

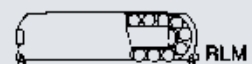
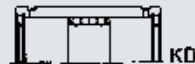
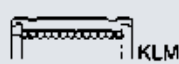
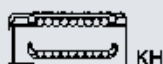
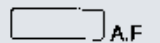
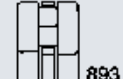
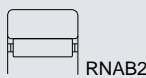
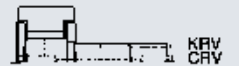
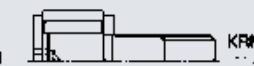
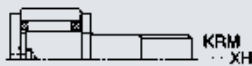
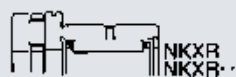
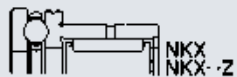
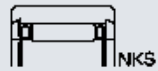
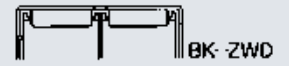
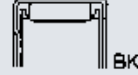
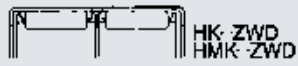
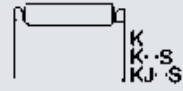
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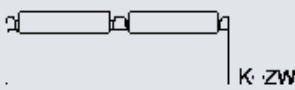
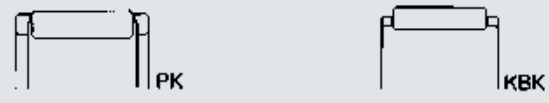
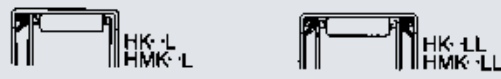
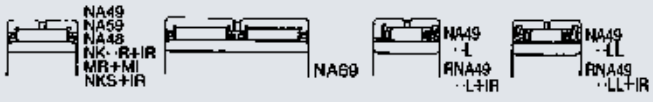

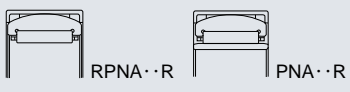

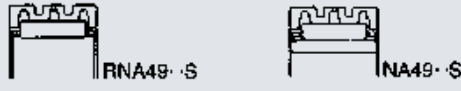
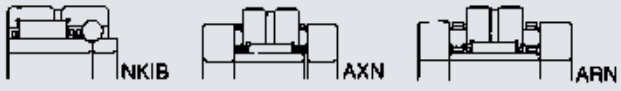
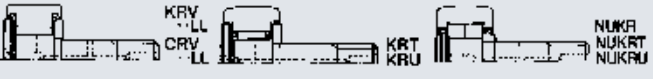
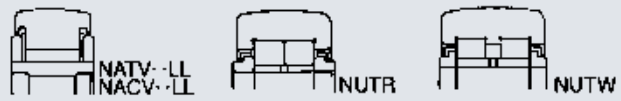
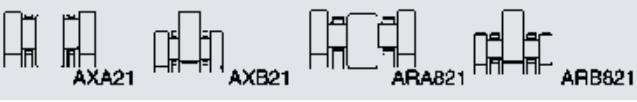


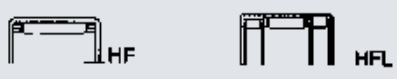
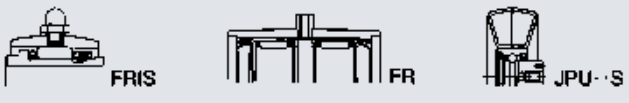
# Needle Roller Bearings



CAT. NO. **2300-X/E**

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## Warranty

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

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

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

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

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

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**NTN**

**Needle Roller Bearings**

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## 1. Classification and Characteristics of Needle Bearings

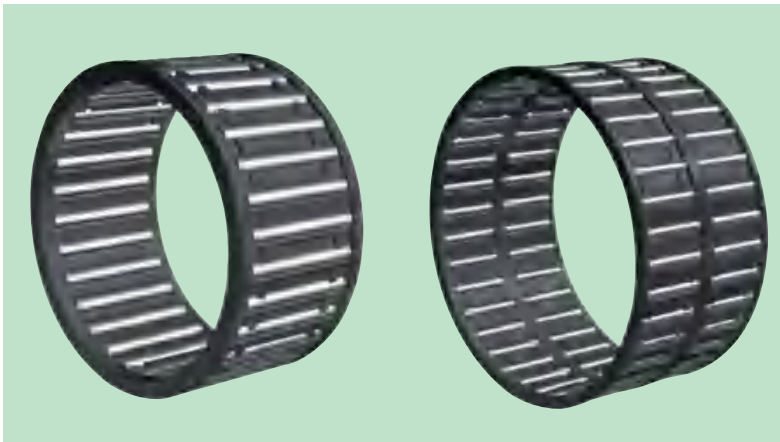
Needle roller bearings have relatively small diameter cylindrical rolling elements whose length is much larger than their diameter.

Compared with other types of rolling bearings, needle roller bearings have a small cross-sectional height and significant load-bearing capacity and rigidity relative to their volume. Also, because the inertial forces acting on

them is limited, they are an ideal choice for applications with oscillating motion. Needle roller bearings also work well in compact and lightweight machine designs and they serve as a ready replacement for sliding bearings.

NTN offers several different types of needle roller bearings.

### Needle roller and cage assembly



A needle roller and cage assembly includes needle rollers and a cage that guides and retains the rollers.

- | These assemblies use both the shaft and housing as raceway surfaces. Consequently, the cross-sectional thickness of the assembly is small, roughly equivalent to the diameter of the needle rollers.
- | Because this bearing type has no inner or outer rings, the installation is much easier.
- | These assemblies are available in both single-row and double-row configurations.
- | As long as the tolerance limits of the shaft and housing are satisfied, the bearing radial internal clearance can be adjusted.

### Needle roller and cage assembly for connecting rods

A needle roller and cage assembly for connecting rods includes needle rollers and a cage that guides and retains the rollers. This bearing type is used for connecting rods in compact and mid-sized internal combustion engines (e.g. outboard engines and multipurpose engines), as well as reciprocating compressors.

### Needle roller and cage assembly for large end



- | This product boasts a unique light-weight high-strength design to cope with crank motion involving the simultaneous rotation and revolution on the large-end side of connecting rod. At the same time, the outer diameter of the cage surface is precision-finished so that the assembly maintains the appropriate cage-riding clearance.
- | The cage is made of high-tensile special steel with a surface hardened treatment.
- | The assembly uses an outer diameter-guided system.
- | If an application has poor lubrication, the cage can be protected with a surface treatment using a non-ferrous metal.
- | For applications with a one-piece crank shaft, split-type cage design is also available.

## Needle roller and cage assembly for small end connecting rods



- | The small end of connecting rods are subjected to high impact loads and high-speed oscillation. To address this condition, these bearings boast a unique light-weight high-strength design. In addition the cage bore surface is precision-finished so that the assembly maintains an appropriate cage-riding clearance.
- | The cage is made from high tensile special steel and the cage surface is hardened.
- | The cage is bore-guided and the guide surface is designed to be as long as possible to minimize surface pressure.
- | Rollers with the longest possible length are used. At the same time, the maximum number of smaller diameter rollers are incorporated in order to reduce the contact pressure on the rollers.

## Drawn-cup needle roller bearing



- | This bearing type includes an outer ring and needle rollers, which are both drawn from special thin steel plate by precision deep drawing, and a cage which guides the needle rollers precisely.
- | This bearing product comprises an outer ring formed through precision deep-drawing process from a thin special steel blank; needle rollers; and cage that guides the rollers.
- | A hardened and ground shaft or inner ring (IR Series) is used as the raceway.
- | This bearing needs no axial clamping due to easy installation and a press-fit in the housing.
- | Both a closed end type to close around the end of the shaft and an open end type are available.
- | Furthermore, a type with a seal installed on a single side or on both sides is also available.
- | The standard type includes a needle roller and cage assembly. In addition to this type, a special type with full complement rollers is available as an option.

## Machined-ring needle roller bearings



- | This product mainly includes machined components — an outer ring and inner ring, needle rollers and a cage that guides the rollers. In this bearing, the cage or needle rollers are guided by the rib or side plate of the outer ring. Consequently, the roller and cage assembly cannot be separated from the outer ring. When the user wants to use the shaft as the raceway surface, NTN can offer a variant without an inner ring.
- | Available in both metric dimensions and inch dimensions.
- | This product is best-suited to a space-saving design due to its low section height, and large load capacity.
- | Another advantage is high rigidity and high bearing accuracy due to the machined outer ring.
- | This bearing can be used with a housing made of light metal, because of its highly rigid outer ring. (Other than NKS small size products)
- | The outer ring has a lubrication hole and lubrication groove.
- | Both single-row and double-row types are available.
- | A type with seal installed on a single side or on both sides is also available.

## Machined-ring needle roller bearing separable type



This product is essentially comprised of a machined outer ring, inner ring, and, needle rollers with a cage to guide the rollers. With this bearing, the roller and cage assembly can be separated from the outer ring. If the user wants to use the shaft directly as a raceway surface, NTN offers a variant that lacks inner ring.

- ┆ Easy to install: The following components can be mounted independently: cage and roller assembly, and the inner and outer rings.
- ┆ Radial Internal Clearance: Radial internal clearance is selected by combining individual independent components with the desired clearance.
- ┆ Space Saving Design: Best-suited to save space because of its low section height and large load capacity.
- ┆ High Rigidity: The machined (precut) outer ring allows the bearing to have high rigidity and high bearing.
- ┆ Housing Material: This bearing can be mounted in light alloy housings because of the outer ring high rigidity.
- ┆ Single and double row types bearings available. The outer ring of the double row bearing has a lubrication hole and groove.

## Inner ring



Most needle roller bearings lack an inner ring and use the shaft as raceway surface. However, there may be cases where the shaft surface cannot be changed on the machine to the required hardness and/or roughness so in this case an inner ring may be used. NTN inner rings are made of high carbon chromium bearing steel blank that is heat-treated, and then finish-ground to higher precision.

- ┆ Can also be used as a bushing.
- ┆ Available in both metric and inch series.
- ┆ Lubrication hole type at the raceway center is also available.

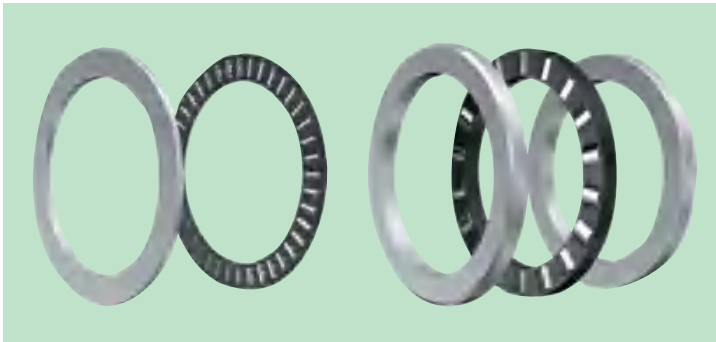
## Clearance-adjustable needle roller bearing



This product is essentially comprised of a machined outer ring, inner ring, and, needle rollers with a cage to guide the rollers. This product features an outer ring with a unique cross-sections shape machined from a solid blank material. With this bearing, the roller and cage assembly cannot be separated from the outer ring. If the user wants to use the shaft directly as a raceway surface, NTN offers a variant that lacks inner ring.

- ┆ Clearance Reduction: The outer ring raceway diameter is reduced by clamping the outer ring axially, which then reduces the roller assembly bore diameter.
- ┆ Clearance Adjustment: Axial clamping force on the bearing can be adjusted to alter the reduction on outer ring raceway diameter.
- ┆ Application: This bearing is used on machine tools main spindle and other similar applications which require high speed rotational accuracy of JIS Grade-4.

## Thrust roller bearing



The product is comprised of needle or cylindrical rollers, a cage that guides and retains the rollers, and a disk shaped bearing ring, and is capable of holding an axial load in one direction. The mounting surface can be used as raceway surface when the mounting surface are beat-treated and finished. As a result, the bearing can be supplied without bearing ring raceways.

- ┆ Space Saving Design: Best-suited to save space because of its small section height and large load capacity.
- ┆ Bearing Types: Current available bearing ring types are AS, WS, GS, and ZS. The AS type consists of a thin steel disk having undergone surface-hardening, while the WS, GS and ZS types are machined.

## Complex needle roller bearings — Needle roller bearing with thrust bearing —



This complex bearing is comprised of a needle roller bearing for supporting radial load and a thrust bearing for supporting axial load which are assembled integrally. Both thrust ball bearing and thrust roller bearing type are available to support axial load.

- ┆ A variant of thrust bearing are equipped with a dust cover that positively prevents outward release of oil splash and protects the bearing against ingress of dust.

## Complex needle roller bearings

### — Needle roller bearing with angular contact ball bearing, needle roller bearing with three-point contact ball bearing —



This complex bearing is comprised of a needle roller bearing for supporting radial load, a ball bearing for supporting comparatively small axial load and machined inner and outer rings which are all assembled integrally. Both angular contact ball bearing and three-point contact ball bearing are available to support the axial load.

- ┆ The complex needle roller bearings (NKIA Series) use an angular contact ball bearing as the thrust bearing to support a one-directional axial load.
- ┆ The complex needle roller bearings (NKIB Series) use a three-point contact ball bearing as the thrust bearing to support a double-directional axial load in addition the position in axial direction can be fixed.

## Needle roller bearing with double thrust roller bearing



This is a complex bearing wherein a thrust needle roller bearing or a thrust cylindrical roller bearing intends to support an axial load is configured at the double sides of a radial needle roller bearing for supporting radial load.

- ┆ Bi-Direction Axial Loading: This bearing can support large axial loads from both sides.
- ┆ Application: This complex bearing is designed to support a machine tool precision ball screw.

The track roller bearing is a needle roller bearing with thick outer ring, which is applied to cam roller, guide roller, eccentric roller or rocker arm.

The track roller bearings are mainly categorized into a stud type track roller bearing (cam follower) and a yoke type track roller bearing (roller follower). Various types of the roller follower and the cam follower are available.

## Cam follower — Needle roller type —



- This is a bearing designed for rotation of the outer ring. A needle roller and cage assembly and a stud instead of inner ring are fitted in the thick-walled outer ring. The stud is threaded to be mounted easily. This cam follower (bearing) uses needle rollers as its rolling element and it is available with cage or full complement roller bearing type without cage.
- ┆ The bearing type with cage is suitable to comparatively high speed running because its rollers are guided by the cage.
  - ┆ Having more rollers relative to a given size, a full complement roller type boasts greater load capacity.
  - ┆ The outer surface is available in both spherical (crowning) profile and cylindrical profile.
  - ┆ This cam follower (bearing) is selectively available in both metric and inch sizes.
  - ┆ A seal built-in type is also available.
  - ┆ The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

## Cam follower — Cylindrical roller type —



- This is a full complement roller bearing designed for rotation of the outer ring. Double-row cylindrical rollers and a stud instead of inner ring are fitted in the thick-walled outer ring. The stud is threaded to be mounted easily.
- ┆ Compared with needle roller type of a given size, cylindrical roller type of a similar size boasts greater load capacity.
  - ┆ A steel plate is press-fitted in the outer ring and a labyrinth seal is formed between the face ring and the outer ring.
  - ┆ The outer surface is available in both spherical (crowning) profile and cylindrical profile.
  - ┆ The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

## Cam follower — Eccentric type —



- This is a cam follower (bearing) where the studs of the needle roller type and cylindrical roller type are prescribed and made eccentric. It can then be adjusted by making eccentric the outer ring relative position against the raceway.
- ┆ Load distribution is easily adjustable in configuring two or more cam followers in linear form.
  - ┆ Preload can be applied by adjustment of load distribution.
  - ┆ Alignment is possible even when the mounting hole is not processed in high accuracy.
  - ┆ The outer surface is selectively available in both spherical (crowning) profile and cylindrical profile.
  - ┆ The stud is either a recessed head type allowing use of a screwdriver or hexagon socket head type so as to be mounted and adjusted easily.

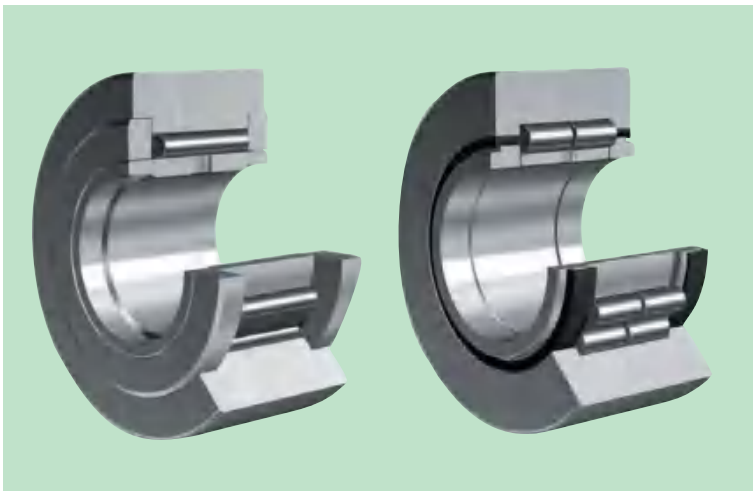
## Roller follower — Without axial guide —



This roller follower is a bearing designed for rotation of the outer ring. A needle roller and cage assembly and a synthetic rubber seal reinforced with steel plate are assembled in a thick-walled outer ring.

- | The outer ring, the needle roller and cage assembly, and the rubber seal are non-separable from each other.
- | The outer ring is thick-walled type so that it is resistible to high load and impact load.
- | **A shaft must be provided with a thrust washer and a flange, because the outer ring has no ribs (or face ring) and no axial guide function.**
- | The outer surface is available in both spherical (crowning) profile and cylindrical profile.
- | The spherical outer ring is effective in damping offset load which is caused by deviation in installing.
- | The bearing with cylindrical outer ring is suitable for cases of large load and low-hardness track surface, due to its large area of contact with the mating track surface.

## Roller follower — With axial guide —



This roller follower is a bearing designed for rotation of the outer ring. A needle roller and cage assembly, an inner ring, and a face ring are assembled in a thick-walled outer ring.

- This bearing uses needle rollers as its rolling element. It is available with a cage or full complement roller bearing without cage. The outer ring is guided axially by a face ring which is press-fitted in the inner ring.
- | The outer ring is thick-walled type so that it is resistible to high load and impact load.
  - | The outer surface is available in both spherical (crowning) profile and cylindrical profile.
  - | The spherical outer ring is effective in damping offset load which is caused by deviation in installing.
  - | The bearing with cylindrical outer ring is suitable for cases of large load and low-hardness track surface, due to its large area of contact with the mating track surface.
  - | This bearing is easier to handle because it needs no mounting of a guide (thrust washer, etc.) on the shaft unlike other types without axial guide (RNA22, NA22).

The components described below are for needle roller bearing.

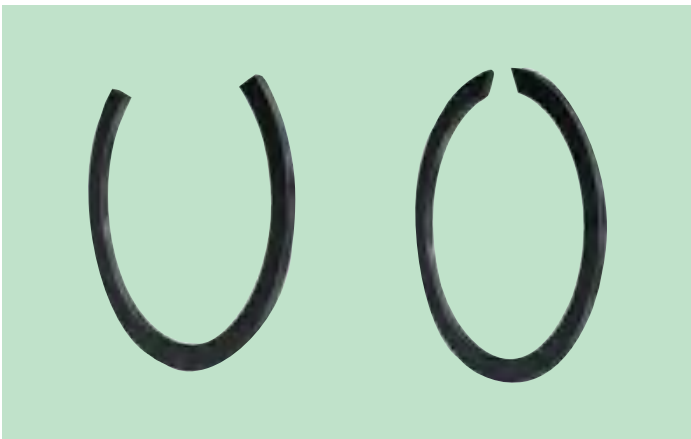
## Needle rollers



The needle rollers with flat end round end faces are standard. These rollers are made of high-carbon chrome bearing steel, surface-finished by grinding and buffing after heat-treatment.

- ┆ A-Inter-diameter tolerance of the needle rollers is 2mm maximum.
- ┆ Rollers with crowned rolling surfaces are also available, which can reduce edge load.
- ┆ These needle rollers are supplied individually for applications (pin, shaft).

## Snap rings



These are special-purposed rings used for axially positioning, guiding the inner and outer rings, or the needle roller and cage assembly in needle roller bearing.

- ┆ Two types are available, for either shaft and/or housing use.
- ┆ The snap ring product range cover smaller cross-sectional height products for use in needle roller bearings. The product range also covers snap rings of smaller dimensional range.
- ┆ For the axial guide it is recommended to provide a spacer between the cage and the snap ring.

## Seals

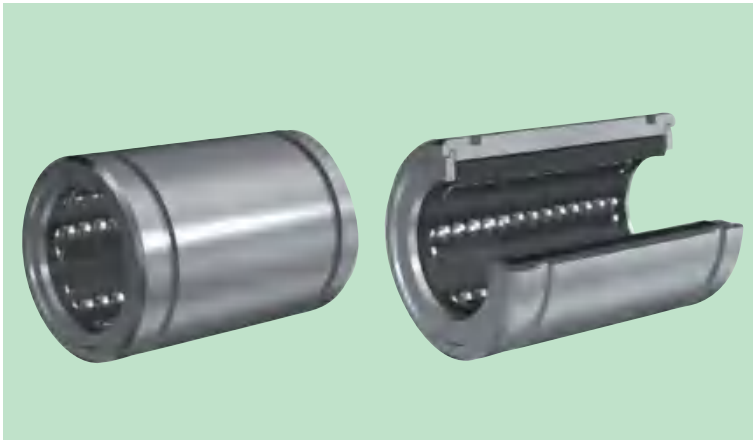


This product line covers special seals that have been designed for use with low profile needle roller bearings. The product prevents ingress of contamination and help retain grease.

- ┆ G-type seal with one lip and GD-type seal with two lips are selectively available on application.
- ┆ These seals consist of a ring section formed from steel sheet as well as synthetic rubber material. Their operating temperature ranges from -25 to 120°C. They are capable of continuous range at a maximum temperature of 100°C.
- ┆ These seals act to prevent the ingress of contamination and over-consumption of lubrication grease.
- ┆ The radial section height of each seal is designed to match the drawn-cup needle roller bearings. Hence, these seals require no additional finishing of the housing. This facilitates handling.

This catalogue describes the following ones of linear motion bearings.

## Linear ball bearing — Machined ring type —



The product assembly includes a machined outer ring, side plate, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision linear motion bearing develops infinite linear motion on the shaft.

- | Standard type, clearance-adjustable type and open type are selectively available on application.
- | Some bearings of these types are provided with a synthetic rubber seal at single side or double sides to prevent invasion of foreign matter.
- | The steel balls in this product are reliably guided by the cage. Consequently, this product develops stable linear motion on the shaft with minimum frictional resistance.
- | **No rotational motion is available.**

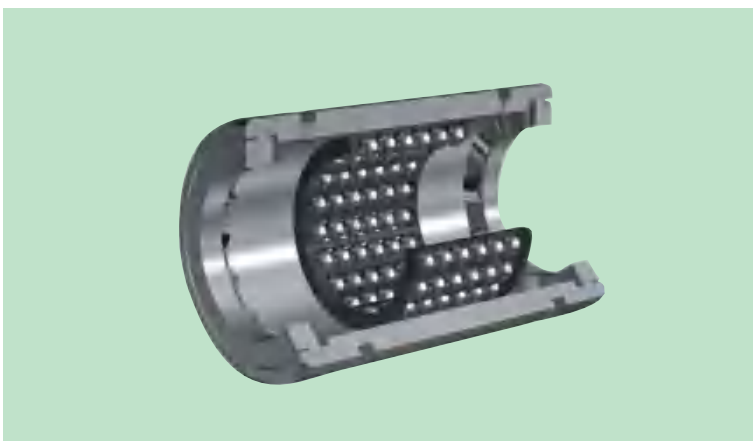
## Linear ball bearing — Drawn cup type —



The product assembly includes an outer ring formed through precision deep-drawing of thin sheet steel material, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision linear motion bearing develops infinite linear motion on the shaft.

- | The outer ring made of thin steel plate creates a smaller section height and allows for a more compact linear motion system.
- | Easy to install — This bearing is press-fitted in the housing so that it requires no axial fixing.
- | **No rotational motion available.**
- | Some bearings of this type are provided with a synthetic rubber seal at double sides to prevent invasion of foreign matter therein.

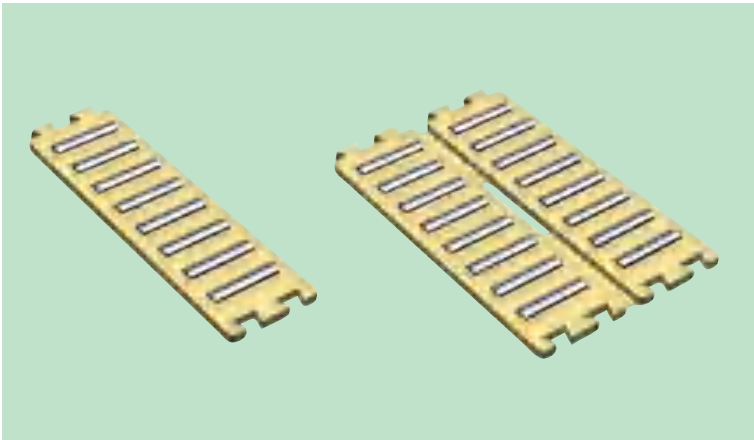
## Linear ball bearing — Stroking type —



The product assembly includes a machined outer ring, side plate, steel balls, and a synthetic resin cage that retains the steel balls. This high-precision bearing rotates and develops finite linear motion on the shaft. The outer ring is provided with a snap ring on both sides and a wavy spring washer is provided between the snap ring and the cage to damp on the impact acting on the cage and to prevent wear of the cage.

- | Some bearings of this type are provided with a synthetic rubber seal on each side to prevent invasion of foreign matter.
- | The outer ring is grooved so that the snap ring can be fitted and fixed easily.

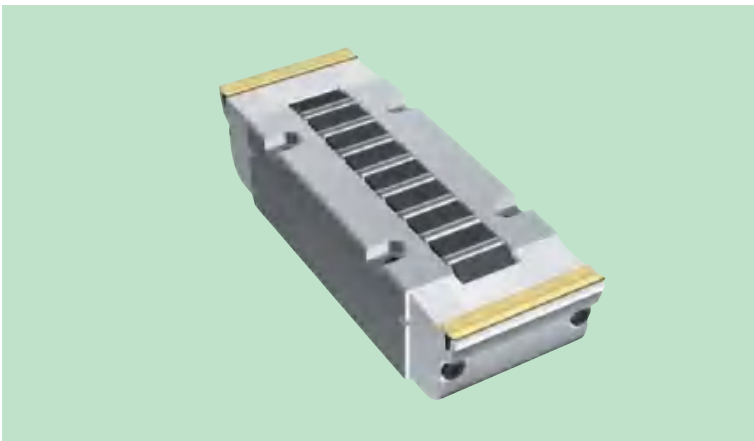
## Linear flat roller



This flat roller bearing, comprised of a flat cage and needle rollers, reciprocates on a flat raceway by motion of linear movable components.

- Two material types are available for the cage—synthetic resin and pressed sheet steel.
- FF type molded resin cage – Multiple cages may be joined together in a serial configuration.
- Press-formed steel plate cage – Cage to cage jointing is unavailable, but it can be supplied at any specified length.
- double-row synthetic resin cage has an elastic seam along its center line. When immersed in a hot oil bath heated to 70 to 90°C the cage can be “folded” to any desired cross-sectional angle so that it can be fitted to a V-sectioned face.

## Linear roller bearing

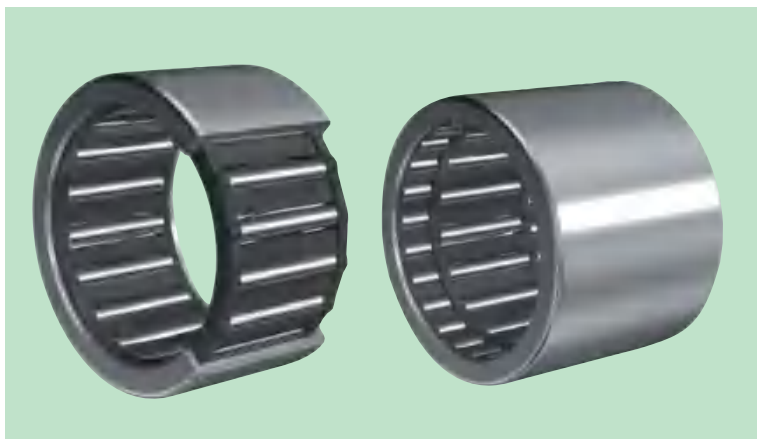


This type has the function of enabling cylindrical rollers to circulate within a track frame and ensures infinite linear motion on a plane.

- Low friction factor due to the cage assembly preventing neighboring rollers from touching each other.
- High load rating due to use of cylindrical rollers

This catalogue describes the following products, too.

