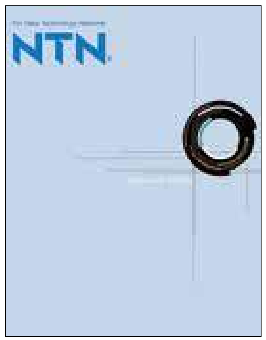
Guide book for each industrial field

Cement Equipment Product Guidebook

CAT.No.8026/E

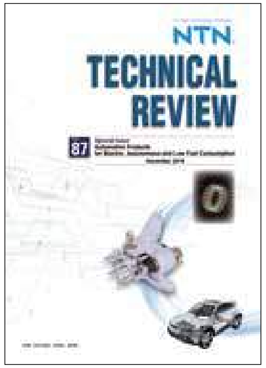
Corporate Profile

Corporate Profile

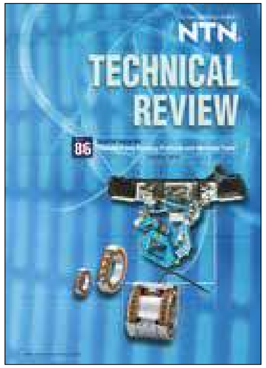


2. Introduction of technical reviews

No. 87 (November 2019)
Special issue on
"Automotive Products for Electric, Autonomous and Low Fuel Consumption"

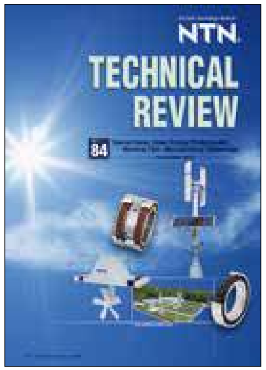


No. 86 (October 2018)
Special issue on
"Robotics and Sensing Products and Machine Tools"



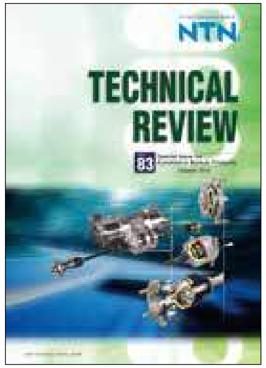
No. 85 (October 2017)
Special issue on
"Automotive Products and Electric Module Products"

No. 84 (November 2016)
Special issue :
Green Energy Products and Machine Tool / Manufacturing Technology



Introduction of Catalogs and Technical Reviews NTN

No. 83 (October 2015)
Special issue for
Automotive Module Products



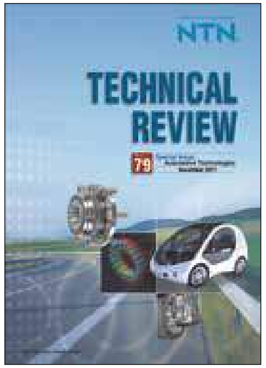
No. 82 (October 2014)
Special issue :
Composite Material, Technology and Products for Industrial Machines

No. 81 (November 2013)
Special issue :
Automotive Products and Technologies

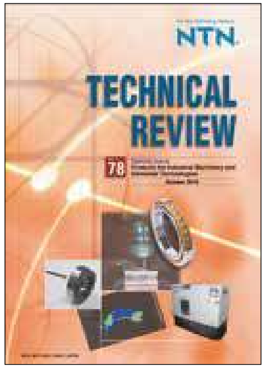
No. 80 (October 2012)
Special issue :
Environment and Energy

Introduction of Catalogs and Technical Reviews

No. 79 (November 2011)
Special issue:
Automotive Technologies



No. 78 (October 2010)
Special issue:
Products for Industrial Machinery and Elemental Technologies



No. 77 (December 2009)
Special issue:
Efforts for the Environment

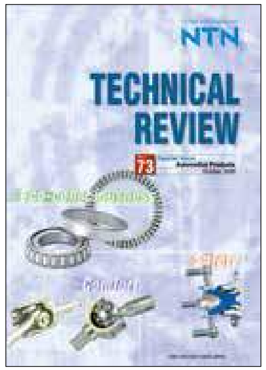
No. 76 (October 2008)
Special issue:
Elemental Technologies

Introduction of Catalogs and Technical Reviews
NTN

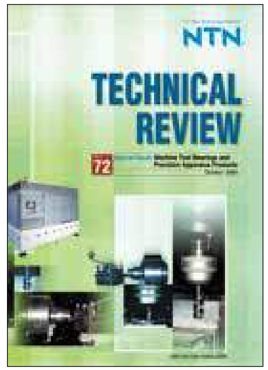
No. 75 (October 2007)
Special issue:
Automotive Environmental Technologie

No. 74 (November 2006)
Special issue:
Products for Industrial Machinery

No. 73 (October 2005)
Special issue:
Automotive Products



No. 72 (October 2004)
Special issue:
Machine Tool Bearings and Precision Apparatus Products



Introduction of Catalogs and Technical Reviews

Appendix Table Contents

Appendix Table

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-1

Single row radial ball bearings			67							68 78							
Double row radial ball bearings																	
Cylindrical roller bearings											N28	N38	NN48				
Needle roller bearings													NA48				
Spherical roller bearings																	
Nominal bearing bore diameter d		Diameter series 7						Diameter series 8									
		Nominal bearing outer diameter D	Dimension series					Nominal bearing outer diameter D	Dimension series								
Number	Dimension		17	27	37	47	17～47		08	18	28	38	48	58	68	08	18～68
			Nominal width B				Chamfer dimension r_s min		Nominal width B							Chamfer dimension r_s min	
—	0.6	2	0.8	—	—	—	0.05	2.5	—	1	—	1.4	—	—	—	—	0.05
1	1	2.5	1	—	—	—	0.05	3	—	1	—	1.5	—	—	—	—	0.05
—	1.5	3	1	—	1.8	—	0.05	4	—	1.2	—	2	—	—	—	—	0.05
2	2	4	1.2	—	2	—	0.05	5	—	1.5	—	2.3	—	—	—	—	0.08
—	2.5	5	1.5	1.8	2.3	—	0.08	6	—	1.8	—	2.6	—	—	—	—	0.08
3	3	6	2	2.5	3	—	0.08	7	—	2	—	3	—	—	—	—	0.1
4	4	7	2	2.5	3	—	0.08	9	—	2.5	3.5	4	—	—	—	—	0.1
5	5	8	2	2.5	3	—	0.08	11	—	3	4	5	—	—	—	—	0.15
6	6	10	2.5	3	3.5	—	0.1	13	—	3.5	5	6	—	—	—	—	0.15
7	7	11	2.5	3	3.5	—	0.1	14	—	3.5	5	6	—	—	—	—	0.15
8	8	12	2.5	—	3.5	—	0.1	16	—	4	5	6	8	—	—	—	0.2
9	9	14	3	—	4.5	—	0.1	17	—	4	5	6	8	—	—	—	0.2
00	10	15	3	—	4.5	—	0.1	19	—	5	6	7	9	—	—	—	0.3
01	12	18	4	—	5	—	0.2	21	—	5	6	7	9	—	—	—	0.3
02	15	21	4	—	5	—	0.2	24	—	5	6	7	9	—	—	—	0.3
03	17	23	4	—	5	—	0.2	26	—	5	6	7	9	—	—	—	0.3
04	20	27	4	—	5	7	0.2	32	4	7	8	10	12	16	22	0.3	0.3
/22	22	30	4	—	5	7	0.2	34	4	7	—	10	—	16	22	0.3	0.3
05	25	32	4	—	5	7	0.2	37	4	7	8	10	12	16	22	0.3	0.3
/28	28	35	4	—	5	7	0.2	40	4	7	—	10	—	16	22	0.3	0.3
06	30	37	4	—	5	7	0.2	42	4	7	8	10	12	16	22	0.3	0.3
/32	32	40	4	—	6	8	0.2	44	4	7	—	10	—	16	22	0.3	0.3
07	35	44	5	—	7	9	0.3	47	4	7	8	10	12	16	22	0.3	0.3
08	40	50	6	—	8	10	0.3	52	4	7	8	10	12	16	22	0.3	0.3
09	45	55	6	—	8	10	0.3	58	4	7	8	10	13	18	23	0.3	0.3
10	50	62	6	—	10	12	0.3	65	5	7	10	12	15	20	27	0.3	0.3
11	55	68	7	—	10	13	0.3	72	7	9	11	13	17	23	30	0.3	0.3
12	60	75	7	—	12	15	0.3	78	7	10	12	14	18	24	32	0.3	0.3
13	65	80	7	—	12	15	0.3	85	7	10	13	15	20	27	36	0.3	0.6
14	70	85	7	—	12	15	0.3	90	8	10	13	15	20	27	36	0.3	0.6
15	75	90	7	—	12	15	0.3	95	8	10	13	15	20	27	36	0.3	0.6
16	80	95	7	—	12	15	0.3	100	8	10	13	15	20	27	36	0.3	0.6
17	85	105	10	—	15	—	0.6	110	9	13	16	19	25	34	45	0.3	1
18	90	110	10	—	15	—	0.6	115	9	13	16	19	25	34	45	0.3	1
19	95	115	10	—	15	—	0.6	120	9	13	16	19	25	34	45	0.3	1
20	100	120	10	—	15	—	0.6	125	9	13	16	19	25	34	45	0.3	1
21	105	125	10	—	15	—	0.6	130	9	13	16	19	25	34	45	0.3	1
22	110	135	13	—	19	—	1	140	10	16	19	23	30	40	54	0.6	1
24	120	145	13	—	19	—	1	150	10	16	19	23	30	40	54	0.6	1
26	130	160	16	—	23	—	1	165	11	18	22	26	35	46	63	0.6	1.1
28	140	170	16	—	23	—	1	175	11	18	22	26	35	46	63	0.6	1.1
30	150	180	16	—	23	—	1	190	13	20	24	30	40	54	71	0.6	1.1
32	160	190	16	—	23	—	1	200	13	20	24	30	40	54	71	0.6	1.1
34	170	200	16	—	23	—	1	215	14	22	27	34	45	60	80	0.6	1.1

Appendix Tables

Appendix Table
NTN

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-2

Unit: mm

Single row radial ball bearings				69 79									160	60 70								
Double row radial ball bearings																						
Cylindrical roller bearings				N19	N29	NN39	NN49							N10	N20	NN30	NN40					
Needle roller bearings							NA49	NA59	NA69													
Spherical roller bearings						239	249									230	240					
Nominal bearing bore diameter d		Diameter series 9										Diameter series 0										
		Nominal bearing outer diameter D	Dimension series									Nominal bearing outer diameter D	Dimension series									
Number	Dimension		09	19	29	39	49	59	69	09	19～39	49～69		00	10	20	30	40	50	60	00	10～60
			Nominal width B							Chamfer dimension r_s min				Nominal width B							Chamfer dimension r_s min	
—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	1	4	—	1.6	—	2.3	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—
—	1.5	5	—	2	—	2.6	—	—	—	—	0.15	—	6	—	2.5	—	3	—	—	—	—	0.15
2	2	6	—	2.3	—	3	—	—	—	—	0.15	—	7	—	2.8	—	3.5	—	—	—	—	0.15
—	2.5	7	—	2.5	—	3.5	—	—	—	—	0.15	—	8	—	2.8	—	4	—	—	—	—	0.15
3	3	8	—	3	—	4	—	—	—	—	0.15	—	9	—	3	—	5	—	—	—	—	0.15
4	4	11	—	4	—	5	—	—	—	—	0.15	—	12	—	4	—	6	—	—	—	—	0.2
5	5	13	—	4	—	6	10	—	—	—	0.2	0.15	14	—	5	—	7	—	—	—	—	0.2
6	6	15	—	5	—	7	10	—	—	—	0.2	0.15	17	—	6	—	9	—	—	—	—	0.3
7	7	17	—	5	—	7	10	—	—	—	0.3	0.15	19	—	6	8	10	—	—	—	—	0.3
8	8	19	—	6	—	9	11	—	—	—	0.3	0.2	22	—	7	9	11	14	19	25	—	0.3
9	9	20	—	6	—	9	11	—	—	—	0.3	0.3	24	—	7	10	12	15	20	27	—	0.3
00	10	22	—	6	8	10	13	16	22	—	0.3	0.3	26	—	8	10	12	16	21	29	—	0.3
01	12	24	—	6	8	10	13	16	22	—	0.3	0.3	28	7	8	10	12	16	21	29	0.3	0.3
02	15	28	—	7	8.5	10	13	18	23	—	0.3	0.3	32	8	9	11	13	17	23	30	0.3	0.3
03	17	30	—	7	8.5	10	13	18	23	—	0.3	0.3	35	8	10	12	14	18	24	32	0.3	0.3
04	20	37	7	9	11	13	17	23	30	0.3	0.3	0.3	42	8	12	14	16	22	30	40	0.3	0.6
/22	22	39	7	9	11	13	17	23	30	0.3	0.3	0.3	44	8	12	14	16	22	30	40	0.3	0.6
05	25	42	7	9	11	13	17	23	30	0.3	0.3	0.3	47	8	12	14	16	22	30	40	0.3	0.6
/28	28	45	7	9	11	13	17	23	30	0.3	0.3	0.3	52	8	12	15	18	24	32	43	0.3	0.6
06	30	47	7	9	11	13	17	23	30	0.3	0.3	0.3	55	9	13	16	19	25	34	45	0.3	1
/32	32	52	7	10	13	15	20	27	36	0.3	0.6	0.6	58	9	13	16	20	26	35	47	0.3	1
07	35	55	7	10	13	15	20	27	36	0.3	0.6	0.6	62	9	14	17	20	27	36	48	0.3	1
08	40	62	8	12	14	16	22	30	40	0.3	0.6	0.6	68	9	15	18	21	28	38	50	0.3	1
09	45	68	8	12	14	16	22	30	40	0.3	0.6	0.6	75	10	16	19	23	30	40	54	0.3	1
10	50	72	8	12	14	16	22	30	40	0.3	0.6	0.6	80	10	16	19	23	30	40	54	0.6	1
11	55	80	9	13	16	19	25	34	45	0.3	1	1	90	11	18	22	26	35	46	63	0.6	1.1
12	60	85	9	13	16	19	25	34	45	0.3	1	1	95	11	18	22	26	35	46	63	0.6	1.1
13	65	90	9	13	16	19	25	34	45	0.6	1	1	100	11	18	22	26	35	46	63	0.6	1.1
14	70	100	10	16	19	23	30	40	54	0.6	1	1	110	13	20	24	30	40	54	71	0.6	1.1
15	75	105	10	16	19	23	30	40	54	0.6	1	1	115	13	20	24	30	40	54	71	0.6	1.1
16	80	110	10	16	19	23	30	40	54	0.6	1	1	125	14	22	27	34	45	60	80	0.6	1.1
17	85	120	11	18	22	26	35	46	63	0.6	1.1	1.1	130	14	22	27	34	45	60	80	0.6	1.1
18	90	125	11	18	22	26	35	46	63	0.6	1.1	1.1	140	16	24	30	37	50	67	90	1	1.5
19	95	130	11	18	22	26	35	46	63	0.6	1.1	1.1	145	16	24	30	37	50	67	90	1	1.5
20	100	140	13	20	24	30	40	54	71	0.6	1.1	1.1	150	16	24	30	37	50	67	100	1	1.5
21	105	145	13	20	24	30	40	54	71	0.6	1.1	1.1	160	18	26	33	41	56	75	109	1	2
22	110	150	13	20	24	30	40	54	71	0.6	1.1	1.1	170	19	28	36	45	60	80	109	1	2
24	120	165	14	22	27	34	45	60	80	0.6	1.1	1.1	180	19	28	36	46	60	80	109	1	2
26	130	180	16	24	30	37	50	67	90	1	1.5	1.5	200	22	33	42	52	69	95	125	1.1	2
28	140	190	16	24	30	37	50	67	90	1	1.5	1.5	210	22	33	42	53	69	95	125	1.1	2
30	150	210	19	28	36	45	60	80	109	1	2	2	225	24	35	45	56	75	100	136	1.1	2.1
32	160	220	19	28	36	45	60	80	109	1	2	2	240	25	38	48	60	80	109	145	1.5	2.1
34	170	230	19	28	36	45	60	80	109	1	2	2	260	28	42	54	67	90	122	160	1.5	2.1