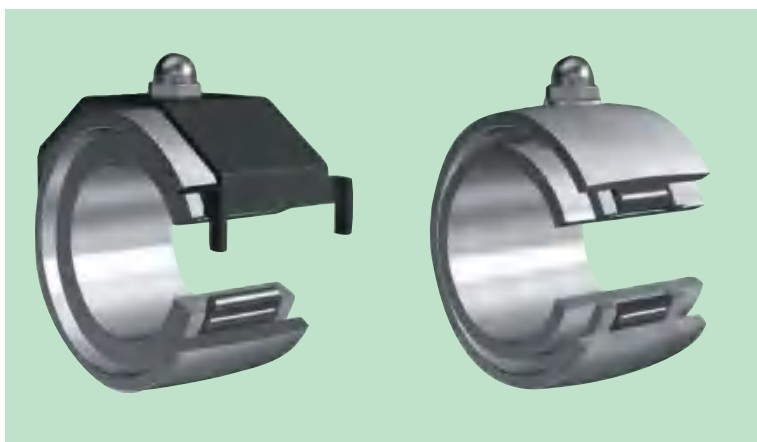
## One-way clutch



Comprised of an outer ring drawn from thin special steel plate by precision deep drawing, a spring, needle rollers and a cage, the one-way clutch can transmit torque in only one direction.

- | Boasting low frictional torque during over-running, this one-way clutch also features high transmittable torque despite its small cross-sectional height.
- | A certain one-way clutch variant has a built-in bearing that supports radial loading. Another variant has a plated outer ring for improved corrosion resistance.
- | HF HFL types can be retained axially by merely press-fitting into a housing.
- | These one-way clutches use the outer ring drawn by precision deep drawing, which requires a housing with wall thickness of a specified value or more.
- | The HF type unit alone is not capable of bearing radial loads, and both ends must be supported with external radial bearings. (On the other hand, HFL type includes integrated radial bearings on each side.)

## Bottom roller bearing — For textile machinery —



This product has a built-in needle roller bearing pre-filled with grease and is used to support bottom rollers. The spherical outer surface of the outer ring can allow a degree of bottom roller installation error. In order to prevent fiber entry into the bearing, tight clearances are maintained between the outer ring and double-ribbed inner ring, and the rib outer diameter surfaces are knurled.

## Tension Pulley — For Textile Machinery —



These pulleys are used to guide and tension the tapes and belts driving the spindles of a fine spinning machine, a roving frame, a false twister, etc. The structure is comprised of a precision deep-drawn plate steel pulley which is press-fitted to the outer ring of a bearing.

## 2. Load Rating and Life

### 2.1 Bearing life

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

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

### 2.2 Basic rated life and basic dynamic load rating

A group of seemingly identical bearings, when subjected to identical operating conditions will exhibit a wide diversity in their durability. This disparity in lives can be accounted for by differences in the fatigue of the bearing material itself. This disparity is considered statistically when calculating bearing life.

**The basic rated life is based on a 90% statistical model. In this model 90% of an identical group of bearings subjected to identical operating conditions will attain or surpass the stated number of revolutions without any flaking due to rolling fatigue.** For bearings operating at fixed constant speeds, the basic operating life (90% reliability) is expressed in the total number of hours of operation.

**Basic dynamic load rating expressed a rolling bearing’s capacity to support a dynamic load. The basic dynamic load rating is the load under which the basic rating life of the bearing is 1 million revolutions.** This is expressed as pure radial load for radial bearings and pure axial load load for thrust bearings. These are referred to as **basic dynamic radial load rating ( $C_r$ )**, and **Basic dynamic axial load rating ( $C_a$ )**.

The basic dynamic load ratings given in the tables of this catalog are for bearings constructed of NTN standard bearing materials using standard manufacturing technologies. For information about the basic dynamic load rating for a bearing using non-standard material and/or manufacturing techniques, contact NTN Engineering.

The relationship between the basic rated life, the basic dynamic load rating and the bearing load can be expressed in formula (2.1).

Basic Rated Life specified in ISO 281.

$$L_{10} = \left( \frac{C}{P} \right)^p \dots\dots\dots(2.1)$$

where,

$p = 10/3$  .....For roller bearing

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

$L_{10}$  : Basic rated life ( $10^6$  revolutions)

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

$P$  : Bearing load, (N) (kgf)  
(radial bearings:  $P_r$ , thrust bearings:  $P_a$ )

Furthermore, the basic rated life can be expressed in hours using **formula (2.2)**

$$L_{10h} = 500 f_h^p \dots\dots\dots(2.2)$$

$$f_h = f_n \frac{C}{P} \dots\dots\dots(2.3)$$

$$f_n = \left( \frac{33.3}{n} \right)^{1/p} \dots\dots\dots(2.4)$$

where,

$L_{10h}$  : Basic rated life, h

$f_h$  : Life factor

$f_n$  : Speed factor

$n$  : Rotational speed, r/ min

**Formula (2.2)** can also be expressed as **formula (2.5).**

$$L_{10h} = \frac{10^6}{60 n} \left( \frac{C}{P} \right)^p \dots\dots\dots(2.5)$$

When several bearings are incorporated into a piece of equipment it is possible to calculate the bearing life of the whole system by way of **formula (2.6).**

$$L = \frac{1}{\left( \frac{1}{L_1^e} + \frac{1}{L_2^e} + \dots + \frac{1}{L_n^e} \right)^{1/e}} \dots\dots\dots(2.6)$$

where,

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

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

$L$  : Total basic rated life of bearing as a whole, h

$L_1, L_2 \dots L_n$  : Individual basic rated life of bearings, 1, 2, ..., n, h

### 2.3 Required bearing life for a give application

When selecting a bearing, it is essential to determine the required life of the bearing under the intended operating conditions. The life requirement is usually determined by the durability and reliability required for the particular application. General guidelines for required life are shown in **Table 2.1.**

While the fatigue life of bearing is an important factor to consider when sizing the bearing it is also important to consider the strengths and rigidities of shaft and housing.

**Table 2.1 Operating conditions and required life (reference information)**

Operation profile	Life Requirement $L_{10h}$ × 10 <sup>3</sup> hrs.				
	~4	4~12	12~30	30~60	60~
Machine to be run for a short time or only occasionally.	Home electric appliances Power tools	Agricultural machinery Office equipment			
Machine to be run for a short time or only occasionally; however, the machine needs to perform reliably.	Medical equipment Measuring instruments	Home air-conditioner Construction machinery Elevator Cranes	Cranes (sheave)		
Machine to be run for a prolonged time (but not continuous).	Passenger cars Motor cycles	Compact electric motors Buses and trucks General gearing equipment Woodworking machinery	Spindle on machine tool Multi-purpose electric motor for production plant Crusher Vibration screen	Critical gearing equipment Calender rolls for rubber or plastic materials Offset printing press	
Machine to be always run at least 8 hours a day.		Roll neck on steel rolling machinery Escalator Conveyor Centrifugal separator	Axles on rolling stocks Air-conditioning equipment Large electric motor Compressor and pump	Axles on locomotives Traction motors Hoist for mines Press flywheels	Pulp or paper making machinery Propulsion system for ships
Machine to be run 24 hours a day, and must continue operating even in the event of accident.					City water facility Drain and ventilation system for mines Electric power station equipment

## 2.4 Adjusted rating life

While the basic rating life (90% reliability) for a given bearing can be calculated with the formulas in Subsection 2.2 a number of factors may be present which adjust that life. In some applications it may be necessary to calculate bearing life at greater than 90% reliability. Special materials or manufacturing processes may be applied to the bearing in an effort to increase life. Furthermore, bearing life may be affected by the operating conditions (lubrication, temperature, running speed, etc.).

The basic rating life can be adjusted to consider these factors. The resultant basic rating life is called the **adjusted rating life**, and can be determined by **formula (2.7)**:

$$L_{na} = a_1 \cdot a_2 \cdot a_3 (C/P)^P \dots\dots\dots(2.7)$$

where,

- $L_{na}$  : Adjusted life rating 10<sup>6</sup> revolutions
- $a_1$  : Reliability adjustment factor
- $a_2$  : Bearing material adjustment factor
- $a_3$  : Operating condition adjustment factor

### 2.4.1 Reliability adjustment factor $a_1$

The reliability adjustment factor,  $a_1$ , is used when a reliability higher than 90% is required. Values are shown in **Table 2.2**.

### 2.4.2 Bearing material adjustment factor for $a_2$

When non-standard bearing materials or manufacturing processes are used, the life-related bearing characteristics are inevitably changed. In this case, the bearing life is adjusted using the life adjustment factor,  $a_2$ .

The basic dynamic load ratings found in the "Bearing Dimensions Table" of the catalog assume the use of standard NTN materials and manufacturing processes /

**Table 2.2 Values of reliability adjustment factor  $a_1$**

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

techniques. In this case  $a_2=1$ .

When special materials or manufacturing techniques are used in the manufacture of the bearing an  $a_2 \neq 1$  will need to be applied. In such a case, feel free to contact NTN for further information.

When bearings made of high carbon chrome bearing steel are used at temperatures greater than 120°C for a significant period of time significant dimensional changes will occur in the bearing. To limit these changes and their effect on bearing life a special dimension-stabilizing heat-treatment (**TS treatment**) is used. The specific treatment is determined according to the maximum operating temperature. However, this dimension-stabilizing treatment results in lower bearing hardness which reduces bearing life. To account for this, the bearing life is adjusted using the  $a_2$  factor shown in **Table 2.3**.

**Table 2.3 Life adjustment values ( $a_2$ ) for dimension-stabilizing heat-treated (TS-treated) bearings**

Code	Maximum operating temperature	Life adjustment factor for bearing material $a_2$
TS2-	160°C	1.00
TS3-	200°C	0.73
TS4-	250°C	0.48

**2.4.3 Life adjustment factor for operating conditions  $a_3$**

The life adjustment factor for operating conditions ( $a_3$ ) is used to adjust the bearing life when operating under non-ideal conditions such as deteriorated lubricated, the ingress of foreign matter (contamination) or excessively high the rotational speeds.

Generally the life adjustment factor in the case of optimum lubrication and no contamination is  $a_3=1$ . When the bearing operates under particularly good conditions it is possible to have  $a_3>1$ . However,  $a_3<1$  is applied in the following cases.

**Low dynamic viscosity of grease or oil at bearing operating temperature**

Radial needle roller bearing 13mm<sup>2</sup>/s and less

Thrust needle roller bearing 20mm<sup>2</sup>/s and less

**Particularly low rotational speed**

(The product of rotational speed  $n$  min<sup>-1</sup> by pitch circle diameter ( $D_{pw}$  mm) of rolling element is  $D_{pw} \cdot n < 10000$ .)

**High operating temperature of bearing**

When standard bearings operate at high temperatures hardness of the raceway hardness is reduced, impacting bearing life, In such cases the bearing life is adjusted by multiplying the value shown in Fig.2.1.

**However, this does not apply to bearings having undergone dimension-stabilizing (TS) treatment.**

**Ingress of foreign matter (contamination) and/or moisture into lubricant**

When using a bearing operating under suboptimal conditions please feel free to NTN for assistance in applying the adjustment factors.

If the lubricating conditions are not favorable a factor of  $a_2 \times a_3 < 1$  is usually applied. This is true even if special materials and manufacturing techniques are used that would result in a life adjustment factor  $a_2 > 1$ .

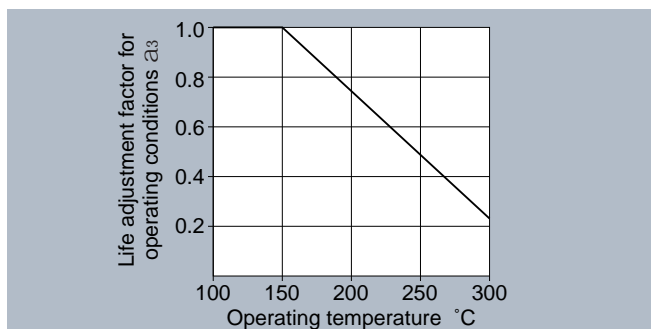


Fig. 2.1 Life adjustment factor for operating conditions depending on operating temperature

**2.5 Effect of surface hardness on basic dynamic load rating**

It is possible to use the shaft or housing surface as the raceway surface. Under these conditions the surface layer of the shaft/housing must be hardened to HRC58 to 64 and a proper hardening depth must be achieved.

Methods such as ordinary quenching, carburizing or induction quenching can be used to harden the shaft/housing. If it is not possible to sufficiently harden the surface the load rating of the bearing will need to be reduced. The basic load rating must be adjusted by multiplying the hardness factor shown in Fig.2.2.

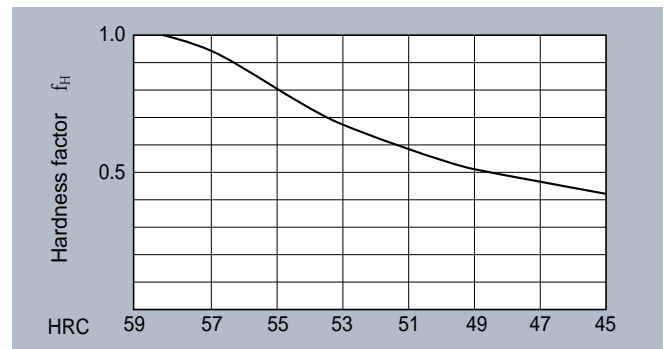


Fig. 2.2 Hardness factor

**2.6 Bearing life under oscillating motion**

The life of a bearing under oscillating motion can be determined by formula (2.8).

$$L_{osc} = \Omega L_{Rot} \dots \dots \dots (2.8)$$

where,

$L_{osc}$  : Life of bearing with oscillating motion

$L_{Rot}$  : Life of bearing subject to rotational speed min<sup>-1</sup> identical to oscillation frequency cpm

Ex.) Rating life determined from 90 min<sup>-1</sup> that is equivalent to cyclic rate of 90 cpm.

$\Omega$  : Oscillation factor (showing the relation with half angle  $\beta$  of oscillation angle per Fig.2.3).

Generally, Fig.2.3 applies to cases where the critical oscillation angle  $2\beta$  is greater than the critical oscillation angle  $2\beta_c$ . Critical oscillation angle is principally governed by the internal design of the bearing; in particular, the number of rolling elements included in one row.

There may be a case where the bearing needs to be used at an angle smaller than its critical oscillation angle: however, the bearing life will be shorter than the

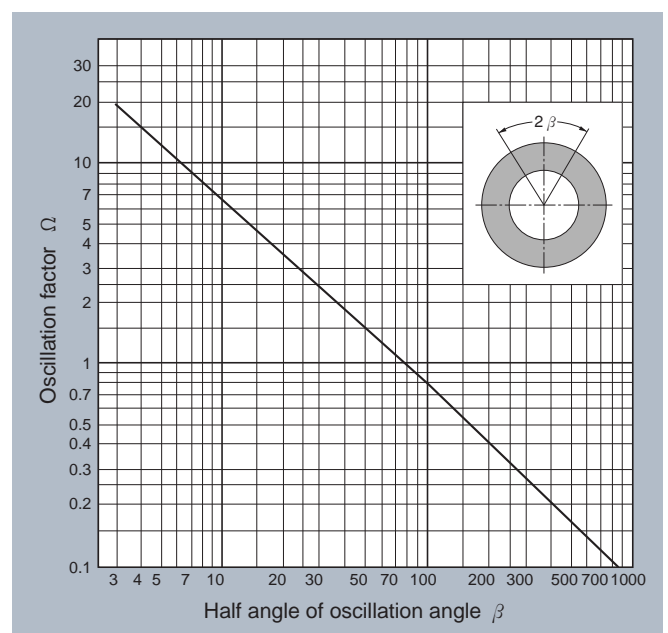


Fig. 2.3 Relationship of oscillation angle  $\beta$  to factor  $\Omega$

calculated life determined using the data in **Fig.2.3**. If the oscillation angle of the bearing is unknown, determine  $\Omega$ , assuming that  $\beta = \beta_c$ . For the data about an intended bearing, contact **NTN Engineering**.

When the oscillation angle  $2\beta$  is very small, difficulty in forming an oil film on the contact surface of rolling ring to rolling element could result in **fretting** corrosion.

In the case of inner ring oscillation, the critical oscillation angle is expressed in **formula (2.9)**.

$$\text{Critical oscillation angle } 2\beta_c \geq \frac{360^\circ}{Z} \cdot \frac{D_{pw}}{D_{pw} - D_w \cos \alpha} \dots(2.9)$$

Where,

- $Z$  : Number of rolling elements (per row)
- $d_p$  : Pitch circle diameter (PCD) of rolling element
- $D_p$  : Rolling element diameter
- $e$  : Contact angle

(In the case of outer ring oscillation, the right side denominator is  $D_{pw} + D_w \cos \alpha$ .)

**2.7 Life of bearing with linear motion**

In the case of bearings with linear motion such as linear ball bearing, linear flat roller bearing, etc., the relationship among axial travel distance, bearing load and load rating can be expressed in **formulas (2.10), (2.11)**.

When the rolling elements are balls;

$$L = 50 \times \left( \frac{C_r}{P_r} \right)^3 \dots(2.10)$$

When the rolling elements are rollers;

$$L = 100 \times \left( \frac{C_r}{P_r} \right)^{10/3} \dots(2.11)$$

where,

- $L$  : Load rating km
- $C_r$  : Basic dynamic load rating N (kgf)
- $P_r$  : Bearing load N (kgf)

**Fig.2.4** shows the relationship of  $C_r/P_r$  to  $L$ .

Furthermore, when the travel motion frequency and travel distance remain unchanged, the lifetime of bearing can be determined by **formulas (2.12), (2.13)**.

When the rolling elements are balls;

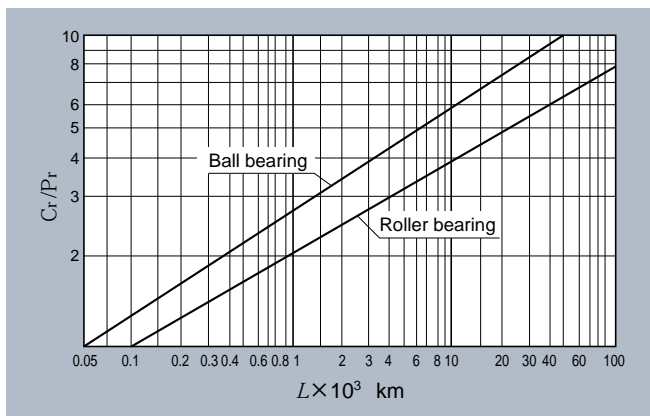
$$L_h = \frac{50 \times 10^3}{60 \cdot S} \left( \frac{C_r}{P_r} \right)^3 \dots(2.12)$$

When the rolling elements are rollers;

$$L_h = \frac{100 \times 10^3}{60 \cdot S} \left( \frac{C_r}{P_r} \right)^{10/3} \dots(2.13)$$

where,

- $L_h$ : Travel life h
- $S$  : Travel distance per minute m/min
- $S = 2 \cdot L \cdot n$
- $L$  : Stroke length m
- $n$  : Stroke cycle cpm



**Fig. 2.4** Life of bearing with axial motion

### 2.8 Fitting misalignment and crowning

Generally it is well known that stress concentrations at the edge portion of the roller (so called, edge load) arising from fitting misalignment could result in rapid reduction of bearing lifetime. "Crowning" is adopted as a countermeasure against such rapid reduction of bearing lifetime. In that case, however, unless it is designed properly this crowning would cause the effective contact length of the roller to be reduced, which could then lead to shorter bearing life. It is therefore necessary to calculate a proper crowning based on the extent of fitting misalignment and load condition.

For Reference purposes, **Figs. 2.5 to 2.7** show computer generated examples of contact surface pressure profiles for various scenarios. These profiles demonstrate how crowning can reduce edge surface contact pressure in conditions of misalignment.

**Fig. 2.8** shows an example of a computer generated relationship between allowable fitting misalignment and bearing life. It is possible to see from this Figure how the bearing lifetime is influenced by fitting misalignment.

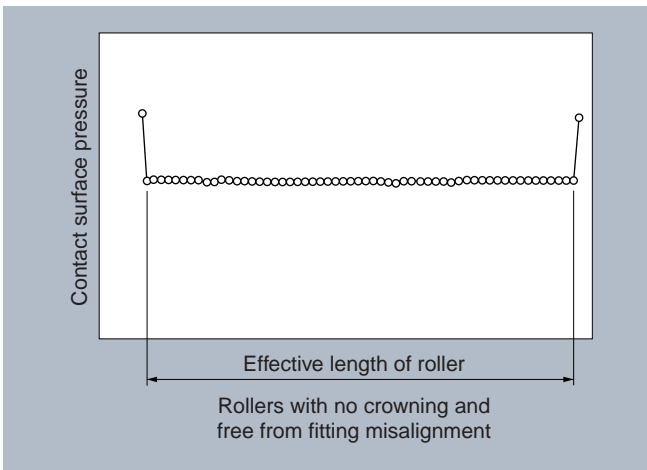


Fig. 2.5

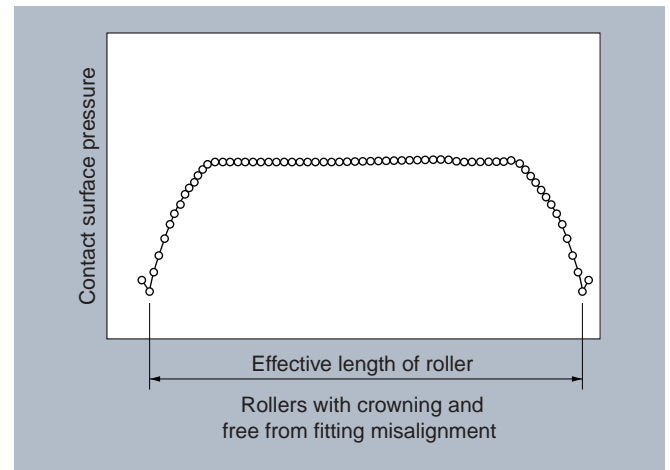


Fig. 2.7

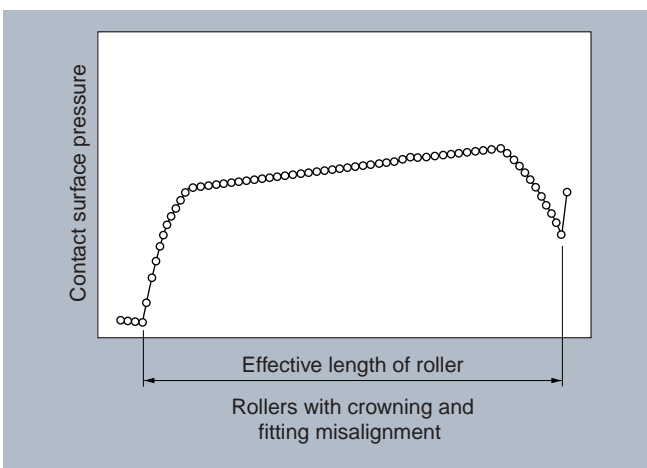


Fig. 2.6

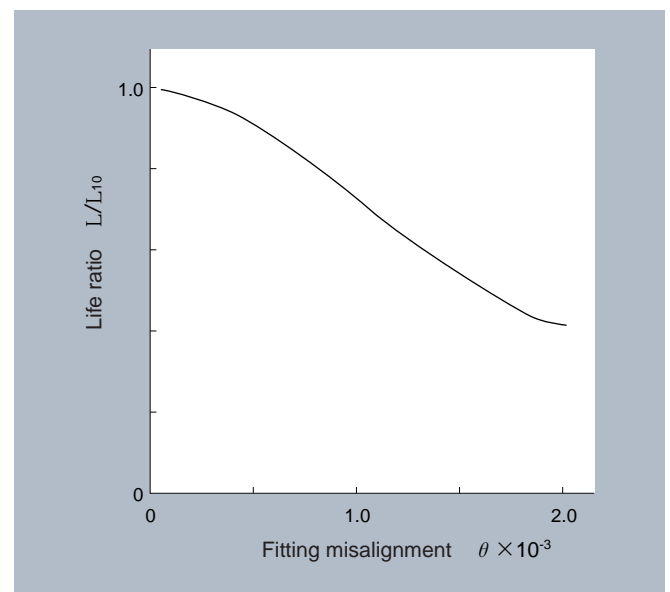


Fig. 2.8 Relationship of fitting misalignment to bearing lifetime

**2.9 Basic static load rating**

“Basic static load rating” is defined as the minimum static load acting on the center of a rolling element which results in a calculated contact stress value of:

4,000 MPa (408kgf/mm<sup>2</sup>) for Roller bearings.

4,200 MPa (428kgf/mm<sup>2</sup>) for Ball Bearings.

It has been empirically shown that the resulting permanent deformation on the rolling element and raceway caused by these magnitudes of contact stress is approximately 0.0001 time as great as the diameter of rolling element, and that this deformation level is maximum allowable deformation for smooth running of the bearing.

Basic static load rating for radial bearings is known as “**basic static radial load rating**”, and that for axial thrust bearing as “**basic static axial load rating**”. The bearing dimension tables in this catalog provide data for these load rating types under the parameter names  $C_{or}$ , and  $C_{oa}$ .

**2.10 Allowable static bearing load**

The basic static load rating described in **Subsection 2.9** is generally deemed as an allowable static bearing limit load, but in some cases this allowable limit load is set up larger than the basic static load rating and in some other cases it is set up smaller, according to the requirements for revolving smoothness and friction.

Generally this allowable limit load is decided considering the safety factor  $S_o$  in the following **formula (2.14)** and **Table 2.4**.

$$S_o = C_o / P_o \dots\dots\dots(2.14)$$

where,

$S_o$  : Safety factor

$C_o$  : Basic static rated load, N (kgf)

(For radial bearings:  $C_{or}$ ,

For thrust bearings:  $C_{oa}$ )

$P_{o\ max}$  : Maximum static bearing load, N (kgf)

(For radial bearings:  $P_{or\ max}$ ,

For thrust bearings:  $C_{oa\ max}$ )

**Table 2.4 Lower limit value of safety factor  $S_o$**

Operating conditions	Roller bearings	Ball bearings
Requirement for high revolving accuracy	3	2
Requirement for ordinal revolving accuracy (ordinary-purposed)	1.5	1
Where minor deterioration of revolving accuracy is allowed (Ex. Low speed revolution, duty load application, etc.)	1	0.5

- Remarks: 1. The lower limit of  $S_o$  for drawn cup needle roller bearings is set at 3; for Premium Shell Product, the limit is set at 2.  
 2. The lower limit of  $S_o$  is set at 3 for an application where the AS type raceway is used in an axial thrust bearing.  
 3. Where vibration and shock load act on bearing,  $P_{o\ max}$  shall be determined considering the shock load factor.

## 3. Calculation of Bearing Loads

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

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

### 3.1 Load acting on shafts

#### 3.1.1 Load factors

The actual shaft loads on a machine that uses a bearing are usually greater than the theoretically determined values owing to vibration and impact occurring on the machine. For this reason, loads actually acting on a shaft system are often determined through multiplication by an appropriate load factors listed in **Table 3.1** and **Table 3.2**.

$$K = f_w \cdot f_z \cdot K_C \dots\dots\dots(3.1)$$

where

- $K$  : Actual load acting on shaft N (kgf)
- $K_C$  : Theoretically calculated value N (kgf)
- $f_w$  : Load factor (**Table 3.1**)
- $f_z$  : Gear factor (**Table 3.2**)

**Table 3.1** Load factor  $f_w$

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

**Table 3.2** Gear factor  $f_z$

Types of gear	$f_z$
Precision ground gears (Pitch and profile errors of less than 0.02mm)	1.05–1.1
Ordinary machined gears (Pitch and profile errors of less than 0.1mm)	1.1–1.3

### 3.1.2 Load acting on gears

The loads acting on gears can be divided into tangential load ( $K_t$ ), radial load ( $K_s$ ) and axial load ( $K_a$ ). The magnitude and acting direction of each load differ depending on the types of gear. This paragraph describes how to calculate the loads acting on parallel shaft gears and cross shaft gears for general use.

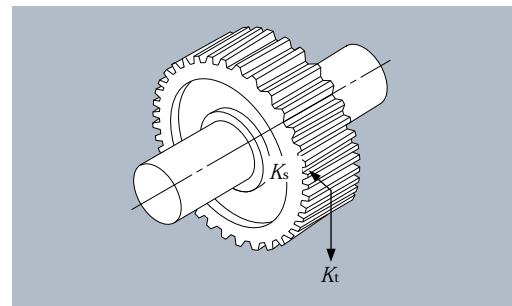
#### (1) Load acting on parallel shaft gear

**Figs. 3.1** to **3.3** illustrate the loads acting on spur gear and helical gear which are used with a parallel shaft. The magnitude of each load can be determined using the formulas (3.2) to (3.5).