Appendix Tables

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-3

Single row radial ball bearings			67							68 78							
Double row radial ball bearings																	
Cylindrical roller bearings											N28	N38	NN48				
Needle roller bearings													NA48				
Spherical roller bearings																	
Nominal bearing bore diameter d		Diameter series 7						Diameter series 8									
		Nominal bearing outer diameter D	Dimension series					Nominal bearing outer diameter D	Dimension series								
Number	Dimension		17	27	37	47	17～47		08	18	28	38	48	58	68	08	18～68
			Nominal width B				Chamfer dimension $r_{s\,min}$		Nominal width B							Chamfer dimension $r_{s\,min}$	
36	180	215	18	—	26	—	1.1	225	14	22	27	34	45	60	80	0.6	1.1
38	190	230	20	—	30	—	1.1	240	16	24	30	37	50	67	90	1	1.5
40	200	240	20	—	30	—	1.1	250	16	24	30	37	50	67	90	1	1.5
44	220	—	—	—	—	—	—	270	16	24	30	37	50	67	90	1	1.5
48	240	—	—	—	—	—	—	300	19	28	36	45	60	80	100	1	2
52	260	—	—	—	—	—	—	320	19	28	36	45	60	80	100	1	2
56	280	—	—	—	—	—	—	350	22	33	42	52	69	95	125	1.1	2
60	300	—	—	—	—	—	—	380	25	38	48	60	80	109	145	1.5	2.1
64	320	—	—	—	—	—	—	400	25	38	48	60	80	109	145	1.5	2.1
68	340	—	—	—	—	—	—	420	25	38	48	60	80	109	145	1.5	2.1
72	360	—	—	—	—	—	—	440	25	38	48	60	80	109	145	1.5	2.1
76	380	—	—	—	—	—	—	480	31	46	60	75	100	136	180	2	2.1
80	400	—	—	—	—	—	—	500	31	46	60	75	100	136	180	2	2.1
84	420	—	—	—	—	—	—	520	31	46	60	75	100	136	180	2	2.1
88	440	—	—	—	—	—	—	540	31	46	60	75	100	136	180	2	2.1
92	460	—	—	—	—	—	—	580	37	56	72	90	118	160	218	2.1	3
96	480	—	—	—	—	—	—	600	37	56	72	90	118	160	218	2.1	3
/500	500	—	—	—	—	—	—	620	37	56	72	90	118	160	218	2.1	3
/530	530	—	—	—	—	—	—	650	37	56	72	90	118	160	218	2.1	3
/560	560	—	—	—	—	—	—	680	37	56	72	90	118	160	218	2.1	3
/600	600	—	—	—	—	—	—	730	42	60	78	98	128	175	236	3	3
/630	630	—	—	—	—	—	—	780	48	69	88	112	150	200	272	3	4
/670	670	—	—	—	—	—	—	820	48	69	88	112	150	200	272	3	4
/710	710	—	—	—	—	—	—	870	50	74	95	118	160	218	290	4	4
/750	750	—	—	—	—	—	—	920	54	78	100	128	170	230	308	4	5
/800	800	—	—	—	—	—	—	980	57	82	106	136	180	243	325	4	5
/850	850	—	—	—	—	—	—	1030	57	82	106	136	180	243	325	4	5
/900	900	—	—	—	—	—	—	1090	60	85	112	140	190	258	345	5	5
/950	950	—	—	—	—	—	—	1150	63	90	118	150	200	272	355	5	5
/1000	1000	—	—	—	—	—	—	1220	71	100	128	165	218	300	400	5	6
/1060	1060	—	—	—	—	—	—	1280	71	100	128	165	218	300	400	5	6
/1120	1120	—	—	—	—	—	—	1360	78	106	140	180	243	325	438	5	6
/1180	1180	—	—	—	—	—	—	1420	78	106	140	180	243	325	438	5	6
/1250	1250	—	—	—	—	—	—	1500	80	112	145	185	250	335	450	6	6
/1320	1320	—	—	—	—	—	—	1600	88	122	165	206	280	375	500	6	6
/1400	1400	—	—	—	—	—	—	1700	95	132	175	224	300	400	545	6	7.5
/1500	1500	—	—	—	—	—	—	1820	—	140	185	243	315	—	—	—	7.5
/1600	1600	—	—	—	—	—	—	1950	—	155	200	265	345	—	—	—	7.5
/1700	1700	—	—	—	—	—	—	2060	—	160	206	272	355	—	—	—	7.5
/1800	1800	—	—	—	—	—	—	2180	—	165	218	290	375	—	—	—	9.5
/1900	1900	—	—	—	—	—	—	2300	—	175	230	300	400	—	—	—	9.5
/2000	2000	—	—	—	—	—	—	2430	—	190	250	325	425	—	—	—	9.5

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-4 Unit: mm

Single row radial ball bearings				69 79										160	60 70							
Double row radial ball bearings																						
Cylindrical roller bearings				N19	N29	NN39	NN49								N10	N20	NN30	NN40				
Needle roller bearings							NA49	NA59	NA69													
Spherical roller bearings						239	249										230	240				
Nominal bearing bore diameter d		Diameter series 9											Diameter series 0									
		Nominal bearing outer diameter D	Dimension series										Nominal bearing outer diameter D	Dimension series								
Number	Dimension		09	19	29	39	49	59	69	09	19～39	49～69		00	10	20	30	40	50	60	00	10～60
			Nominal width B							Chamfer dimension $r_{s\,min}$				Nominal width B							Chamfer dimension $r_{s\,min}$	
36	180	250	22	33	42	52	69	95	125	1.1	2	2	280	31	46	60	74	100	136	180	2	2.1
38	190	260	22	33	42	52	69	95	125	1.1	2	2	290	31	46	60	75	100	136	180	2	2.1
40	200	280	25	38	48	60	80	109	145	1.5	2.1	2.1	310	34	51	66	82	109	150	200	2	2.1
44	220	300	25	38	48	60	80	109	145	1.5	2.1	2.1	340	37	56	72	90	118	160	218	2.1	3
48	240	320	25	38	48	60	80	109	145	1.5	2.1	2.1	360	37	56	72	92	118	160	218	2.1	3
52	260	360	31	46	60	75	100	136	180	2	2.1	2.1	400	44	65	82	104	140	190	250	3	4
56	280	380	31	46	60	75	100	136	180	2	2.1	2.1	420	44	65	82	106	140	190	250	3	4
60	300	420	37	56	72	90	118	160	218	2.1	3	3	460	50	74	95	118	160	218	290	4	4
64	320	440	37	56	72	90	118	160	218	2.1	3	3	480	50	74	95	121	160	218	290	4	4
68	340	460	37	56	72	90	118	160	218	2.1	3	3	520	57	82	106	133	180	243	325	4	5
72	360	480	37	56	72	90	118	160	218	2.1	3	3	540	57	82	106	134	180	243	325	4	5
76	380	520	44	65	82	106	140	190	250	3	4	4	560	57	82	106	135	180	243	325	4	5
80	400	540	44	65	82	106	140	190	250	3	4	4	600	63	90	118	148	200	272	355	5	5
84	420	560	44	65	82	106	140	190	250	3	4	4	620	63	90	118	150	200	272	355	5	5
88	440	600	50	74	95	118	160	218	290	4	4	4	650	67	94	122	157	212	280	375	5	6
92	460	620	50	74	95	118	160	218	290	4	4	4	680	71	100	128	163	218	300	400	5	6
96	480	650	54	78	100	128	170	230	308	4	5	5	700	71	100	128	165	218	300	400	5	6
/500	500	670	54	78	100	128	170	230	308	4	5	5	720	71	100	128	167	218	300	400	5	6
/530	530	710	57	82	106	136	180	243	325	4	5	5	780	80	112	145	185	250	335	450	6	6
/560	560	750	60	85	112	140	190	258	345	5	5	5	820	82	115	150	195	258	355	462	6	6
/600	600	800	63	90	118	150	200	272	355	5	5	5	870	85	118	155	200	272	365	488	6	6
/630	630	850	71	100	128	165	218	300	400	5	6	6	920	92	128	170	212	290	388	515	6	7.5
/670	670	900	73	103	136	170	230	308	412	5	6	6	980	100	136	180	230	308	425	560	6	7.5
/710	710	950	78	106	140	180	243	325	438	5	6	6	1030	103	140	185	236	315	438	580	6	7.5
/750	750	1000	80	112	145	185	250	335	450	6	6	6	1090	109	150	195	250	335	462	615	7.5	7.5
/800	800	1060	82	115	150	195	258	355	462	6	6	6	1150	112	155	200	258	345	475	630	7.5	7.5
/850	850	1120	85	118	155	200	272	365	488	6	6	6	1220	118	165	212	272	365	500	670	7.5	7.5
/900	900	1180	88	122	165	206	280	375	500	6	6	6	1280	122	170	218	280	375	515	690	7.5	7.5
/950	950	1250	95	132	175	224	300	400	545	6	7.5	7.5	1360	132	180	236	300	412	560	730	7.5	7.5
/1000	1000	1320	103	140	185	236	315	438	580	6	7.5	7.5	1420	136	185	243	308	412	560	750	7.5	7.5
/1060	1060	1400	109	150	195	250	335	462	615	7.5	7.5	7.5	1500	140	195	250	325	438	600	800	9.5	9.5
/1120	1120	1460	109	150	195	250	335	462	615	7.5	7.5	7.5	1580	145	200	265	345	462	615	825	9.5	9.5
/1180	1180	1540	115	160	206	272	355	488	650	7.5	7.5	7.5	1660	155	212	272	355	475	650	875	9.5	9.5
/1250	1250	1630	122	170	218	280	375	515	690	7.5	7.5	7.5	1750	—	218	290	375	500	—	—	—	9.5
/1320	1320	1720	128	175	230	300	400	545	710	7.5	7.5	7.5	1850	—	230	300	400	530	—	—	—	12
/1400	1400	1820	—	185	243	315	425	—	—	—	9.5	9.5	1950	—	243	315	412	545	—	—	—	12
/1500	1500	1950	—	195	258	335	450	—	—	—	9.5	9.5	2120	—	272	355	462	615	—	—	—	12
/1600	1600	2060	—	200	265	345	462	—	—	—	9.5	9.5	2240	—	280	365	475	630	—	—	—	12
/1700	1700	2180	—	212	280	355	475	—	—	—	9.5	9.5	2360	—	290	375	500	650	—	—	—	15
/1800	1800	2300	—	218	290	375	500	—	—	—	12	12	2500	—	308	400	530	690	—	—	—	15
/1900	1900	2430	—	230	308	400	530	—	—	—	12	12	—	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-5

Single row radial ball bearings														62 72		622	632					
Double row radial ball bearings														12		42 22	52 32					
Cylindrical roller bearings						NN31								N2		N22	N32					
Needle roller bearings																						
Spherical roller bearings						231	241									222	232					
Nominal bearing bore diameter *d*		Diameter series 1										Diameter series 2										
		Nominal bearing outer diameter *D*	Dimension series									Nominal bearing outer diameter *D*	Dimension series									
			01	11	21	31	41	51	61	01	11~61		82	02	12	22	32	42	52	62	82	02~62
Number	Dimension		Nominal width *B*							Chamfer dimension *r*s min			Nominal width *B*								Chamfer dimension *r*s min	
—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—			—	—
1	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—			—	—
—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—			—	—
2	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—			—	—
—	—	—	—	—	—	—	—			—	—	—	—	—	—	—	—	—			—	—
3	3	—	—	—	—	—	—			—	—	10	2.5	4	—	—	5	—	—	—	0.1	0.15
4	4	—	—	—	—	—	—			—	—	13	3	5	—	—	7	—	—	—	0.15	0.2
5	5	15	—	—	—	7	—	—	—	—	0.3	16	3.5	5	—	—	8	—	—	—	0.15	0.3
6	6	18	—	—	8	10	—	—	—	—	0.3	19	4	6	—	—	10	—	18	23	0.2	0.3
7	7	21	—	—	9	11	14	19	25	—	0.3	22	5	7	—	—	11	—	20	27	0.3	0.3
8	8	23	—	—	10	12	15	20	27	—	0.3	24	5	8	—	—	12	—	21	29	0.3	0.3
9	9	25	—	—	10	12	16	21	29	—	0.3	26	6	8	—	—	13	—	23	30	0.3	0.3
00	10	28	—	—	12	14	18	24	32	—	0.3	30	7	9	—	14	14.3	—	27	36	0.3	0.6
01	12	30	—	—	12	14	18	24	32	—	0.3	32	7	10	—	14	15.9	—	27	36	0.3	0.6
02	15	33	—	—	12	14	18	24	32	—	0.3	35	8	11	—	14	15.9	20	27	36	0.3	0.6
03	17	37	—	—	13	15	20	27	36	—	0.6	40	8	12	—	16	17.5	22	30	40	0.3	0.6
04	20	44	—	—	15	18	24	32	43	—	0.6	47	9	14	—	18	20.6	27	36	48	0.3	1
/22	22	47	—	—	16	19	25	34	45	—	1	50	9	14	—	18	20.6	27	36	48	0.3	1
05	25	50	—	—	16	19	25	34	45	—	1	52	10	15	—	18	20.6	27	36	48	0.3	1
/28	28	55	—	—	17	20	27	36	48	—	1	58	10	16	—	19	23	30	40	54	0.6	1
06	30	58	—	—	18	21	28	38	50	—	1	62	10	16	—	20	23.8	32	43	58	0.6	1
/32	32	62	—	—	19	23	30	40	54	—	1	65	11	17	—	21	25	33	43	60	0.6	1
07	35	68	—	—	21	25	33	43	60	—	1.1	72	12	17	—	23	27	37	50	67	0.6	1.1
08	40	75	—	—	22	26	35	46	63	—	1.1	80	13	18	—	23	30.2	40	54	71	0.6	1.1
09	45	80	—	—	22	26	35	46	63	—	1.1	85	13	19	—	23	30.2	40	54	71	0.6	1.1
10	50	85	—	—	22	26	35	46	63	—	1.1	90	13	20	—	23	30.2	40	54	71	0.6	1.1
11	55	95	—	—	24	30	40	54	71	—	1.1	100	14	21	—	25	33.3	45	60	80	0.6	1.5
12	60	100	—	—	24	30	40	54	71	—	1.1	110	16	22	—	28	36.5	50	67	90	1	1.5
13	65	110	—	—	27	34	45	60	80	—	1.5	120	18	23	—	31	38.1	56	75	100	1	1.5
14	70	115	—	—	27	34	45	60	80	—	1.5	125	18	24	—	31	39.7	56	75	100	1	1.5
15	75	125	—	—	30	37	50	67	90	—	1.5	130	18	25	—	31	41.3	56	75	100	1	1.5
16	80	130	—	—	30	37	50	67	90	—	1.5	140	19	26	—	33	44.4	60	80	109	1	2
17	85	140	—	—	31	41	56	75	100	—	1.5	150	21	28	—	36	49.2	65	88	118	1.1	2
18	90	150	—	—	33	45	60	80	109	—	2	160	22	30	—	40	52.4	69	95	125	1.1	2
19	95	160	—	—	39	52	65	88	118	—	2	170	24	32	—	43	55.6	75	100	136	1.1	2.1
20	100	165	21	30	39	52	65	88	118	1.1	2	180	25	34	—	46	60.3	80	109	145	1.5	2.1
21	105	175	22	33	42	56	69	95	125	1.1	2	190	27	36	—	50	65.1	85	115	155	1.5	2.1
22	110	180	22	33	42	56	69	95	125	1.1	2	200	28	38	—	53	69.8	90	122	160	1.5	2.1
24	120	200	25	38	48	62	80	109	145	1.5	2	215	—	40	42	58	76	95	128	170	—	2.1
26	130	210	25	38	48	64	80	109	145	1.5	2	230	—	40	46	64	80	100	136	180	—	3
28	140	225	27	40	50	68	85	115	155	1.5	2.1	250	—	42	50	68	88	109	150	200	—	3

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-6 Unit: mm

Single row radial ball bearings					63 73		623	633				64 74		
Double row radial ball bearings					13		43 23	53 33						
Cylindrical roller bearings					N3		N23	N33				N4		
Needle roller bearings														
Spherical roller bearings					213		223							
Nominal bearing bore diameter *d*		Diameter series 3									Diameter series 4			
		Nominal bearing outer diameter *D*	Nominal bearing outer diameter *D*	Dimension series							Nominal bearing outer diameter *D*	Dimension series		
				83	03	13	23	33	83	03~33		04	24	
Number	Dimension			Nominal width *B*					Chamfer dimension *r*s min			Nominal width *B*		Chamfer dimension *r*s min
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	3	—	13	—	5	—	—	7	—	0.2	—	—	—	—
4	4	—	16	—	5	—	—	9	—	0.3	—	—	—	—
5	5	15	19	—	6	—	—	10	—	0.3	—	—	—	—
6	6	18	22	—	7	—	11	13	—	0.3	—	—	—	—
7	7	21	26	—	9	—	13	15	—	0.3	—	—	—	—
8	8	23	28	—	9	—	13	15	—	0.3	30	10	14	0.6
9	9	25	30	—	10	—	14	16	—	0.6	32	11	15	0.6
00	10	28	35	9	11	—	17	19	0.3	0.6	37	12	16	0.6
01	12	30	37	9	12	—	17	19	0.3	1	42	13	19	1
02	15	33	42	9	13	—	17	19	0.3	1	52	15	24	1.1
03	17	37	47	10	14	—	19	22.2	0.6	1	62	17	29	1.1
04	20	44	52	10	15	—	21	22.2	0.6	1.1	72	19	33	1.1
/22	22	47	56	11	16	—	21	25	0.6	1.1	—	—	—	—
05	25	50	62	12	17	—	24	25.4	0.6	1.1	80	21	36	1.5
/28	28	55	68	13	18	—	24	30	0.6	1.1	—	—	—	—
06	30	58	72	13	19	—	27	30.2	0.6	1.1	90	23	40	1.5
/32	32	62	75	14	20	—	28	32	0.6	1.1	—	—	—	—
07	35	68	80	14	21	—	31	34.9	0.6	1.5	100	25	43	1.5
08	40	75	90	16	23	—	33	36.5	1	1.5	110	27	46	2
09	45	80	100	17	25	—	36	39.7	1	1.5	120	29	50	2
10	50	85	110	19	27	—	40	44.4	1	2	130	31	53	2.1
11	55	95	120	21	29	—	43	49.2	1.1	2	140	33	57	2.1
12	60	100	130	22	31	—	46	54	1.1	2.1	150	35	60	2.1
13	65	110	140	24	33	—	48	58.7	1.1	2.1	160	37	64	2.1
14	70	115	150	25	35	—	51	63.5	1.5	2.1	180	42	74	3
15	75	125	160	27	37	—	55	68.3	1.5	2.1	190	45	77	3
16	80	130	170	28	39	—	58	68.3	1.5	2.1	200	48	80	3
17	85	140	180	30	41	—	60	73	2	3	210	52	86	4
18	90	150	190	30	43	—	64	73	2	3	225	54	90	4
19	95	160	200	33	45	—	67	77.8	2	3	240	55	95	4
20	100	165	215	36	47	51	73	82.6	2.1	3	250	58	98	4
21	105	175	225	37	49	53	77	87.3	2.1	3	260	60	100	4
22	110	180	240	42	50	57	80	92.1	3	3	280	65	108	4
24	120	200	260	44	55	62	86	106	3	3	310	72	118	5
26	130	210	280	48	58	66	93	112	3	4	340	78	128	5
28	140	225	300	50	62	70	102	118	4	4	360	82	132	5