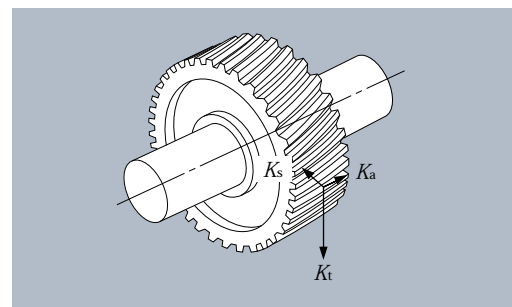
$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \quad \text{N} \quad \dots\dots\dots(3.2)$$

$$K_t = \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \quad \text{(kgf)}$$

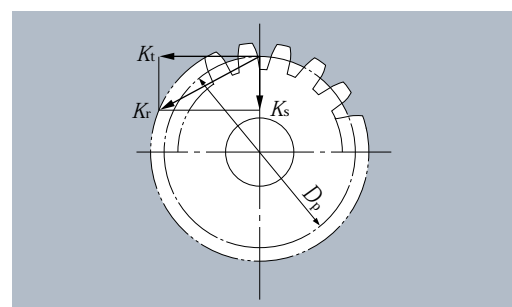
$$K_s = K_t \cdot \tan \alpha \quad \text{(Spur gear)} \quad \dots\dots\dots(3.3a)$$



**Fig. 3.1** Load acting on spur gear



**Fig. 3.2** Load acting on helical gear



**Fig. 3.3** Composite radial force acting on gear

$$= K_t \cdot \frac{\tan \alpha}{\cos \beta} \text{ (for helical gear) } \dots\dots\dots (3.3b)$$

$$K_r = \sqrt{K_t^2 + K_s^2} \dots\dots\dots (3.4a)$$

$$K_a = K_t \cdot \tan \beta \text{ (for helical gear) } \dots\dots\dots (3.5)$$

where,

- $K_t$  : Tangential load acting on gear (Tangential force) N (kgf)
- $K_s$  : Radial load acting on gear (separating force) N (kgf)
- $K_r$  : Load acting perpendicularly on gear shaft (composite force of tangential force and separating force) N (kgf)
- $K_a$  : Parallel load acting on gear shaft N (kgf)
- $H$  : Transmission power kw
- $n$  : Rotational speed  $\text{min}^{-1}$
- $D_p$  : Pitch circle diameter of gear mm
- $\alpha$  : Gear pressure angle deg
- $\beta$  : Gear helix angle deg

**(2) Loads acting on cross shaft gears**

**Figs. 3.4 and 3.5** illustrate the loads acting on straight-tooth bevel gears and spiral bevel gears which are used with cross shafts.

The calculation methods for these gear loads are shown in **Table 3.3**. Herein, to calculate gear loads for straight bevel gears, the helix angle ( $\beta$ ) is 0.

- $K_t$  : Tangential load acting on gear (Tangential force) N (kgf)
- $K_s$  : Radial load acting on gear (separating force) N (kgf)
- $K_a$  : Parallel load acting on gear shaft (axial load) N (kgf)
- $H$  : Transmission power kw
- $n$  : Rotational speed  $\text{min}^{-1}$
- $D_{pm}$  : Mean pitch circle diameter mm

- $\alpha$  : Gear pressure angle deg
- $\beta$  : Gear helix angle deg
- $\delta$  : Pitch cone angle of gear deg

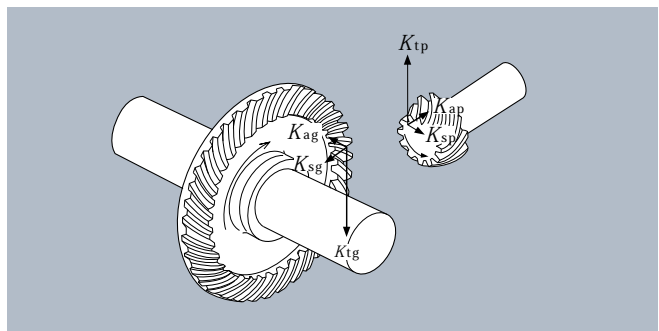
In general, the relationship between the loads acting on pinion and pinion gear can be expressed as follows, due to the perpendicular intersection of two shafts.

$$K_{sp} = K_{ag} \dots\dots\dots (3.6)$$

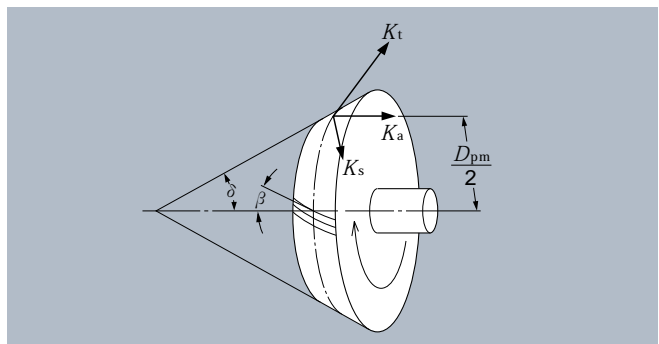
$$K_{ap} = K_{sg} \dots\dots\dots (3.7)$$

where,

- $K_{sp}, K_{sg}$  : Pinion and pinion gear separating force N (kgf)
- $K_{ap}, K_{ag}$  : Axial load acting on pinion and pinion gear N (kgf)



**Fig. 3.4** Load acting on bevel gears



**Fig.3.5** Bevel gear diagram

**Table 3.3** Calculation formulas for determining loads acting on bevel gears

Unit N

Type of load	Rotational direction	Clockwise	Counter clockwise	Clockwise	Counter clockwise
	Helix angle	To right	To left	To left	To right
Tangential load (tangential force) $K_t$		$K_t = \frac{19.1 \times 10^6 \cdot H}{D_{pm} \cdot n}, \left\{ \frac{1.95 \times 10^6 \cdot H}{D_{pm} \cdot n} \right\}$			
Radial load (separating force) $K_s$	Drive side	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$
	Driven side	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$	$K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$
Load parallel to gear train (Axial load) $K_a$	Drive side	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$
	Driven side	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$	$K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$

The orientation of loading on a spiral bevel gear will vary depending on the direction of the helix angle, the direction of rotation and whether the gear is a driving or driven gear.

The separating force ( $K_s$ ) and the axial load ( $K_a$ ) are shown in the positive direction in **Fig. 3.5**. The direction of rotation and the helix direction are defined as viewed from the large end of the gear. For the gear illustrated in **Fig. 3.5** these directions are clockwise and to the right.

### 3.1.3 Loads acting on chain and belt shafts

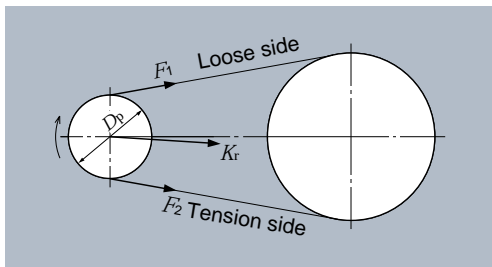
When power is transmitted by means of a chain or belt as illustrated in **Fig. 3.6**, the loads acting on the sprocket or pulley can be determined by **formula (3.8)**.

$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \left( \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \right) \dots\dots\dots(3.8)$$

where,

- $K_t$  : Load acting on sprocket or pulley N (kgf)
- $HP$  : Transmission power kW
- $D_p$  : Pitch circle diameter of sprocket or pulley mm

For belt drives, an initial tension is applied to ensure sufficient normal force between the belt and pulley during operation.



**Fig. 3.6** Loads acting on chain/ belt

Taking into account the initial tension, the radial load acting on the pulley can be determined by **formula (3.9)**. For chain drives, the radial load can be expressed using the same formula, if vibration and shock are taken into consideration.

$$K_r = f_b \cdot K_t \dots\dots\dots(3.9)$$

where,

- $K_r$  : Radial load acting on sprocket or pulley N (kgf)
- $f_b$  : Chain/belt factor (**Table 3.4**)

**Table 3.4** Chain/belt factor  $f_b$

Type of chain / belt	$f_b$
Chain (single row type)	1.2–1.5
Vee-belt	1.5–2.0
Timing belt	1.1–1.3
Flat belt (with tension pulley)	2.5–3.0
Flat belt	3.0–4.0

### 3.2 Bearing load distribution

Any loads acting on shafts are distributed to the bearings. The bearing load distribution is determined by considering the shaft to be a static beam supported by the bearings.

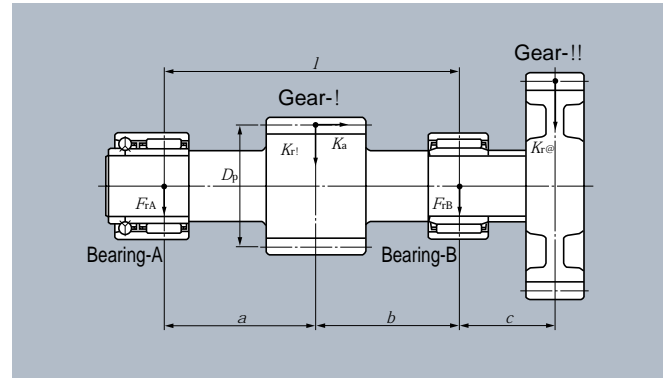
For example, the loads acting on the bearings supporting the gear shaft illustrated in **Fig. 3.7** can be expressed using **formulas (3.10)** and **(3.11)**.

$$F_{rA} = K_{r1} \frac{b}{l} - K_{r@} \frac{c}{l} - K_a \frac{D_p}{2l} \dots\dots\dots(3.10)$$

$$F_{rB} = K_{r1} \frac{a}{l} + K_{r@} \frac{a+b+c}{l} + K_a \frac{D_p}{2l} \dots\dots\dots(3.11)$$

where,

- $F_{rA}$  : Radial load acting on bearing-A N (kgf)
- $F_{rB}$  : Radial load acting on bearing-B N (kgf)
- $K_{r1}$  : Radial load acting on gear-I N (kgf)
- $K_a$  : Axial load acting on gear-I N (kgf)
- $K_{r2}$  : Axial load acting on gear-II N (kgf)
- $D_p$  : Pitch circle diameter of gear-I mm
- $l$  : Bearing to bearing distance mm



**Fig. 3.7** Gear shaft

### 3.3 Mean load

The load on bearings used in machines will often fluctuate according to a fixed duty cycle. The load on bearings operating under such conditions can be converted to a mean load ( $F_m$ ). The mean load is a load which gives the bearings the same life they would have under constant operating conditions.

#### (1) Stepped fluctuating load

The mean bearing load,  $F_m$ , for stepped loads is calculated using **formula (3.12)**, where  $F_1, F_2, \dots, F_n$  are the bearing loads, and the rotational speed and running time are  $n_1, n_2, \dots, n_n$  and  $t_1, t_2, \dots, t_n$  respectively.

$$F_m = \left( \frac{\sum (F_i^p n_i t_i)}{\sum (n_i t_i)} \right)^{1/p} \dots \dots \dots (3.12)$$

where:

- $p=10/3$  for roller bearing
- $p=3$  for ball bearing

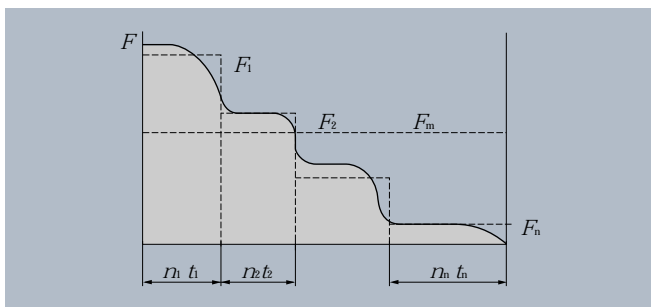


Fig. 3.8 Stepped fluctuating load

#### (2) Cyclical load

Where the bearing load can be expressed as a function of time  $F(t)$ , repeating with cycle time ( $t_0$ ), the mean load can be expressed **formula (3.13)**.

$$F_m = \left( \frac{1}{t_0} \int_0^{t_0} F(t)^p dt \right)^{1/p} \dots \dots \dots (3.13)$$

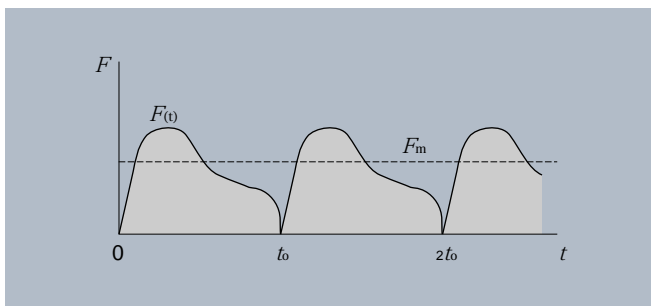


Fig. 3.9 Load fluctuating as cyclical function of time

#### (3) Linearly fluctuating load

The mean load  $F_m$  can be approximated by **formula (3.14)**.

$$F_m = \frac{F_{min} + 2F_{max}}{3} \dots \dots \dots (3.14)$$

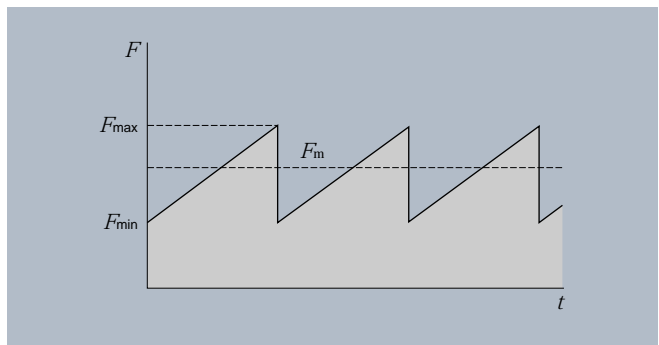


Fig. 3.10 Linearly fluctuating load

#### (4) Sinusoidal load

The mean load  $F_m$ , can be approximated by **formulas (3.15)**, and **(3.16)**.

case of (a)  $F_m = 0.75 F_{max} \dots \dots \dots (3.15)$

case of (b)  $F_m = 0.65 F_{max} \dots \dots \dots (3.16)$

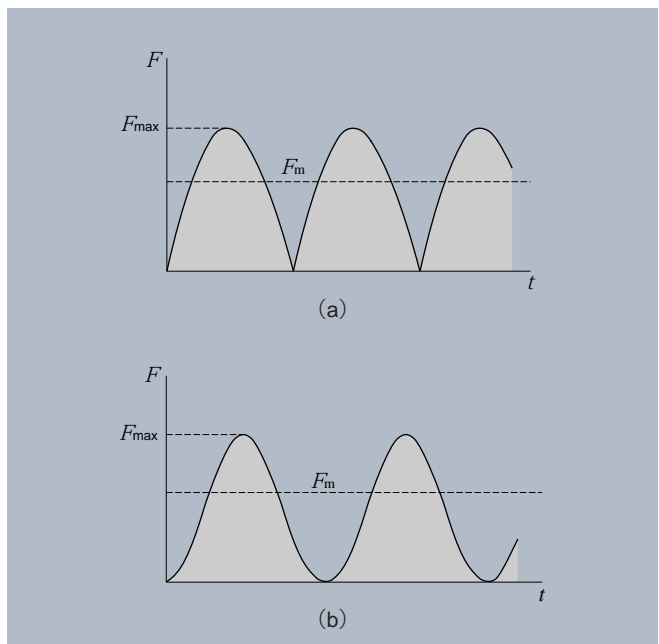


Fig. 3.11 Sinusoidal load



## 4. Bearing Accuracy

The dimensional, profile and running accuracies of rolling bearings are specified in ISO Standard as applicable and JIS B 1514 (Accuracy of Rolling Bearings).

"Dimensional accuracy" and "Profile accuracy" are the items indispensable in installing the rolling bearings on a shaft and in a bearing housing, and allowable bearing run-out in running is specified as the running accuracy.

### Dimensional accuracy:

Dimensional accuracy means the respective allowable values for bore diameter, outer diameter, width or height (limited to thrust bearing) and chamfering dimension.

### Profile accuracy:

Profile accuracy relates to tolerances for inside diameter variation, mean inside diameter variation, outside diameter variation, mean outside diameter variation, and ring width variation.

### Running accuracy:

Running accuracy relates to tolerances for radial runout and axial runout with inner ring and outer ring, perpendicularity of ring face, perpendicularity of outside surface, and raceway thickness variation (thrust bearing).

Regarding the accuracy class of the machined ring needle roller bearings, class-0 is equivalent to bearings of the normal precision class, and precision becomes progressively higher as the class number becomes smaller; i.e. Class 6 is less precise than Class 5, which is less precise than Class 4, and so on.

Bearings of Class-0 are mostly used for general applications while bearings of Class-5 or Class-4 are used where the required running accuracies and revolutions are high or less friction and less fluctuation are required for bearings.

Various bearing types are available for NTN needle roller bearings and the representative types and the accuracy classes applicable to them are as shown in **Table 4.1**.

Dimensional item symbols used in the accuracy standard are given in **Table 4.2**, the radial bearing accuracy specified every accuracy class given in **Table 4.3**, the thrust bearing accuracy specified every accuracy class given in **Table 4.4**, and the allowable values for chamfering dimension given in **Table 4.5**.

**Table 4.1 Bearing types and corresponding accuracy classes**

Bearing type		Applicable accuracy class				Applicable table
Needle roller bearing, Clearance-adjustable needle roller bearing		JIS Class-0 —	JIS Class-6 —	JIS Class-5 —	JIS class-4 JIS class-4	<b>Table 4.3</b> <b>Table 4.3</b>
Complex bearing	Radial bearing	JIS Class-0	JIS Class-6	JIS Class-5	—	<b>Table 4.3</b>
	Thrust bearing	NTN Class 0	NTN Class 6	NTN Class 5	NTN Class 4	<b>Table 4.4</b>
Needle roller bearing with double-direction thrust roller bearing	Radial bearing	—	—	JIS Class-5	JIS Class-4	<b>Table 4.3</b>
	Thrust bearing	—	—	NTN Class 5	NTN Class 4	<b>Table 4.4</b>
Thrust roller bearing Roller follower/cam follower		NTN Class 0 JIS Class-0	NTN Class 6 —	NTN Class 5 —	NTN Class 4 —	<b>Table 4.4</b> <b>Table 4.3</b>

**Table 4.2 Dimensional item symbols used in applicable standards**  
●Radial bearings

Classification	Symbols	Symbol representation	Symbols under JIS B 0021 (Reference)
Dimensional accuracy	$\Delta d_{mp}$	Dimensional tolerance for in-plane mean bore diameter	————
	$\Delta d_s$	Dimensional tolerance for bore diameter	————
	$\Delta D_{mp}$	Dimensional tolerance for in-plane mean outer diameter	————
	$\Delta D_s$	Dimensional tolerance for outer diameter	————
	$\Delta B_s$	Dimensional tolerance for inner ring width	————
	$\Delta C_s$	Dimensional tolerance for outer ring width	————
Profile accuracy	$V_{dp}$	Variation of in-plane bore diameter	Roundness $\bigcirc$ <sup>1)</sup>
	$V_{dmp}$	Variation of in-plane mean bore diameter	Cylindricity $\text{⌀}$ <sup>2)</sup>
	$V_{Dp}$	Variation of in-plane outer diameter	Roundness $\bigcirc$ <sup>1)</sup>
	$V_{Dmp}$	Variation of in-plane mean outer diameter	Cylindricity $\text{⌀}$ <sup>2)</sup>
	$V_{Bs}$	Variation of inner ring width	Parallelism $//$
	$V_{Cs}$	Variation of outer ring width	Parallelism $//$
Running accuracy	$K_{ia}$	Radial run-out of inner ring	Run-out $\nearrow$
	$K_{ea}$	Radial run-out of outer ring	Run-out $\nearrow$
	$S_{ia}$	Axial run-out of inner ring	————
	$S_{ea}$	Axial run-out of outer ring	————
	$S_d$	Perpendicularity of face (inner ring)	Perpendicularity $\perp$
	$S_D$	Perpendicularity of outside surface (outer ring)	Perpendicularity $\perp$

### ●Thrust bearings

Classification	Symbols	Symbol representation	Symbols under JIS B 0021 (Reference)
Dimensional accuracy	$\Delta d_{mp}$	Single plane mean bore diameter deviation on single-direction bearing	————
	$\Delta d_{2mp}$	Single plane mean bore diameter deviation on central washer	————
	$\Delta D_{mp}$	Dimensional tolerance for in-plane mean outer diameter	————
Profile accuracy	$V_{dp}$	Bore diameter variation in a single radial plane on single-direction bearing	Roundness $\bigcirc$ <sup>1)</sup>
	$V_{d2p}$	Bore diameter variation in a single radial plane on central washer	Roundness $\bigcirc$ <sup>1)</sup>
	$V_{Dp}$	Variation of in-plane outer diameter	Roundness $\bigcirc$ <sup>1)</sup>
Running accuracy	$S_i$	Raceway thickness variation on shaft washer	Run-out $\nearrow$
	$S_e$	Raceway thickness variation on housing washer	Run-out $\nearrow$

- 1) The roundness specified in JIS B 0021 is applicable to the tolerance  $V_{dp}$  for variation of radial in-plane bore diameter or nearly half of  $V_{Dp}$ .
- 2) The cylindricity specified in JIS B 0021 is applicable to the tolerance  $V_{dmp}$  for in-uniformity of radial in-plane mean diameter or nearly half of  $V_{Dmp}$ .

**Table 4.3 Tolerances for radial bearings**  
**Table 4.3(1) Inner rings**

Nominal bore diameter <i>d</i> mm		Dimensional tolerance for mean bore diameter $\Delta_{dmp}$								Variation of mean bore diameter $V_{d\phi}$				Allowable variation of bore diameter $V_{dmp}$			
		Class 0		Class 6		Class 5		Class 4		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4
		high	low	high	low	high	low	high	low								
2.5 <sup>1</sup>	10	0	-8	0	-7	0	-5	0	-4	10	9	5	4	6	5	3	2
10	18	0	-8	0	-7	0	-5	0	-4	10	9	5	4	6	5	3	2
18	30	0	-10	0	-8	0	-6	0	-5	13	10	6	5	8	6	3	2.5
30	50	0	-12	0	-10	0	-8	0	-6	15	13	8	6	9	8	4	3
50	80	0	-15	0	-12	0	-9	0	-7	19	15	9	7	11	9	5	3.5
80	120	0	-20	0	-15	0	-10	0	-8	25	19	10	8	15	11	5	4
120	150	0	-25	0	-18	0	-13	0	-10	31	23	13	10	19	14	7	5
150	180	0	-25	0	-18	0	-13	0	-10	31	23	13	10	19	14	7	5
180	250	0	-30	0	-22	0	-15	0	-12	38	28	15	12	23	17	8	6
250	315	0	-35	0	-25	0	-18	—	—	44	31	18	—	26	19	9	—
315	400	0	-40	0	-30	0	-23	—	—	50	38	23	—	30	23	12	—
400	500	0	-45	0	-35	—	—	—	—	56	44	—	—	34	26	—	—

1 2.5mm is included in this dimensional category.  
 2 This table is applied to the ball bearings.

**Table 4.3 (2) Outer rings**

Nominal outer diameter <i>D</i> mm		Dimensional tolerance for mean outer diameter $\Delta_{Dmp}$								Allowable variation of outer diameter $V_{Dp}$				Allowable variation of mean outer diameter $V_{Dmp}$			
		Class 0		Class 6		Class 5		Class 4		Class 0	Class 6	Class 5	Class 4	Class 0	Class 6	Class 5	Class 4
		high	low	high	low	high	low	high	low								
6 <sup>1</sup>	18	0	-8	0	-7	0	-5	0	-4	10	9	5	4	6	5	3	2
18	30	0	-9	0	-8	0	-6	0	-5	12	10	6	5	7	6	3	2.5
30	50	0	-11	0	-9	0	-7	0	-6	14	11	7	6	8	7	4	3
50	80	0	-13	0	-11	0	-9	0	-7	16	14	9	7	10	8	5	3.5
80	120	0	-15	0	-13	0	-10	0	-8	19	16	10	8	11	10	5	4
120	150	0	-18	0	-15	0	-11	0	-9	23	19	11	9	14	11	6	5
150	180	0	-25	0	-18	0	-13	0	-10	31	23	13	10	19	14	7	5
180	250	0	-30	0	-20	0	-15	0	-11	38	25	15	11	23	15	8	6
250	315	0	-35	0	-25	0	-18	0	-13	44	31	18	13	26	19	9	7
315	400	0	-40	0	-28	0	-20	0	-15	50	35	20	15	30	21	10	8
400	500	0	-45	0	-33	0	-23	—	—	56	41	23	—	34	25	12	—
500	630	0	-50	0	-38	0	-28	—	—	63	48	28	—	38	29	14	—

1 6mm is included in this dimensional category.  
 2 This table is applied to the ball bearings.

# 4. Bearing Accuracy

NTN

Unit  $\mu\text{m}$

Radial run-out $K_{ia}$				Perpendicularity of face $S_d$		Axial run-out $S_{ia} \text{ } ^2$		Allowable width deviation $\Delta_{Bs}$				Allowable width variation $V_{Bs}$				Nominal bore diameter $d$ mm	
Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 0,6	Class 5,4	Class 0,6	Class 5,4	Class 0	Class 6	Class 5	Class 4	over	incl.
max				max		max		high	low	high	low	max					
10	6	4	2.5	7	3	7	3	0	-120	0	-40	15	15	5	2.5	2.5 <sup>1</sup>	10
10	7	4	2.5	7	3	7	3	0	-120	0	-80	20	20	5	2.5	10	18
13	8	4	3	8	4	8	4	0	-120	0	-120	20	20	5	2.5	18	30
15	10	5	4	8	4	8	4	0	-120	0	-120	20	20	5	3	30	50
20	10	5	4	8	5	8	5	0	-150	0	-150	25	25	6	4	50	80
25	13	6	5	9	5	9	5	0	-200	0	-200	25	25	7	4	80	120
30	18	8	6	10	6	10	7	0	-250	0	-250	30	30	8	5	120	150
30	18	8	6	10	6	10	7	0	-250	0	-250	30	30	8	5	150	180
40	20	10	8	11	7	13	8	0	-300	0	-300	30	30	10	6	180	250
50	25	13	—	13	—	15	—	0	-350	0	-350	35	35	13	—	250	315
60	30	15	—	15	—	20	—	0	-400	0	-400	40	40	15	—	315	400
65	35	—	—	—	—	—	—	0	-450	—	—	50	45	—	—	400	500

Unit  $\mu\text{m}$

Radial run-out $K_{ea}$				Perpendicularity of outside surface $S_b$		Axial run-out $S_{ea} \text{ } ^2$		Allowable width deviation $\Delta_{Cs}$				Allowable width variation $V_{Cs}$				Nominal outer diameter $D$ mm			
Class 0	Class 6	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 0,6,5,4				Class 0	Class 6	Class 5	Class 4	over	incl.		
max				max		max						max							
15	8	5	3	8	4	8	5	Depending on the tolerance of $\Delta_{Bs}$ for $d$ of same bearing.								6 <sup>1</sup>	18		
15	9	6	4	8	4	8	5					Depending on				5	2.5	18	30
20	10	7	5	8	4	8	5					the applicable				5	2.5	30	50
25	13	8	5	8	4	10	5					allowable				6	3	50	80
35	18	10	6	9	5	11	6					value of $V_{Bs}$				8	4	80	120
40	20	11	7	10	5	13	7					for $d$ of same				8	5	120	150
45	23	13	8	10	5	14	8					bearing.				8	5	150	180
50	25	15	10	11	7	15	10									10	7	180	250
60	30	18	11	13	8	18	10									11	7	250	315
70	35	20	13	13	10	20	13									13	8	315	400
80	40	23	—	15	—	23	—					15	—	400	500				
100	50	25	—	18	—	25	—					18	—	500	630				

**Table 4.4 Tolerances of thrust roller bearings**

**Table 4.4 (1) Inner rings and center rings**

Unit  $\mu\text{m}$

Nominal bore diameter $d$ or $d_2$ mm		Allowable deviation of mean diameter $\Delta d_{mp}$ or $\Delta d_{2mp}$				Allowable variation of bore diameter $V_{dp}$ or $V_{d2p}$		Allowable variation of raceway thickness <sup>1</sup> $S$			
over	incl.	Class 0, 6, 5		Class 4		Class 0, 6, 5 max	Class 4	Class 0	Class 6	Class 5	Class 4
		high	low	high	low						
—	18	0	−8	0	−7	6	5	10	5	3	2
18	30	0	−10	0	−8	8	6	10	5	3	2
30	50	0	−12	0	−10	9	8	10	6	3	2
50	80	0	−15	0	−12	11	9	10	7	4	3
80	120	0	−20	0	−15	15	11	15	8	4	3
120	180	0	−25	0	−18	19	14	15	9	5	4
180	250	0	−30	0	−22	23	17	20	10	5	4
250	315	0	−35	0	−25	26	19	25	13	7	5
315	400	0	−40	0	−30	30	23	30	15	7	5
400	500	0	−45	0	−35	34	26	30	18	9	6
500	630	0	−50	0	−40	38	30	35	21	11	7

<sup>1</sup> The complex bearings are applicable to the category of single plane bearing  $d$  which corresponds to the same nominal outer diameter of same diameter series, without being applicable to  $d_2$  category.

**Table 4.4 (2) Outer rings**

Unit  $\mu\text{m}$

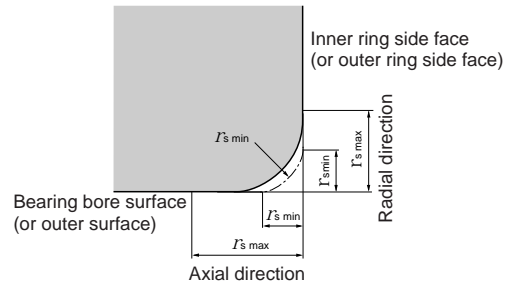
Nominal outer diameter $D$ mm		Allowable deviation of mean outer diameter $\Delta D_{mp}$				Allowable variation of outer diameter $V_{Dp}$		Allowable variation of raceway thickness $S_e$			
over	incl.	Class 0,6,5		Class 4		Class 0,6,5 max	Class 4	Class 0,6,5,4 max			
		high	low	high	low						
10	18	0	−11	0	−7	8	5	Depending on the applicable allowable value of $S_1$ for $d$ or $d_2$ of same bearing.			
18	30	0	−13	0	−8	10	6				
30	50	0	−16	0	−9	12	7				
50	80	0	−19	0	−11	14	8				
80	120	0	−22	0	−13	17	10				
120	180	0	−25	0	−15	19	11				
180	250	0	−30	0	−20	23	15				
250	315	0	−35	0	−25	26	19				
315	400	0	−40	0	−28	30	21				
400	500	0	−45	0	−33	34	25				
500	630	0	−50	0	−38	38	29				
630	800	0	−75	0	−45	55	34				

**Table 4.5 Allowable critical value for chamfering dimension**

**Table 4.5 (1) Radial bearings**

Unit mm

$f's \text{ min}^1$	Nominal bore diameter $d$		Radial direction	Axial direction
	over	incl.		
0.15	—	—	0.3	0.6
0.2	—	—	0.5	0.8
0.3	—	40	0.6	1
	40	—	0.8	1
0.6	—	40	1	2
	40	—	1.3	2
1	—	50	1.5	3
	50	—	1.9	3
1.1	—	120	2	3.5
	120	—	2.5	4
1.5	—	120	2.3	4
	120	—	3	5
2	—	80	3	4.5
	80	220	3.5	5
	220	—	3.8	6
2.1	—	280	4	6.5
	280	—	4.5	7
2.5	—	100	3.8	6
	100	280	4.5	6
	280	—	5	7
3	—	280	5	8
	280	—	5.5	8
4	—	—	6.5	9



1 Allowable minimum values for the chamfering dimension "r".

**Table 4.5 (2) Thrust bearings**

Unit mm

$f's \text{ min}^1$	Radial and axial directions	
	$f's \text{ max}$	
0.3	0.8	
0.6	1.5	
1	2.2	
1.1	2.7	
1.5	3.5	
2	4	
2.1	4.5	
3	5.5	

1 Allowable minimum values for the chamfering dimension "r".

**Table 4.6 Basic tolerances**

Unit  $\mu\text{m}$

Basic dimension (mm)		IT basic tolerance classes									
over	incl.	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10
	3	0.8	1.2	2	3	4	6	10	14	25	40
3	6	1	1.5	2.5	4	5	8	12	18	30	48
6	10	1	1.5	2.5	4	6	9	15	22	36	58
10	18	1.2	2	3	5	8	11	18	27	43	70
18	30	1.5	2.5	4	6	9	13	21	33	52	84
30	50	1.5	2.5	4	7	11	16	25	39	62	100
50	80	2	3	5	8	13	19	30	46	74	120
80	120	2.5	4	6	10	15	22	35	54	87	140
120	180	3.5	5	8	12	18	25	40	63	100	160
180	250	4.5	7	10	14	20	29	46	72	115	185
250	315	6	8	12	16	23	32	52	81	130	210
315	400	7	9	13	18	25	36	57	89	140	230
400	500	8	10	15	20	27	40	63	97	155	250
500	630	9	11	16	22	30	44	70	110	175	280
630	800	10	13	18	25	35	50	80	125	200	320
800	1 000	11	15	21	29	40	56	90	140	230	360
1 000	1 250	13	18	24	34	46	66	105	165	260	420
1 250	1 600	15	21	29	40	54	78	125	195	310	500
1 600	2 000	18	25	35	48	65	92	150	230	370	600
2 000	2 500	22	30	41	57	77	110	175	280	440	700
2 500	3 150	26	36	50	69	93	135	210	330	540	860

## 5. Bearing Internal Clearance

### 5.1 Bearing internal clearance

Bearing radial internal clearance (free clearance) is the amount of internal clearance a bearing has before being installed on a shaft or into a housing. When either the inner ring or the outer ring is fixed and the other ring is free to move, displacement takes place in the radial direction. This amount of displacement is called the radial internal clearance.

The radial internal clearance values of NTN machined ring needle roller bearings are listed in **Table 5.1**. **Table 5.1 (1)** shows the interchangeable clearances, which remain unchanged even if inner or outer ring are switched with those from different bearings. **Table 5.1 (2)** shows non-interchangeable clearances, which are supplied as matched sets due to the tighter clearance ranges. Bearing clearances are represented by the symbols C2, normal, C3, and C4 in increasing order from smallest to largest. Non-interchangeable clearances symbols are followed by "NA" for identification.

**For radial clearance values for bearings other than machined ring needle roller bearings, refer to "Commentary" provided with the appropriate dimension tables.**

### 5.2 Running clearance

#### 5.2.1 Running clearance selection

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

Theoretically, regarding bearing life, the optimum operating internal clearance of any bearing would be a slight negative clearance after the bearing has reached normal operating temperature.

Unfortunately, under actual operating conditions, maintaining such optimum tolerances is often difficult at best. Due to various fluctuating operating conditions this slight minus clearance can quickly become a large minus, greatly lowering the life of the bearing and causing excessive heat to be generated. Therefore, an initial internal clearance that will result in a slightly greater than minus internal operating clearance should be selected.

Under normal operating conditions (e.g. normal load, fit, speed, temperature, etc.), a standard internal clearance will give a very satisfactory operating clearance.

**Table 5.1 Radial internal clearance in machined ring needle roller bearing**  
**Table 5.1 (1) Interchangeable bearings**

Nominal bore diameter <i>d</i> (mm)		Radial internal clearance							
		C2		Normal <sup>1</sup>		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
—	10	0	30	10	40	25	55	35	65
10	18	0	30	10	40	25	55	35	65
18	24	0	30	10	40	25	55	35	65
24	30	0	30	10	45	30	65	40	70
30	40	0	35	15	50	35	70	45	80
40	50	5	40	20	55	40	75	55	90
50	65	5	45	20	65	45	90	65	105
65	80	5	55	25	75	55	105	75	125
80	100	10	60	30	80	65	115	90	140
100	120	10	65	35	90	80	135	105	160
120	140	10	75	40	105	90	155	115	180
140	160	15	80	50	115	100	165	130	195
160	180	20	85	60	125	110	175	150	215
180	200	25	95	65	135	125	195	165	235
200	225	30	105	75	150	140	215	180	255
225	250	40	115	90	165	155	230	205	280
250	280	45	125	100	180	175	255	230	310
280	315	50	135	110	195	195	280	255	340
315	355	55	145	125	215	215	305	280	370
355	400	65	160	140	235	245	340	320	415
400	450	70	190	155	275	270	390	355	465

<sup>1</sup> Supplementary suffix codes of clearance is not added to bearing numbers.

**Table 5.1 (2) Non-interchangeable bearings**

Nominal bore diameter <i>d</i> (mm)		Radial internal clearance							
		C2NA		NA <sup>2</sup>		C3NA		C4NA	
over	incl.	min	max	min	max	min	max	min	max
—	10	10	20	20	30	35	45	45	55
10	18	10	20	20	30	35	45	45	55
18	24	10	20	20	30	35	45	45	55
24	30	10	25	25	35	40	50	50	60
30	40	12	25	25	40	45	55	55	70
40	50	15	30	30	45	50	65	65	80
50	65	15	35	35	50	55	75	75	90
65	80	20	40	40	60	70	90	90	110
80	100	25	45	45	70	80	105	105	125
100	120	25	50	50	80	95	120	120	145
120	140	30	60	60	90	105	135	135	160
140	60	35	65	65	100	115	150	150	180
160	180	35	75	75	110	125	165	165	200
180	200	40	80	80	120	140	180	180	220
200	225	45	90	90	135	155	200	200	240
225	250	50	100	100	150	170	215	215	265
250	280	55	110	110	165	185	240	240	295
280	315	60	120	120	180	205	265	265	325
315	355	65	135	135	200	225	295	295	360
355	400	75	150	150	225	255	330	330	405
400	450	85	170	170	255	285	370	370	455

<sup>2</sup> For bearing with normal clearance, only NA is added to bearing numbers. EX. NA4920NA

## 5.2.2 Calculation of running clearance

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

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

where,

- $\delta_{\text{eff}}$  : Running clearance mm
- $\delta_o$  : Free clearance mm
- $\delta_f$  : Reduction in internal clearance by interference mm
- $\delta_t$  : Reduction in internal clearance due to inner/outer ring temperature difference mm

### (1) Reduction in radial clearance by interference

When bearings are installed with interference fits on shafts and in housings, the inner ring will expand and the outer ring will contract; thus reducing the bearing's internal clearance. The amount of expansion or contraction varies depending on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. The differential is approximately 85% of the effective interference. For details, refer to **Table 6.4** on page A-35.

$$\delta_f \approx 0.85 \cdot \Delta_{\text{deff}} \quad \text{.....(5.2)}$$

where,

- $\delta_f$  : Reduction in internal clearance by interference mm
- $\Delta_{\text{deff}}$  : Effective interference mm

### (2) Reduction in radial clearance due to inner/outer ring temperature difference

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

$$\delta_t = \alpha \cdot \Delta T \cdot D_o \quad \text{.....(5.3)}$$

where,

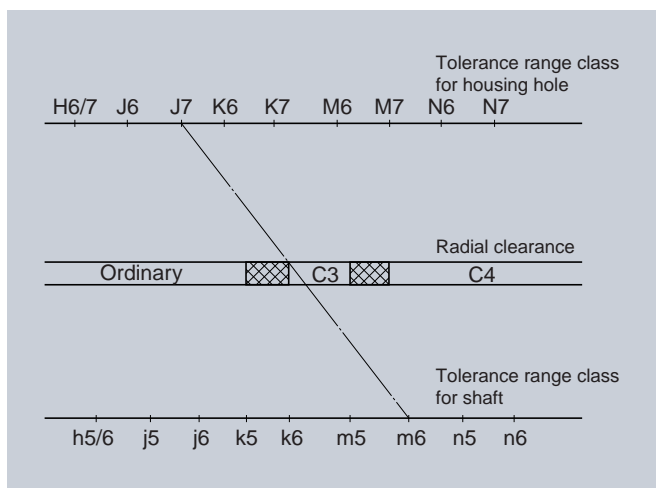
- $\delta_t$  : Reduction in internal clearance due to inner/outer ring temperature difference mm
- $\alpha$  : Linear expansion coefficient of bearing steel  $12.5 \times 10^{-6}/^\circ\text{C}$
- $\Delta T$  : Inner ring – outer ring temperature difference °C
- $D_o$  : Outer ring raceway diameter mm

When a shaft or housing is directly used as a raceway, the temperature difference ( $\Delta T$ ) can be determined, treating the shaft as an inner ring and the housing as an outer ring.

## 5.3 Fits and bearing radial internal clearance

Once the dimensional tolerances for the shaft outside diameter and the housing bore diameter have been determined, a simple nomogram such as a one in **Fig. 5.1** may be used as a guide to determine the initial radial internal clearance for the bearing that will later lead to an appropriate internal clearance of the installed bearing. The nomogram in **Fig. 5.1** is used as the guideline as stated above. For details feel free to contact **NTN**.

For example, where the fit condition of a needle roller bearing with an inner ring is already given as J7 m6, **Fig.5.1** shows that clearance C3 must be used to get the standard running clearance after installation.



**Fig. 5.1 Relationship between bearing fits and radial clearance**

## 6. Bearing Fits

### 6.1 About bearing fits

For rolling bearings, the inner ring and outer ring are fixed on the shaft or in the housing so that relative movement does not occur between the fitted surfaces of the bearing ring and the shaft or housing in radial, axial and rotational directions when a load acts on the bearing. Depending on presence/absence of interference, fit modes can be categorized into “**interference fit**”, “**transition fit**”, and “**loose fit**”.

The most effective practice to position a bearing is to provide an interference on the fit surfaces between the bearing ring and shaft or housing. Furthermore, as its advantage this tight fit method supports the thin-walled bearing ring with uniform load throughout its entire circumference without any loss of load carrying capacity.

The needle roller bearing is a bearing type which allows separation of the inner ring and the outer ring from one another and, therefore, it can be installed on a shaft or in a housing with an interference applied to both. In the case of "tight fit", the ease of bearing installation and removal. The bearing ring subjected to stationary load can be "loose-fitted". In contrast, tight fitting may not apply to all bearing applications because ease of mounting or removal of the bearing will be jeopardized.

### 6.2 Necessity of proper fit

Improper fit could lead to damage and shorter life of the bearing. Therefore, advance careful analysis is needed for selection of proper fit. Representative examples of bearing defects caused by improper fit are as described below.

- ┆ Fracture of bearing ring, and displacement of bearing ring

- ┆ Wear of bearing ring, shaft and housing caused by creep and fretting corrosion
- ┆ Seizure caused by insufficient internal clearance
- ┆ Insufficient running accuracy and abnormal noise caused by deformed raceway surface

### 6.3 Fit selection

Fit selection is generally done in accordance with the rule specified hereunder.

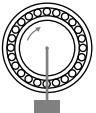
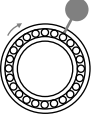
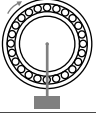

The loads acting on each bearing ring are divided into running load, stationary load and directionally unstable load according to the direction and characteristic of loads acting on the bearing.

A bearing ring that carries both running load and indeterminate direction load is provided with tight fit while a bearing ring that carries static load may be provided with either transition fit or loose fit (refer to **Table 6.1**).

Where load of high magnitude or vibration and shock loads act on a bearing or if a light alloy/plastic housing is used, it is necessary to secure a large interference. **However, if this type of practice is applied, it is necessary to consider the rigidity of housing in order to avoid problems including deformation or fracture of the housing, deformation of the bearing, galling on fit surfaces, as well as resultant poor fit accuracy.**

For an application subjected to high running accuracy, bearings of high accuracy must be used with a shaft and a housing of higher dimensional accuracy so as not to require a large interference. Applying a large interference would cause the shaft or housing profile to be transferred to the bearing track, which could then interfere with the bearing running accuracy.

**Table 6.1 Radial load and bearing fit**

Bearing running conditions	Sketch	Load characteristic	Bearing fit	
			Inner ring	Outer ring
Inner ring : Rotation Outer ring: static Load direction: constant		Rotating inner ring load	Needs to be tight fit	May be loose fit
Inner ring: static Outer ring: rotation Load direction: rotating with outer ring		Static outer ring load		
Inner ring: static Outer ring: rotation Load direction: constant		Rotating inner ring load	May be loose fit	Needs to be tight fit
Inner ring: rotation Outer ring: static Load direction : rotating with inner ring		Static outer ring load		
Inner ring: rotation or static Outer ring: rotation or static Load direction: The direction can not be fixed.	Load direction is non-constant due to directional fluctuation, unbalanced load, etc.	Directionally unstable load	Needs to be tight fit	Needs to be tight fit

**6.4 Recommended fits**

The dimensional tolerances for the diameter of a shaft and the bore diameter of a bearing housing, on/in which a bearing is installed, are standardized under the metric system in ISO 286 and JIS B 0401 (Bases of tolerances, deviations and fits). Hence, bearing fits are determined by selection of the dimensional tolerances for shaft diameter and housing bore diameter as applicable.

**Table 6.2** shows the recommended fits for the machined ring needle roller bearings (with inner ring) that are generally selected based on the dimensional and load conditions. **Table 6.3** shows the numerical fit values.

**For the recommended fits for others than the machined ring needle roller bearings, refer to "Commentary" described in the respective Dimension Tables.**

**Table 6.2 General standards for fits of machined ring needle roller bearing (JIS Class 0, Class 6)**

**Table 6.2 (1) Tolerance range classes for shaft (recommended)**

Conditions			Tolerance range class
Load characteristic	Load magnitude	Shaft diameter <i>d</i> mm	
Rotating inner ring load or directionally unstable load	Light load	— 50	j5
	Ordinary load	— 50	k5
		50 — 150	m5
		150 —	m6
	Heavy load and shock load	— 150	m6
150 —		n6	
Inner ring static load	Medium- and low-speed rotation, light load	All dimensions	g6
	General application		h6
	When high rotational accuracy is required		h5

**Table 6.2 (2) Tolerance range classes for housing bore (recommended)**

Conditions		Tolerance range class
Load characteristic	Load magnitude	
Outer ring static load	Ordinary and heavy load	J7
	Two-split housing, ordinary load	H7
Rotating outer ring load	Light load	M7
	Ordinary load	N7
	Heavy load and shock load	P7
Directionally unstable load	Light load	J7
	Ordinary load	K7
	Heavy load and shock load	M7
When high rotational accuracy under light load is required		K6

Remarks: Light load, ordinary load and heavy load are classified per the following criteria.

Light load :  $P \leq 0.06 C_r$

Ordinary load :  $0.06 C_r < P \leq 0.12 C_r$

Heavy load :  $P > 0.12 C_r$

**6.5 Lower limit and upper limit of interference**

When an intended bearing application requires an interference on the bearing, determine the appropriate interference taking into account the following considerations:

- Determine the lower limit taking into account the following factors:
  - (1) Reduction in interference due to radial load
  - (2) Reduction in interference due to temperature difference
  - (3) Reduction in interference due to poor roughness on fit surfaces
- Recommended upper limit is 1/1000 as large as the shaft diameter or smaller.

The formulas for calculating the required interference are presented below:

**(1) Radial load and required interference**

When a radial load acts on a bearing, the interference between the inner ring and shaft will decrease. The interference required to maintain an effective interference can be determined by **formulas (6.1) and (6.2)** below:

For  $F_r \leq 0.3 C_{or}$ ,

$$\Delta d_F = 0.08 \sqrt{\frac{d \cdot F_r}{B}} \left( 0.25 \sqrt{\frac{d \cdot F_r}{B}} \right) \dots\dots\dots (6.1)$$

For  $F_r > 0.3 C_{or}$ ,

$$\Delta d_F = 0.02 \frac{F_r}{B} \left( 0.2 \frac{F_r}{B} \right) \dots\dots\dots (6.2)$$

Where,

$\Delta d_F$  : Required effective interference mm

$d$  : Bearing bore diameter mm

$B$  : Inner ring width mm

$F_r$  : Radial load N (kgf)

$C_{or}$  : Basic static load rating N (kgf)

**Table 6.3 Numerical fit values for radial bearing (JIS Class-0)**  
**Table 6.3(1) Bearing fits on shaft**

Unit  $\mu\text{m}$

Nominal bore diameter $d$ mm	Allowable deviation of mean bore diameter $\Delta d_{mp}$		g6		h5		h6		j5		k5		m5		m6		n6		
			Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	Bearing	Shaft	
over	incl.	high	low																
3	6	0	-8	4T~12L		8T~5L		8T~8L		11T~2L		14T~1T		17T~4T		20T~4T		24T~8T	
6	10	0	-8	3T~14L		8T~6L		8T~9L		12T~2L		15T~1T		20T~6T		23T~6T		27T~10T	
10	18	0	-8	2T~17L		8T~8L		8T~11L		13T~3L		17T~1T		23T~7T		26T~7T		31T~12T	
18	30	0	-10	3T~20L		10T~9L		10T~13L		15T~4L		21T~2T		27T~8T		31T~8T		38T~15T	
30	50	0	-12	3T~25L		12T~11L		12T~16L		18T~5L		25T~2T		32T~9T		37T~9T		45T~17T	
50	80	0	-15	5T~29L		15T~13L		15T~19L		21T~7L		30T~2T		39T~11T		45T~11T		54T~20T	
80	120	0	-20	8T~34L		20T~15L		20T~22L		26T~9L		38T~3T		48T~13T		55T~13T		65T~23T	
120	140	0	-25	11T~39L		25T~18L		25T~25L		32T~11L		46T~3T		58T~15T		65T~15T		77T~27T	
140	160																		
160	180																		
180	200	0	-30	15T~44L		30T~20L		30T~29L		37T~13L		54T~4T		67T~17T		76T~17T		90T~31T	
200	225																		
225	250																		
250	280	0	-35	18T~49L		35T~23L		35T~32L		42T~16L		62T~4T		78T~20T		87T~20T		101T~34T	
280	315																		
315	355	0	-40	22T~54L		40T~25L		40T~36L		47T~18L		69T~4T		86T~21T		97T~21T		113T~37T	
355	400																		
400	450	0	-45	25T~60L		45T~27L		45T~40L		52T~20L		77T~5T		95T~23T		108T~23T		125T~40T	
450	500																		

**Table 6.3 (2) Bearing fits in housing hole**

Unit  $\mu\text{m}$

Nominal outer diameter $D$ mm	Allowable deviation of mean outer diameter $\Delta D_{mp}$		H7		J7		K6		K7		M7		N7		P7		
			Housing	Bearing	Housing	Bearing	Housing	Bearing	Housing	Bearing	Housing	Bearing	Housing	Bearing	Housing	Bearing	
over	incl.	high	low														
6	10	0	-8	0~23L		7T~16L		7T~10L		10T~13L		15T~8L		19T~4L		24T~1T	
10	18	0	-8	0~26L		8T~18L		9T~10L		12T~14L		18T~8L		23T~3L		29T~3T	
18	30	0	-9	0~30L		9T~21L		11T~11L		15T~15L		21T~9L		28T~2L		35T~5T	
30	50	0	-11	0~36L		11T~25L		13T~14L		18T~18L		25T~11L		33T~3L		42T~6T	
50	80	0	-13	0~43L		12T~31L		15T~17L		21T~22L		30T~13L		39T~4L		52T~8T	
80	120	0	-15	0~50L		13T~37L		18T~19L		25T~25L		35T~15L		45T~5L		59T~9T	
120	150	0	-18	0~58L		14T~44L		21T~22L		28T~30L		40T~18L		52T~6L		68T~10T	
150	180	0	-25	0~65L		14T~51L		21T~29L		28T~37L		40T~25L		52T~13L		68T~3T	
180	250	0	-30	0~76L		16T~60L		24T~35L		33T~43L		46T~30L		60T~16L		79T~3T	
250	315	0	-35	0~87L		16T~71L		27T~40L		36T~51L		52T~35L		66T~21L		88T~1T	
315	400	0	-40	0~97L		18T~79L		29T~47L		40T~57L		57T~40L		73T~24L		98T~1T	
400	500	0	-45	0~108L		20T~88L		32T~53L		45T~63L		63T~45L		80T~28L		108T~0	

Remarks: Fit symbols "L" and "T" represent bearing clearance and interference respectively.

**(2) Temperature difference and required interference**

Heat is generated in a running bearing, and temperature difference occurs across the inner ring and outer ring: as a result, the interference between the inner ring and shaft will decrease. When the difference between bearing temperature and ambient temperature is taken as  $\Delta T$ , the interference needed for maintaining an effective interference can be determined by **formula (6.3)**:

$$\Delta d_f = 0.0015 \cdot d \cdot \Delta T \dots \dots \dots (6.3)$$

Where,

- $\Delta d_f$  : Required effective interference for temperature difference  $\mu\text{m}$
- $\Delta T$  : Difference between bearing temperature and ambient temperature  $^{\circ}\text{C}$
- $d$  : Bearing bore diameter  $\text{mm}$

**(3) Fitting surface roughness and required interference**

The fitting surface is smoothed (surface roughness is made less) by bearing fits so that the interference reduces correspondingly. The interference reduction differs depending on the fitting surface roughness and generally the following reduction values must be used.

- For ground shafts : 1.0 to 2.5mm
- For lathe-turned shafts : 5.0 to 7.0 mm

**(4) Maximum interference**

Tensile stress or compressive stress occurs on a bearing ring that has been installed to a shaft or housing with possible interference between these members. Excessively large interference can cause the bearing ring to fracture or shorten the fatigue life of the bearing. Therefore, usually **set the maximum allowable interference at 1/1000 as large as the shaft diameter or smaller; or such that the maximum circumferential tensile stress occurring on the fitting surfaces is not greater than 130 MPa** (refer to Table 6.4).

**(5) Stress and deformation caused by interference**

When bearing ring (solid) is fitted with interference, it deforms elastically and this elastic deformation results in stress. (See Fig.6.1) The fitting surface pressure of bearing ring, circumferential tensile stress (inner ring), compressive stress (outer ring) and radial expansion of raceway (inner ring), and shrinkage (outer ring) can be calculated from Table 6.4.

**Table 6.4 Deformation and stress caused by bearing fit**

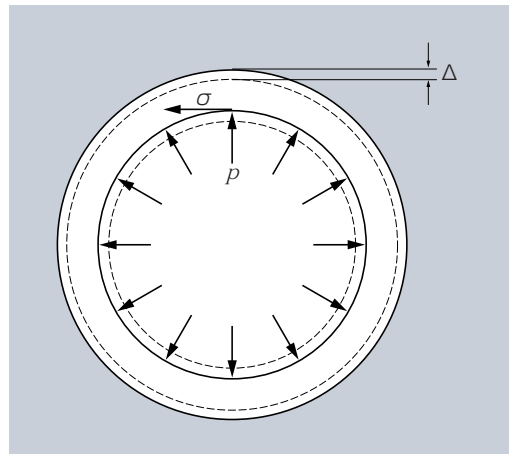
Item	Inner ring	Outer ring
Surface pressure $p$ MPa	$p_i = \frac{E \Delta d_{eff}}{2d} \frac{(1-k^2)(1-k_0^2)}{1-k^2k_0^2}$	$p_e = \frac{E \Delta D_{eff}}{2D} \frac{(1-l^2)(1-h_0^2)}{1-l^2h_0^2}$
Circumferential maximum stress $\sigma$ MPa	$\sigma_i = p_i \frac{1+k^2}{1-k^2}$ (Tensile stress)	$\sigma_e = p_e \frac{2}{1-l^2}$ (Compressive stress)
Radial elastic deformation of raceway $\Delta$	$\Delta_i = \Delta d_{eff} \cdot k \frac{1-k_0^2}{1-k^2k_0^2}$ (Expansion)	$\Delta_e = \Delta D_{eff} \cdot h \frac{1-h_0^2}{1-l^2h_0^2}$ (Shrinkage)

Where,

$$k = \frac{d}{d_i}, k_0 = \frac{d_0}{d}, h = \frac{D_e}{D}, h_0 = \frac{D}{D_0}$$

**Remarks (Symbol representation)**

- $d$  : Inner ring bore diameter (shaft diameter)  $\text{mm}$
- $d_0$  : Hollow shaft bore diameter (For solid shaft,  $d_0=0$ )  $\text{mm}$
- $d_i$  : Inner ring raceway diameter  $\text{mm}$
- $\Delta d_{eff}$  : Effective interference for inner ring  $\text{mm}$
- $D$  : Outer ring outer diameter (housing hole diameter)  $\text{mm}$
- $D_0$  : Housing outer diameter (For sufficient housing size,  $D_0=\infty$ )  $\text{mm}$
- $D_e$  : Outer ring raceway diameter  $\text{mm}$
- $\Delta D_{eff}$  : Effective interference for outer ring  $\text{mm}$
- $E$  : Modulus of elasticity (Young factor)  $2.07 \times 10^5$  (21200) MPa (kgf/mm<sup>2</sup>)



**Fig.6.1**

## 7. Limiting Speeds

At a higher bearing running speed, the bearing temperature will be higher due to frictional heat generated inside the bearing, possibly leading to failures such as seizure. As a result, the bearing will fail to continue stable operation. A maximum running speed that allows a bearing to run without developing such a problem heat buildup is known as a **limiting speed** ( $\text{min}^{-1}$ ) and can vary depending on the bearing type, dimensions, cage type, load, acceleration/deceleration conditions, lubrication conditions and cooling conditions.

As a guideline, each bearing dimension table contains data about limiting bearing speeds obtained from grease lubrication and oil lubrication. However, it should be noted that these values are based on the following assumptions:

- ┆ Bearing that has been manufactured per NTN standard design specification and is provided with an appropriate internal clearance has been correctly mounted.
- ┆ Bearing is lubricated with a good quality lubricant, which is resupplied and replaced at correct intervals.
- ┆ Bearing is operated under ordinary loading conditions ( $P \leq 0.09 G$ ) and at an ordinary operating temperature.

If the user is thinking of a bearing application whose running speed exceeds the limiting speed in the relevant dimension table, the user has to adopt a bearing that satisfies stricter requirements for cage specification, internal clearance, bearing accuracy, etc. and make special considerations which typically include adoption of forced circulating lubrication system.

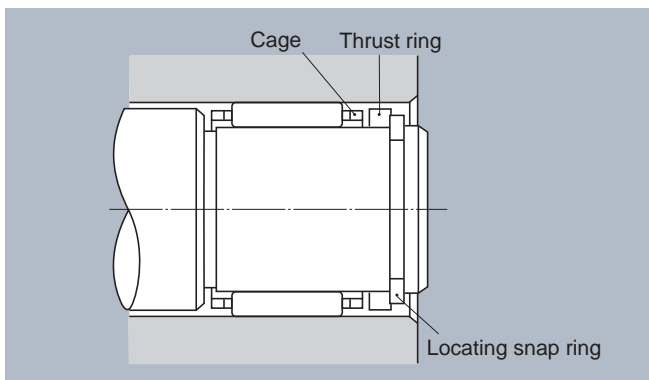
## 8. Shaft and Housing Design

Even if the bearing to be used is selected correctly, it can not fulfill its specific function unless the shaft/housing on/in which it is installed is designed correctly. For needle roller bearings, special attention must be paid to shaft and housing designs, since the bearing ring thickness is thinner compared to other rolling bearing types.

### 8.1 Design of bearing installing portions

For needle roller and cage assemblies, attention must be paid to the axial guidance surface, such as a shaft shoulder. This guiding surface should be smooth and free from burrs. Under challenging load and/or speed conditions, a hardened and ground surface is required.