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-7

Single row radial ball bearings														62 72		622	632					
Double row radial ball bearings														12		42 22	52 32					
Cylindrical roller bearings						NN31								N2		N22	N32					
Needle roller bearings																						
Spherical roller bearings						231	241									222	232					
Nominal bearing bore diameter d		Diameter series 1										Diameter series 2										
		Nominal bearing outer diameter D	Dimension series									Nominal bearing outer diameter D	Dimension series									
Number	Dimension		01	11	21	31	41	51	61	01	11~61		82	02	12	22	32	42	52	62	82	02~62
			Nominal width B								Chamfer dimension r_s min		Nominal width B								Chamfer dimension r_s min	
30	150	250	31	46	60	80	100	136	180	2	2.1	270	—	45	54	73	96	118	160	218	—	3
32	160	270	34	51	66	86	109	150	200	2	2.1	290	—	48	58	80	104	128	175	236	—	3
34	170	280	34	51	66	88	109	150	200	2	2.1	310	—	52	62	86	110	140	190	250	—	4
36	180	300	37	56	72	96	118	160	218	2.1	3	320	—	52	62	86	112	140	190	250	—	4
38	190	320	42	60	78	104	128	175	236	3	3	340	—	55	65	92	120	150	200	272	—	4
40	200	340	44	65	82	112	140	190	250	3	3	360	—	58	70	98	128	160	218	290	—	4
44	220	370	48	69	88	120	150	200	272	3	4	400	—	65	78	108	144	180	243	325	—	4
48	240	400	50	74	95	128	160	218	290	4	4	440	—	72	85	120	160	200	272	355	—	4
52	260	440	57	82	106	144	180	243	325	4	4	480	—	80	90	130	174	218	300	400	—	5
56	280	460	57	82	106	146	180	243	325	4	5	500	—	80	90	130	176	218	300	400	—	5
60	300	500	63	90	118	160	200	272	355	5	5	540	—	85	98	140	192	243	325	438	—	5
64	320	540	71	100	128	176	218	300	400	5	5	580	—	92	105	150	208	258	355	462	—	5
68	340	580	78	106	140	190	243	325	438	5	5	620	—	92	118	165	224	280	375	500	—	6
72	360	600	78	106	140	192	243	325	438	5	5	650	—	95	122	170	232	290	388	515	—	6
76	380	620	78	106	140	194	243	325	438	5	5	680	—	95	132	175	240	300	400	545	—	6
80	400	650	80	112	145	200	250	335	450	6	6	720	—	103	140	185	256	315	438	580	—	6
84	420	700	88	122	165	224	280	375	500	6	6	760	—	109	150	195	272	335	462	615	—	7.5
88	440	720	88	122	165	226	280	375	500	6	6	790	—	112	155	200	280	345	475	630	—	7.5
92	460	760	95	132	175	240	300	400	545	6	7.5	830	—	118	165	212	296	365	500	670	—	7.5
96	480	790	100	136	180	248	308	425	560	6	7.5	870	—	125	170	224	310	388	530	710	—	7.5
/500	500	830	106	145	190	264	325	450	600	7.5	7.5	920	—	136	185	243	336	412	560	750	—	7.5
/530	530	870	109	150	195	272	335	462	615	7.5	7.5	980	—	145	200	258	355	450	600	—	—	9.5
/560	560	920	115	160	206	280	355	488	650	7.5	7.5	1030	—	150	206	272	365	475	630	—	—	9.5
/600	600	980	122	170	218	300	375	515	690	7.5	7.5	1090	—	155	212	280	388	488	670	—	—	9.5
/630	630	1030	128	175	230	315	400	545	710	7.5	7.5	1150	—	165	230	300	412	515	710	—	—	12
/670	670	1090	136	185	243	336	412	560	750	7.5	7.5	1220	—	175	243	315	438	545	750	—	—	12
/710	710	1150	140	195	250	345	438	600	800	9.5	9.5	1280	—	180	250	325	450	560	775	—	—	12
/750	750	1220	150	206	272	365	475	630	—	9.5	9.5	1360	—	195	265	345	475	615	825	—	—	15
/800	800	1280	155	212	272	375	475	650	—	9.5	9.5	1420	—	200	272	355	488	615	—	—	—	15
/850	850	1360	165	224	290	400	500	690	—	12	12	1500	—	206	280	375	515	650	—	—	—	15
/900	900	1420	165	230	300	412	515	710	—	12	12	1580	—	218	300	388	515	670	—	—	—	15
/950	950	1500	175	243	315	438	545	750	—	12	12	1660	—	230	315	412	530	710	—	—	—	15
/1000	1000	1580	185	258	335	462	580	775	—	12	12	1750	—	243	330	425	560	750	—	—	—	15
/1060	1060	1660	190	265	345	475	600	800	—	12	15	—	—	—	—	—	—	—			—	—
/1120	1120	1750	—	280	365	475	630	—	—	—	15	—	—	—	—	—	—	—			—	—
/1180	1180	1850	—	290	388	500	670	—	—	—	15	—	—	—	—	—	—	—			—	—
/1250	1250	1950	—	308	400	530	710	—	—	—	15	—	—	—	—	—	—	—			—	—
/1320	1320	2060	—	325	425	560	750	—	—	—	15	—	—	—	—	—	—	—			—	—
/1400	1400	2180	—	345	450	580	775	—	—	—	19	—	—	—	—	—	—	—			—	—
/1500	1500	2300	—	355	462	600	800	—	—	—	19	—	—	—	—	—	—	—			—	—

Appendix table-1: Boundary dimensions of radial bearings (Tapered roller bearings not included)-8 Unit: mm

Single row radial ball bearings					63 73		623	633				64 74		
Double row radial ball bearings					13		43 23	53 33						
Cylindrical roller bearings					N3		N23	N33				N4		
Needle roller bearings														
Spherical roller bearings					213		223							
Nominal bearing bore diameter d		Diameter series 3									Diameter series 4			
		Nominal bearing outer diameter D	Nominal bearing outer diameter D	Dimension series							Nominal bearing outer diameter D	Dimension series		
Number	Dimension			83	03	13	23	33	83	03~33		04	24	Chamfer dimension r_s min
				Nominal width B					Chamfer dimension r_s min			Nominal width B		
30	150	250	320	—	65	75	108	128	—	4	380	85	138	5
32	160	270	340	—	68	79	114	136	—	4	400	88	142	5
34	170	280	360	—	72	84	120	140	—	4	420	92	145	5
36	180	300	380	—	75	88	126	150	—	4	440	95	150	6
38	190	320	400	—	78	92	132	155	—	5	460	98	155	6
40	200	340	420	—	80	97	138	165	—	5	480	102	160	6
44	220	370	460	—	88	106	145	180	—	5	540	115	180	6
48	240	400	500	—	95	114	155	195	—	5	580	122	190	6
52	260	440	540	—	102	123	165	206	—	6	620	132	206	7.5
56	280	460	580	—	108	132	175	224	—	6	670	140	224	7.5
60	300	500	620	—	109	140	185	236	—	7.5	710	150	236	7.5
64	320	540	670	—	112	155	200	258	—	7.5	750	155	250	9.5
68	340	580	710	—	118	165	212	272	—	7.5	800	164	265	9.5
72	360	600	750	—	125	170	224	290	—	7.5	850	180	280	9.5
76	380	620	780	—	128	175	230	300	—	7.5	900	190	300	9.5
80	400	650	820	—	136	185	243	308	—	7.5	950	200	315	12
84	420	700	850	—	136	190	250	315	—	9.5	980	206	325	12
88	440	720	900	—	145	200	265	345	—	9.5	1030	212	335	12
92	460	760	950	—	155	212	280	365	—	9.5	1060	218	345	12
96	480	790	980	—	160	218	290	375	—	9.5	1120	230	365	15
/500	500	830	1030	—	170	230	300	388	—	12	1150	236	375	15
/530	530	870	1090	—	180	243	325	412	—	12	1220	250	400	15
/560	560	920	1150	—	190	258	335	438	—	12	1280	258	412	15
/600	600	980	1220	—	200	272	355	462	—	15	1360	272	438	15
/630	630	1030	1280	—	206	280	375	488	—	15	1420	280	450	15
/670	670	1090	1360	—	218	300	400	515	—	15	1500	290	475	15
/710	710	1150	1420	—	224	308	412	530	—	15	—	—	—	—
/750	750	1220	1500	—	236	325	438	560	—	15	—	—	—	—
/800	800	1280	1600	—	258	355	462	600	—	15	—	—	—	—
/850	850	1360	1700	—	272	375	488	630	—	19	—	—	—	—
/900	900	1420	1780	—	280	388	500	650	—	19	—	—	—	—
/950	950	1500	1850	—	290	400	515	670	—	19	—	—	—	—
/1000	1000	1580	1950	—	300	412	545	710	—	19	—	—	—	—
/1060	1060	1660	—	—	—	—	—	—	—	—	—	—	—	—
/1120	1120	1750	—	—	—	—	—	—	—	—	—	—	—	—
/1180	1180	1850	—	—	—	—	—	—	—	—	—	—	—	—
/1250	1250	1950	—	—	—	—	—	—	—	—	—	—	—	—
/1320	1320	2060	—	—	—	—	—	—	—	—	—	—	—	—
/1400	1400	2180	—	—	—	—	—	—	—	—	—	—	—	—
/1500	1500	2300	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-2: Boundary dimensions of tapered roller bearing-1

Tapered roller bearings		329						320X						330					
		Diameter series 9						Diameter series 0						Diameter series 0					
			Dimension series 29						Dimension series 20						Dimension series 30				
Bore diameter No.	Bearing bore diameter	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring
	d	*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)	
02	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
03	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
04	20	—	—	—	—	—	—	42	15	15	12	0.6	0.6	—	—	—	—	—	—
/22	22	—	—	—	—	—	—	44	15	15	11.5	0.6	0.6	—	—	—	—	—	—
05	25	—	—	—	—	—	—	47	15	15	11.5	0.6	0.6	47	17	17	14	0.6	0.6
/28	28	—	—	—	—	—	—	52	16	16	12	1	1	—	—	—	—	—	—
06	30	47	12	12	9	0.3	0.3	55	17	17	13	1	1	55	20	20	16	1	1
/32	32	—	—	—	—	—	—	58	17	17	13	1	1	—	—	—	—	—	—
07	35	55	14	14	11.5	0.6	0.6	62	18	18	14	1	1	62	21	21	17	1	1
08	40	62	15	15	12	0.6	0.6	68	19	19	14.5	1	1	68	22	22	18	1	1
09	45	68	15	15	12	0.6	0.6	75	20	20	15.5	1	1	75	24	24	19	1	1
10	50	72	15	15	12	0.6	0.6	80	20	20	15.5	1	1	80	24	24	19	1	1
11	55	80	17	17	14	1	1	90	23	23	17.5	1.5	1.5	90	27	27	21	1.5	1.5
12	60	85	17	17	14	1	1	95	23	23	17.5	1.5	1.5	95	27	27	21	1.5	1.5
13	65	90	17	17	14	1	1	100	23	23	17.5	1.5	1.5	100	27	27	21	1.5	1.5
14	70	100	20	20	16	1	1	110	25	25	19	1.5	1.5	110	31	31	25.5	1.5	1.5
15	75	105	20	20	16	1	1	115	25	25	19	1.5	1.5	115	31	31	25.5	1.5	1.5
16	80	110	20	20	16	1	1	125	29	29	22	1.5	1.5	125	36	36	29.5	1.5	1.5
17	85	120	23	23	18	1.5	1.5	130	29	29	22	1.5	1.5	130	36	36	29.5	1.5	1.5
18	90	125	23	23	18	1.5	1.5	140	32	32	24	2	1.5	140	39	39	32.5	2	1.5
19	95	130	23	23	18	1.5	1.5	145	32	32	24	2	1.5	145	39	39	32.5	2	1.5
20	100	140	25	25	20	1.5	1.5	150	32	32	24	2	1.5	150	39	39	32.5	2	1.5
21	105	145	25	25	20	1.5	1.5	160	35	35	26	2.5	2	160	43	43	34	2.5	2
22	110	150	25	25	20	1.5	1.5	170	38	38	29	2.5	2	170	47	47	37	2.5	2
24	120	165	29	29	23	1.5	1.5	180	38	38	29	2.5	2	180	48	48	38	2.5	2
26	130	180	32	32	25	2	1.5	200	45	45	34	2.5	2	200	55	55	43	2.5	2
28	140	190	32	32	25	2	1.5	210	45	45	34	2.5	2	210	56	56	44	2.5	2
30	150	210	38	38	30	2.5	2	225	48	48	36	3	2.5	225	59	59	46	3	2.5
32	160	220	38	38	30	2.5	2	240	51	51	38	3	2.5	—	—	—	—	—	—
34	170	230	38	38	30	2.5	2	260	57	57	43	3	2.5	—	—	—	—	—	—
36	180	250	45	45	34	2.5	2	280	64	64	48	3	2.5	—	—	—	—	—	—
38	190	260	45	45	34	2.5	2	290	64	64	48	3	2.5	—	—	—	—	—	—
40	200	280	51	51	39	3	2.5	310	70	70	53	3	2.5	—	—	—	—	—	—
44	220	300	51	51	39	3	2.5	340	76	76	57	4	3	—	—	—	—	—	—
48	240	320	51	51	39	3	2.5	360	76	76	57	4	3	—	—	—	—	—	—
52	260	360	63.5	63.5	48	3	2.5	400	87	87	65	5	4	—	—	—	—	—	—
56	280	380	63.5	63.5	48	3	2.5	420	87	87	65	5	4	—	—	—	—	—	—
60	300	420	76	76	57	4	3	460	100	100	74	5	4	—	—	—	—	—	—
64	320	440	76	76	57	4	3	480	100	100	74	5	4	—	—	—	—	—	—
68	340	460	76	76	57	4	3	—	—	—	—	—	—	—	—	—	—	—	—
72	360	480	76	76	57	4	3	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-2: Boundary dimensions of tapered roller bearing-2

Unit: mm

Tapered roller bearings		331						302						322					
		Diameter series 1						Diameter series 2						Diameter series 2					
			Dimension series 31						Dimension series 02						Dimension series 22				
Bore diameter No.	Bearing bore diameter	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring	Bearing outer diameter	Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring
	d	*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)	
02	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
03	17	—	—	—	—	—	—	40	13.25	12	11	1	1	40	17.25	16	14	1	1
04	20	—	—	—	—	—	—	47	15.25	14	12	1	1	47	19.25	18	15	1	1
/22	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
05	25	—	—	—	—	—	—	52	16.25	15	13	1	1	52	19.25	18	16	1	1
/28	28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
06	30	—	—	—	—	—	—	62	17.25	16	14	1	1	62	21.25	20	17	1	1
/32	32	—	—	—	—	—	—	65	18.25	17	15	1	1	—	—	—	—	—	—
07	35	—	—	—	—	—	—	72	18.25	17	15	1.5	1.5	72	24.25	23	19	1.5	1.5
08	40	75	26	26	20.5	1.5	1.5	80	19.75	18	16	1.5	1.5	80	24.75	23	19	1.5	1.5
09	45	80	26	26	20.5	1.5	1.5	85	20.75	19	16	1.5	1.5	85	24.75	23	19	1.5	1.5
10	50	85	26	26	20	1.5	1.5	90	21.75	20	17	1.5	1.5	90	24.75	23	19	1.5	1.5
11	55	95	30	30	23	1.5	1.5	100	22.75	21	18	2	1.5	100	26.75	25	21	2	1.5
12	60	100	30	30	23	1.5	1.5	110	23.75	22	19	2	1.5	110	29.75	28	24	2	1.5
13	65	110	34	34	26.5	1.5	1.5	120	24.75	23	20	2	1.5	120	32.75	31	27	2	1.5
14	70	120	37	37	29	2	1.5	125	26.25	24	21	2	1.5	125	33.25	31	27	2	1.5
15	75	125	37	37	29	2	1.5	130	27.25	25	22	2	1.5	130	33.25	31	27	2	1.5
16	80	130	37	37	29	2	1.5	140	28.25	26	22	2.5	2	140	35.25	33	28	2.5	2
17	85	140	41	41	32	2.5	2	150	30.5	28	24	2.5	2	150	38.5	36	30	2.5	2
18	90	150	45	45	35	2.5	2	160	32.5	30	26	2.5	2	160	42.5	40	34	2.5	2
19	95	160	49	49	38	2.5	2	170	34.5	32	27	3	2.5	170	45.5	43	37	3	2.5
20	100	165	52	52	40	2.5	2	180	37	34	29	3	2.5	180	49	46	39	3	2.5
21	105	—	—	—	—	—	—	190	39	36	30	3	2.5	190	53	50	43	3	2.5
22	110	180	56	56	43	2.5	2	200	41	38	32	3	2.5	200	56	53	46	3	2.5
24	120	200	62	62	48	2.5	2	215	43.5	40	34	3	2.5	215	61.5	58	50	3	2.5
26	130	—	—	—	—	—	—	230	43.75	40	34	4	3	230	67.75	64	54	4	3
28	140	—	—	—	—	—	—	250	45.75	42	36	4	3	250	71.75	68	58	4	3
30	150	—	—	—	—	—	—	270	49	45	38	4	3	270	77	73	60	4	3
32	160	—	—	—	—	—	—	290	52	48	40	4	3	290	84	80	67	4	3
34	170	—	—	—	—	—	—	310	57	52	43	5	4	310	91	86	71	5	4
36	180	—	—	—	—	—	—	320	57	52	43	5	4	320	91	86	71	5	4
38	190	—	—	—	—	—	—	340	60	55	46	5	4	340	97	92	75	5	4
40	200	—	—	—	—	—	—	360	64	58	48	5	4	360	104	98	82	5	4
44	220	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
48	240	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
52	260	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56	280	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	300	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
64	320	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
68	340	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72	360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-2: Boundary dimensions of tapered roller bearing-3