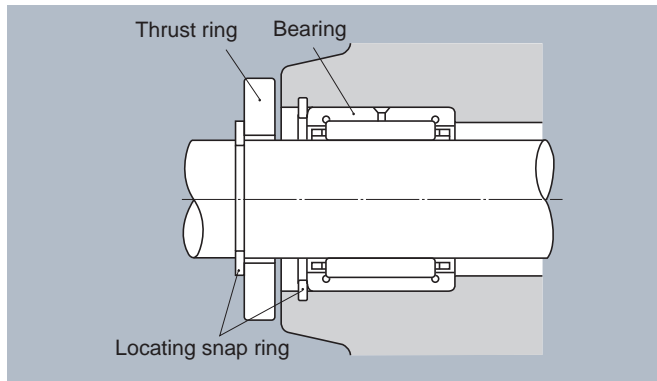
In cases where a snap ring is used as a locating shoulder (**Fig. 8.1**), a thrust ring should be used between the snap ring and bearing cage to prevent the cut section of the snap ring from contacting the cage directly. NTN offers WR type snap rings that are customdesigned for axial retention of needle roller & cage assemblies. (Refer to the Dimensions Table on page B-267.)



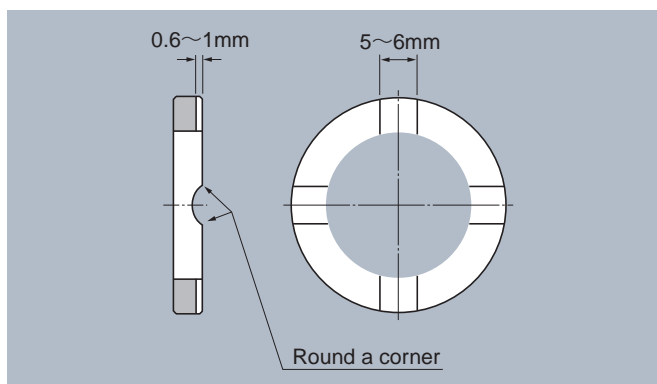
**Fig. 8.1** Bearing fixing by thrust ring

Since a radial needle roller bearing can move freely on the shaft along the axial direction, a ball bearing or thrust bearing is used on the side opposite to the radial needle roller bearing in order to locate the shaft in the axial direction. With an application where the axial load is low and the running speed is not high (for example, an idle gear in gearbox), a thrust ring may be installed to a shaft as shown in **Fig. 8.2** to form a sliding bearing between the thrust ring and the housing end face in order to axially position the bearing. **Fig.8.3** illustrates an example of the above thrust ring with oil groove on its guide surface. The boundary between this oil groove and the plane area must be chamfered for deburring.

In general, for proper installation of needle roller bearing the inner ring and outer ring are both positioned in axial direction so that the bearing displaces in axial direction while running.



**Fig. 8.2** Bearing fixing in axial direction



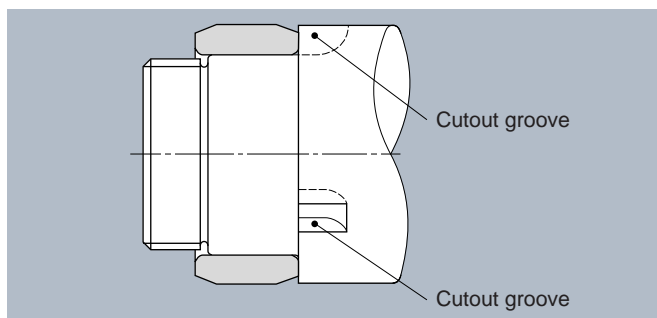
**Fig. 8.3** Design of thrust ring guide surface

#### (1) Inner ring

For fixing inner ring correctly on a shaft, the shaft shoulder face is finished at the right angle against the shaft axial center and, in addition, the shaft corner radius must be smaller than the inner ring chamfer dimension.

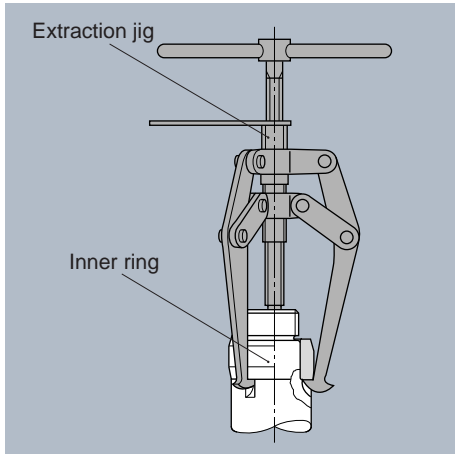
To simplify inner ring extraction work, cutout grooves for engagement with jaws of an extraction jig are formed at the shoulder of the shaft as shown in **Fig. 8.4**, and the inner ring is extracted with the extraction jig according to a method illustrated in **Fig. 8.5**. Furthermore, for facilitating inner ring pull-out work the shaft shoulder is provided with a notched groove, as illustrated in **Fig. 8.5**, to accept an inner ring pull-out jig (puller).

NTN snap ring WR type for shaft use (Refer to Dimensions Table on page B-267) can be used for simply fixing inner ring in axial direction. (**Fig. 8.6**) Moreover,

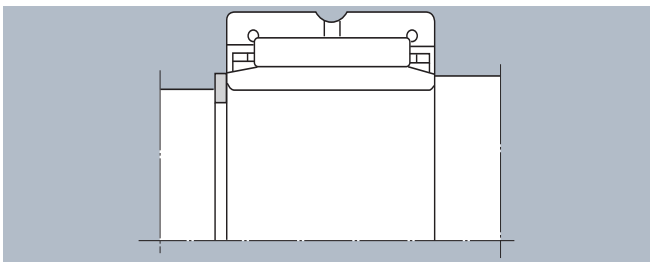


**Fig. 8.4** Cutout groove for inner ring extraction

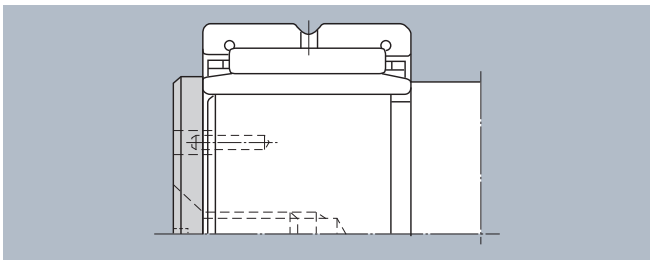
inner ring can be fixed in axial direction using an end plate or a side ring as illustrated in **Figs. 8.7** and **8.8**.



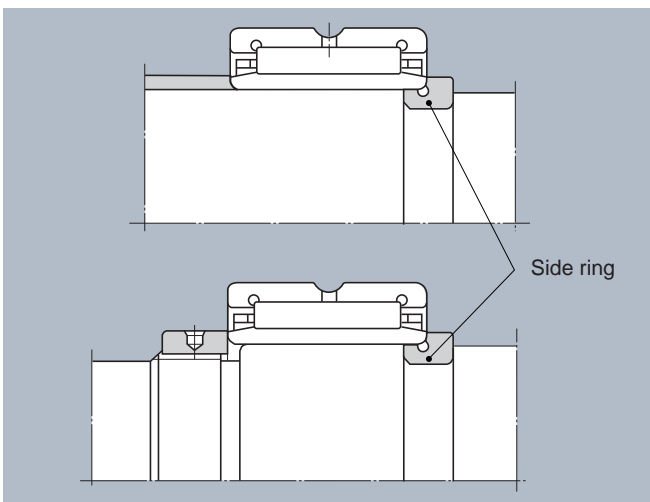
**Fig. 8.5** Inner ring extraction with extraction jig



**Fig. 8.6** Inner ring fixing method with snap ring



**Fig. 8.7** Inner ring fixing method with end plate



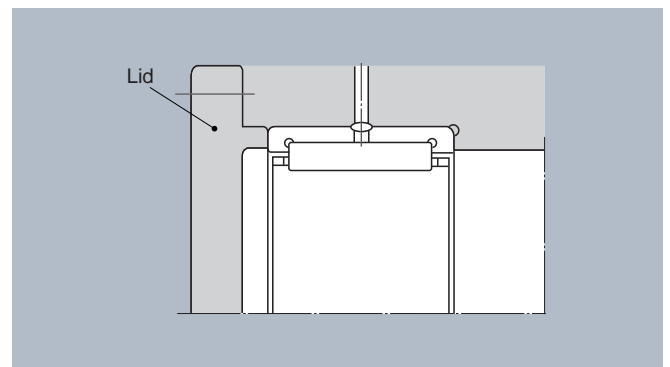
**Fig.8.8** Inner ring fixing method with side ring

## (2) Outer ring

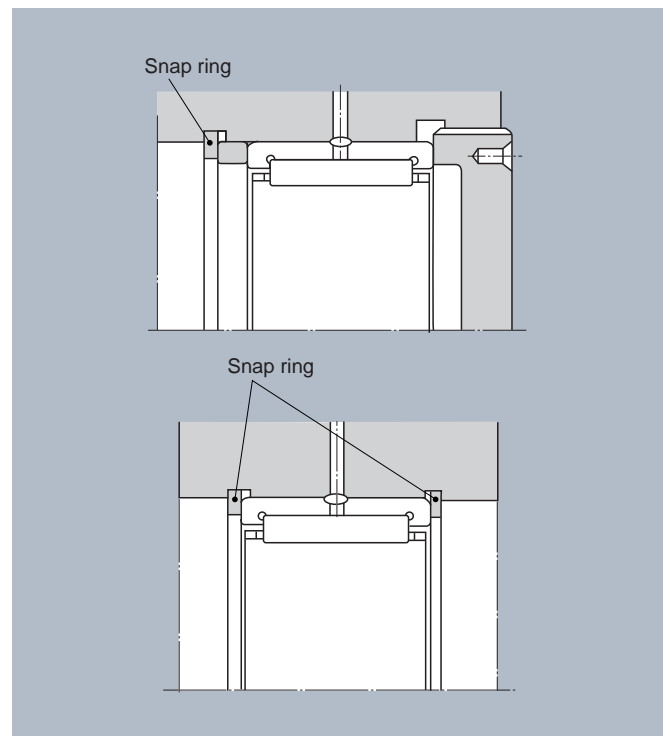
Similarly to Para. 8.1(1) "Inner Ring", good care must be exercised of the shoulder profile of bearing housing for fixing outer ring in axial direction.

**Figs. 8.9** and **8.10** illustrate the methods of fixing outer ring in axial direction.

For the outer ring also, the NTN snap ring type BR for housing (refer to the dimension table in page B-269) can be used. NTN BR type snap rings are designed to the dimensions adaptable to the needle roller bearings with low section height. However, commercially available snap rings conforming to JIS standard as applicable can also be used for the same bearings with adequately high section height.



**Fig. 8.9** Outer ring fixing by lid



**Fig. 8.10** Outer ring fixing method with snap ring

## 8.2 Bearing fitting dimensions

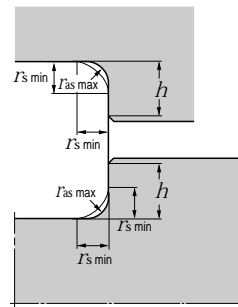
### 8.2.1 Shoulder height and corner roundness

The respective shoulder heights " $h$ ", of the shaft and housing are designed to be larger than the maximum bearing chamfer dimension  $r_{s\ max}$ , so the bearing end face comes in contact with the flat zone. The corner roundness " $r_{as}$ " is designed to be smaller than the minimum bearing chamfer dimension " $r_{s\ min}$ " so as not to interfere with the bearing. Generally the radius of the shaft and housing corner roundness shown in **Table 8.1** is used as the shoulder heights of the shaft and housing.

The dimensions of the shafts and housings related to bearing installation are as described in the dimensions table for each bearing type. The shoulder diameter shown in this table means the effective shoulder diameter which comes in contact with the side face of bearing excluding the chamfered portion of the shoulder.

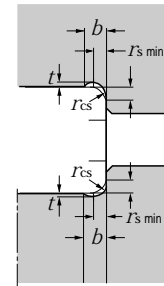
**Table 8.1** Radius of shaft /housing corner roundness and shoulder height

Unit mm		
$r_{s\ min}$	$r_{as\ max}$	$h$ (min)
0.15	0.15	0.6
0.2	0.2	0.8
0.3	0.3	1
0.6	0.6	2
1	1	2.5
1.1	1	3.25
1.5	1.5	4
2	2	4.5
2.1	2	5.5
2.5	2	5.5
3	2.5	6.5
4	3	8



**Table 8.2** Relief grinding dimension for shaft and housing corners

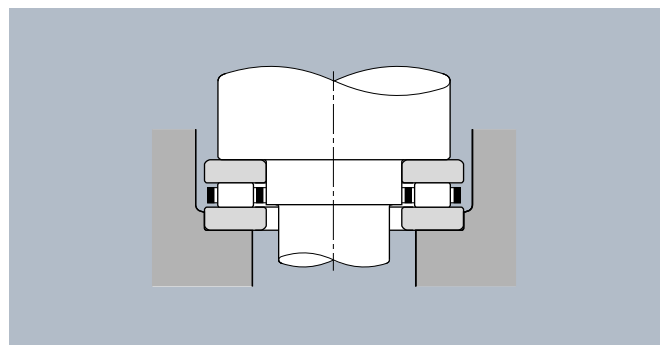
Unit mm			
$r_{s\ min}$	$b$	$t$	$r_{cs}$
1	2	0.2	1.3
1.1	2.4	0.3	1.5
1.5	3.2	0.4	2
2	4	0.5	2.5
2.1	4	0.5	2.5
3	4.7	0.5	3
4	5.9	0.5	4



### 8.2.3 Mounting dimensions for thrust bearings

To be able to satisfy requirements for load capacity and rigidity, the surface of bearing ring on any thrust bearing needs to be sufficiently large. Therefore, the mounting dimensions in the dimension table for the intended bearing needs to be satisfied (**Fig. 8.12**).

Because of this, shoulder heights for thrust bearings have to be greater compared to radial bearings. (For the mounting dimensions of a particular thrust bearing, refer to the dimension table for that bearing.)

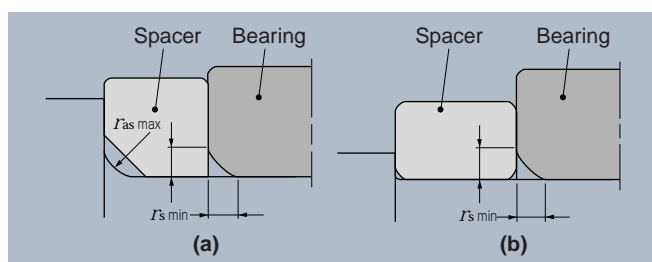


**Fig. 8.12**

### 8.2.2 Applications of spacer and relief grinding

There may be cases where corner roundness  $r_{as\ max}$  needs to be greater than the chamfering dimension on the bearing in order to mitigate stress concentration and enhance shaft strength (**Fig. 8.11a**), or where sufficiently large contact area is not available because of a low shaft shoulder (**Fig. 8.11b**). Then, a spacer can be inserted between the shaft shoulder and bearing.

Dimensions of ground-finished fit surfaces on shafts and housings are listed in **Table 8.2**.



**Fig. 8.11** Spacer applications

### 8.3 Shaft and housing accuracy

The bearing ring of a needle roller bearings is thin-walled. Consequently, degree of physical accuracy of the raceway surface of the bearing ring is governed by physical accuracy of the fit surface of the shaft or housing to which the intended bearing is installed.

**Table 8.3** summarizes recommended physical accuracy (tolerances) on the fit surfaces of the shaft and housing under ordinary bearing operating conditions: the characteristics in question are dimensional accuracy, shape accuracy, surface roughness, and runout of the shaft shoulder relative to fit surface.

For an application that adopts a double-split housing, the bore side of each housing half may be relieved: consequently, when the housing halves are joined together and the mating surfaces are forced together, resultant deformation on the outer ring is minimal.

**Table 8.3 Shaft and housing accuracy (recommended)**

Characteristic item	Shaft	Housing
Dimensional accuracy	IT6 (IT5)	IT7 (IT6)
Roundness cylindricality (max)	IT3	IT4
Shoulder perpendicularity (max)	IT3	IT3
Fitting surface roughness	0.8a	1.6a

Remarks: The parenthesized values are applied to the bearings of accuracy class 5 and higher.

### 8.4 Raceway surface accuracy

For needle roller bearings, the shaft and housing are used as the raceway surface on applications. The raceway dimensional accuracy, profile accuracy and surface roughness of the shaft/housing must be equivalent to the raceway accuracy of the bearing itself. **Table 8.4** shows the specified surface accuracy and surface roughness of the shaft/housing raceway.

**Table 8.4 Raceway surface accuracy (recommendation)**

Characteristic item	Shaft	Housing
Dimensional accuracy	IT5 (IT4)	IT6 (IT5)
Roundness cylindricality (max)	IT3 (IT2)	IT4 (IT3)
Shoulder perpendicularity (max)	IT3	IT3
Surface roughness	For shaft diameter of $\phi$ 80 and less :0.2a For shaft diameter of over $\phi$ 80 to 120 :0.3a For shaft diameter of over $\phi$ 120 :0.4a	

Note) The parenthesized values are applied where high rotational accuracy is required.

### 8.5 Material and hardness of raceway surface

When the outer surface or bore surface of the shaft(hollowed) or housing is used as raceway, it must be hardened to HRC58 to 64 in order to obtain sufficient load capacity. For that, the materials shown in **Table 8.5** are used after heat-treated properly.

**Table 8.5 Materials used for raceway**

Kinds of steel	Representative example	Related standards
High carbon chrome bearing steel	SUJ2	JIS G 4805
Carbon tool steel	SK85 (previously: SK5)	JIS G 4401
Nickel chrome molybdenum steel	SNCM420	JIS G 4053 (previously: JIS G 4103)
Chrome steel	SCr420	JIS G 4053 (previously: JIS G 4104)
Chrome molybdenum steel	SCM420	JIS G 4053 (previously: JIS G 4105)
Stainless steel	SUSU440C	JIS G 4303

When steel is surface-hardened by carburizing or carbonitriding, JIS Standard defines the depth from surface up to HV550 as an effective hardened layer. The minimum value of effective hardened layer depth is approximately expressed in **formula (8.1)**.

$$E_{ht \min} \geq 0.8D_w (0.1+0.002 D_w) \dots\dots\dots(8.1)$$

Where,

$E_{ht \min}$  : Minimum effective hardened layer depth mm

$D_w$  : Roller diameter mm

### 8.6 Allowable bearing inclination

The inner ring and outer ring of the bearing incline a little eventually against one another depending on shaft deflection, shaft /housing machining accuracy, fitting deviation, etc. Although this allowable inclination differs depending on bearing type, bearing load, internal clearance, etc., the inclination degree shown in **Table 8.6** must be used as a guideline in the case of general applications because even minor inclination of the inner and outer ring could cause a reduction of bearing life and damage the cage.

**Table 8.6**

Bearing type	Allowable inclination
Radial needle roller bearing	1/2 000
Thrust bearing	1/10 000

## 9. Lubrication

### 9.1 Purpose of lubrication

When a bearing is lubricated, its rolling and sliding surfaces are covered with a thin oil film that prevents the occurrence of metal-to-metal contact. Lubrication of rolling bearings offers the following benefits:

- (1) Reduction of friction and wear
- (2) Discharge of friction heat
- (3) Further extension of bearing life
- (4) Rust prevention
- (5) Prevention of foreign matter invasion

To fully realize these benefits developed, the bearing user has to adopt a lubrication system that best suits the projected bearing operating conditions, select quality lubricant, and adopt a relevant sealing design that helps regulate the amount of lubricant retained, prevent the ingress of foreign materials and leakage of the lubricant.

### 9.2 Lubrication systems and characteristics

In general, bearing lubrication systems usually available as grease lubrication and oil lubrication, each featuring unique advantages and disadvantages. The user needs to select an appropriate lubrication system that best suits the user's bearing performance requirements.

**Table 9.1** summarizes the different features of grease and oil lubrication.

**Table 9.1** Characteristic comparison of grease and oil lubrication

Lubrication method Comparative items	Grease lubrication	Oil lubrication
Handling	◎	△
Reliability	○	◎
Cooling effect	×	○ (Recirculation needed)
Seal structure	○	△
Power loss	○	○
Environmental pollution	○	△
High speed operation of bearing	×	○

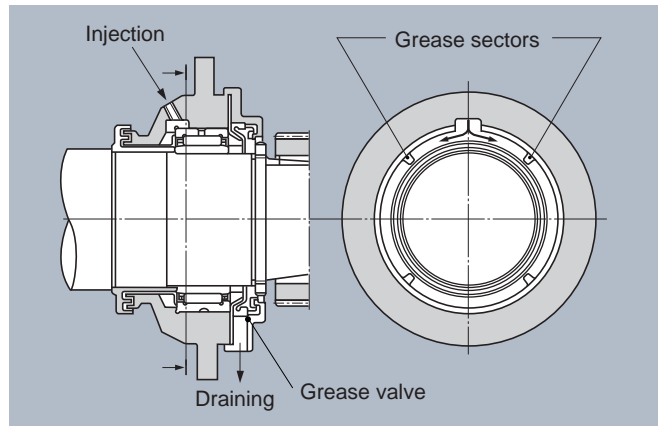
◎ : Extraordinarily advantageous    ○ : Advantageous  
 △ : Fairly advantageous              × : Disadvantageous

### 9.3 Grease lubrication

Grease lubrication is the simplest lubrication method. This method enables a simplified design of the seal structure, and is broadly used.

Important points for this lubrication method are to select an optimum grease and to fill it securely in the bearing. Particularly where the cage is guided by the inner ring or outer ring of bearing, care must be exercised so the guide surface is fully greased throughout its entire area.

If requiring refilling of grease, the bearing should be provided with grease sectors as a refilling means and a grease valve or an equivalent as a means of discharge.



**Fig. 9.1** An example of bearing unit with grease sector and grease valve

**Fig. 9.1** illustrates an example of bearing unit with grease sector and a grease valve. An amount of grease injected through a port, such as a grease nipple, is blocked by the grease sectors, then fills the space and the excess fluid flows into the bearing. Grease is circulated through the interior of bearing, and excess amount of grease pushed out of the bearing is allowed to drain through the grease valve.

#### 9.3.1 About grease

Grease lubrication is **composed of a lubrication base oil (ex. mineral oil base or a synthetic oil base) held with a thickener, and various additives added thereto.** The properties of grease are determined by the kinds and combination of base oil, thickener, and additives.

Commons grease types and their characteristics are summarized in **Table 9.2.** Characteristics of greases of a similar type can vary greatly depending on the brands. Therefore, **to be able to select an optimal grease brand, it is necessary to check grease characteristic data, available from grease manufacturers.**

##### (1) Base oil

Base oils used in grease are **mineral oil**, or synthetic oils such as **ester oil** and **ether oil**.

**Lubricating performance of a given lubricant is mainly governed by lubricating performance of the base oil.** Generally, greases comprising a low-viscosity base oil excel in low-temperature characteristics and high-speed performance, while greases with a high-viscosity base oil boast excellent high-temperature, high-load characteristics.

##### (2) Thickener

Thickeners are blended and diffused in base oil to hold grease in a semi-solid form. Commonly used thickeners include: metal soaps derived from **lithium**, **sodium** and **calcium**; non-metal soap thickeners made from inorganic materials such as **silica gel** and **bentonite**, and organic materials such as **urea** and **fluoro carbon**. The grease characteristics such as **critical operating temperature**, **mechanical stability**, **durability**, etc. are mainly

Table 9.2 Grease varieties and characteristics

Grease name	Lithium grease			Sodium grease (Fiber grease)	Calcium compound base grease	Aluminum grease	Non-soap grease	
Thickener	Li soap			Na soap	Ca+Na soap Ca+Li soap	Al soap	Bentone, silica gel, urea, carbon black, etc.	
Base oil	Mineral oil	Diester oil	Silicone oil	Mineral oil	Mineral oil	Mineral oil	Mineral oil	Synthetic oil
Dropping point °C	170~190	170~190	200~250	150~180	150~180	70~90	250 or more	250 or more
Operating temperature range °C	-30~+130	-50~+130	-50~+160	-20~+130	-20~+120	-10~+80	-10~+130	-50~+200
Mechanical stability	Excellent	Good	Good	Excellent to good	Excellent to good	Good to poor	Good	Good
Pressure resistance	Good	Good	Poor	Good	Excellent to good	Good	Good	Good
Water resistance	Good	Good	Good	Good to poor	Good to poor	Good	Good	Good
Applications	Broadest application. Grease for universal type rolling bearings.	Excellent in low temperature characteristic and anti-friction characteristic.	suited to high temperature and low temperature. Low oil film strength and unsuitable for high load application.	emulsified by inclusion of water content. Comparatively excellent in high temperature characteristic.	Excellent in water resistance and mechanical stability. Suitable for bearing subjected to shock load.	Excellent in viscosity characteristic. Suitable for bearing subjected to vibration.	Available for use in wide temperature range from low to high temperature. Some of non-soap base greases are excellent in heat resistance, cold resistance, chemical resistance, etc. subject to proper combination of base oil and thickener. Grease for universal type rolling bearings.	

Remarks: The operating temperature range in this table is the general characteristic value, not the guaranteed value.

determined by the kind of thickener used. Generally, water resistance of sodium soap grease is poor. Non-soap thickeners made from bentone and urea feature excellent high-temperature characteristics.

**(3) Additives**

Any greases contain various additives to improve the performance. For example: **oxidation inhibitors, extreme pressure additives (EP additives), rust inhibitors, corrosion inhibitors, etc.**

A grease containing extreme pressure additives is used for bearings subjected to high load or shock load. A grease containing oxidation stabilizer is used for bearing applications wherein the operating temperature is comparatively high and the grease is not replenished for a long time.

**(4) Consistency**

"Consistency" is an index showing the hardness or fluidity of grease. **The higher the numerical value, the harder the consistency.** Lubricants commonly used for lubrication of rolling bearings are those having NLGI consistency number 1, 2 or 3.

Table 9.3 shows the general relationship of grease consistency to application.

**(5) Grease mixing**

Mixing dissimilar greases will alter the characteristics of grease: for example, consistency will vary (usually, the grease mixture will be softer compared with original greases) and the permissible operating temperature will be lower. **Therefore, in principle, do not mix greases other than mixing of portions of same grease brand.**

Where mixing of different greases is inevitable, greases composed of the same thickener and similar base oil must be

Table 9.3 Grease consistency

NLGI consistency No.		JIS (ASTM) 60-cycle mixed grease consistency	Application
0		355-385	For centralized greasing
1		310-340	For centralized greasing
2		265-295	For general application, for tight-sealed bearing
3		220-250	For general application, for high temperature
4		175-205	Special application

selected. Even when greases of the same kind are mixed together, the properties of the mixed grease could vary depending on difference in additives, etc. It is therefore necessary to check the property variation in advance.

**9.3.2 Grease fill amount**

Grease fill amount differs depending on housing design, available volume, rotational speed, kind of grease, etc.

As a guideline, approximately 50% to 80% of the static volume within a bearing and housing is filled with grease. When intending higher running speed, or wanting to limit temperature rise, fill grease sparingly. **Too much grease fill would cause the grease temperature to rise, which would then lead to reduction of the specific lubrication performance due to leak of the softened grease, or quality change such as oxidation, etc.**

**9.3.3 Grease replenishment**

A bearings grease must be replenished at proper intervals because its lubrication performance deteriorates with running time. This replenishing interval differs depending on bearing type, dimension, rotational speed, bearing temperature, kind of grease used, etc.

**Fig.9.2** gives the replenishing interval chart as a guideline. This chart is subject to use of a grease for ordinary rolling bearings under usual operating conditions.

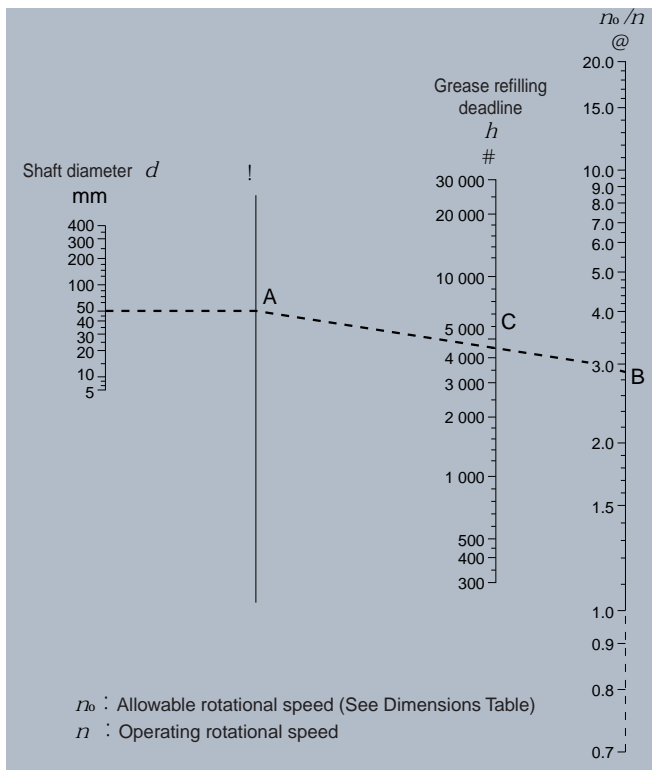
Needless to say, the grease replenishing interval must be shortened as the bearing temperature gets higher. As an approximate guideline, when the bearing temperature is 80°C or more, the replenishing interval shall be shortened by 1/1.5 whenever the bearing temperature rises by 10°C.

**[Ex.]** Let us determine grease replenishment intervals for NA4910R that is run at a speed of  $n = 1600 \text{ min}^{-1}$ . From the dimension table for **NA4910R**, the shaft diameter (bearing bore diameter)  $d = 50 \text{ mm}$ , limiting speed  $n_0 = 4700 \text{ mn}^{-1}$ :

Accordingly,

$$\frac{n_0}{n} = \frac{4700}{1600} \doteq 2.9$$

Plot a line horizontally from  $d=50$  point in **Fig. 9.2** and deem the intersection point with the vertical line ! as A. Thereafter, connect  $n_0/n=3$  point B on the vertical line @ and said A point together, with a straight line, and determine the intersection point C with the vertical line #.



**Fig.9.2** Chart for determination of grease replenishing interval

The grease replenishing interval of approximately 4600 hours can be read from the intersection point C.

**9.3.4 Solid grease**

**(lubricant for special “Polylube” bearings)**

This unique solid grease consists of lubricating grease and ultra heavy molecular weight polyethylene (UHMW-PE) as main components. For more detailed information, refer to page A-54 in this document or the special catalog (Japanese only) “Polylube Needle Bearings” (NTN CAT. NO. 3605).

**9.4 Oil lubrication**

In general, oil lubrication is more suitable for high speed or high temperature applications than grease lubrication. Oil lubrication is suitable for the cases where heat generated in a bearing or heat transferred to a bearing must be discharged outside the bearing.

**9.4.1 Lubrication method**

**(1) Oil bath lubrication**

Oil bath lubrication is the most common lubrication scheme among various oil lubrication systems. It is used for low-speed and medium-speed bearing applications. An important point in this method is control of oil level in an oil bath.

For that, when bearings are installed on a horizontal shaft, it is common that a point close to the center of the rolling element in the lowest position should be deemed as the oil level to be secured during shutdown. In this case, the housing must be designed with such a profile as to minimize variation in oil level therein. Furthermore, it is desirable to provide the housing with an oil gauge to facilitate level check during running as well as shutdown.

When bearings are installed on a vertical shaft, it is okay if 50 to 80% of the rolling elements are dipped in an oil bath under low speed running, but in the cases of high speed running and bearings used in multiple rows it is desirable to adopt the drip lubrication and circulating lubrication methods, or others described hereunder.

**(2) Spray lubrication**

This method sprays lubrication oil by an impeller of simple structure, which is mounted on the shaft, without directly dipping a bearing in an oil batch. This can be applied to bearings running at considerably high speed.

**(3) Drip lubrication**

This lubrication method is used where bearing runs at comparatively high speed with medium and less loads act thereon. In this method, oil drips from an oiler on the top of a bearing unit, striking the rolling elements for atomizing lubrication (**Fig. 9.3**) and a small amount of oil passes through the bearing. In many cases the bearing is lubricated with several drips per minute

though the number of oil drips per specific unit differs depending on bearing type and dimension.

### (4) Circulating lubrication

This circulating lubrication method is adopted to cool down bearings or to lubricate by a centralized lubrication system. As added features with this method the oil feed line is equipped with a cooler to cool down the lubrication oil and an oil filter to purify the lubrication oil.

Under this circulating lubrication system, the lubrication oil must be discharged from each bearing after having passed through it. For that, it is important to provide an oil inlet and an oil outlet on each bearing in opposite position and to make the oil discharge port size as large as possible or otherwise to discharge the oil compulsorily. (Fig.9.4)

### (5) Others

Jet lubrication, oil mist lubrication, air-operated oil lubrication, etc. are available as other lubrication methods.

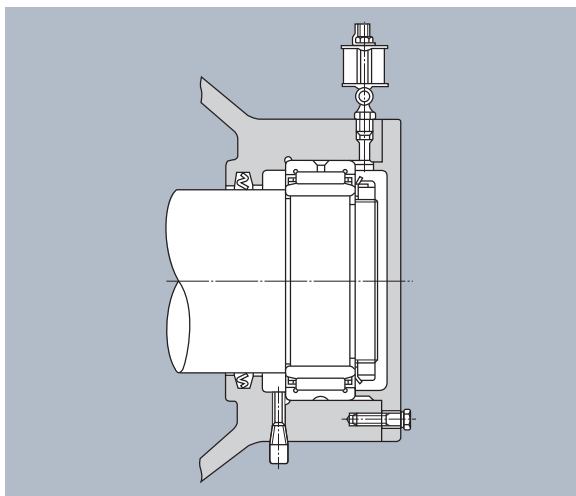


Fig. 9.3 Drip lubrication

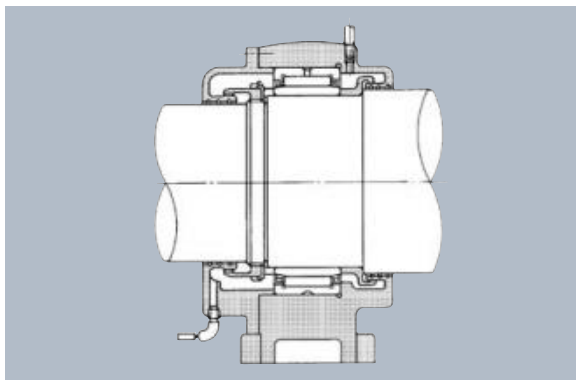


Fig.9.4 Circulating lubrication

### 9.4.2 Lubrication oil

To lubricate rolling bearings, mineral oil lubricants are often used, the examples of which include **spindle oil**, **machine oil** and **turbine oil**. When a rolling bearing is used in a demanding operating environment where the ambient temperature can be **not lower than 150°C** or **not higher than -30°C**, a rolling bearing should be lubricated with **synthetic oils** such as **diester oil**, **silicone oil** and **fluoro carbon oil**.

With lubrication oil, its viscosity is one of the important characteristics that determine the lubrication performance. Too low viscosity of lubrication oil causes imperfect forming of an oil film leading to damage of bearing surface, while too high viscosity of lubrication oil causes great viscosity resistance, which then leads to temperature rise and increase of friction loss.

Generally lubrication oil of lower viscosity is used for the faster rotational speed of bearing, while lubrication oil of higher viscosity is used for the heavier bearing loads.

A lubricant for a rolling bearing has to satisfy viscosity listed in **Table 9.4** at the operating temperature of that rolling bearing. **Fig. 9.5** shows the lubrication oil viscosity - temperature characteristic chart, which should be referred to when selecting a lubrication oil of optimal viscosity under actual operating temperature.

Furthermore, **Table 9.5** shows the criterion for selection of the lubrication oil viscosity according to the actual bearing operating conditions.

Table 9.4 Oil viscosity required for each bearing type

Bearing type	Required viscosity mm <sup>2</sup> /s
Radial needle roller bearing	13
Thrust needle roller bearing	20

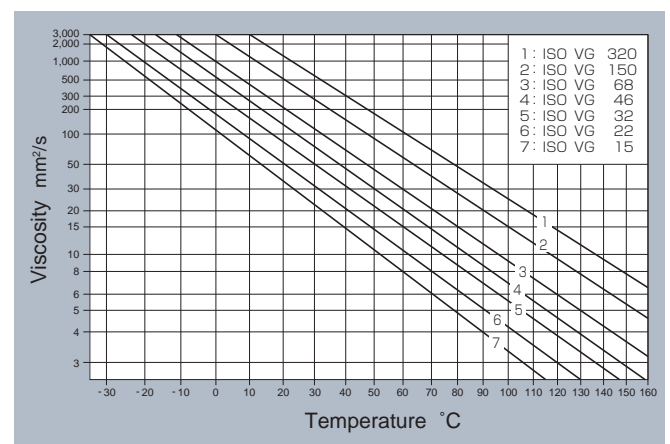


Fig. 9.5 Lubrication oil viscosity - temperature characteristic chart

**Table 9.5 Criteria for selection of lubrication oil (Reference)**

Bearing operating temperature °C	$d_n$ value	ISO viscosity grades for lubrication oil (VG)		
		Ordinary load		Heavy load or shock load
-30~0	up to allowable rotational speed	22	32	46
0~60	up to 15000	46	68	100
	15 000~80 000	32	46	68
	80 000~150 000	22	32	32
60~100	up to 15000	150		220
	15 000~80 000	100		150
	80 000~150 000	68	100 150	
100~150	up to allowable rotational speed	320		

Remarks:  
 1. Subject to oil bath lubrication or circulating lubrication.  
 2. Apply to NTN for other operating conditions other than those specified in this Table.

**9.4.3 Oil supply rate**

When lubricating oil is force-fed into a bearing, the amount of heat generated in the bearing is equal to a sum of amount of heat diffused from the housing and amount of heat removed by lubricating oil.

A standard oil supply rate to be used as a guideline when using an ordinary housing can be determined by **formula (9.1)**. The amount of heat diffused can vary depending on the shape of housing. Therefore, for bearing operation on an actual machine, begin with an oil supply rate approximately 1.5 to 2 times as much as the value determined by **formula (9.1)**, and determine an optimal supply rate through a series of adjustment efforts. It may be convenient to perform calculations with an assumption that there is no heat radiation from the housing and all the heat generated is removed with the lubricating oil. In such a case, take the shaft diameter  $d = 0$  and then determine the oil supply rate  $q$ .

$$Q = K \cdot q \dots\dots\dots(9.2)$$

Where,

$Q$ : Oil supply rate per bearing assembly cm<sup>3</sup>/min

$K$ : Coefficient governed by temperature rise with lubricating oil in operating mode (**Table 9.6**)

$q$ : Oil supply rate determined from the chart cm<sup>3</sup>/min (**Fig. 9.6**)

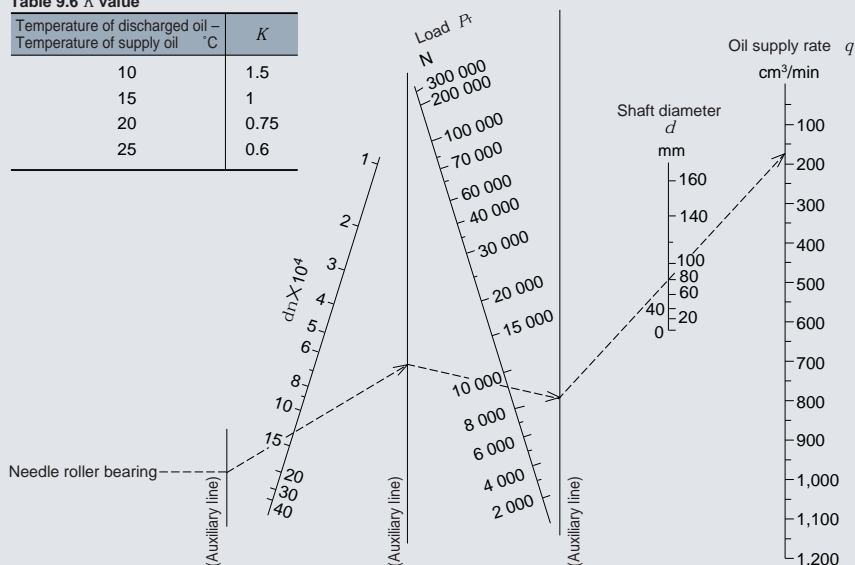
**9.4.4 Guideline for lubricating oil change**

**How often the lubricating oil needs to be changed varies depending on the factors including bearing operating conditions, amount of oil in the lubrication system, and lubricating oil type. As a guideline, perform oil change for an oil bath lubrication system approximately once a year if the oil temperature in the bath is regulated at 50°C or lower, or at least every three months if the oil temperature in the bath reaches a range from 80 to 100°C.**

**For a critical machine involving needle roller bearings, the user is recommended to monitor current lubrication performance of the lubricating oil and deterioration in oil cleanliness at regular intervals to establish the user's unique oil change schedule.**

**Table 9.6 K value**

Temperature of discharged oil - Temperature of supply oil °C	K
10	1.5
15	1
20	0.75
25	0.6



**Fig. 9.6 Chart for determining oil supply rate**

## 10. Sealing Devices

### 10.1 Non-contact seal and contact seal

The purpose of using a seal is to prevent a lubricant held in a bearing from leaking outside the bearing and to prevent powder, water content, etc. from invading into the bearing from outside.

It is very important to design a sealing device with full consideration of the operating conditions, lubricating

condition, environmental condition, economical merit, etc., so that the bearing is not adversely affected by the sealing device during operation.

The bearing seals are mainly classified into non-contact seal, contact seal types. as shown in **Tables 10.1** and **10.2**, which must then be selected correctly according to each application, under full consideration of the characteristics of each sealing type.

Table 10.1 Seals (Non-contact seals)

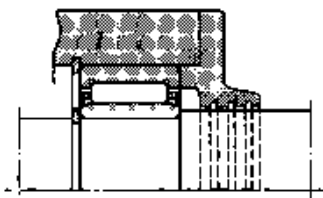
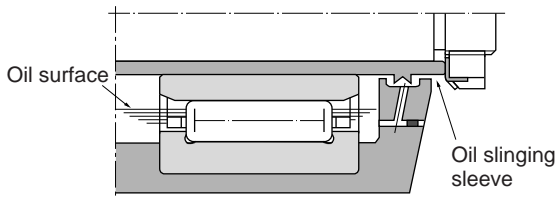
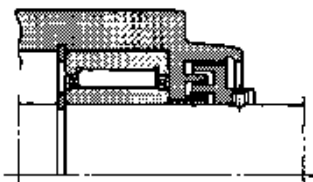
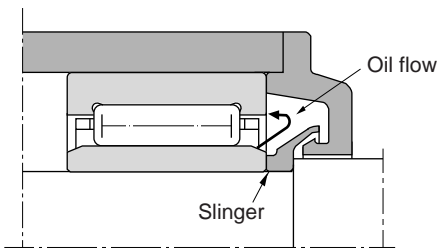

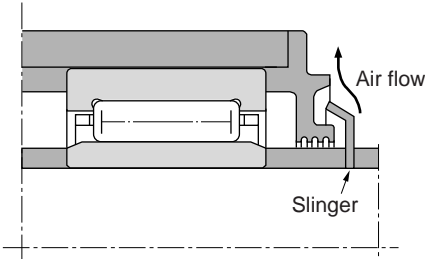
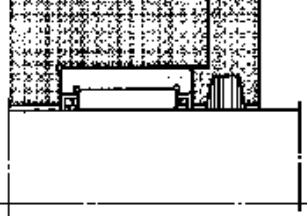
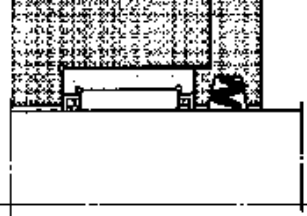
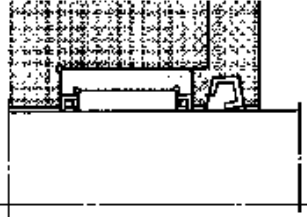
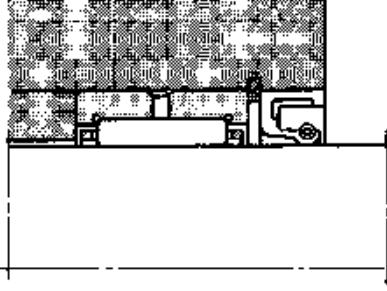
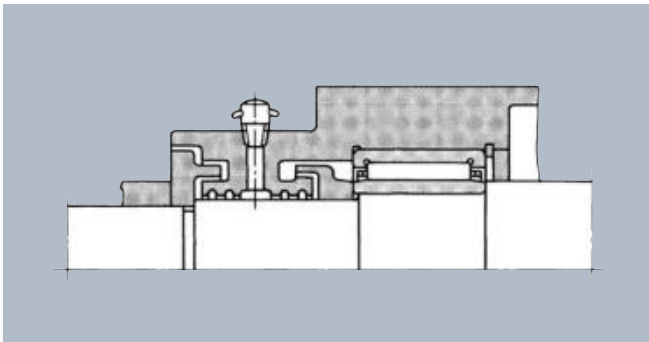
		Non-contact seals		
Seal name		Oil groove seal Labyrinth seal (axial, radial)	Slinger seal	Air seal
Features	<p><b>&lt;Oil groove seal&gt;</b> This seal is fitted at either one side of a housing or a shaft, or fitted at the both sides for sealing. In this case, this seal has an effect in preventing invasion of foreign matter from outside by retaining grease in the oil grooves.</p> <p><b>&lt; Labyrinth seal &gt;</b> This seal having a high sealing effect due to its multiple labyrinths and long passage is mainly used for grease lubrication. Generally it is suited to a high speed bearing, but it has a dust-proofing effect even under low speed running if the seal grooves are filled up with grease. It is convenient if this seal is provided with a grease nipple.</p>		<p>In oil lubrication, this seal has an effect in slinging and returning the oil thrown out along its sleeve by centrifugal force if its sleeve is provided with projections.</p> <p>A seal example illustrated in <b>Fig. 10.6</b> prevents invasion of foreign matter from outside.</p>	
Application examples	 <p><b>Fig. 10.1 Oil groove seal</b></p>		 <p><b>Fig. 10.4 Slinger with projections</b></p>	
	 <p><b>Fig. 10.2 Axial labyrinth seal</b></p>		 <p><b>Fig. 10.5 Slinger intended for back flow of flown-out oil by centrifuge</b></p>	
	 <p><b>Fig. 10.3 Radial labyrinth seal</b></p>		 <p><b>Fig. 10.6 Slinger provided at outer side</b></p>	

Table 10.2 Seals (Contact seals)

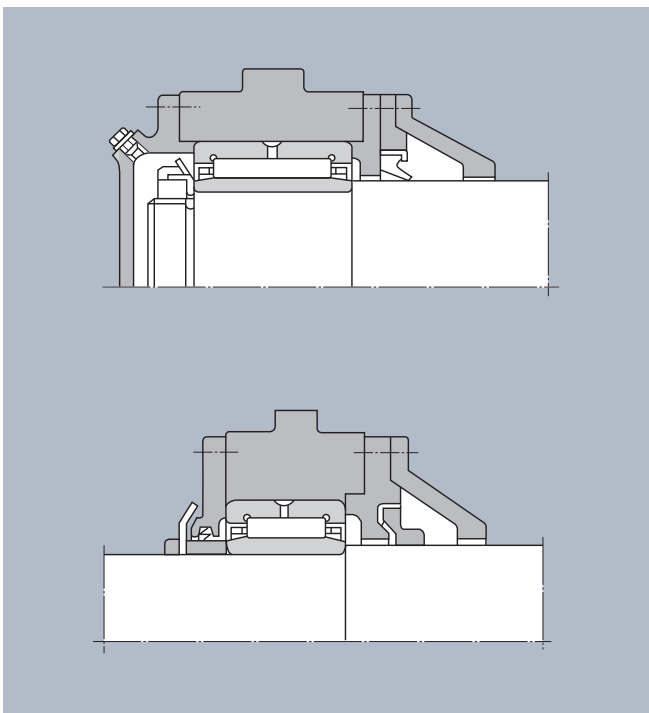
Contact seals	
Seal name	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Seal ring (felt seal, etc.) O-ring, piston ring</p> </div> <div style="text-align: center;"> <p>Oil seal, V-shaped ring seal, mechanical seal</p> </div> </div>
Features	<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p><b>&lt;O-ring seal&gt;</b> This seal type seals a fluid by pressing its elastic body onto the sliding surface with a constant contact pressure. Generally the contact seals are better in sealing performance than the non-contact seals, but the friction torque and temperature rise are greater than those of the non-contact seals.</p> <p><b>&lt;Felt seal&gt;</b> This is the simplest of the contact seals, which is mainly used for grease lubrication and suited to prevention of fine dust, but oil penetration and purging are occasionally unavoidable to some extent.</p> </div> <div style="width: 48%;"> <p><b>&lt; Oil seal &gt;</b> This seal type intended to seal lubricant at the sliding portion between its lip and a shaft. The oil seal is an effective seal and is the most frequently used. The lip must be oriented outward to prevent invasion of water content and foreign matter from outside and oriented inward to prevent lubricant from leaking out of the housing. Furthermore, another seal type with two or more lips is also available for preventing lubricant purge and dust contamination.</p> </div> </div>
Application examples	<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;">  <p style="text-align: center;">Fig. 10.7 Felt seal</p>  <p style="text-align: center;">Fig.10.8 Z type grease seal</p>  <p style="text-align: center;">Fig. 10.9 GS type grease seal</p> </div> <div style="width: 48%; text-align: center;">  <p style="text-align: center;">Fig. 10.10 Oil seal</p> </div> </div>

## 10.2 Combined seals

Several seal types are used in combination for an application in an environment where dust, water components, etc. exist as well as for mechanical portions which cannot to be contaminated by lubricant leak.



**Fig. 10.11 Combined non-contact seal**  
Combination of labyrinth seal and oil groove seal



**Fig. 10.12 Combined seal**  
Combination of contact seal and non-contact seal

## 10.3 Clearance setting

Oil groove seals and labyrinth seals have better sealing effects as the shaft - housing clearance gets smaller, but the actual clearance is generally selected from the following clearance values, under consideration of machining and assembling conditions, shaft deformation, etc.

**Table 10.3 Clearances (Optional)**

Seal type	Shaft diameter	Radial clearance	Axial clearance
Oil groove seal	50 or less	0.2~0.4	—
	Over 50 to 200	0.5~1.0	
Labyrinth seal	50 or less	0.2~0.4	1.0~2.0
	Over 50 to 200	0.5~1.0	3.0~5.0

## 10.4 NTN seals

Special-purposed NTN seals are available for needle roller bearings. (Refer to **Table 10.4** on page A-49.) For the more detailed information refer to the "Dimensions Table" on page B-273.

## 10.5 Seal materials and corresponding operating temperature ranges

The oil seal lip is ordinarily made of nitrile rubber, but acrylic rubber, silicone rubber and fluoro-rubber are used as the lip material depending on operating temperature, sealing objective, etc. **Table 10.5** shows the allowable operating temperature ranges available for the respective materials.

**Table 10.5 Seal materials and corresponding operating temperature ranges (Reference)**

Seal materials	Operating temperature ranges °C
Nitrile rubber	-25~+100
Acrylic rubber	-15~+130
Silicone rubber	-70~+150
Fluoro-rubber	-30~+180

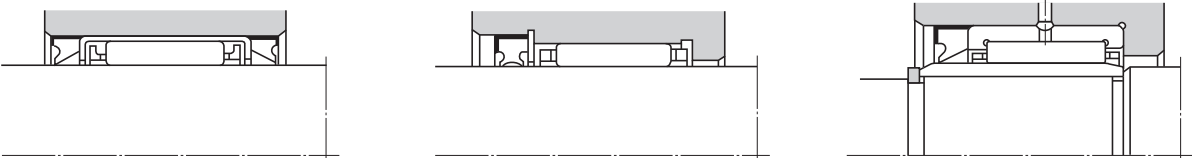
## 10.6 Seal types and allowable speed

The allowable speed for the contact seal type depends on the surface roughness, accuracy and lubrication properties of sliding surface, operating temperature, etc. **Table 10.6** shows the allowable speed for each seal type, as a guideline.

**Table 10.6 Seal types and corresponding allowable speed (Reference)**

Seal types	Allowable speed m/s
Oil seal (nitrile rubber)	16 or less
Oil seal (acrylic rubber)	26 or less
Oil seal (fluoro-rubber)	32 or less
Z-grease seal (nitrile rubber)	6 or less
V-ring seal (nitrile rubber)	40 or less

**Table 10.4 Seals (NTN contact seals)**

Seal type	Contact seals (G type, GD type)	
Seal type	Seal using mainly direct contact	
Features	This seal type is a special-purposed seal for needle roller bearings which was designed for smaller section height. This is a synthetic rubber contact seal reinforced with steel plate, for use in the operating temperature range of -25 to +120°C and, under continuous running condition, used at 100°C or less. For applications under special operating conditions of greater than 120°C, please contact contact NTN engineering.	
Application examples		

**Fig. 10.13 Bearing sealing by NTN seals (Example)**

## 10.7 Shaft surface roughness

Sealing performance and seal life depend on the surface roughness, accuracy and hardness of shaft sliding surface with which the seal lip comes in contact. **Table 10.7** shows the surface roughness as a guideline. For improved wear resistance of shaft surface it is desirable to maintain shaft surface hardness at least at HRC40 (HRC55 if possible) by heat treatment or hard chrome plating.

**Table 10.7 Shaft surface hardness (Reference)**

Speed m/s		Surface roughness
over	incl.	Ra
	5	0.8a
5	10	0.4a
10		0.2a

## 11. Bearing Handling

Bearings are precision parts. In order to preserve their accuracy and reliability, care must be exercised in their handling. In particular, bearing cleanliness must be maintained, sharp impacts avoided and rust prevented.

### [1] Keep the bearing and other related parts clean

Foreign matters such as dust, moisture, etc. causes harmful effects on the life of the bearing. To avoid such harmful effects, bearings must be kept clean. In addition, tools, lubricants, washing oils, work environments, etc. must always be maintained in clean condition.

### [2] Careful handling

Any shock to a bearing in handling could result in creating surface flaws and indentations of its raceway surface and rolling elements. In severe cases, cracking and chipping can occur. To avoid such defects, bearings must be handled with care.

### [3] Use proper handling tools

Inappropriate tools should be avoided when installing and removing bearings. Specific tools suited to the individual bearing types must be used. Special-purpose handling tools must be used particularly when installing a drawn cup needle roller bearing.

### [4] Protect bearing from rusting

As a general rule, rust preventive oil is coated on all bearings. Direct handling of bearings should be avoided since the natural oil on hands can cause rusting of the bearings. To protect bearings from this type of rust, use a pair of gloves or coat mineral oil on the hands if directly handling the bearings with hands.

## 11.1 Bearing storage

Store bearings at room temperature with a relative humidity of 60% or less.

## 11.2 Washing

Never rotate a bearing with foreign matter within the raceway. This could result in damage to the raceway surfaces or rolling elements.

Therefore, any dismounted bearing is usually washed by light oil, kerosene or any other mild solvent to completely remove foreign matter.

In this case, two washing containers must be used: one for rough washing and another for finish washing.

Rough washing is done for removal of oil and foreign matter from bearings, while finish washing is done for fine washing of the roughly-washed bearing.

Further, any containers used for washing must be provided with a steel net in the center above the bottom of the container, as illustrated in **Fig. 11.1**, to prevent the bearing from coming in direct contact with the bottom of the container.

Furthermore, rust preventive treatment must be applied to the bearing immediately after washing, to protect it from corrosion.

**Do not rinse grease-prefilled bearings (shielded bearings, sealed bearings, one-way clutches, etc.). Otherwise, prefilled grease can wash away or deteriorate.**

**In addition, follow all applicable legal requirements such as environmental preservation, industrial labor safety laws, etc. and use the washing instructions provided by the detergent manufacturer and washing tank manufacturer.**

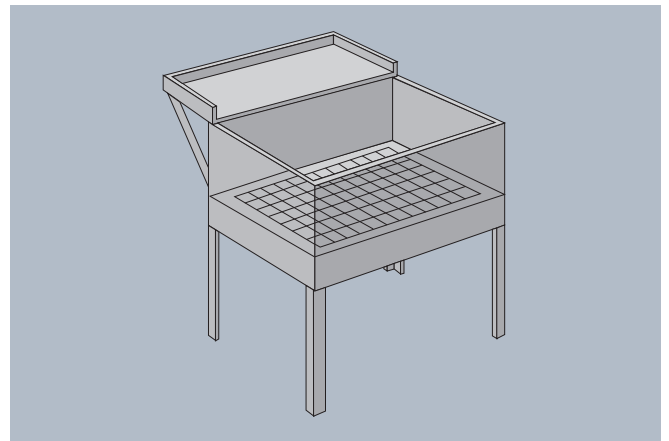


Fig. 11.1 Washing tank

## 11.3 Installation

Depending on bearing type and fitting conditions, the methods described below are used as a general method of installation. However, for installation of drawn cup needle roller bearings refer to Commentary given in the Dimensions Table.

### (1) Preparations prior to installing

For the installation of bearings, it is desirable to prepare a clean and dry work place.

Contaminants, burrs, chips, etc. must be removed completely from all the parts related to a shaft and a housing before installing. Keep bearing in original packaging until ready for installation.

If the bearing is used in a grease-lubricated machine, it may be installed without removing the rust preventive oil coat on it. However, remove the rust preventive coat if the bearing is to be used with oil lubrication, or grease lubrication. Lubrication performance of the grease is jeopardized when mixed with the rust preventive agent. Use uncontaminated cleaning oil to remove the rust preventive agent coat and then allow the cleaning oil to dry or thoroughly wipe it away. Only then, install the bearing.

**Do not to wash shield type and seal type bearings and one-way clutches.**

## (2) Interference-fit with a mechanical or hydraulic press

In general, the press-fit method using a press machine is used for the installation of bearings. The bearing ring (inner ring or outer ring) is press-fitted slowly via a backing strip as illustrated in **Fig. 11.2**. **Do not apply the press force to a bearing through its rolling elements. See example illustrated in Fig. 11.3.**

Further, a small bearing with minimal interference may be installed by hammering the bearing ring with a plastic hammer or similar tool. **In that case, however, the uniform hammering force must be applied to the bearing side face via the backing strip as illustrated in Fig. 11.2, because direct hammering to the bearing end face or partial hammering by use of a punch could impair the specific bearing performance.**

While installing a bearing, NEVER hit the outer ring with a hard tool such as a hammer to fit the inner ring over the shaft. Never hammer the inner ring to install the bearing to the shaft. Otherwise, a flaw and/or dent mark may occur on the raceway surface and rolling elements of the bearing. Also, coating the fitting surfaces with high-viscosity oil will help reduce friction on the fitting surfaces.