Tapered roller bearings		332						303						303D					
Bore diameter No.	Bearing bore diameter	Bearing outer diameter	Diameter series 2, Dimension series 32					Bearing outer diameter	Diameter series 3, Dimension series 03					Bearing outer diameter	Diameter series 3, Dimension series 03				
			Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring		Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring		Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring
	d	*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)	
02	15	—	—	—	—	—	—	42	14.25	13	11	1	1	—	—	—	—	—	—
03	17	—	—	—	—	—	—	47	15.25	14	12	1	1	—	—	—	—	—	—
04	20	—	—	—	—	—	—	52	16.25	15	13	1.5	1.5	—	—	—	—	—	—
/22	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
05	25	52	22	22	18	1	1	62	18.25	17	15	1.5	1.5	62	18.25	17	13	1.5	1.5
/28	28	58	24	24	19	1	1	—	—	—	—	—	—	—	—	—	—	—	—
06	30	62	25	25	19.5	1	1	72	20.75	19	16	1.5	1.5	72	20.75	19	14	1.5	1.5
/32	32	65	26	26	20.5	1	1	—	—	—	—	—	—	—	—	—	—	—	—
07	35	72	28	28	22	1.5	1.5	80	22.75	21	18	2	1.5	80	22.75	21	15	2	1.5
08	40	80	32	32	25	1.5	1.5	90	25.25	23	20	2	1.5	90	25.25	23	17	2	1.5
09	45	85	32	32	25	1.5	1.5	100	27.25	25	22	2	1.5	100	27.25	25	18	2	1.5
10	50	90	32	32	24.5	1.5	1.5	110	29.25	27	23	2.5	2	110	29.25	27	19	2.5	2
11	55	100	35	35	27	2	1.5	120	31.5	29	25	2.5	2	120	31.5	29	21	2.5	2
12	60	110	38	38	29	2	1.5	130	33.5	31	26	3	2.5	130	33.5	31	22	3	2.5
13	65	120	41	41	32	2	1.5	140	36	33	28	3	2.5	140	36	33	23	3	2.5
14	70	125	41	41	32	2	1.5	150	38	35	30	3	2.5	150	38	35	25	3	2.5
15	75	130	41	41	31	2	1.5	160	40	37	31	3	2.5	160	40	37	26	3	2.5
16	80	140	46	46	35	2.5	2	170	42.5	39	33	3	2.5	170	42.5	39	27	3	2.5
17	85	150	49	49	37	2.5	2	180	44.5	41	34	4	3	180	44.5	41	28	4	3
18	90	160	55	55	42	2.5	2	190	46.5	43	36	4	3	190	46.5	43	30	4	3
19	95	170	58	58	44	3	2.5	200	49.5	45	38	4	3	200	49.5	45	32	4	3
20	100	180	63	63	48	3	2.5	215	51.5	47	39	4	3	—	—	—	—	—	—
21	105	190	68	68	52	3	2.5	225	53.5	49	41	4	3	—	—	—	—	—	—
22	110	—	—	—	—	—	—	240	54.5	50	42	4	3	—	—	—	—	—	—
24	120	—	—	—	—	—	—	260	59.5	55	46	4	3	—	—	—	—	—	—
26	130	—	—	—	—	—	—	280	63.75	58	49	5	4	—	—	—	—	—	—
28	140	—	—	—	—	—	—	300	67.75	62	53	5	4	—	—	—	—	—	—
30	150	—	—	—	—	—	—	320	72	65	55	5	4	—	—	—	—	—	—
32	160	—	—	—	—	—	—	340	75	68	58	5	4	—	—	—	—	—	—
34	170	—	—	—	—	—	—	360	80	72	62	5	4	—	—	—	—	—	—
36	180	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
38	190	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40	200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
44	220	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
48	240	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
52	260	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
56	280	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	300	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
64	320	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
68	340	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72	360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Appendix Table

NTN

Appendix table-2: Boundary dimensions of tapered roller bearing-4

Unit: mm

Tapered roller bearings		313						323					
Bore diameter No.	Bearing bore diameter	Bearing outer diameter	Diameter series 3, Dimension series 13					Bearing outer diameter	Diameter series 3, Dimension series 23				
			Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring		Assembly width	Inner ring width	Outer ring width	Chamfer dimension Inner ring	Chamfer dimension Outer ring
	d	*D*	*T*	*B*	*C*	*r*(min.)		*D*	*T*	*B*	*C*	*r*(min.)	
02	15	—	—	—	—	—	—	—	—	—	—	—	—
03	17	—	—	—	—	—	—	47	20.25	19	16	1	1
04	20	—	—	—	—	—	—	52	22.25	21	18	1.5	1.5
/22	22	—	—	—	—	—	—	—	—	—	—	—	—
05	25	—	—	—	—	—	—	62	25.25	24	20	1.5	1.5
/28	28	—	—	—	—	—	—	—	—	—	—	—	—
06	30	—	—	—	—	—	—	72	28.75	27	23	1.5	1.5
/32	32	—	—	—	—	—	—	—	—	—	—	—	—
07	35	—	—	—	—	—	—	80	32.75	31	25	2	1.5
08	40	—	—	—	—	—	—	90	35.25	33	27	2	1.5
09	45	—	—	—	—	—	—	100	38.25	36	30	2	1.5
10	50	—	—	—	—	—	—	110	42.25	40	33	2.5	2
11	55	—	—	—	—	—	—	120	45.5	43	35	2.5	2
12	60	—	—	—	—	—	—	130	48.5	46	37	3	2.5
13	65	—	—	—	—	—	—	140	51	48	39	3	2.5
14	70	—	—	—	—	—	—	150	54	51	42	3	2.5
15	75	—	—	—	—	—	—	160	58	55	45	3	2.5
16	80	—	—	—	—	—	—	170	61.5	58	48	3	2.5
17	85	—	—	—	—	—	—	180	63.5	60	49	4	3
18	90	—	—	—	—	—	—	190	67.5	64	53	4	3
19	95	—	—	—	—	—	—	200	71.5	67	55	4	3
20	100	215	56.5	51	35	4	3	215	77.5	73	60	4	3
21	105	225	58	53	36	4	3	225	81.5	77	63	4	3
22	110	240	63	57	38	4	3	240	84.5	80	65	4	3
24	120	260	68	62	42	4	3	260	90.5	86	69	4	3
26	130	280	72	66	44	5	4	—	—	—	—	—	—
28	140	300	77	70	47	5	4	—	—	—	—	—	—
30	150	320	82	75	50	5	4	—	—	—	—	—	—
32	160	—	—	—	—	—	—	—	—	—	—	—	—
34	170	—	—	—	—	—	—	—	—	—	—	—	—
36	180	—	—	—	—	—	—	—	—	—	—	—	—
38	190	—	—	—	—	—	—	—	—	—	—	—	—
40	200	—	—	—	—	—	—	—	—	—	—	—	—
44	220	—	—	—	—	—	—	—	—	—	—	—	—
48	240	—	—	—	—	—	—	—	—	—	—	—	—
52	260	—	—	—	—	—	—	—	—	—	—	—	—
56	280	—	—	—	—	—	—	—	—	—	—	—	—
60	300	—	—	—	—	—	—	—	—	—	—	—	—
64	320	—	—	—	—	—	—	—	—	—	—	—	—
68	340	—	—	—	—	—	—	—	—	—	—	—	—
72	360	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-3: Boundary dimensions of single direction thrust bearings-1

Thrust ball bearings										511					512	522				
Spherical roller thrust bearings														292						
		Diameter series 0					Diameter series 1					Diameter series 2								
Bore diameter code	Nominal bearing bore diameter	Nominal bearing outer diameter	Dimension series			Chamfer dimension	Nominal bearing outer diameter	Dimension series			Chamfer dimension	Nominal bearing outer diameter	Dimension series						Chamfer dimension	Chamfer dimension
			70	90	10			71	91	11			72	92	12	22	22			
			Nominal height					Nominal height					Nominal height				Central raceway washer			
																	Nominal bore diameter	Nominal height		
	d	D	T			r (min.)	D	T			r (min.)	D	T				d_2	B	r (min.)	r_1 (min.)
4	4	12	4	—	6	0.3	—	—	—	—	—	16	6	—	8	—	—	—	0.3	—
6	6	16	5	—	7	0.3	—	—	—	—	—	20	6	—	9	—	—	—	0.3	—
8	8	18	5	—	7	0.3	—	—	—	—	—	22	6	—	9	—	—	—	0.3	—
00	10	20	5	—	7	0.3	24	6	—	9	0.3	26	7	—	11	—	—	—	0.6	—
01	12	22	5	—	7	0.3	26	6	—	9	0.3	28	7	—	11	—	—	—	0.6	—
02	15	26	5	—	7	0.3	28	6	—	9	0.3	32	8	—	12	22	10	5	0.6	0.3
03	17	28	5	—	7	0.3	30	6	—	9	0.3	35	8	—	12	—	—	—	0.6	—
04	20	32	6	—	8	0.3	35	7	—	10	0.3	40	9	—	14	26	15	6	0.6	0.3
05	25	37	6	—	8	0.3	42	8	—	11	0.6	47	10	—	15	28	20	7	0.6	0.3
06	30	42	6	—	8	0.3	47	8	—	11	0.6	52	10	—	16	29	25	7	0.6	0.3
07	35	47	6	—	8	0.3	52	8	—	12	0.6	62	12	—	18	34	30	8	1	0.3
08	40	52	6	—	9	0.3	60	9	—	13	0.6	68	13	—	19	36	30	9	1	0.6
09	45	60	7	—	10	0.3	65	9	—	14	0.6	73	13	—	20	37	35	9	1	0.6
10	50	65	7	—	10	0.3	70	9	—	14	0.6	78	13	—	22	39	40	9	1	0.6
11	55	70	7	—	10	0.3	78	10	—	16	0.6	90	16	21	25	45	45	10	1	0.6
12	60	75	7	—	10	0.3	85	11	—	17	1	95	16	21	26	46	50	10	1	0.6
13	65	80	7	—	10	0.3	90	11	—	18	1	100	16	21	27	47	55	10	1	0.6
14	70	85	7	—	10	0.3	95	11	—	18	1	105	16	21	27	47	55	10	1	1
15	75	90	7	—	10	0.3	100	11	—	19	1	110	16	21	27	47	60	10	1	1
16	80	95	7	—	10	0.3	105	11	—	19	1	115	16	21	28	48	65	10	1	1
17	85	100	7	—	10	0.3	110	11	—	19	1	125	18	24	31	55	70	12	1	1
18	90	105	7	—	10	0.3	120	14	—	22	1	135	20	27	35	62	75	14	1.1	1
20	100	120	9	—	14	0.6	135	16	21	25	1	150	23	30	38	67	85	15	1.1	1
22	110	130	9	—	14	0.6	145	16	21	25	1	160	23	30	38	67	95	15	1.1	1
24	120	140	9	—	14	0.6	155	16	21	25	1	170	23	30	39	68	100	15	1.1	1.1
26	130	150	9	—	14	0.6	170	18	24	30	1	190	27	36	45	80	110	18	1.5	1.1
28	140	160	9	—	14	0.6	180	18	24	31	1	200	27	36	46	81	120	18	1.5	1.1
30	150	170	9	—	14	0.6	190	18	24	31	1	215	29	39	50	89	130	20	1.5	1.1
32	160	180	9	—	14	0.6	200	18	24	31	1	225	29	39	51	90	140	20	1.5	1.1
34	170	190	9	—	14	0.6	215	20	27	34	1.1	240	32	42	55	97	150	21	1.5	1.1
36	180	200	9	—	14	0.6	225	20	27	34	1.1	250	32	42	56	98	150	21	1.5	2
38	190	215	11	—	17	1	240	23	30	37	1.1	270	36	48	62	109	160	24	2	2
40	200	225	11	—	17	1	250	23	30	37	1.1	280	36	48	62	109	170	24	2	2
44	220	250	14	—	22	1	270	23	30	37	1.1	300	36	48	63	110	190	24	2	2
48	240	270	14	—	22	1	300	27	36	45	1.5	340	45	60	78	—	—	—	2.1	—
52	260	290	14	—	22	1	320	27	36	45	1.5	360	45	60	79	—	—	—	2.1	—
56	280	310	14	—	22	1	350	32	42	53	1.5	380	45	60	80	—	—	—	2.1	—
60	300	340	18	24	30	1	380	36	48	62	2	420	54	73	95	—	—	—	3	—
64	320	360	18	24	30	1	400	36	48	63	2	440	54	73	95	—	—	—	3	—

Note: 1. Dimension series 22, 23, and 24 are double row bearing series. For double row bearings, d2 becomes the nominal bearing bore diameter.
2. For the outer diameter of the shaft raceway washer and the inner diameter of the housing raceway washer, see the dimension table of thrust bearings.

Appendix table-3: Boundary dimensions of single direction thrust bearings-2

Unit: mm

			513	523								514	524									Thrust ball bearings
		293									294											Spherical roller thrust bearings
Diameter series 3									Diameter series 4									Diameter series 5				
Nominal bearing outer diameter	Dimension series						Chamfer dimension	Chamfer dimension	Nominal bearing outer diameter	Dimension series						Chamfer dimension	Chamfer dimension	Nominal bearing outer diameter	Dimension series	Chamfer dimension	Nominal bearing bore diameter	Bore diameter code
	73	93	13	23	23					74	94	14	24	24					95			
	Nominal height				Central raceway washer					Nominal height				Central raceway washer					Nominal height			
					Nominal bore diameter	Nominal height								Nominal bore diameter	Nominal height							
D	T				d_2	B	r (min.)	r_1 (min.)	D	T				d_2	B	r (min.)	r_1 (min.)	D	T	r (min.)	d	
20	7	—	11	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	4	4
24	8	—	12	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	6	6
26	8	—	12	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	8	8
30	9	—	14	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	10	00
32	9	—	14	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	12	01
37	10	—	15	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	15	02
40	10	—	16	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	52	21	1	17	03
47	12	—	18	—	—	—	1	—	—	—	—	—	—	—	—	—	—	60	24	1	20	04
52	12	—	18	34	20	8	1	0.3	60	16	21	24	45	15	11	1	0.6	73	29	1.1	25	05
60	14	—	21	38	25	9	1	0.3	70	18	24	28	52	20	12	1	0.6	85	34	1.1	30	06
68	15	—	24	44	30	10	1	0.3	80	20	27	32	59	25	14	1.1	0.6	100	39	1.1	35	07
78	17	22	26	49	30	12	1	0.6	90	23	30	36	65	30	15	1.1	0.6	110	42	1.5	40	08
85	18	24	28	52	35	12	1	0.6	100	25	34	39	72	35	17	1.1	0.6	120	45	2	45	09
95	20	27	31	58	40	14	1.1	0.6	110	27	36	43	78	40	18	1.5	0.6	135	51	2	50	10
105	23	30	35	64	45	15	1.1	0.6	120	29	39	48	87	45	20	1.5	0.6	150	58	2.1	55	11
110	23	30	35	64	50	15	1.1	0.6	130	32	42	51	93	50	21	1.5	0.6	160	60	2.1	60	12
115	23	30	36	65	55	15	1.1	0.6	140	34	45	56	101	50	23	2	1	170	63	2.1	65	13
125	25	34	40	72	55	16	1.1	1	150	36	48	60	107	55	24	2	1	180	67	3	70	14
135	27	36	44	79	60	18	1.5	1	160	38	51	65	115	60	26	2	1	190	69	3	75	15
140	27	36	44	79	65	18	1.5	1	170	41	54	68	120	65	27	2.1	1	200	73	3	80	16
150	29	39	49	87	70	19	1.5	1	180	42	58	72	128	65	29	2.1	1.1	215	78	4	85	17
155	29	39	50	88	75	19	1.5	1	190	45	60	77	135	70	30	2.1	1.1	225	82	4	90	18
170	32	42	55	97	85	21	1.5	1	210	50	67	85	150	80	33	3	1.1	250	90	4	100	20
190	36	48	63	110	95	24	2	1	230	54	73	95	166	90	37	3	1.1	270	95	5	110	22
210	41	54	70	123	100	27	2.1	1.1	250	58	78	102	177	95	40	4	1.5	300	109	5	120	24
225	42	58	75	130	110	30	2.1	1.1	270	63	85	110	192	100	42	4	2	320	115	5	130	26
240	45	60	80	140	120	31	2.1	1.1	280	63	85	112	196	110	44	4	2	340	122	5	140	28
250	45	60	80	140	130	31	2.1	1.1	300	67	90	120	209	120	46	4	2	360	125	6	150	30
270	50	67	87	153	140	33	3	1.1	320	73	95	130	226	130	50	5	2	380	132	6	160	32
280	50	67	87	153	150	33	3	1.1	340	78	103	135	236	135	50	5	2.1	400	140	6	170	34
300	54	73	95	165	150	37	3	2	360	82	109	140	245	140	52	5	3	420	145	6	180	36
320	58	78	105	183	160	40	4	2	380	85	115	150	—	—	—	5	—	440	150	6	190	38
340	63	85	110	192	170	42	4	2	400	90	122	155	—	—	—	5	—	460	155	7.5	200	40
360	63	85	112	—	—	—	4	—	420	90	122	160	—	—	—	6	—	500	170	7.5	220	44
380	63	85	112	—	—	—	4	—	440	90	122	160	—	—	—	6	—	540	180	7.5	240	48
420	73	95	130	—	—	—	5	—	480	100	132	175	—	—	—	6	—	580	190	9.5	260	52
440	73	95	130	—	—	—	5	—	520	109	145	190	—	—	—	6	—	620	206	9.5	280	56
480	82	109	140	—	—	—	5	—	540	109	145	190	—	—	—	6	—	670	224	9.5	300	60
500	82	109	140	—	—	—	5	—	580	118	155	205	—	—	—	7.5	—	710	236	9.5	320	64