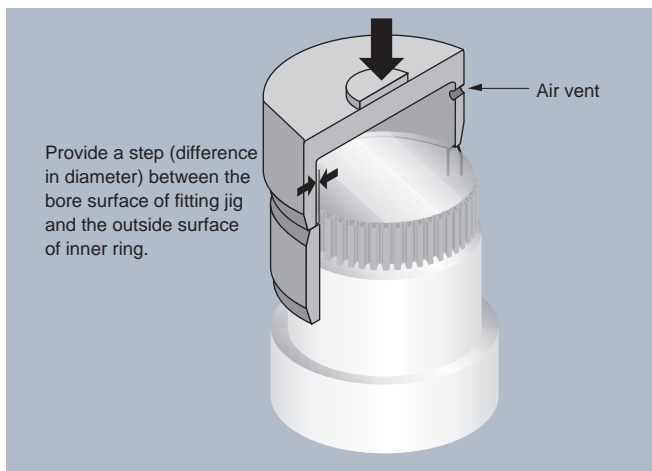


Fig. 11.2 Press-fitting of inner ring

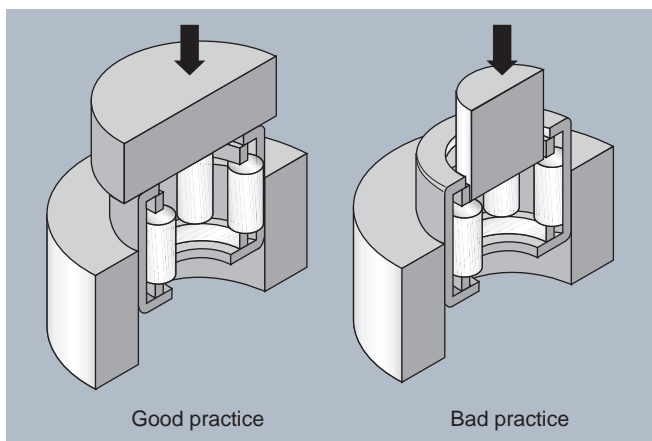


Fig.11.3 Good practice for press-fitting

## (3) Shrink fit

This method too, is often used to install a bearing onto a shaft. The inner ring is heated in a medium such as a clean oil bath to expand its bore and is then fitted over the shaft. The oil used for this process should be pure mineral oil as it is less corrosive. The inner ring fitted onto the shaft is then allowed to stand to cool down. During the cool-down period, the inner ring shrinks in the axial direction too: therefore, the inner ring should be kept forced toward the shaft shoulder until it is fully cool in order to avoid a gap between it and the shaft shoulder. **Fig. 11.4** graphically illustrates the relationship between the expansion of the inner ring bore and the heating temperature. **Remember, however, that the inner ring must not be heated in excess of 120°C. Also, do not apply shrink fit technique to a bearing with prefilled grease, or a bearing with a shield or seal.**

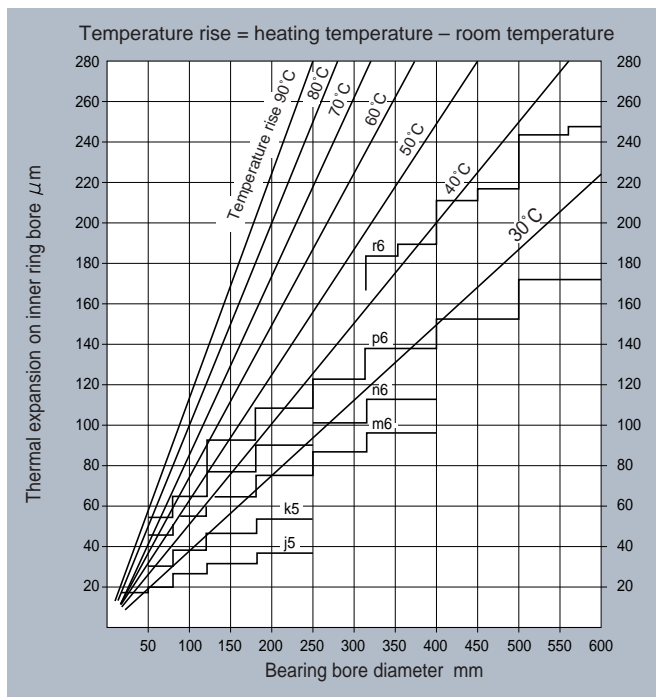


Fig. 11.4 Temperature rise needed for successful shrink fitting for inner ring

## 11.4 Bearing running test

To ensure that the bearing has been properly installed, a running test is performed after mounting.

Avoid running the bearing at its rated speed immediately after its installation. Otherwise, the bearing can fail if it has been incorrectly installed, or can seize if it is poorly lubricated. The shaft or housing should first be rotated by hand. If turning the shaft manually has proved to be problem-free, turn it at low speed with no load, and gradually increase the running speed and load while monitoring smoothness of bearing operation.

Carefully monitor noise and heat buildup on the running bearing. If any problem is detected, stop and

**inspect the machine. If necessary, remove and inspect the bearing.**

Sound level and tone of a running bearing can be checked by a sound scope held in contact with the bearing housing. The sound is normal if a pure sound is heard. A high metallic sound or irregular sounds from the bearing, indicates an error of function. In such a case, the possible cause of the failure can be measured by using a vibrometer to quantitatively determine vibration amplitude and frequency.

Generally, bearing temperature can be estimated from the housing surface temperature. However, if the bearing outer ring is accessible through oil holes, etc, the temperature can be more accurately measured.

Under normal conditions, bearing temperatures rise with rotation and then reach a stable operating temperature after a certain period of time. If the temperature does not level off and continues to rise, if there is a sudden temperature rise, or if the temperature is unusually high, the bearing must be inspected.

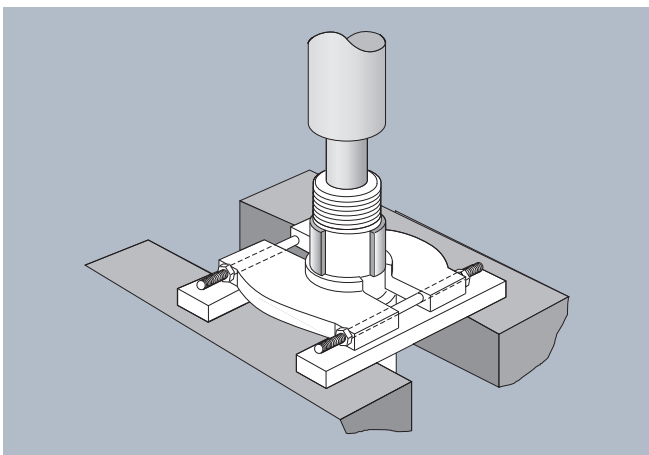
Table 11.1 shows the required check items.

**Table 11.1**

Hand operation	Variation in torque Over-torque Sticking Abnormal sound	Imperfect installation Under-clearance, great seal friction, etc. Indent and flaw on raceway surface Inclusion of dust and other foreign matter
Power operation	Abnormal noise and vibration Abnormal temperature	Inclusion of dust and other foreign matter, indent on raceway surface, over-clearance, inadequate lubrication Use of improper lubricant, incorrect installation, under-clearance

**11.5 Bearing removal (dismounting)**

Bearings are often removed as part of periodic inspection procedures or during the replacement of other parts. In this case, these bearings must be handled with the same care as when it was installed. Bearings, shafts,



**Fig. 11.5 Bearing removal by a press machine**

housings and other related parts must be designed to prevent damage during the dismounting procedure and the proper dismounting tools must be employed.

Regarding the dismounting method, generally the press method (Fig. 11.5) and the puller method (Fig. 11.6) are used to dismount the inner ring depending on bearing type and fitting conditions.

**Be sure to apply the extraction force to the inner ring or outer ring only when removing the bearing. Never attempt to extract the bearing ring by applying force through the rolling elements.**

**11.6 Force needed for press-fitting and extraction**

The force needed for press-fitting or extracting a particular inner ring onto or from a shaft can be determined by formula (11.1) below:

$$K_a = f_k f_E \frac{d}{d+3} \Delta d_F \dots \dots \dots (11.1)$$

Where,

$K_a$  : Force required for press-fitting or extraction N (kgf)

$f_k$  : Resistance factor being determined by shaft to inner ring friction factor

For press-fitting..... 40 (4)

For extraction..... 60 (6)

$f_E$  : Coefficient depending on inner ring dimension

$$f_E = B [1 - (\frac{d}{F_i})^2]$$

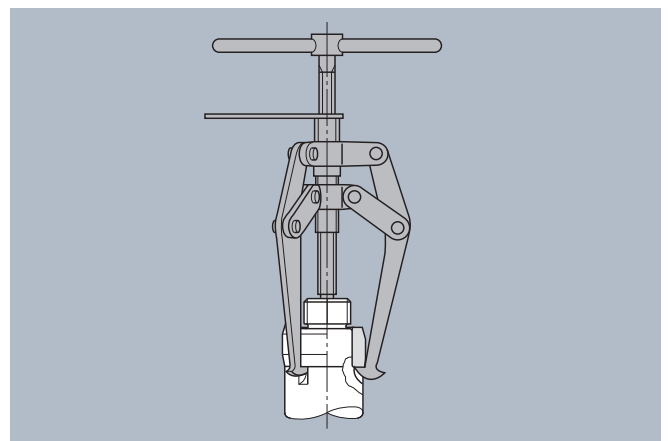
$B$  : Inner ring width mm

$d$  : Inner ring bore diameter mm

$F_i$  : Mean outer diameter of inner ring mm

$\Delta d_F$  : Apparent interference  $\mu m$

Actual press-fit force and extraction force could eventually exceed the respective calculate value due to installing error. Hence, it is recommended to design the dismounting tools so as to have the strength (rigidity) resistible to a load 5 times as much as the calculated press-fit force and pull-out force.



**Fig. 11.6 Bearing removal by a puller**

## 12. New Products Information

### 12.1 HL Bearing

Bearing flaking can be categorized into two types: that which originates from inside of the bearing (subsurface flaking), and that which originates from the surface of the bearing.

Subsurface flaking usually occurs in areas where lubrication is considered to be good. This problem is believed to occur only when there exists a high level of contact stress. Present day steel is sufficiently clean so that cleanliness is not a contributing factor.

On the other hand, surface flaking is believed to be caused in areas where lubrication is insufficient. It is widely known that this problem is related to the oil film parameter (i.e. the ratio of oil film thickness at the point of contact to the combined surface roughness of the two objects in contact) which was derived from the elastohydrodynamic lubrication theory (EHL theory).

To reduce surface flaking, the oil film parameter needs to be increased. To do this, bearing manufacturers have been working on both improving lubricants and surface roughness of the bearing raceway.

The EHL theory is based on the major premise that surface roughness of the contact surfaces is uniform. However, there are cases where the surface roughness determined in accordance with the EHL theory does not agree with the actual measured surface roughness.

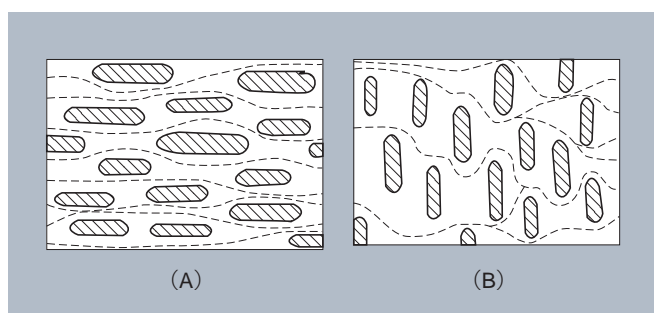
In recent years a new theory has emerged. It contends that oil film formation in the contact areas can be improved by changing the character and direction of the machined parts surface finish.

NTN developed the long life HL (High Lubrication) bearing, based on the Micro EHL Theory, to reduce the problem of surface flaking.

#### 12.1.1 Basic concept of HL bearing

The basic concept behind the development of the HL bearing is expressed by **Fig. 12.1**. These diagrams are based on a flow model of the lubricant inside the contact area, developed by H.S. Cheng and his associates. The hatched areas in the diagrams are the contact points (elastically deformed) while the dotted lines show the flow of the lubricant.

The flow resistance of the lubricant is greater in (B) than in (A). This means that the volume of lubricant in



**Fig. 12.1** Directional characteristics of finished surfaces and their effect on lubricant movement in a flow model

each contact area increases, and accordingly the thickness of the oil film on the rolling contact surface also increases.

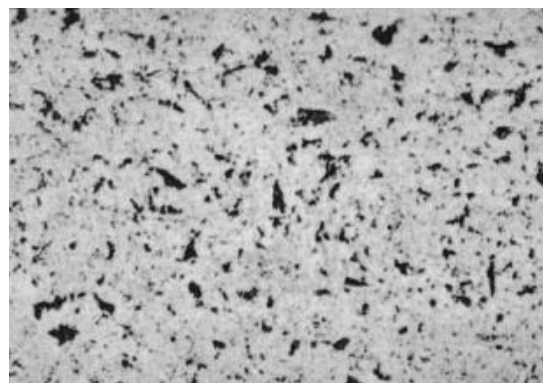
#### 12.1.2 HL surface

As shown in **Fig. 12.2**, this newly developed surface (the HL surface : HL = High Lubrication) features a countless number of indentations (which are called micro oil pots) of about  $10\ \mu\text{m}$  which are produced at random. The black areas in the figure are the micro oil pots. This surface, featuring the desired size and number of micro oil pots, can be produced by changing the grinding conditions. Depth of the micro oil pots is about  $1\ \mu\text{m}$ .

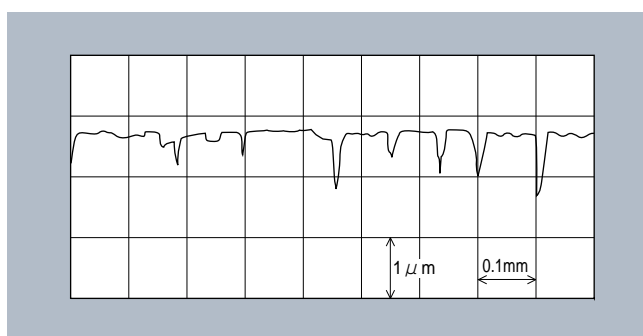
#### 12.1.3 HL bearing application examples

The HL surface-treated bearings are widely used in various fields. Such as car transmission, hydraulic devices, various reduction gears, etc.

HL surface treatment is applied to special applications, such as the rocker arm of a car engine where HL is an effective seizure preventive measure.



**Fig. 12.2** Magnified photo showing HL roller surface



**Fig. 12.3** HL surface roughness

## 12.2 Bearings with Solid Grease

"Solid grease" is a lubricant essentially composed of lubricating grease and ultra-high polymer polyethylene. Solid grease has the same viscosity as ordinary grease at normal temperature, but as a result of a special heat treatment process, this grease solidifies retaining a large proportion of the lubricant in it.

Thanks to this solidification, the grease does not easily leak from the bearing, even when the bearing is subjected to strong vibrations or centrifugal force, helping to extend bearing life.

All NTN needle roller bearings with Solid Grease are "full pack" products whose bearing space is nearly fully prefilled with solid grease.

### 12.2.1 Features of Bearings with Solid Grease

#### (1) Reduced lubricant leakage

Because the base oil is retained in a solid mixture, it is less likely to leak out of the bearing. During operation, temperature rise and/or centrifugal force will cause a gradual release of the base oil into the raceway groove. Eliminating grease leakage from the bearing ensures a consistent supply of lubricant and prevents contamination of the surrounding environment.

#### (2) Superior lubrication

Bearings with solid grease resist grease leakage prolonging bearing life in applications where high centrifugal force or vibration are present. The solid lubricant does not emulsify when exposed to water also extending both grease and bearing life.

#### (3) Sealing effect

Though solid grease protects a bearing against ingress of foreign matters (water, dust, etc.), it is not a sufficient means as a sealing device. Therefore, for applications that need reliable sealing performance, we recommend the use of contact type rubber seals.

### 12.2.2 Varieties of NTN needle roller bearings with Solid Grease

The NTN needle roller bearings with Solid Grease can be categorized into the general purpose group and the high-speed group (Table 12.1).

### 12.2.3 Precautions for using NTN needle roller bearing with Solid Grease

- (1) Each NTN needle roller bearing type has unique set of available dimensions. For detailed information, contact NTN Engineering.
- (2) A minimum radial load is required to prevent skidding of the rolling elements when using full-pack solid grease. The minimum load required is approximately 1% of the bearing dynamic load rating.
- (3) Do not use any NTN needle roller bearing with Solid Grease in a situation where it will come into contact with organic solvents (acetone, petroleum benzene, refined kerosene, etc.).

### 12.2.4 Typical applications of bearings with Solid Grease

- | Bearing for the paper feeder of a printing machine
- | Bearing for the mast roller guide of a forklift
- | Support bearing for the swing arm of a motorcycle
- | Bearing for a machine tool
- | Guide bearing for the guide unit of a press machine
- | Bearing for the link mechanism of an automatic loom
- | Bearing for the conveyor guide of a food packaging machine

For detailed information about NTN bearings with Solid Grease, refer to NTN CAT. NO. 3022 (Bearings with Solid Grease).



Table 12.1 Varieties of NTN needle roller bearings with Solid Grease

Type	General purpose group (LP03)	High-speed group (LP08)
Major components	(Resin) Super high-molecular weight polyethylene (Lubricant) Li-mineral oil based grease	(Resin) Super high-molecular weight polyethylene (Lubricant) Urea-synthetic oil based grease
Permissible temperature range (Bearing outer ring)	-20 – 80°C 60°C max. for prolonged operation	-20 – 100°C 80°C max. for prolonged operation
	For installing the bearing to a shaft or housing, shrink fit technique may be adopted. However, be sure to limit the maximum heating temperature to 100°C and maximum retention time to 2 hours. During this process, be careful not to turn the bearing.	
Limiting speed $F_w$ : Roller set bore diameter (mm) $n$ : Operating running speed (min <sup>-1</sup> )	$F_w \cdot n$ value $\leq 3 \times 10^4$	$F_w \cdot n$ value $\leq 6 \times 10^4$

## 13. Bearing Type Symbols and Auxiliary Symbols

**Table 13.1 Bearing Type Symbols**

Type code	Bearing type	Type code	Bearing type
811	Single-direction thrust cylindrical roller bearing, dimension series 11	KRVT	Cam follower, full complement roller type, w/ tapped hole
812	Single-direction thrust cylindrical roller bearing, dimension series 12	KRV	Cam follower, full complement roller type
893	Single-direction thrust cylindrical roller bearing, dimension series 93	KRVU	Cam follower, full complement roller and shaft eccentric type
874	Single-direction thrust cylindrical roller bearing, dimension series 74	KV··S	Needle roller and cage assembly
A	Needle roller, spherical type	MI	Inner ring, inch series
ARA821	Double-direction thrust cylindrical roller bearing	MR	Machined ring needle roller bearing without inner ring, inch series
ARB821	Double-direction thrust cylindrical roller bearing	NA22	Roller follower with inner ring, dimension series 22
ARN	Needle roller bearing with double-direction thrust cylindrical roller bearing	NA48	Machined ring needle roller bearing with inner ring, dimension series 48
AS11	Steel plate thrust washer, dimension series 11	NA49	Machined ring needle roller bearing with inner ring, dimension series 49
AXA21	Double-direction thrust needle roller bearing	NA59	Machined ring needle roller bearing with inner ring, dimension series 59
AXB21	Double-direction thrust needle roller bearing	NA69	Machined ring needle roller bearing with inner ring, dimension series 69
AXK11	Needle roller and cage thrust assembly, dimension series 11	NA49··S	Clearance-adjustable needle roller bearing with inner ring
AXN	Needle roller bearing with double-direction thrust needle roller bearing	NAB2	Separable roller follower, w/ inner ring, diameter series2
BF	Metallic flat cage for linear flat rollers	NACV	Roller follower, full complement roller type, inch series
BK	Drawn cup needle roller bearing with close end	NAO	Machined ring needle roller bearing, separable type, with inner ring
BR	Housing snap ring	NATR	Roller follower
CR	Cam follower, inch series	NATV	Roller follower, full complement roller type
CRV	Full complement roller for cam follower,	NIP	Grease nipple
DCL	inch series	NK	Machined ring needle roller bearing without inner ring
	Drawn cup needle roller bearing with open end, inch series	NKIA59	Complex bearing : Needle roller bearing with angular ball bearing dimension series 59
F	Needle roller, plane type	NKIB59	Complex bearing : Needle roller bearing with three-point contact type ball bearing dimension series 59
FF	Linear flat roller	NKS	Machined ring needle roller bearing, w/o inner ring
FR	Bottom roller bearing, for drawing frame	NKX	Complex bearing : needle roller bearing with thrust ball bearing without dust-proof cover
FRIS	Bottom roller bearing, for fine spinning frame and flyer frame	NKX··Z	Complex bearing: Needle roller bearing with thrust ball bearing with dust-proof cover
G	Synthetic rubber seal, one-lip type	NKXR	Complex bearing: Needle roller bearing with thrust cylindrical roller bearing without dust-proof cover
GD	Synthetic rubber seal, double-lip type	NKXR··Z	Complex bearing: Needle roller bearing with thrust cylindrical roller bearing with dust-proof cover
GK	Needle rollers with split type cage	NUKR	Cam follower, full complement roller type
GS811	Housing washer, dimension series 11	NUKRT	Cam follower, full complement roller type, w/ tapped hole
GS812	Housing washer, dimension series 12	NUKRU	Cam follower, full complement roller type, w/ tapped hole, eccentric stud
GS893	Housing washer, dimension series 93	NUTR2	Roller follower, diameter series 2
GS874	Housing washer, dimension series 74	NUTR3	Roller follower, diameter series 3
HCK	Drawn cup needle roller bearing for universal joint	NUTW	Roller follower, outer ring with center rib
HF	One-way clutch	PCJ	Needle roller and cage assembly, inch series
HFL	One-way clutch integral with bearing	PK	Needle roller and cage assembly, for large end
HK	Drawn cup needle roller bearing with open end	PNA··R	Self-aligning needle roller bearing with inner ring
HMK	Drawn cup needle roller bearing with open end, for heavy load application	RF	Polyamide resin cage for linear flat rollers
IR	Inner ring	RLM	Linear roller bearing
JF··S	Tension pulley holder	RNA22	Roller follower without inner ring, dimension series 22
JPU··S	Tension pulley and jockey pulley	RNA48	Machined ring needle roller bearing without inner ring, dimension series 48
K	Needle rollers with cage	RNA49	Machined ring needle roller bearing without inner ring, dimension series 49
K811	Cylindrical roller and cage thrust assembly, dimension series 11	RNA59	Machined ring needle roller bearing without inner ring, dimension series 59
K812	Cylindrical roller and cage thrust assembly, dimension series 12	RNA69	Machined ring needle roller bearing without inner ring, dimension series 69
K893	Cylindrical roller and cage thrust assembly, dimension series 93	RNA49··S	Clearance-adjustable needle roller bearing, without inner ring
K874	Cylindrical roller and cage thrust assembly, dimension series 74	RNAB2	Separable roller follower, w/o inner ring, diameter series 2
KBK	Needle roller and cage assembly, for small end	RNAO	Machined ring needle roller bearing, separable type, without inner ring
KD	Linear ball bearing, stroking type	RPNA··R	Self-aligning needle roller bearing, w/o inner ring
KH	Linear ball bearing, drawn cup type	WR	Snap ring for shaft
KJ··S	Needle roller and cage assembly	WS811	Thrust inner ring, dimension series 11
KLM	Linear ball bearing, machined ring type	WS812	Thrust inner ring, dimension series 12
KLM··S	Linear ball bearing, clearance-adjustable type	WS893	Thrust inner ring, dimension series 93
KLM··P	Linear ball bearing, open type	WS874	Thrust inner ring, dimension series 74
KMJ	Needle roller and cage assembly	ZS	Thrust central ring
KLJ··S	Needle roller and cage assembly		
KR	Cam follower		
KRM	Miniature cam follower		
KRMV	Miniature cam follower, full complement roller type		
KRT	Cam follower, w/ tapped hole		
KRU	Cam follower, shaft eccentric type		

**Table 13.2 Auxiliary symbols**

Symbol		Symbol representation	
Initial symbols	Material heat-treatment symbols	TS-	Bearing for high temperature application which was heat-treated for dimensional stabilization
		E-	Bearing made of case-hardened steel
		8Q-	Nitro-carburized cage
F-		Bearing made of stainless steel	
C-		Bearing made of carbon steel	
Expansion compensation	EC-	Expansion-compensated bearing	
Basic symbols			
Suffix	Internal construction symbols	ZW	Double-row cage
		A,B,C	Internal construction change
	Cage symbols	J,JW	Steel plate punched cage
		L1	High strength brass cage
		T2	Polyamide resin cage
		S	Welded cage
	Seal symbol	L,LL	With synthetic rubber seal
	Bearing ring profile symbols	D	With oil hole
		D1	With oil hole and oil groove
		H	Cam follower with hexagon hole
	Roller symbol	T	Crowning and special heat treatment
	Combination symbols	D2,Dn	Complex bearing using two or more same bearings
	Clearance symbols	C2	Clearance smaller than ordinary clearance
C3		Clearance larger than ordinary clearance	
C4		Radial clearance larger than C3	
NA		Non-interchangeable clearance	
Accuracy class symbols	P6	Bearing of JIS Class-6	
	P5	Bearing of JIS Class-5	
	P4	Bearing of JIS Class-4	
Lubrication symbols	/2AS	SHELL ALVANIA Grease 2	
	/3AS	SHELL ALVANIA Grease 3	
	/P03	Solid Grease	
Special symbols	V1~Vn	Special specification, requirements	

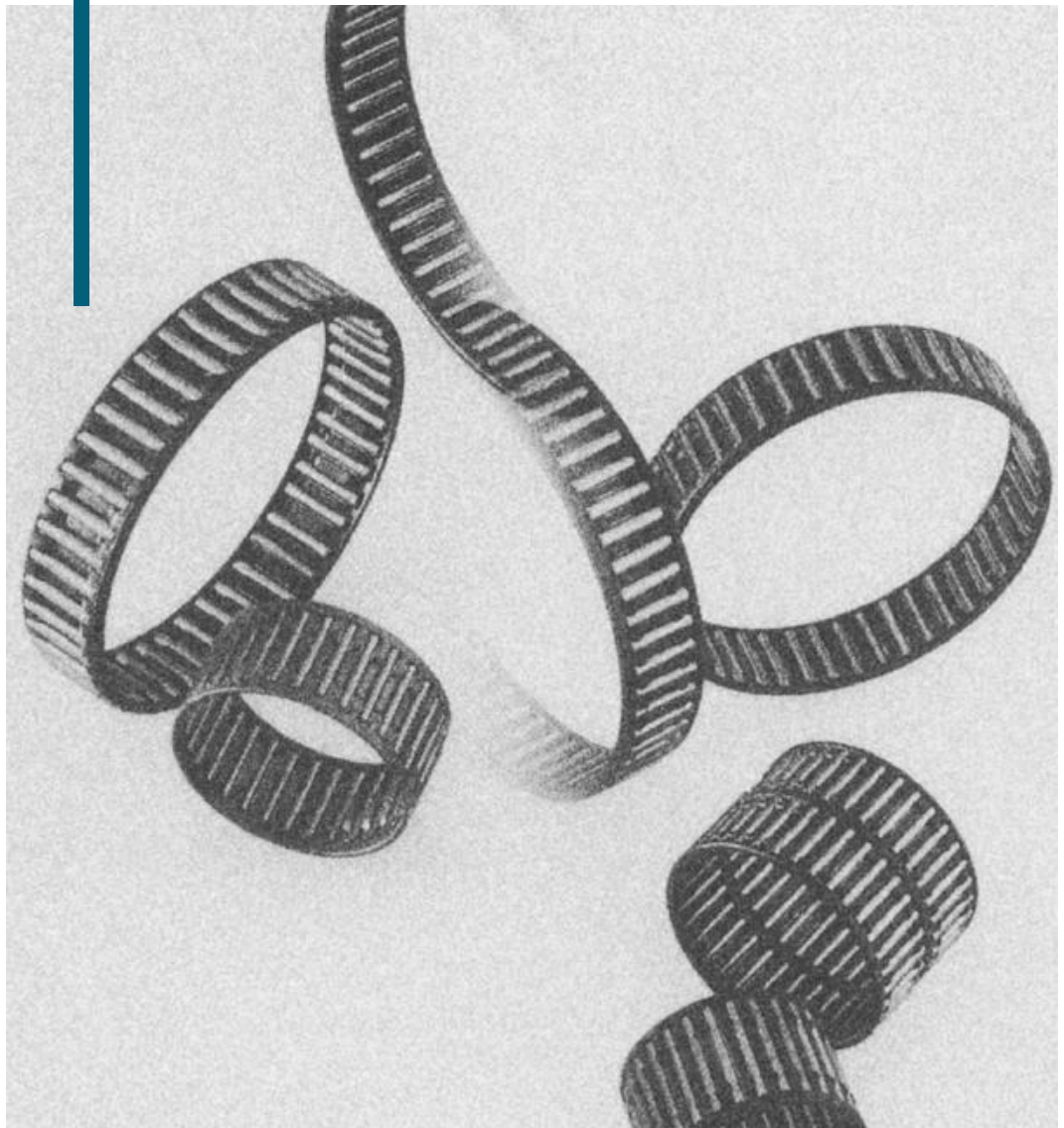
## Needle Roller Bearings

### *BEARING TABLES*

Needle roller and cage assemblies	B- 3~ 22
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# Needle Roller and Cage Assemblies

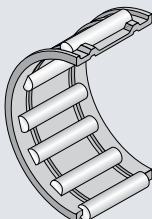
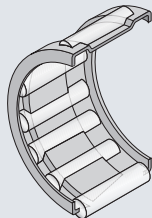
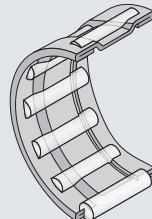
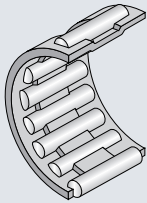
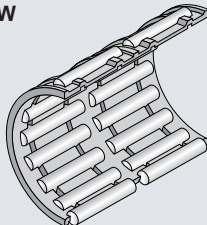
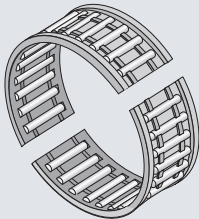


## Needle Roller and Cage Assemblies

This needle roller and cage assembly is one of the basic components for the needle roller bearing of a construction wherein the needle rollers are fitted with a cage so as not to separate from each other. The use of this roller and cage assembly enables to design a compact and lightweight construction by utilizing a shaft

or a housing as the direct raceway surface, without using inner ring and outer ring.