Appendix table-3: Boundary dimensions of single direction thrust bearings-3

Thrust ball bearings										511	
Spherical roller thrust bearings											
Bore diameter code	Nominal bearing bore diameter	Diameter series 0					Diameter series 1				
		Nominal bearing outer diameter	Dimension series			Chamfer dimension	Nominal bearing outer diameter	Dimension series			Chamfer dimension
			70	90	10			71	91	11	
			Nominal height					Nominal height			
	d	D		T		r (min.)	D		T		r (min.)
68	340	380	18	24	30	1	420	36	48	64	2
72	360	400	18	24	30	1	440	36	48	65	2
76	380	420	18	24	30	1	460	36	48	65	2
80	400	440	18	24	30	1	480	36	48	65	2
84	420	460	18	24	30	1	500	36	48	65	2
88	440	480	18	24	30	1	540	45	60	80	2.1
92	460	500	18	24	30	1	560	45	60	80	2.1
96	480	520	18	24	30	1	580	45	60	80	2.1
/500	500	540	18	24	30	1	600	45	60	80	2.1
/530	530	580	23	30	38	1.1	640	50	67	85	3
/560	560	610	23	30	38	1.1	670	50	67	85	3
/600	600	650	23	30	38	1.1	710	50	67	85	3
/630	630	680	23	30	38	1.1	750	54	73	95	3
/670	670	730	27	36	45	1.5	800	58	78	105	4
/710	710	780	32	42	53	1.5	850	63	85	112	4
/750	750	820	32	42	53	1.5	900	67	90	120	4
/800	800	870	32	42	53	1.5	950	67	90	120	4
/850	850	920	32	42	53	1.5	1000	67	90	120	4
/900	900	980	36	48	63	2	1060	73	95	130	5
/950	950	1030	36	48	63	2	1120	78	103	135	5
/1000	1000	1090	41	54	70	2.1	1180	82	109	140	5
/1060	1060	1150	41	54	70	2.1	1250	85	115	150	5
/1120	1120	1220	45	60	80	2.1	1320	90	122	160	5
/1180	1180	1280	45	60	80	2.1	1400	100	132	175	6
/1250	1250	1360	50	67	85	3	1460	—	—	175	6
/1320	1320	1440	—	—	95	3	1540	—	—	175	6
/1400	1400	1520	—	—	95	3	1630	—	—	180	6
/1500	1500	1630	—	—	105	4	1750	—	—	195	6
/1600	1600	1730	—	—	105	4	1850	—	—	195	6
/1700	1700	1840	—	—	112	4	1970	—	—	212	7.5
/1800	1800	1950	—	—	120	4	2080	—	—	220	7.5
/1900	1900	2060	—	—	130	5	2180	—	—	220	7.5
/2000	2000	2160	—	—	130	5	2300	—	—	236	7.5
/2120	2120	2300	—	—	140	5	2430	—	—	243	7.5
/2240	2240	2430	—	—	150	5	2670	—	—	258	9.5
/2360	2360	2550	—	—	150	5	2700	—	—	265	9.5
/2500	2500	2700	—	—	160	5	2850	—	—	272	9.5

Note: 1. Dimension series 22, 23, and 24 are double row bearing series.
2. For the outer diameter of the shaft raceway washer and the inner diameter of the housing raceway washer, see the dimension table of thrust bearings.

Appendix table-3: Boundary dimensions of single direction thrust bearings-4

Unit: mm

Thrust ball bearings					512	522				
Spherical roller thrust bearings				292						
Bore diameter code	Nominal bearing bore diameter	Nominal bearing outer diameter	Diameter series 2							
			Dimension series						Chamfer dimension	Chamfer dimension
			72	92	12	22	22			
			Nominal height				Central raceway washer			
							Nominal bore diameter	Nominal height		
	d	D		T			d_2	B	r (min.)	r_1 (min.)
68	340	460	54	73	96	—	—	—	3	—
72	360	500	63	85	110	—	—	—	4	—
76	380	520	63	85	112	—	—	—	4	—
80	400	540	63	85	112	—	—	—	4	—
84	420	580	73	95	130	—	—	—	5	—
88	440	600	73	95	130	—	—	—	5	—
92	460	620	73	95	130	—	—	—	5	—
96	480	650	78	103	135	—	—	—	5	—
/500	500	670	78	103	135	—	—	—	5	—
/530	530	710	82	109	140	—	—	—	5	—
/560	560	750	85	115	150	—	—	—	5	—
/600	600	800	90	122	160	—	—	—	5	—
/630	630	850	100	132	175	—	—	—	6	—
/670	670	900	103	140	180	—	—	—	6	—
/710	710	950	109	145	190	—	—	—	6	—
/750	750	1000	112	150	195	—	—	—	6	—
/800	800	1060	118	155	205	—	—	—	7.5	—
/850	850	1120	122	160	212	—	—	—	7.5	—
/900	900	1180	125	170	220	—	—	—	7.5	—
/950	950	1250	136	180	236	—	—	—	7.5	—
/1000	1000	1320	145	190	250	—	—	—	9.5	—
/1060	1060	1400	155	206	265	—	—	—	9.5	—
/1120	1120	1460	—	206	—	—	—	—	9.5	—
/1180	1180	1520	—	206	—	—	—	—	9.5	—
/1250	1250	1610	—	216	—	—	—	—	9.5	—
/1320	1320	1700	—	228	—	—	—	—	9.5	—
/1400	1400	1790	—	234	—	—	—	—	12	—
/1500	1500	1920	—	252	—	—	—	—	12	—
/1600	1600	2040	—	264	—	—	—	—	15	—
/1700	1700	2160	—	276	—	—	—	—	15	—
/1800	1800	2280	—	288	—	—	—	—	15	—
/1900	1900	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—
/2120	2120	—	—	—	—	—	—	—	—	—
/2240	2240	—	—	—	—	—	—	—	—	—
/2360	2360	—	—	—	—	—	—	—	—	—
/2500	2500	—	—	—	—	—	—	—	—	—

Appendix table-3: Boundary dimensions of single direction thrust bearings-5 Unit: mm

Thrust ball bearings				513			523			
Spherical roller thrust bearings			293							
		Diameter series 3								
			Dimension series							
			73	93	13	23	23			
			Nominal height				Central raceway washer			
Bore diameter code	Nominal bearing bore diameter d	Nominal bearing outer diameter D	T				Nominal bore diameter d_2	Nominal height B	Chamfer dimension r (min.)	Chamfer dimension r_1 (min.)
68	340	540	90	122	160	—	—	—	5	—
72	360	560	90	122	160	—	—	—	5	—
76	380	600	100	132	175	—	—	—	6	—
80	400	620	100	132	175	—	—	—	6	—
84	420	650	103	140	180	—	—	—	6	—
88	440	680	109	145	190	—	—	—	6	—
92	460	710	112	150	195	—	—	—	6	—
96	480	730	112	150	195	—	—	—	6	—
/500	500	750	112	150	195	—	—	—	6	—
/530	530	800	122	160	212	—	—	—	7.5	—
/560	560	850	132	175	224	—	—	—	7.5	—
/600	600	900	136	180	236	—	—	—	7.5	—
/630	630	950	145	190	250	—	—	—	9.5	—
/670	670	1000	150	200	258	—	—	—	9.5	—
/710	710	1060	160	212	272	—	—	—	9.5	—
/750	750	1120	165	224	290	—	—	—	9.5	—
/800	800	1180	170	230	300	—	—	—	9.5	—
/850	850	1250	180	243	315	—	—	—	12	—
/900	900	1320	190	250	335	—	—	—	12	—
/950	950	1400	200	272	355	—	—	—	12	—
/1000	1000	1460	—	276	—	—	—	—	12	—
/1060	1060	1540	—	288	—	—	—	—	15	—
/1120	1120	1630	—	306	—	—	—	—	15	—
/1180	1180	1710	—	318	—	—	—	—	15	—
/1250	1250	1800	—	330	—	—	—	—	19	—
/1320	1320	1900	—	348	—	—	—	—	19	—
/1400	1400	2000	—	360	—	—	—	—	19	—
/1500	1500	2140	—	384	—	—	—	—	19	—
/1600	1600	2270	—	402	—	—	—	—	19	—
/1700	1700	—	—	—	—	—	—	—	—	—
/1800	1800	—	—	—	—	—	—	—	—	—
/1900	1900	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—
/2120	2120	—	—	—	—	—	—	—	—	—
/2240	2240	—	—	—	—	—	—	—	—	—
/2360	2360	—	—	—	—	—	—	—	—	—
/2500	2500	—	—	—	—	—	—	—	—	—

Note: 1. Dimension series 22, 23, and 24 are double row bearing series.
2. For the outer diameter of the shaft raceway washer and the inner diameter of the housing raceway washer, see the dimension table of thrust bearings.

Appendix table-3: Boundary dimensions of single direction thrust bearings-6 Unit: mm

Thrust ball bearings				514			524						
Spherical roller thrust bearings			294										
		Diameter series 4									Diameter series 5		
			Dimension series									Dimension series	
			74	94	14	24	24					95	
			Nominal height				Central raceway washer						
Bore diameter code	Nominal bearing bore diameter d	Nominal bearing outer diameter D	T				Nominal bore diameter d_2	Nominal height B	Chamfer dimension r (min.)	Chamfer dimension r_1 (min.)	Nominal bearing outer diameter D	Nominal height T	Chamfer dimension r (min.)
68	340	620	125	170	220	—	—	—	7.5	—	750	243	12
72	360	640	125	170	220	—	—	—	7.5	—	780	250	12
76	380	670	132	175	224	—	—	—	7.5	—	820	265	12
80	400	710	140	185	243	—	—	—	7.5	—	850	272	12
84	420	730	140	185	243	—	—	—	7.5	—	900	290	15
88	440	780	155	206	265	—	—	—	9.5	—	950	308	15
92	460	800	155	206	265	—	—	—	9.5	—	980	315	15
96	480	850	165	224	290	—	—	—	9.5	—	1000	315	15
/500	500	870	165	224	290	—	—	—	9.5	—	1060	335	15
/530	530	920	175	236	308	—	—	—	9.5	—	1090	335	15
/560	560	980	190	250	335	—	—	—	12	—	1150	355	15
/600	600	1030	195	258	335	—	—	—	12	—	1220	375	15
/630	630	1090	206	280	365	—	—	—	12	—	1280	388	15
/670	670	1150	218	290	375	—	—	—	15	—	1320	388	15
/710	710	1220	230	308	400	—	—	—	15	—	1400	412	15
/750	750	1280	236	315	412	—	—	—	15	—	—	—	—
/800	800	1360	250	335	438	—	—	—	15	—	—	—	—
/850	850	1440	—	354	—	—	—	—	15	—	—	—	—
/900	900	1520	—	372	—	—	—	—	15	—	—	—	—
/950	950	1600	—	390	—	—	—	—	15	—	—	—	—
/1000	1000	1670	—	402	—	—	—	—	15	—	—	—	—
/1060	1060	1770	—	426	—	—	—	—	15	—	—	—	—
/1120	1120	1860	—	444	—	—	—	—	15	—	—	—	—
/1180	1180	1950	—	462	—	—	—	—	19	—	—	—	—
/1250	1250	2050	—	480	—	—	—	—	19	—	—	—	—
/1320	1320	2160	—	505	—	—	—	—	19	—	—	—	—
/1400	1400	2280	—	530	—	—	—	—	19	—	—	—	—
/1500	1500	—	—	—	—	—	—	—	—	—	—	—	—
/1600	1600	—	—	—	—	—	—	—	—	—	—	—	—
/1700	1700	—	—	—	—	—	—	—	—	—	—	—	—
/1800	1800	—	—	—	—	—	—	—	—	—	—	—	—
/1900	1900	—	—	—	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—	—	—	—
/2120	2120	—	—	—	—	—	—	—	—	—	—	—	—
/2240	2240	—	—	—	—	—	—	—	—	—	—	—	—
/2360	2360	—	—	—	—	—	—	—	—	—	—	—	—
/2500	2500	—	—	—	—	—	—	—	—	—	—	—	—

Appendix table-4: Comparison table of SI and CGS series gravity units-1

Unit system \ Quantity	Length L	Mass M	Time T	Acceleration	Force	Stress	Pressure	Energy
SI	m	kg	s	m/s^2	N	Pa	Pa	J
CGS system	cm	g	s	Gal	dyn	dyn/cm^2	dyn/cm^2	erg
Gravitation system	m	$kgf \cdot s^2/m$	s	m/s^2	kgf	kgf/m^2	kgf/m^2	kgf · m

Appendix table-5: SI-customary unit conversion table-1

Quantity	Unit designation	Code	Conversion rate to SI	SI unit designation	Code
Angle	Degree	°	$\pi/180$	Radian	rad
	Minute	′	$\pi/10\,800$		
	Second	″ (sec)	$\pi/648\,000$		
Length	Meter	m	1	Meter	m
	Micron	μ	10^{-6}		
	Angstrom	Å	10^{-10}		
Area	Square meter	m^2	1	Square meter	m^2
	Are	a	10^2		
	Hectare	ha	10^4		
Volume	Cubic meter	m^3	1	Cubic meter	m^3
	Liter	ℓ.L	10^{-3}		
Mass	Kilogram	kg	1	Kilogram	kg
	Ton	t	10^3		
	Kilogram force / square second per meter	$kgf \cdot s^2/m$	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meters per second	m/s	1	Meters per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s^{-1}(pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute (rpm)	rpm(r/min)	1/60	Per second	s^{-1}
Angular velocity	Radians per second	rad/s	1	Radians per second	rad/s
Acceleration	Meters per square second	m/s^2	1	Radians per second	m/s^2
	G	G	9.806 65		
Force	Kilogram force	kgf	9.806 65	Newton	N
	Ton force	tf	9 806.65		
	Dyne	dyn	10^{-5}		
Force moment	Kilogram force / meter	kgf · m	9.806 65	Newton meter	N · m
Inertia moment	Kilogram force / meter / square second	$kgf \cdot m \cdot s^2$	9.806 65	Kilogram / square meter	$kg \cdot m^2$
Stress	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal or newton per square meter	Pa or N/m^2
Pressure	Kilogram force per square meter	kgf/m^2	9.806 65	Pascal	Pa
	Meter water column	mH_2O	9 806.65		
	Meter of mercury	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmosphere	atm	101 325		
	Bar	bar	10^5		
Energy	Erg	erg	10^{-7}	Joule	J
	IT calorie	cal_{IT}	4.186 8		
	Kilogram force / meter	kgf · m	9.806 65		
	Kilowatt hour	kW · h	3.600×10^6		
	Metric horsepower per hour	PS · h	$2.647\,79 \times 10^6$		
Power rate and power	Watt	W	1	Watt	W
	Metric horsepower	PS	735.5		
	Kilogram force / meter per second	kgf · m/s	9.806 65		

Appendix table-4: Comparison table of SI and CGS series gravity units-2

Unit system \ Quantity	Power rate	Temperature	Viscosity	Dynamic viscosity	Flux	Flux density	Magnetic field strength
SI	W	K	Pa · s	m^2/s	Wb	T	A/m
CGS system	erg/s	°C	P	St	Mx	Gs	Oe
Gravitation system	kgf · m/s	°C	$kgf \cdot s/m^2$	m^2/s	—	—	—

Appendix table-5: SI-customary unit conversion table-2

Quantity	Unit designation	Code	Conversion rate to SI	SI unit designation	Code
Viscosity	Poise	P	10^{-1}	Pascal second	Pa · s
	Centipoise	cP	10^{-3}		
	Kilogram force / square second per meter	$kgf \cdot s/m^2$	9.806 65		
Dynamic viscosity	Stoke	St	10^{-4}	Square meter per second	m^2/s
	Centistoke	cSt	10^{-6}		
Temperature	Degree	°C	+273.15	Kelvin	K
Radioactivity	Curie	Ci	3.7×10^{10}	Becquerel	Bq
Dosage	Roentgen	R	2.58×10^{-4}	Coulombs per kilogram	C/kg
Absorption dosage	Rad	rad	10^{-2}	Gray	Gy
Dosage equivalent	Rem	rem	10^{-2}	Sievert	Sv
Dosage equivalent	Maxwell	Mx	10^{-8}	Weber	Wb
Flux density	Gamma	γ	10^{-9}	Tesla	T
	Gauss	Gs	10^{-4}		
Magnetic field strength	Oersted	Oe	$10^3/4\pi$	Amperes per meter	A/m
Magnetic field strength	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Curren	Ampere	A	1	Ampere	A

Appendix table-6: Tenth power multiples of SI unit

Multiples of unit	Prefix		Multiples of unit	Prefix	
	Designation	Code		Designation	Code
10^{18}	Exa	E	10^{-1}	Deci	d
10^{15}	Peta	P	10^{-2}	Centi	c
10^{12}	Tera	T	10^{-3}	Milli	m
10^9	Giga	G	10^{-6}	Micro	μ
10^6	Mega	M	10^{-9}	Nano	n
10^3	Kilo	k	10^{-12}	Pico	p
10^2	Hecto	h	10^{-15}	Femto	f
10	Deca	da	10^{-18}	Atto	a

Appendix table-7: Dimensional tolerance for shafts

Diameter division mm		a13		c12		d6		e6		e13		f5		f6		g5		g6	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
–	3[1]	− 270	− 410	− 60	− 160	− 20	− 26	− 14	− 20	− 14	− 154	− 6	−10	− 6	− 12	− 2	− 6	− 2	− 8
3	6	− 270	− 450	− 70	− 190	− 30	− 38	− 20	− 28	− 20	− 200	−10	−15	− 10	− 18	− 4	− 9	− 4	− 12
6	10	− 280	− 500	− 80	− 230	− 40	− 49	− 25	− 34	− 25	− 245	−13	−19	− 13	− 22	− 5	−11	− 5	− 14
10	18	− 290	− 560	− 95	− 275	− 50	− 61	− 32	− 43	− 32	− 302	−16	−24	− 16	− 27	− 6	−14	− 6	− 17
18	30	− 300	− 630	−110	− 320	− 65	− 78	− 40	− 53	− 40	− 370	−20	−29	− 20	− 33	− 7	−16	− 7	− 20
30	40	− 310	− 700	−120	− 370	− 80	− 96	− 50	− 66	− 50	− 440	−25	−36	− 25	− 41	− 9	−20	− 9	− 25
40	50	− 320	− 710	−130	− 380														
50	65	− 340	− 800	−140	− 440	−100	−119	− 60	− 79	− 60	− 520	−30	−43	− 30	− 49	−10	−23	−10	− 29
65	80	− 360	− 820	−150	− 450														
80	100	− 380	− 920	−170	− 520	−120	−142	− 72	− 94	− 72	− 612	−36	−51	− 36	− 58	−12	−27	−12	− 34
100	120	− 410	− 950	−180	− 530														
120	140	− 460	−1 090	−200	− 600	−145	−170	− 85	−110	− 85	− 715	−43	−61	− 43	− 68	−14	−32	−14	− 39
140	160	− 520	−1 150	−210	− 610														
160	180	− 580	−1 210	−230	− 630														
180	200	− 660	−1 380	−240	− 700	−170	−199	−100	−129	−100	− 820	−50	−70	− 50	− 79	−15	−35	−15	− 44
200	225	− 740	−1 460	−260	− 720														
225	250	− 820	−1 540	−280	− 740														
250	280	− 920	−1 730	−300	− 820	−190	−222	−110	−142	−110	− 920	−56	−79	− 56	− 88	−17	−40	−17	− 49
280	315	−1 050	−1 860	−330	− 850														
315	355	−1 200	−2 090	−360	− 930	−210	−246	−125	−161	−125	−1 015	−62	−87	− 62	− 98	−18	−43	−18	− 54
355	400	−1 350	−2 240	−400	− 970														
400	450	−1 500	−2 470	−440	−1 070	−230	−270	−135	−175	−135	−1 105	−68	−95	− 68	−108	−20	−47	−20	− 60
450	500	−1 650	−2 620	−480	−1 110														
500	560	–	–	–	–	−260	−304	−145	−189	−145	−1 245	–	–	− 76	−120	–	–	−22	− 66
560	630																		
630	710	–	–	–	–	−290	−340	−160	−210	−160	−1 410	–	–	− 80	−130	–	–	−24	− 74
710	800																		
800	900	–	–	–	–	−320	−376	−170	−226	−170	−1 570	–	–	− 86	−142	–	–	−26	− 82
900	1 000																		
1 000	1 120	–	–	–	–	−350	−416	−195	−261	−195	−1 845	–	–	− 98	−164	–	–	−28	− 94
1 120	1 250																		
1 250	1 400	–	–	–	–	−390	−468	−220	−298	−220	−2 170	–	–	−110	−188	–	–	−30	−108
1 400	1 600																		
1 600	1 800	–	–	–	–	–	–	−240	−332	−240	−2 540	–	–	−120	−212	–	–	−32	−124
1 800	2 000																		
2 000	2 240	–	–	–	–	–	–	−260	−370	−260	−3 060	–	–	−130	−240	–	–	−34	−144
2 240	2 500																		
2 500	2 800	–	–	–	–	–	–	−290	−425	−290	−3 590	–	–	−145	−280	–	–	−38	−173
2 800	3 150																		

1) Basic tolerance **a** is not used for the basic size tolerance with respect to the size of 1 mm or below shown in drawings.

Diameter division mm		j5		js5		j6		js6		j7		k4		k5		k6		m5	
Over	Incl.	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
–	3	+2	− 2	+ 2	− 2	+ 4	− 2	+ 3	− 3	+ 6	− 4	+ 3	0	+ 4	0	+ 6	0	+ 6	+ 2
3	6	+3	− 2	+ 2.5	− 2.5	+ 6	− 2	+ 4	− 4	+ 8	− 4	+ 5	+1	+ 6	+1	+ 9	+1	+ 9	+ 4
6	10	+4	− 2	+ 3	− 3	+ 7	− 2	+ 4.5	− 4.5	+10	− 5	+ 5	+1	+ 7	+1	+ 10	+1	+12	+ 6
10	18	+5	− 3	+ 4	− 4	+ 8	− 3	+ 5.5	− 5.5	+12	− 6	+ 6	+1	+ 9	+1	+ 12	+1	+15	+ 7
18	30	+5	− 4	+ 4.5	− 4.5	+ 9	− 4	+ 6.5	− 6.5	+13	− 8	+ 8	+2	+11	+2	+ 15	+2	+17	+ 8
30	40	+6	− 5	+ 5.5	− 5.5	+11	− 5	+ 8	− 8	+15	−10	+ 9	+2	+13	+2	+ 18	+2	+20	+ 9
40	50																		
50	65	+6	− 7	+ 6.5	− 6.5	+12	− 7	+ 9.5	− 9.5	+18	−12	+10	+2	+15	+2	+ 21	+2	+24	+11
65	80																		
80	100	+6	− 9	+ 7.5	− 7.5	+13	− 9	+11	−11	+20	−15	+13	+3	+18	+3	+ 25	+3	+28	+13
100	120																		
120	140	+7	−11	+ 9	− 9	+14	−11	+12.5	−12.5	+22	−18	+15	+3	+21	+3	+ 28	+3	+33	+15
140	160																		
160	180																		
180	200	+7	−13	+10	−10	+16	−13	+14.5	−14.5	+25	−21	+18	+4	+24	+4	+ 33	+4	+37	+17
200	225																		
225	250																		
250	280	+7	−16	+11.5	−11.5	+16	−16	+16	−16	+26	−26	+20	+4	+27	+4	+ 36	+4	+43	+20
280	315																		
315	355	+7	−18	+12.5	−12.5	+18	−18	+18	−18	+29	−28	+22	+4	+29	+4	+ 40	+4	+46	+21
355	400																		
400	450	+7	−20	+13.5	−13.5	+20	−20	+20	−20	+31	−32	+25	+5	+32	+5	+ 45	+5	+50	+23
450	500																		
500	560	–	–	+16	−16	–	–	+22	−22	–	–	–	–	–	–	+ 44	0	–	–
560	630																		
630	710	–	–	+18	−18	–	–	+25	−25	–	–	–	–	–	–	+ 50	0	–	–
710	800																		
800	900	–	–	+20	−20	–	–	+28	−28	–	–	–	–	–	–	+ 56	0	–	–
900	1 000																		
1 000	1 120	–	–	+23.5	−23.5	–	–	+33	−33	–	–	–	–	–	–	+ 66	0	–	–
1 120	1 250																		
1 250	1 400	–	–	+27.5	−27.5	–	–	+39	−39	–	–	–	–	–	–	+ 78	0	–	–
1 400	1 600																		
1 600	1 800	–	–	+32.5	−32.5	–	–	+46	−46	–	–	–	–	–	–	+ 92	0	–	–
1 800	2 000																		
2 000	2 240	–	–	+39	−39	–	–	+55	−55	–	–	–	–	–	–	+110	0	–	–
2 240	2 500																		
2 500	2 800	–	–	+48	−48	–	–	+67.5	−67.5	–	–	–	–	–	–	+135	0	–	–
2 800	3 150																		

Unit: μm

h4		h5		h6		h7		h8		h9		h10		h11		h13		js4		Diameter division mm	
Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Over	Incl.
0	− 3	0	− 4	0	− 6	0	− 10	0	− 14	0	− 25	0	− 40	0	− 60	0	− 140	+ 1.5	− 1.5	–	3
0	− 4	0	− 5	0	− 8	0	− 12	0	− 18	0	− 30	0	− 48	0	− 75	0	− 180	+ 2	− 2	3	6
0	− 4	0	− 6	0	− 9	0	− 15	0	− 22	0	− 36	0	− 58	0	− 90	0	− 220	+ 2	− 2	6	10
0	− 5	0	− 8	0	− 11	0	− 18	0	− 27	0	− 43	0	− 70	0	− 110	0	− 270	+ 2.5	− 2.5	10	18
0	− 6	0	− 9	0	− 13	0	− 21	0	− 33	0	− 52	0	− 84	0	− 130	0	− 330	+ 3	− 3	18	30
0	− 7	0	−11	0	− 16	0	− 25	0	− 39	0	− 62	0	−100	0	− 160	0	− 390	+ 3.5	− 3.5	30	40
																				40	50
0	− 8	0	−13	0	− 19	0	− 30	0	− 46	0	− 74	0	−120	0	− 190	0	− 460	+ 4	− 4	50	65
																				65	80
0	−10	0	−15	0	− 22	0	− 35	0	− 54	0	− 87	0	−140	0	− 220	0	− 540	+ 5	− 5	80	100
																				100	120
0	−12	0	−18	0	− 25	0	− 40	0	− 63	0	−100	0	−160	0	− 250	0	− 630	+ 6	− 6	120	140
																				140	160
																				160	180
0	−14	0	−20	0	− 29	0	− 46	0	− 72	0	−115	0	−185	0	− 290	0	− 720	+ 7	− 7	180	200
																				200	225
																				225	250
0	−16	0	−23	0	− 32	0	− 52	0	− 81	0	−130	0	−210	0	− 320	0	− 810	+ 8	− 8	250	280
																				280	315
0	−18	0	−25	0	− 36	0	− 57	0	− 89	0	−140	0	−230	0	− 360	0	− 890	+ 9	− 9	315	355
																				355	400
0	−20	0	−27	0	− 40	0	− 63	0	− 97	0	−155	0	−250	0	− 400	0	− 970	+10	−10	400	450
																				450	500
0	−22	0	−32	0	− 44	0	− 70	0	−110	0	−175	0	−280	0	− 440	0	−1 100	+11	−11	500	560
																				560	630
0	−25	0	−36	0	− 50	0	− 80	0	−125	0	−200	0	−320	0	− 500	0	−1 250	+12.5	−12.5	630	710
																				710	800
0	−28	0	−40	0	− 56	0	− 90	0	−140	0	−230	0	−360	0	− 560	0	−1 400	+14	−14	800	900
																				900	1 000
0	−33	0	−47	0	− 66	0	−105	0	−165	0	−260	0	−420	0	− 660	0	−1 650	+16.5	−16.5	1 000	1 120
																				1 120	1 250
0	−39	0	−55	0	− 78	0	−125	0	−195	0	−310	0	−500	0	− 780	0	−1 950	+19.5	−19.5	1 250	1 400
																				1 400	1 600
0	−46	0	−65	0	− 92	0	−150	0	−230	0	−370	0	−600	0	− 920	0	−2 300	+23	−23	1 600	1 800
																				1 800	2 000
0	−55	0	−78	0	−110	0	−175	0	−280	0	−440	0	−700	0	−1 100	0	−2 800	+27.5	−27.5	2 000	2 240
																				2 240	2 500
0	−68	0	−96	0	−135	0	−210	0	−330	0	−540	0	−860	0	−1 350	0	−3 300	+34	−34	2 500	2 800
																				2 800	3 150

Unit: μm

m6		n5		n6		p5		p6		r6		r7		Basic tolerance				Diameter division mm	
Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	IT2	IT3	IT5	IT7	Over	Incl.
+ 8	+ 2	+ 8	+ 4	+ 10	+ 4	+10	+ 6	+ 12	+ 6	+ 16	+ 10	+ 20	+ 10	1.2	2	4	10	–	3
+ 12	+ 4	+13	+ 8	+ 16	+ 8	+17	+12	+ 20	+ 12	+ 23	+ 15	+ 27	+ 15	1.5	2.5	5	12	3	6
+ 15	+ 6	+16	+10	+ 19	+ 10	+21	+15	+ 24	+ 15	+ 28	+ 19	+ 34	+ 19	1.5	2.5	6	15	6	10
+ 18	+ 7	+20	+12	+ 23	+ 12	+26	+18	+ 29	+ 18	+ 34	+ 23	+ 41	+ 23	2	3	8	18	10	18
+ 21	+ 8	+24	+15	+ 28	+ 15	+31	+22	+ 35	+ 22	+ 41	+ 28	+ 49	+ 28	2.5	4	9	21	18	30
+ 25	+ 9	+28	+17	+ 33	+ 17	+37	+26	+ 42	+ 26	+ 50	+ 34	+ 59	+ 34	2.5	4	11	25	30	40
																		40	50
+ 30	+11	+33	+20	+ 39	+ 20	+45	+32	+ 51	+ 32	+ 60	+ 41	+ 71	+ 41	3	5	13	30	50	65
										+ 62	+ 43	+ 73	+ 43					65	80
+ 35	+13	+38	+23	+ 45	+ 23	+52	+37	+ 59	+ 37	+ 73	+ 51	+ 86	+ 51	4	6	15	35	80	100
										+ 76	+ 54	+ 89	+ 54					100	120
+ 40	+15	+45	+27	+ 52	+ 27	+61	+43	+ 68	+ 43	+ 88	+ 63	+103	+ 63	5	8	18	40	120	140
										+ 90	+ 65	+105	+ 65					140	160
										+ 93	+ 68	+108	+ 68					160	180
+ 46	+17	+51	+31	+ 60	+ 31	+70	+50	+ 79	+ 50	+106	+ 77	+123	+ 77	7	10	20	46	180	200
										+109	+ 80	+126	+ 80					200	225
										+113	+ 84	+130	+ 84					225	250
+ 52	+20	+57	+34	+ 66	+ 34	+79	+56	+ 88	+ 56	+126	+ 94	+146	+ 94	8	12	23	52	250	280
										+130	+ 98	+150	+ 98					280	315
+ 57	+21	+62	+37	+ 73	+ 37	+87	+62	+ 98	+ 62	+144	+108	+165	+108	9	13	25	57	315	355
										+150	+114	+171	+114					355	400
+ 63	+23	+67	+40	+ 80	+ 40	+95	+68	+108	+ 68	+166	+126	+189	+126	10	15	27	63	400	450
										+172	+132	+195	+132					450	500
+ 70	+26	–	–	+ 88	+ 44	–	–	+122	+ 78	+194	+150	+220	+150	11	16	30	70	500	560
										+199	+155	+225	+155					560	630
+ 80	+30	–	–	+100	+ 50	–	–	+138	+ 88	+225	+175	+255	+175	13	18	35	80	630	710
										+235	+185	+265	+185					710	800
+ 90	+34	–	–	+112	+ 56	–	–	+156	+100	+266	+210	+300	+210	15	21	40	90	800	900
										+276	+220	+310	+220					900	1 000
+106	+40	–	–	+132	+ 66	–	–	+186	+120	+316	+250	+355	+250	18	24	46	105	1 000	1 120
										+326	+260	+365	+260					1 120	1 250
+126	+48	–	–	+156	+ 78	–	–	+218	+140	+378	+300	+425	+300	21	29	54	125	1 250	1 400
										+408	+330	+455	+330					1 400	1 600
+150	+58	–	–	+184	+ 92	–	–	+262	+170	+462	+370	+520	+370	25	35	65	150	1 600	1 800
										+492	+400	+550	+400					1 800	2 000
+178	+68	–	–	+220	+110	–	–	+305	+195	+550	+440	+615	+440	30	41	77	175	2 000	2 240
										+570	+460	+635	+460					2 240	2 500
+211	+76	–	–	+270	+135	–	–	+375	+240	+685	+550	+760	+550	36	50	93	210	2 500	2 800
										+715	+580	+790	+580					2 800	3 150

Appendix Tables

Appendix table-8: Dimensional tolerance for housing bore

Diameter division mm Over	Incl.	E7 Upper	E7 Lower	E10 Upper	E10 Lower	E11 Upper	E11 Lower	E12 Upper	E12 Lower	F6 Upper	F6 Lower	F7 Upper	F7 Lower	F8 Upper	F8 Lower	G6 Upper	G6 Lower
–	3	+24	+14	+54	+14	+74	+14	+114	+14	+12	+6	+16	+6	+20	+6	+8	+2
3	6	+32	+20	+68	+20	+95	+20	+140	+20	+18	+10	+22	+10	+28	+10	+12	+4
6	10	+40	+25	+83	+25	+115	+25	+175	+25	+22	+13	+28	+13	+35	+13	+14	+5
10	18	+50	+32	+102	+32	+142	+32	+212	+32	+27	+16	+34	+16	+43	+16	+17	+6
18	30	+61	+40	+124	+40	+170	+40	+250	+40	+33	+20	+41	+20	+53	+20	+20	+7
30 40	40 50	+75	+50	+150	+50	+210	+50	+300	+50	+41	+25	+50	+25	+64	+25	+25	+9
50 65	65 80	+90	+60	+180	+60	+250	+60	+360	+60	+49	+30	+60	+30	+76	+30	+29	+10
80 100	100 120	+107	+72	+212	+72	+292	+72	+422	+72	+58	+36	+71	+36	+90	+36	+34	+12
120 140 160	140 160 180	+125	+85	+245	+85	+335	+85	+485	+85	+68	+43	+83	+43	+106	+43	+39	+14
180 200 225	200 225 250	+146	+100	+285	+100	+390	+100	+560	+100	+79	+50	+96	+50	+122	+50	+44	+15
250 280	280 315	+162	+110	+320	+110	+430	+110	+630	+110	+88	+56	+108	+56	+137	+56	+49	+17
315 355	355 400	+182	+125	+355	+125	+485	+125	+695	+125	+98	+62	+119	+62	+151	+62	+54	+18
400 450	450 500	+198	+135	+385	+135	+535	+135	+765	+135	+108	+68	+131	+68	+165	+68	+60	+20
500 560	560 630	+215	+145	+425	+145	+585	+145	+845	+145	+120	+76	+146	+76	+186	+76	+66	+22
630 710	710 800	+240	+160	+480	+160	+660	+160	+960	+160	+130	+80	+160	+80	+205	+80	+74	+24
800 900	900 1 000	+260	+170	+530	+170	+730	+170	+1 070	+170	+142	+86	+176	+86	+226	+86	+82	+26
1 000 1 120	1 120 1 250	+300	+195	+615	+195	+855	+195	+1 245	+195	+164	+98	+203	+98	+263	+98	+94	+28
1 250 1 400	1 400 1 600	+345	+220	+720	+220	+1 000	+220	+1 470	+220	+188	+110	+235	+110	+305	+110	+108	+30
1 600 1 800	1 800 2 000	+390	+240	+840	+240	+1 160	+240	+1 740	+240	+212	+120	+270	+120	+350	+120	+124	+32
2 000 2 240	2 240 2 500	+435	+260	+960	+260	+1 360	+260	+2 010	+260	+240	+130	+305	+130	+410	+130	+144	+34
2 500 2 800	2 800 3 150	+500	+290	+1 150	+290	+1 640	+290	+2 390	+290	+280	+145	+355	+145	+475	+145	+173	+38

Unit: μm

G7 Upper	G7 Lower	H6 Upper	H6 Lower	H7 Upper	H7 Lower	H8 Upper	H8 Lower	H9 Upper	H9 Lower	H10 Upper	H10 Lower	H11 Upper	H11 Lower	H13 Upper	H13 Lower	Diameter division mm Over	Incl.
+12	+2	+6	0	+10	0	+14	0	+25	0	+40	0	+60	0	+140	0	–	3
+16	+4	+8	0	+12	0	+18	0	+30	0	+48	0	+75	0	+180	0	3	6
+20	+5	+9	0	+15	0	+22	0	+36	0	+58	0	+90	0	+220	0	6	10
+24	+6	+11	0	+18	0	+27	0	+43	0	+70	0	+110	0	+270	0	10	18
+28	+7	+13	0	+21	0	+33	0	+52	0	+84	0	+130	0	+330	0	18	30
+34	+9	+16	0	+25	0	+39	0	+62	0	+100	0	+160	0	+390	0	30 40	40 50
+40	+10	+19	0	+30	0	+46	0	+74	0	+120	0	+190	0	+460	0	50 65	65 80
+47	+12	+22	0	+35	0	+54	0	+87	0	+140	0	+220	0	+540	0	80 100	100 120
+54	+14	+25	0	+40	0	+63	0	+100	0	+160	0	+250	0	+630	0	120 140 160	140 160 180
+61	+15	+29	0	+46	0	+72	0	+115	0	+185	0	+290	0	+720	0	180 200 225	200 225 250
+69	+17	+32	0	+52	0	+81	0	+130	0	+210	0	+320	0	+810	0	250 280	280 315
+75	+18	+36	0	+57	0	+89	0	+140	0	+230	0	+360	0	+890	0	315 355	355 400
+83	+20	+40	0	+63	0	+97	0	+155	0	+250	0	+400	0	+970	0	400 450	450 500
+92	+22	+44	0	+70	0	+110	0	+175	0	+280	0	+440	0	+1 100	0	500 560	560 630
+104	+24	+50	0	+80	0	+125	0	+200	0	+320	0	+500	0	+1 250	0	630 710	710 800
+116	+26	+56	0	+90	0	+140	0	+230	0	+360	0	+560	0	+1 400	0	800 900	900 1 000
+133	+28	+66	0	+105	0	+165	0	+260	0	+420	0	+660	0	+1 650	0	1 000 1 120	1 120 1 250
+155	+30	+78	0	+125	0	+195	0	+310	0	+500	0	+780	0	+1 950	0	1 250 1 400	1 400 1 600
+182	+32	+92	0	+150	0	+230	0	+370	0	+600	0	+920	0	+2 300	0	1 600 1 800	1 800 2 000
+209	+34	+110	0	+175	0	+280	0	+440	0	+700	0	+1 100	0	+2 800	0	2 000 2 240	2 240 2 500
+248	+38	+135	0	+210	0	+330	0	+540	0	+860	0	+1 350	0	+3 300	0	2 500 2 800	2 800 3 150

Diameter division mm Over	Incl.	J6 Upper	J6 Lower	Js6 Upper	Js6 Lower	J7 Upper	J7 Lower	Js7 Upper	Js7 Lower	K5 Upper	K5 Lower	K6 Upper	K6 Lower	K7 Upper	K7 Lower	M6 Upper	M6 Lower
–	3	+2	−4	+3	−3	+4	−6	+5	−5	0	−4	0	−6	0	−10	−2	−8
3	6	+5	−3	+4	−4	+6	−6	+6	−6	0	−5	+2	−6	+3	−9	−1	−9
6	10	+5	−4	+4.5	−4.5	+8	−7	+7.5	−7.5	+1	−5	+2	−7	+5	−10	−3	−12
10	18	+6	−5	+5.5	−5.5	+10	−8	+9	−9	+2	−6	+2	−9	+6	−12	−4	−15
18	30	+8	−5	+6.5	−6.5	+12	−9	+10.5	−10.5	+1	−8	+2	−11	+6	−15	−4	−17
30 40	40 50	+10	−6	+8	−8	+14	−11	+12.5	−12.5	+2	−9	+3	−13	+7	−18	−4	−20
50 65	65 80	+13	−6	+9.5	−9.5	+18	−12	+15	−15	+3	−10	+4	−15	+9	−21	−5	−24
80 100	100 120	+16	−6	+11	−11	+22	−13	+17.5	−17.5	+2	−13	+4	−18	+10	−25	−6	−28
120 140 160	140 160 180	+18	−7	+12.5	−12.5	+26	−14	+20	−20	+3	−15	+4	−21	+12	−28	−8	−33
180 200 225	200 225 250	+22	−7	+14.5	−14.5	+30	−16	+23	−23	+2	−18	+5	−24	+13	−33	−8	−37
250 280	280 315	+25	−7	+16	−16	+36	−16	+26	−26	+3	−20	+5	−27	+16	−36	−9	−41
315 355	355 400	+29	−7	+18	−18	+39	−18	+28.5	−28.5	+3	−22	+7	−29	+17	−40	−10	−46
400 450	450 500	+33	−7	+20	−20	+43	−20	+31.5	−31.5	+2	−25	+8	−32	+18	−45	−10	−50
500 560	560 630	–	–	+22	−22	–	–	+35	−35	–	–	0	−44	0	−70	−26	−70
630 710	710 800	–	–	+25	−25	–	–	+40	−40	–	–	0	−50	0	−80	−30	−80
800 900	900 1 000	–	–	+28	−28	–	–	+45	−45	–	–	0	−56	0	−90	−34	−90
1 000 1 120	1 120 1 250	–	–	+33	−33	–	–	+52.5	−52.5	–	–	0	−66	0	−105	−40	−106
1 250 1 400	1 400 1 600	–	–	+39	−39	–	–	+62.5	−62.5	–	–	0	−78	0	−125	−48	−126
1 600 1 800	1 800 2 000	–	–	+46	−46	–	–	+75	−75	–	–	0	−92	0	−150	−58	−150
2 000 2 240	2 240 2 500	–	–	+55	−55	–	–	+87.5	−87.5	–	–	0	−110	0	−175	−68	−178
2 500 2 800	2 800 3 150	–	–	+67.5	−67.5	–	–	+105	−105	–	–	0	−135	0	−210	−76	−211

Unit: μm

M7 Upper	M7 Lower	N6 Upper	N6 Lower	N7 Upper	N7 Lower	P6 Upper	P6 Lower	P7 Upper	P7 Lower	R6 Upper	R6 Lower	R7 Upper	R7 Lower	Diameter division mm Over	Incl.
−2	−12	−4	−10	−4	−14	−6	−12	−6	−16	−10	−16	−10	−20	–	3
0	−12	−5	−13	−4	−16	−9	−17	−8	−20	−12	−20	−11	−23	3	6
0	−15	−7	−16	−4	−19	−12	−21	−9	−24	−16	−25	−13	−28	6	10
0	−18	−9	−20	−5	−23	−15	−26	−11	−29	−20	−31	−16	−34	10	18
0	−21	−11	−24	−7	−28	−18	−31	−14	−35	−24	−37	−20	−41	18	30
0	−25	−12	−28	−8	−33	−21	−37	−17	−42	−29	−45	−25	−50	30 40	40 50
0	−30	−14	−33	−9	−39	−26	−45	−21	−51	−35 −37	−54 −56	−30 −32	−60 −62	50 65	65 80
0	−35	−16	−38	−10	−45	−30	−52	−24	−59	−44 −47	−66 −69	−38 −41	−73 −76	80 100	100 120
0	−40	−20	−45	−12	−52	−36	−61	−28	−68	−56 −58 −61	−81 −83 −86	−48 −50 −53	−88 −90 −93	120 140 160	140 160 180
0	−46	−22	−51	−14	−60	−41	−70	−33	−79	−68 −71 −75	−97 −100 −104	−60 −63 −67	−106 −109 −113	180 200 225	200 225 250
0	−52	−25	−57	−14	−66	−47	−79	−36	−88	−85 −89	−117 −121	−74 −78	−126 −130	250 280	280 315
0	−57	−26	−62	−16	−73	−51	−87	−41	−98	−97 −103	−133 −139	−87 −93	−144 −150	315 355	355 400
0	−63	−27	−67	−17	−80	−55	−95	−45	−108	−113 −119	−153 −159	−103 −109	−166 −172	400 450	450 500
−26	−96	−44	−88	−44	−114	−78	−122	−78	−148	−150 −155	−194 −199	−150 −155	−220 −225	500 560	560 630
−30	−110	−50	−100	−50	−130	−88	−138	−88	−168	−175 −185	−225 −235	−175 −185	−225 −265	630 710	710 800
−34	−124	−56	−112	−56	−146	−100	−156	−100	−190	−210 −220	−266 −276	−210 −220	−300 −310	800 900	900 1 000
−40	−145	−66	−132	−66	−171	−120	−186	−120	−225	−250 −260	−316 −326	−250 −260	−355 −365	1 000 1 120	1 120 1 250
−48	−173	−78	−156	−78	−203	−140	−218	−140	−265	−300 −330	−378 −408	−300 −330	−425 −455	1 250 1 400	1 400 1 600
−58	−208	−92	−184	−92	−242	−170	−262	−170	−320	−370 −400	−462 −492	−370 −400	−520 −550	1 600 1 800	1 800 2 000
−68	−243	−110	−220	−110	−285	−195	−305	−195	−370	−440 −460	−550 −570	−440 −460	−615 −635	2 000 2 240	2 240 2 500
−76	−286	−135	−270	−135	−345	−240	−375	−240	−450	−550 −580	−685 −715	−550 −580	−760 −790	2 500 2 800	2 800 3 150

Appendix table-9: Basic tolerance

Unit: μm

Basic dimension mm		IT basic tolerance class									
Over	Incl.	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10
—	3	0.8	1.2	2	3	4	6	10	14	25	40
3	6	1	1.5	2.5	4	5	8	12	18	30	48
6	10	1	1.5	2.5	4	6	9	15	22	36	58
10	18	1.2	2	3	5	8	11	18	27	43	70
18	30	1.5	2.5	4	6	9	13	21	33	52	84
30	50	1.5	2.5	4	7	11	16	25	39	62	100
50	80	2	3	5	8	13	19	30	46	74	120
80	120	2.5	4	6	10	15	22	35	54	87	140
120	180	3.5	5	8	12	18	25	40	63	100	160
180	250	4.5	7	10	14	20	29	46	72	115	185
250	315	6	8	12	16	23	32	52	81	130	210
315	400	7	9	13	18	25	36	57	89	140	230
400	500	8	10	15	20	27	40	63	97	155	250
500	630	9	11	16	22	30	44	70	110	175	280
630	800	10	13	18	25	35	50	80	125	200	320
800	1 000	11	15	21	29	40	56	90	140	230	360
1 000	1 250	13	18	24	34	46	66	105	165	260	420
1 250	1 600	15	21	29	40	54	78	125	195	310	500
1 600	2 000	18	25	35	48	65	92	150	230	370	600
2 000	2 500	22	30	41	57	77	110	175	280	440	700
2 500	3 150	26	36	50	69	93	135	210	330	540	860

Appendix table-10: Viscosity conversion table

Dynamic viscosity mm^2/s	Saybolt SUS (second)	Redwood R″ (second)	Engler E (degree)
2.7	35	32.2	1.18
4.3	40	36.2	1.32
5.9	45	40.6	1.46
7.4	50	44.9	1.60
8.9	55	49.1	1.75
10.4	60	53.5	1.88
11.8	65	57.9	2.02
13.1	70	62.3	2.15
14.5	75	67.6	2.31
15.8	80	71.0	2.42
17.0	85	75.1	2.55
18.2	90	79.6	2.68
19.4	95	84.2	2.81
20.6	100	88.4	2.95
23.0	110	97.1	3.21
25.0	120	105.9	3.49
27.5	130	114.8	3.77
29.8	140	123.6	4.04
32.1	150	132.4	4.32
34.3	160	141.1	4.59
36.5	170	150.0	4.88
38.8	180	158.8	5.15
41.0	190	167.5	5.44
43.2	200	176.4	5.72
47.5	220	194.0	6.28
51.9	240	212	6.85
56.5	260	229	7.38
60.5	280	247	7.95
64.9	300	265	8.51
70.3	325	287	9.24
75.8	350	309	9.95
81.2	375	331	10.7
86.8	400	353	11.4
92.0	425	375	12.1
97.4	450	397	12.8
103	475	419	13.5
108	500	441	14.2
119	550	485	15.6
130	600	529	17.0
141	650	573	18.5
152	700	617	19.9
163	750	661	21.3
173	800	705	22.7
184	850	749	24.2
195	900	793	25.6
206	950	837	27.0
217	1 000	882	28.4
260	1 200	1 058	34.1
302	1 400	1 234	39.8
347	1 600	1 411	45.5
390	1 800	1 587	51
433	2 000	1 763	57
542	2 500	2 204	71
650	3 000	2 646	85
758	3 500	3 087	99
867	4 000	3 526	114
974	4 500	3 967	128
1082	5 000	4 408	142
1150	5 500	4 849	156
1300	6 000	5 290	170
1400	6 500	5 730	185
1510	7 000	6 171	199
1630	7 500	6 612	213
1740	8 000	7 053	227
1850	8 500	7 494	242
1960	9 000	7 934	256
2070	9 500	8 375	270
2200	10 000	8 816	284

Appendix table-11: Kgf to N conversion table

kgf		N	kgf		N	kgf		N
0.1020	**1**	9.8066	3.4670	**34**	333.43	6.8321	**67**	657.04
0.2039	**2**	19.613	3.5690	**35**	343.23	6.9341	**68**	666.85
0.3059	**3**	29.420	3.6710	**36**	353.04	7.0361	**69**	676.66
0.4079	**4**	39.227	3.7730	**37**	362.85	7.1380	**70**	686.46
0.5099	**5**	49.033	3.8749	**38**	372.65	7.2400	**71**	696.27
0.6118	**6**	58.840	3.9769	**39**	382.46	7.3420	**72**	706.08
0.7138	**7**	68.646	4.0789	**40**	392.27	7.4440	**73**	715.88
0.8158	**8**	78.453	4.1808	**41**	402.07	7.5459	**74**	725.69
0.9177	**9**	88.260	4.2828	**42**	411.88	7.6479	**75**	735.50
1.0197	**10**	98.066	4.3848	**43**	421.68	7.7499	**76**	745.30
1.1217	**11**	107.87	4.4868	**44**	431.49	7.8518	**77**	755.11
1.2237	**12**	117.68	4.5887	**45**	441.30	7.9538	**78**	764.92
1.3256	**13**	127.49	4.6907	**46**	451.10	8.0558	**79**	774.72
1.4276	**14**	137.29	4.7927	**47**	460.91	8.1578	**80**	784.53
1.5296	**15**	147.10	4.8946	**48**	470.72	8.2597	**81**	794.34
1.6316	**16**	156.91	4.9966	**49**	480.52	8.3617	**82**	804.14
1.7335	**17**	166.71	5.0986	**50**	490.33	8.4637	**83**	813.95
1.8355	**18**	176.52	5.2006	**51**	500.14	8.5656	**84**	823.76
1.9375	**19**	186.33	5.3025	**52**	509.94	8.6676	**85**	833.56
2.0394	**20**	196.13	5.4045	**53**	519.75	8.7696	**86**	843.37
2.1414	**21**	205.94	5.5065	**54**	529.56	8.8716	**87**	853.18
2.2434	**22**	215.75	5.6085	**55**	539.36	8.9735	**88**	862.98
2.3454	**23**	225.55	5.7104	**56**	549.17	9.0755	**89**	872.79
2.4473	**24**	235.36	5.8124	**57**	558.98	9.1775	**90**	882.60
2.5493	**25**	245.17	5.9144	**58**	568.78	9.2794	**91**	892.40
2.6513	**26**	254.97	6.0163	**59**	578.59	9.3814	**92**	902.21
2.7532	**27**	264.78	6.1183	**60**	588.40	9.4834	**93**	912.02
2.8552	**28**	274.59	6.2203	**61**	598.20	9.5854	**94**	921.82
2.9572	**29**	284.39	6.3223	**62**	608.01	9.6873	**95**	931.63
3.0592	**30**	294.20	6.4242	**63**	617.82	9.7893	**96**	941.44
3.1611	**31**	304.01	6.5262	**64**	627.62	9.8913	**97**	951.24
3.2631	**32**	313.81	6.6282	**65**	637.43	9.9932	**98**	961.05
3.3651	**33**	323.62	6.7302	**66**	647.24	10.0952	**99**	970.86

[How to read the table] If for example you want to convert 10 kgf to N, find "10" in the middle column of the first set of columns. Look in the N column directly to the right of "10," and you will see that 10 kgf equals 98.066 N. Oppositely, to convert 10 N to kgf, look in the kgf column to the left of "10" and you will see that 10 N equals 1.0197 kgf.

1kgf=9.80665N
1N=0.101972kgf

Appendix table-12: Inch / millimeter conversion table

Inch		0″	1″	2″	3″	4″	5″	6″	7″	8″	9″
Fraction	Decimal										
			25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600
1/64	0.015625	0.397	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997
1/32	0.031250	0.794	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394
3/64	0.046875	1.191	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791
1/16	0.062500	1.588	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188
5/64	0.078125	1.984	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584
3/32	0.093750	2.381	27.781	53.181	48.581	103.981	129.381	154.781	180.181	205.581	230.981
7/64	0.109375	2.778	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378
1/ 8	0.125000	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775
9/64	0.140625	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172
5/32	0.156250	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569
11/64	0.171875	4.366	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966
3/16	0.187500	4.762	30.162	55.562	80.962	106.362	131.762	157.162	182.562	207.962	233.362
13/64	0.203125	5.159	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759
7/32	0.218750	5.556	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156
15/64	0.234375	5.953	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553
1/ 4	0.250000	6.350	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950
17/64	0.265625	6.747	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347
9/32	0.281250	7.144	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744
19/64	0.296875	7.541	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141
5/16	0.312500	7.938	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538
21/64	0.328125	8.334	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934
11/32	0.343750	8.731	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331
23/64	0.359375	9.128	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728
3/ 8	0.375000	9.525	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125
25/64	0.390625	9.922	35.322	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522
13/32	0.406250	10.319	35.719	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919
27/64	0.421875	10.716	36.116	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316
7/16	0.437500	11.112	36.512	61.912	87.312	112.721	138.112	163.512	188.912	214.312	239.712
29/64	0.453125	11.509	36.909	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109
15/32	0.468750	11.906	37.306	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506
31/64	0.484375	12.303	37.703	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903
1/ 2	0.500000	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300
33/64	0.515625	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697
17/32	0.531250	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094
35/64	0.546875	13.891	39.291	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491
9/16	0.562500	14.288	39.688	65.088	90.488	115.888	141.283	166.688	192.088	217.488	242.888
37/64	0.578125	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284
19/32	0.593750	15.081	40.481	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681
39/64	0.609375	15.478	40.878	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078
5/ 8	0.625000	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475
41/64	0.640625	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872
21/32	0.656250	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269
43/64	0.671875	17.066	42.466	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666
11/16	0.687500	17.462	42.862	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062
45/64	0.703125	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.056	246.459
23/32	0.718750	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856
47/64	0.734375	18.653	44.053	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253
3/ 4	0.750000	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650
49/64	0.765625	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047
25/32	0.781250	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444
51/64	0.796875	20.241	45.641	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841
13/16	0.812500	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238
53/64	0.828125	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634
27/32	0.843750	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031
55/64	0.859375	21.828	47.228	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428
7/ 8	0.875000	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825
57/64	0.890625	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222
29/32	0.906250	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619
59/64	0.921875	23.416	48.816	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016
15/16	0.937500	23.812	49.212	74.612	100.012	125.412	150.812	176.212	201.612	227.012	252.412
61/64	0.953125	24.209	49.609	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809
31/32	0.968750	24.606	50.006	75.406	100.806	126.206	151.606	177.006	202.406	227.806	253.206
63/64	0.984375	25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603

Appendix table-13: Hardness conversion table (reference)-1

Rockwell hardness C scale 1471.0N	Vickers hardness	Brinell hardness Standard steel balls	Brinell hardness Tungsten carbide steel balls	Rockwell hardness A scale 588.4N	Rockwell hardness B scale 980.7N	Shore hardness
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	—	560	78.5		74
54	577	—	543	78.0		72
53	560	—	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421	421	73.1		60
44	434	409	409	72.5		58
43	423	400	400	72.0		57
42	412	390	390	71.5		56
41	402	381	381	70.9		55
40	392	371	371	70.4	—	54
39	382	362	362	69.9	—	52
38	372	353	353	69.4	—	51
37	363	344	344	68.9	—	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35

1) Quoted from hardness conversion table (SAE J 417)

Appendix table-13: Hardness conversion table (reference)-2

Rockwell hardness C scale 1471.0N	Vickers hardness	Brinell hardness Standard steel balls	Brinell hardness Tungsten carbide steel balls	Rockwell hardness A scale 588.4N	Rockwell hardness B scale 980.7N	Shore hardness
20	238	226	226	60.5	97.8	34
(18)	230	219	219	—	96.7	33
(16)	222	212	212	—	95.5	32
(14)	213	203	203	—	93.9	31
(12)	204	194	194	—	92.3	29
(10)	196	187	187		90.7	28
(8)	188	179	179		89.5	27
(6)	180	171	171		87.1	26
(4)	173	165	165		85.5	25
(2)	166	158	158		83.5	24
(0)	160	152	152		81.7	24

1) Quoted from hardness conversion table (SAE J 417)

Appendix table-14: Kg to lb conversion table

kg		lb	kg		lb	kg		lb
0.454	**1**	2.205	15.422	**34**	74.957	30.391	**67**	147.71
0.907	**2**	4.409	15.876	**35**	77.162	30.844	**68**	149.91
1.361	**3**	6.614	16.329	**36**	79.366	31.298	**69**	152.12
1.814	**4**	8.818	16.783	**37**	81.571	31.751	**70**	154.32
2.268	**5**	11.023	17.237	**38**	83.776	32.205	**71**	156.53
2.722	**6**	13.228	17.690	**39**	85.980	32.659	**72**	158.73
3.175	**7**	15.432	18.144	**40**	88.185	33.112	**73**	160.94
3.629	**8**	17.637	18.597	**41**	90.390	33.566	**74**	163.14
4.082	**9**	19.842	19.051	**42**	92.594	34.019	**75**	165.35
4.536	**10**	22.046	19.504	**43**	94.799	34.473	**76**	167.55
4.990	**11**	24.251	19.958	**44**	97.003	34.927	**77**	169.76
5.443	**12**	26.455	20.412	**45**	99.208	35.380	**78**	171.96
5.897	**13**	28.660	20.865	**46**	101.41	35.834	**79**	174.17
6.350	**14**	30.865	21.319	**47**	103.62	36.257	**80**	176.37
6.804	**15**	33.069	21.772	**48**	105.82	36.741	**81**	178.57
7.257	**16**	35.274	22.226	**49**	108.03	37.195	**82**	180.78
7.711	**17**	37.479	22.680	**50**	110.23	37.648	**83**	182.98
8.165	**18**	39.683	23.133	**51**	112.44	38.102	**84**	185.19
8.618	**19**	41.888	23.587	**52**	114.64	38.555	**85**	187.39
9.072	**20**	44.092	24.040	**53**	116.84	39.009	**86**	189.60
9.525	**21**	46.297	24.494	**54**	119.05	39.463	**87**	191.80
9.979	**22**	48.502	24.948	**55**	121.25	39.916	**88**	194.01
10.433	**23**	50.706	25.401	**56**	123.46	40.370	**89**	196.21
10.886	**24**	62.911	26.855	**57**	125.66	40.823	**90**	198.42
11.340	**25**	55.116	26.308	**58**	127.87	41.277	**91**	200.62
11.793	**26**	57.320	26.762	**59**	130.07	41.730	**92**	202.83
12.247	**27**	59.525	27.216	**60**	132.28	42.184	**93**	205.03
12.701	**28**	61.729	27.669	**61**	134.48	42.638	**94**	207.23
13.154	**29**	63.934	28.123	**62**	136.69	43.091	**95**	209.44
13.608	**30**	66.139	28.576	**63**	138.69	43.546	**96**	211.64
14.061	**31**	68.343	29.030	**64**	141.10	43.996	**97**	213.85
14.515	**32**	70.548	29.484	**65**	143.30	44.452	**98**	216.05
14.969	**33**	72.753	29.937	**66**	145.51	44.906	**99**	218.26

[How to read the table] If for example you want to convert 10 kg to lb, find "10" in the middle column of the first set of columns. Look in the lb column directly to the right of "10," and you will see that 10 kg equals 22.046 lb. Oppositely, to convert 10 lb to kg, look in the kg column to the left of "10" and you will see that 10 lb equals 4.536 kg.

1kg = 2.2046226 lb
1lb = 0.45359237 kg

Appendix table 15: °C to °F conversion table

℃		℉	℃		℉	℃		℉	℃		℉
−73.3	**−100**	−148.0	0.0	**32**	89.6	21.7	**71**	159.8	43.3	**110**	230
−62.2	**−80**	−112.0	0.6	**33**	91.4	22.2	**72**	161.6	46.1	**115**	239
−51.1	**−60**	− 76.0	1.1	**34**	93.2	22.8	**73**	163.4	48.9	**120**	248
−40.0	**−40**	− 40.0	1.7	**35**	95.0	23.3	**74**	165.2	51.7	**125**	257
−34.4	**−30**	− 22.0	2.2	**36**	96.8	23.9	**75**	167.0	54.4	**130**	266
−28.9	**−20**	− 4.0	2.8	**37**	98.6	24.4	**76**	168.8	57.2	**135**	275
−23.3	**−10**	14.0	3.3	**38**	100.4	25.0	**77**	170.6	60.0	**140**	284
−17.8	**0**	32.0	3.9	**39**	102.2	25.6	**78**	172.4	65.6	**150**	302
−17.2	**1**	33.8	4.4	**40**	104.0	26.1	**79**	174.2	71.1	**160**	320
−16.7	**2**	35.6	5.0	**41**	105.8	26.7	**80**	176.0	76.7	**170**	338
−16.1	**3**	37.4	5.6	**42**	107.6	27.2	**81**	177.8	82.2	**180**	356
−15.6	**4**	39.2	6.1	**43**	109.4	27.8	**82**	179.6	87.8	**190**	374
−15.0	**5**	41.0	6.7	**44**	111.2	28.3	**83**	181.4	93.3	**200**	392
−14.4	**6**	42.8	7.2	**45**	113.0	28.9	**84**	183.2	98.9	**210**	410
−13.9	**7**	44.6	7.8	**46**	114.8	29.4	**85**	185.0	104.4	**220**	428
−13.3	**8**	46.4	8.3	**47**	116.6	30.0	**86**	186.8	110.0	**230**	446
−12.8	**9**	48.2	8.9	**48**	118.4	30.6	**87**	188.6	115.6	**240**	464
−12.2	**10**	50.0	9.4	**49**	120.2	31.1	**88**	190.4	121.1	**250**	482
−11.7	**11**	51.0	10.0	**50**	122.0	31.7	**89**	192.2	148.9	**300**	572
−11.1	**12**	53.6	10.6	**51**	123.8	32.2	**90**	194.0	176.7	**350**	662
−10.6	**13**	55.4	11.1	**52**	125.6	32.8	**91**	195.8	204	**400**	752
−10.0	**14**	57.2	11.7	**53**	127.4	33.3	**92**	197.6	232	**450**	842
− 9.4	**15**	59.0	12.2	**54**	129.2	33.9	**93**	199.4	260	**500**	932
− 8.9	**16**	60.8	12.6	**55**	131.0	34.4	**94**	201.2	288	**550**	1022
− 8.3	**17**	62.6	13.3	**56**	132.8	35.0	**95**	203.0	316	**600**	1112
− 7.8	**18**	64.4	13.9	**57**	134.6	35.6	**96**	204.6	343	**650**	1202
− 7.2	**19**	66.2	14.4	**58**	136.4	36.1	**97**	206.6	371	**700**	1292
− 6.7	**20**	68.0	15.0	**59**	138.2	36.7	**98**	208.4	399	**750**	1382
− 6.1	**21**	69.8	15.6	**60**	140.0	37.2	**99**	210.2	427	**800**	1472
− 5.6	**22**	71.5	15.1	**61**	141.8	37.8	**100**	212.0	454	**850**	1562
− 5.0	**23**	73.4	16.7	**62**	143.6	38.3	**101**	213.8	482	**900**	1652
− 4.4	**24**	76.2	17.2	**63**	145.4	38.9	**102**	215.6	510	**950**	1742
− 3.9	**25**	77.0	17.8	**64**	147.2	39.4	**103**	217.4	538	**1000**	1832
− 3.3	**26**	78.8	18.3	**65**	149.0	40.0	**104**	219.2	593	**1100**	2012
− 2.8	**27**	80.5	18.9	**66**	150.8	40.6	**105**	221.0	649	**1200**	2192
− 2.2	**28**	82.4	19.4	**67**	152.6	41.1	**106**	222.6	704	**1300**	2372
− 1.7	**29**	84.2	20.0	**68**	154.4	41.7	**107**	224.6	760	**1400**	2562
− 1.1	**30**	86.0	20.6	**69**	156.2	42.2	**108**	226.4	816	**1500**	2732
− 0.6	**31**	87.8	21.1	**70**	158.0	42.8	**109**	228.2	871	**1600**	2912

[How to read the table] If for example you want to convert 10°C to °F, find "10" in the middle column of the first set of columns. Look in the °F column directly to the right of "10," and you will see that 10°C equals 50.0 °F. Oppositely, to convert 10°F to °C, look in the °C column to the left of "10" and you will see that 10°F equals -12.2°C.

[Conversion formula]

$°C = \frac{5}{9}(°F-32)$

$°F = 32 + \frac{9}{5}°C$

Appendix table-16: Greek alphabet list

Roman type (upright)	Italic type (slanted)		Name
Upper case	Upper case	Lower case	
Α	A	α	Alpha
Β	B	β	Beta
Γ	$\mathit{\Gamma}$	γ	Gamma
Δ	$\mathit{\Delta}$	δ	Delta
Ε	E	ε	Epsilon
Ζ	Z	ζ	Zeta
Η	H	η	Eta
Θ	$\mathit{\Theta}$	θ	Theta
Ι	I	ι	Iota
Κ	K	κ	Kappa
Λ	$\mathit{\Lambda}$	λ	Lambda
Μ	M	μ	Mu
Ν	N	ν	Nu
Ξ	$\mathit{\Xi}$	ξ	Xi
Ο	O	o	Omicron
Π	$\mathit{\Pi}$	π	Pi
Ρ	P	ρ	Rho
Σ	$\mathit{\Sigma}$	σ	Sigma
Τ	T	τ	Tau
Υ	$\mathit{\Upsilon}$	υ	Upsolon
Φ	$\mathit{\Phi}$	ϕ	Phi
Χ	X	χ	Khi
Ψ	$\mathit{\Psi}$	ψ	Psi
Ω	$\mathit{\Omega}$	ω	Omega

MEMO

NTN®

UD FONT

AE81 CAT.No.2203/E 20.09.06 NI/NI