The needle rollers are guided by the cage more precisely than the full complement roller type, hence enabling high speed running of bearing. In addition, its rigidity and load capacity are high for the specific space.

Type of needle roller and cage assembly	Cage type	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and respective dimensions
<b>K</b> (K·S) (K·T2) 	Machined ring type Polyamide resin type	$\phi 3 - \phi 285$	<b>K 20 × 24 × 10 S</b> Roller set bore diameter Roller set outer diameter Width Suffix Type code	K20×24×10S	Roller set bore diameter : $\phi 20$ Roller set outer diameter : $\phi 24$ Width : 10 S : Welded type
	Welded type	$\phi 10 - \phi 100$			
<b>KMJ</b> (KMJ·S) (PCJ) 	Punched type	$\phi 15 - \phi 100$	<b>KMJ 20 × 26 × 13</b> Roller set bore diameter Roller set outer diameter Width Type code	KMJ20×26×13	Roller set bore diameter : $\phi 20$ Roller set outer diameter : $\phi 26$ Width : 13
	Welded type	$\phi 10 - \phi 40$			
<b>KJ·S</b> 	Welded type	$\phi 20 - \phi 40$	<b>KJ 30 × 35 × 17 S</b> Roller set bore diameter Roller set outer diameter Width Suffix Type code	KJ30×35×17S	Roller set bore diameter : $\phi 30$ Roller set outer diameter : $\phi 35$ Width : 17 S : Welded type
<b>KV·S</b> 	Welded type	$\phi 7 - \phi 100$	<b>KV 30 × 35 × 17 S</b> Roller set bore diameter Roller set outer diameter Width Suffix Type code	KV30×35×17S	Roller set bore diameter : $\phi 30$ Roller set outer diameter : $\phi 35$ Width : 17 S : Welded type
<b>K·ZW</b> 	Machined ring type	$\phi 8 - \phi 285$	<b>K 20 × 24 × 45 ZW</b> Roller set bore diameter Roller set outer diameter Width Suffix Type code	K20×24×45ZW	Roller set bore diameter : $\phi 20$ Roller set outer diameter : $\phi 24$ Width : 45 ZW : Double-row type
<b>GK</b> 	Machined ring type Split type	$\phi 8 - \phi 285$	<b>GK 30 × 35 × 17</b> Roller set bore diameter Roller set outer diameter Width Type code	GK30×35×17	Roller set bore diameter : $\phi 30$ Roller set outer diameter : $\phi 35$ Width : 17

The ones with tail code T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C or less. The applied shaft diameter of welded type are described based on size that manufacturers can deal with a manufacturing. Therefore, it has nothing to do with the Dimension Table. Data for the GK type is not included in the dimension table. For detailed information, contact NTN Engineering.

## Diameter variation of needle rollers

Diameter variation of needle rollers within one cage is less than 2μm. The diameter tolerance groups for built-in needle rollers are identified by identification colors on the package label, as shown in **Table 1**.

The standard identification colors marked on each label are red, dark blue, blue, black and white, unless otherwise specially indicated.

In case of two or more bearings are mounted in tandem, those of same identification color must be used for equal distribution of bearing load.

**Table 1 Color identification of diameter tolerances for needle rollers**

Identification color on label	Diameter tolerance μm	Classification
Red	0~ - 2	Standard
Dark blue	- 1~ - 3	
Blue	- 2~ - 4	
Black	- 3~ - 5	
White	- 4~ - 6	
Gray	- 5~ - 7	Semi-standard
Green	- 6~ - 8	
Brown	- 7~ - 9	
Yellow	- 8~ - 10	

## Radial Clearance

When a shaft and a housing are used as the direct raceway surface, the radial clearance is determined by the shaft diameter and the housing hole dimension. Where the diameter tolerances for needle rollers are standard (tolerances color-identified in red, dark blue, blue, black, white), the shaft diameters and housing hole dimensions shown in **Table 2** are used.

**Table 2 Recommended fits**

Shaft diameter mm	Radial clearance					
	Smaller than ordinary clearance		Ordinary clearance		Larger than ordinary clearance	
	Shaft	Housing	Shaft	Housing	Shaft	Housing
~80	j5	G6	h5	G6	g6	G6
80~140	h5	G6	g5	G6	f6	G6
140~	h5	G6	f5	H6	f6	G6

## Shaft and housing specifications

Where a shaft and a housing are used as the direct raceway surface, the raceway surface must meet the specifications described in **Table 3**.

**Table 3 Shaft and housing specifications (recommended)**

Characteristics	Shaft	Housing
Roundness (max)	IT3	IT4
Cylindricity (max)	IT3	IT4
Surface roughness (max)	Refer to <b>Table 8.4</b> on page A-40.	
Surface hardness	HRC58~64	
Depth of hardened layer (min)	Refer to formula (8.1) on page A-40.	

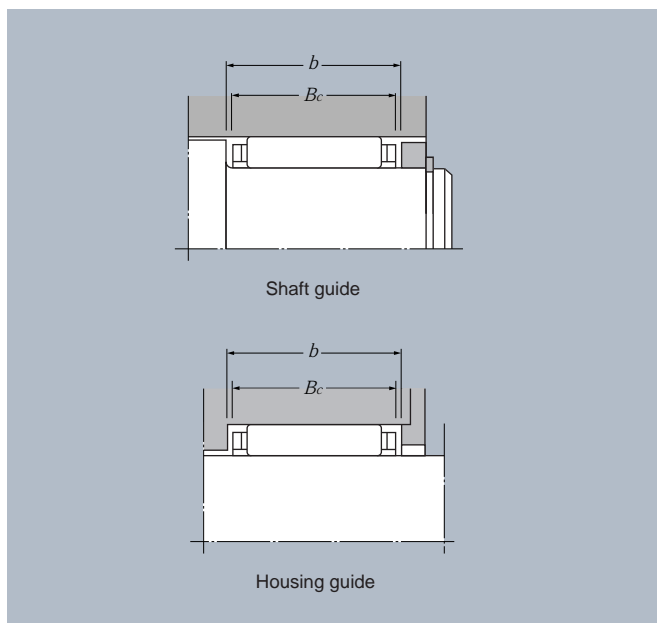
## Bearing installation related dimensions

The tolerances for the nominal dimension "Bc" of cage specified in **Table 4** are recommended as the guide width b of cage.

**Table 4 Guide width dimensions (recommended)**

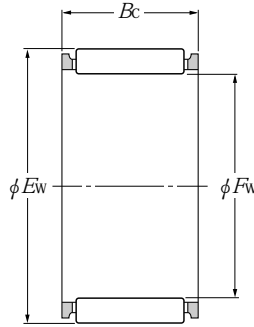
Unit : mm

Classification	Tolerances for guide width <i>b</i>	
	Single row	Double row
Metric system	$B_c \begin{smallmatrix} +0.2 \\ 0 \end{smallmatrix}$	$B_c \begin{smallmatrix} +0.3 \\ +0.1 \end{smallmatrix}$
Inch system	$B_c \begin{smallmatrix} \pm 0.4 \\ +0.2 \end{smallmatrix}$	$B_c \begin{smallmatrix} \pm 0.5 \\ +0.3 \end{smallmatrix}$

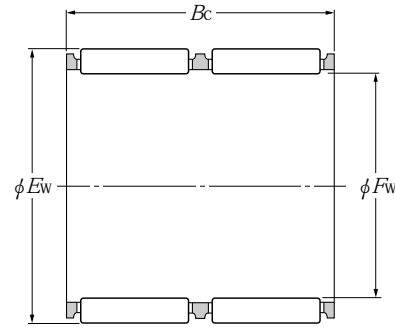


**Fig. 1**

**Type K**  
**Type K··T2**  
**Type K··S**  
**Type K··ZW**  
**Type KMJ**  
**Type KV··S**



**Type K**  
**Type K··T2**  
**Type K··S**

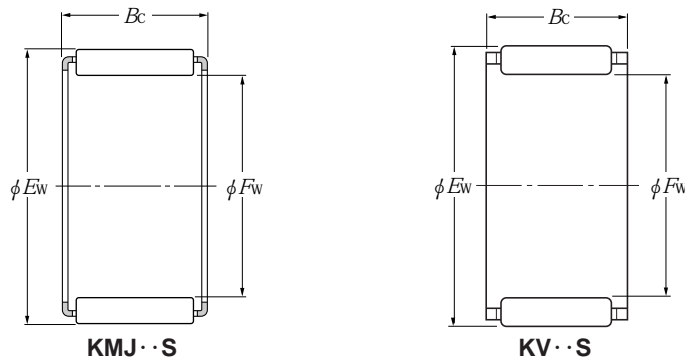


**Type K··ZW**

$F_w$  3~10mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	$\text{min}^{-1}$			kg (approx.)
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>3</b>	6	7 <sup>-0.2</sup>	1 460	970	149	99	33 000	50 000	<b>K3×6×7T2</b>	0.0004
	6	8 <sup>-0.55</sup>	1 560	1 330	159	136	30 000	45 000	<b>K4×6×7.8XT2</b>	0.0003
<b>4</b>	7	7 <sup>-0.2</sup>	1 770	1 270	180	129	30 000	45 000	<b>K4×7×7T2</b>	0.0005
<b>5</b>	8	8 <sup>-0.2</sup>	2 640	2 190	269	224	27 000	40 000	<b>K5×8×8T2</b>	0.0007
	8	10 <sup>-0.55</sup>	2 720	2 250	277	230	27 000	40 000	<b>K5×8×10T2</b>	0.0009
<b>6</b>	9	8	2 660	2 280	272	233	25 000	37 000	<b>K6×9×8T2</b>	0.0009
	9	10 <sup>-0.2</sup>	3 400	3 150	345	320	25 000	37 000	<b>K6×9×10T2</b>	0.0011
	10	13	4 400	3 700	450	380	25 000	37 000	<b>K6×10×13T2</b>	0.0019
<b>7</b>	10	8	2 670	2 350	272	239	23 000	34 000	<b>K7×10×8T2</b>	0.0009
	10	10 <sup>-0.2</sup>	3 400	3 200	345	330	23 000	34 000	<b>K7×10×10T2</b>	0.0011
	10	13	5 050	5 400	515	550	23 000	34 000	<b>KV7×10×12.8X3S</b>	0.0023
<b>8</b>	11	8	3 150	3 000	320	305	21 000	32 000	<b>K8×11×8T2</b>	0.0011
	11	9	3 150	3 000	320	305	21 000	32 000	<b>8E-KV8×11×8.8X2S</b>	0.0019
	11	10	4 000	4 100	410	420	21 000	32 000	<b>K8×11×10T2</b>	0.0013
	11	12 <sup>-0.2</sup>	4 450	4 650	450	475	21 000	32 000	<b>8E-KV8×11×11.8X2S</b>	0.0025
	11	13 <sup>-0.55</sup>	4 850	5 200	495	535	21 000	32 000	<b>K8×11×13</b>	0.0026
	12	10	4 650	4 150	475	425	21 000	32 000	<b>K8×12×10T2</b>	0.0020
	12	12	5 600	5 300	570	545	21 000	32 000	<b>8E-KV8×12×11.8X1S</b>	0.0040
<b>9</b>	12	10 <sup>-0.2</sup>	4 550	5 000	465	510	20 000	30 000	<b>K9×12×10T2</b>	0.0015
	12	13 <sup>-0.55</sup>	5 500	6 400	560	650	20 000	30 000	<b>K9×12×13T2</b>	0.0021
<b>10</b>	13	10	4 550	5 100	460	520	19 000	28 000	<b>K10×13×10T2</b>	0.0016
	13	13	5 450	6 450	555	660	19 000	28 000	<b>8E-KV10×13×12.8XS</b>	0.0032
	14	8	4 300	3 950	435	405	19 000	28 000	<b>K10×14×8</b>	0.0027
	14	10 <sup>-0.2</sup>	5 500	5 450	560	555	19 000	28 000	<b>K10×14×10</b>	0.0034
	14	11 <sup>-0.55</sup>	5 500	5 450	560	555	19 000	28 000	<b>8E-KV10×14×10.8XS</b>	0.0039
	14	11.5	6 800	7 200	695	730	19 000	28 000	<b>KMJ10×14×11.3XS</b>	0.0040
	14	13	6 600	6 900	675	705	19 000	28 000	<b>K10×14×13</b>	0.0044
	14	14	7 150	7 650	730	780	19 000	28 000	<b>8E-KV10×14×13.8X4S</b>	0.0050

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

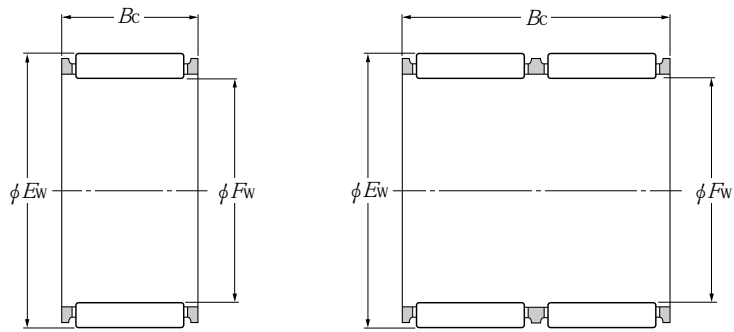


$F_w$  10~15mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm			dynamic N	static	dynamic kgf	static	grease	oil		
$F_w$	$E_w$	$B_c$	$C_r$	$C_{or}$	$C_r$	$C_{or}$	$\text{min}^{-1}$			
10	14	17 <sup>-0.2</sup>	8 050	8 850	820	900	19 000	28 000	8E-K10×14×16.8X1	0.0064
	16	12 <sup>-0.55</sup>	7 100	5 950	720	610	19 000	28 000	K10×16×12	0.0066
11	14	10 <sup>-0.2</sup>	5 050	6 000	515	615	18 000	27 000	K11×14×10	0.0028
	15	9	4 450	5 250	455	535	17 000	26 000	K12×15×9	0.0027
12	15	10	5 000	6 100	510	620	17 000	26 000	8Q-K12×15×10	0.0030
	15	13	6 000	7 700	615	785	17 000	26 000	K12×15×13	0.0038
	15	20	8 550	12 200	875	1 240	17 000	26 000	K12×15×20ZW	0.0059
	16	8	4 850	4 900	495	500	17 000	26 000	K12×16×8	0.0034
	16	11.5	6 750	7 400	685	755	17 000	26 000	KMJ12×16×11.3XS	0.0047
	16	13 <sup>-0.2</sup>	7 500	8 500	765	870	17 000	26 000	8Q-K12×16×13	0.0060
	16	18	9 800	11 900	1000	1220	17 000	26 000	8E-K12×16×17.8X1	0.0070
	16	20	10 300	12 800	1 050	1 300	17 000	26 000	K12×16×19.8X4	0.0100
	17	10	7 350	7 200	745	735	17 000	26 000	KMJ12×17×9.8XS	0.0050
	17	13	9 000	9 400	920	960	17 000	26 000	K12×17×13	0.0075
14	17	18	12 600	14 400	1 280	1 470	17 000	26 000	KV12×17×17.8XS	0.0080
	18	12	8 650	8 000	880	815	17 000	26 000	8Q-K12×18×12	0.0089
	17	10	5 400	7 050	550	720	16 000	24 000	KV14×17×10S	0.0040
	18	10	6 900	8 000	705	815	16 000	24 000	K14×18×10	0.0046
	18	11	7 600	9 050	775	925	16 000	24 000	K14×18×11	0.0053
	18	13	8 300	10 100	845	1 030	16 000	24 000	K14×18×13	0.0063
	18	15 <sup>-0.2</sup>	9 650	12 300	985	1 250	16 000	24 000	K14×18×15S	0.0076
	18	17 <sup>-0.55</sup>	10 900	14 400	1 120	1 470	16 000	24 000	K14×18×17V5	0.0079
	18	39	18 800	28 900	1 910	2 950	16 000	24 000	K14×18×39ZW	0.0180
	19	13	8 950	9 650	915	985	16 000	24 000	K14×19×13	0.0080
15	20	12	9 350	9 150	955	930	16 000	24 000	K14×20×12	0.0095
	20	17	13 500	14 600	1 370	1 490	16 000	24 000	K14×20×17	0.0140
	18	14	7 850	11 600	800	1 190	15 000	23 000	K15×18×14	0.0060
15	19	8 <sup>-0.2</sup>	5 350	5 850	545	600	15 000	23 000	KV15×19×7.8XS	0.0033
	19	10 <sup>-0.55</sup>	6 850	8 050	700	820	15 000	23 000	K15×19×10	0.0055
	19	13	8 250	10 200	840	1 040	15 000	23 000	K15×19×13	0.0067

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

**Type K**  
**Type K··T2**  
**Type K··S**  
**Type K··ZW**  
**Type KMJ**  
**Type KV··S**



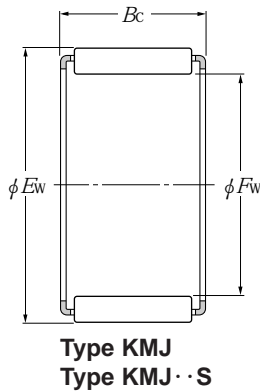
**Type K**  
**Type K··T2**  
**Type K··S**

**Type K··ZW**

$F_w$  15~18mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	$\text{min}^{-1}$		kg	
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$			(approx.)	
15	19	17	10 900	14 600	1 110	1 490	15 000	23 000	<b>K15×19×17</b>	0.0090
	19	24	14 100	20 400	1 440	2 080	15 000	23 000	<b>K15×19×24ZW</b>	0.0130
	20	13	10 100	11 500	1 030	1 170	15 000	23 000	<b>K15×20×13</b>	0.0088
	20	16 <sup>-0.2</sup> -0.55	12 600	15 200	1 280	1 550	15 000	23 000	<b>KMJ15×20×15.8XS</b>	0.0090
	21	15	11 900	12 500	1 210	1 280	15 000	23 000	<b>K15×21×15</b>	0.0130
	21	17	14 900	16 800	1 510	1 720	15 000	23 000	<b>KMJ15×21×16.8X1SK</b>	0.0120
	21	21	16 500	19 100	1 680	1 950	15 000	23 000	<b>K15×21×21</b>	0.0170
16	20	10	7 500	9 250	765	945	15 000	23 000	<b>K16×20×10</b>	0.0057
	20	11	8 300	10 500	845	1 070	15 000	23 000	<b>K16×20×11</b>	0.0061
	20	13	9 050	11 800	925	1 200	15 000	23 000	<b>K16×20×13</b>	0.0071
	20	17	11 900	16 800	1 220	1 710	15 000	23 000	<b>K16×20×17S</b>	0.0092
	22	12 <sup>-0.2</sup> -0.55	11 700	12 500	1 190	1 280	15 000	23 000	<b>K16×22×12</b>	0.0100
	22	13	12 600	13 900	1 290	1 410	15 000	23 000	<b>KMJ16×22×13</b>	0.0110
	22	16	13 600	15 200	1 380	1 550	15 000	23 000	<b>K16×22×15.8X</b>	0.0140
	22	17	14 400	16 400	1 470	1 670	15 000	23 000	<b>K16×22×17</b>	0.0150
22	20	16 000	18 800	1 640	1 920	15 000	23 000	<b>K16×22×20</b>	0.0170	
17	21	10	7 450	9 300	760	950	15 000	22 000	<b>K17×21×10S</b>	0.0056
	21	13	9 400	12 600	960	1 280	15 000	22 000	<b>K17×21×13S</b>	0.0075
	21	15	10 400	14 400	1 060	1 460	15 000	22 000	<b>K17×21×15</b>	0.0089
	21	17 <sup>-0.2</sup> -0.55	11 800	16 900	1 210	1 720	15 000	22 000	<b>K17×21×17</b>	0.0095
	22	20	14 700	19 200	1 500	1 960	15 000	22 000	<b>K17×22×20</b>	0.0150
	23	17	14 400	16 500	1 460	1 690	15 000	22 000	<b>K17×23×17</b>	0.0160
	23	23	16 800	20 200	1 710	2 060	15 000	22 000	<b>K17×23×22.8X1T2</b>	0.0130
18	22	10	7 400	9 400	755	955	14 000	21 000	<b>K18×22×10</b>	0.0061
	22	13	8 900	11 900	910	1 210	14 000	21 000	<b>K18×22×13</b>	0.0077
	22	17 <sup>-0.2</sup> -0.55	11 700	17 000	1 200	1 730	14 000	21 000	<b>K18×22×17</b>	0.0110
	23	20	14 600	19 300	1 490	1 970	14 000	21 000	<b>K18×23×20S</b>	0.0150
	24	12	12 300	13 800	1 250	1 410	14 000	21 000	<b>K18×24×12</b>	0.0120
	24	13	11 600	12 800	1 180	1 300	14 000	21 000	<b>K18×24×13</b>	0.0130

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

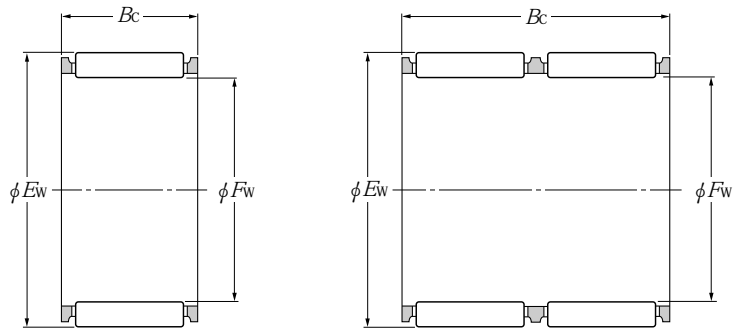


$F_w$  18~22mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
18	24	17	16 000	19 300	1 630	1 970	14 000	21 000	<b>KMJ18×24×17SV1</b>	0.0140
	24	20 <sup>-0.2</sup>	17 000	20 900	1 730	2 130	14 000	21 000	<b>K18×24×20</b>	0.0190
	25	17 <sup>-0.55</sup>	18 000	20 400	1 830	2 080	14 000	21 000	<b>K18×25×17</b>	0.0190
	25	22	22 100	26 600	2 250	2 710	14 000	21 000	<b>K18×25×22</b>	0.0240
19	23	13 <sup>-0.2</sup>	9 650	13 500	985	1 370	14 000	21 000	<b>K19×23×13</b>	0.0082
	23	17 <sup>-0.55</sup>	12 700	19 200	1 300	1 960	14 000	21 000	<b>K19×23×17</b>	0.0110
20	24	10	8 300	11 200	845	1 150	13 000	20 000	<b>K20×24×10S</b>	0.0065
	24	11	9 500	13 400	970	1 370	13 000	20 000	<b>K20×24×11</b>	0.0072
	24	13	10 000	14 300	1 020	1 460	13 000	20 000	<b>K20×24×13S</b>	0.0086
	24	17	13 200	20 400	1 340	2 080	13 000	20 000	<b>K20×24×17S</b>	0.0110
	24	45	16 400	27 100	1 680	2 760	13 000	20 000	<b>K20×24×45ZW</b>	0.0280
	25	40	29 000	48 000	2 950	4 900	13 000	20 000	<b>K20×25×40ZW</b>	0.0330
	26	12 <sup>-0.2</sup>	12 900	15 100	1 320	1 540	13 000	20 000	<b>K20×26×12</b>	0.0130
	26	13 <sup>-0.55</sup>	14 000	16 700	1 420	1 700	13 000	20 000	<b>KMJ20×26×13</b>	0.0120
	26	14	15 800	19 600	1 610	2 000	13 000	13 000	<b>KMJ20×26×13.8X1S</b>	0.0130
	26	17	17 800	22 800	1 810	2 330	13 000	20 000	<b>KMJ20×26×17S</b>	0.0160
	26	20	20 600	27 600	2 100	2 820	13 000	20 000	<b>KMJ20×26×20S</b>	0.0190
	28	17	21 700	2 4600	2 210	2 510	13 000	20 000	<b>KMJ20×28×16.8XS</b>	0.0220
	28	20	24 600	2 8900	2 500	2 940	13 000	20 000	<b>KMJ20×28×19.8X4S</b>	0.0260
28	25	27 100	3 2500	2 760	3 300	13 000	20 000	<b>8Q-K20×28×25</b>	0.0390	
21	25	13 <sup>-0.2</sup>	10 700	1 5900	1 090	1 620	13 000	19 000	<b>KMJ21×25×12.8X1S</b>	0.0081
	25	17 <sup>-0.55</sup>	13 600	2 1500	1 380	2 200	13 000	19 000	<b>K21×25×17</b>	0.0120
22	26	10	8 500	1 1900	865	1 220	12 000	18 000	<b>K22×26×10S</b>	0.0071
	26	11	10 100	1 4900	1 030	1 520	12 000	18 000	<b>8Q-K22×26×11</b>	0.0090
	26	13	10 200	1 5200	1 040	1 550	12 000	18 000	<b>K22×26×13</b>	0.0094
	26	17 <sup>-0.2</sup>	13 500	21 600	1 370	2 200	12 000	18 000	<b>K22×26×17S</b>	0.0120
	27	20 <sup>-0.55</sup>	17 500	2 5900	1 780	2 640	12 000	18 000	<b>K22×27×20</b>	0.0200
	27	28.5	24 200	3 9500	2 470	4 000	12 000	18 000	<b>K22×27×28.3X</b>	0.0276
	27	40	50 500	10 3000	5 150	10 500	12 000	18 000	<b>K22×27×40ZW</b>	0.0390
28	17	17 700	2 3300	1 810	2 380	12 000	18 000	<b>K22×28×17V1</b>	0.0200	

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K  
 Type K··T2  
 Type K··S  
 Type K··ZW  
 Type KMJ  
 Type KMJ··S  
 Type KV··S



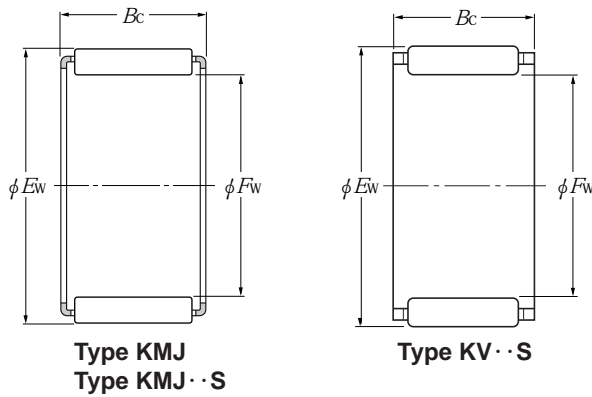
Type K  
 Type K··T2  
 Type K··S

Type K··ZW

$F_w$  22~25mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	$\text{min}^{-1}$		(approx.)	
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
22	29	16	18 700	2 2700	1 910	2 310	12 000	18 000	<b>K22×29×16</b>	0.0230
	30	15 <sup>-0.2</sup>	19 300	21 700	1 970	2 210	12 000	18 000	<b>K22×30×15</b>	0.0220
	30	17.5 <sup>-0.55</sup>	23 200	2 7500	2 370	2 800	12 000	18 000	<b>KMJ22×30×17.3X2S</b>	0.0240
	30	24	31 000	4 0000	3 150	4 100	12 000	18 000	<b>KMJ22×30×23.8X3S</b>	0.0348
23	27	13	11 400	1 7700	1 160	1 800	11 000	17 000	<b>KMJ23×27×12.8X1S</b>	0.0086
	28	24 <sup>-0.2</sup>	19 800	3 1000	2 020	3 150	11 000	17 000	<b>K23×28×24</b>	0.0230
	29	18 <sup>-0.55</sup>	20 600	2 8800	2 100	2 930	11 000	17 000	<b>KMJ23×29×17.8X2S</b>	0.0190
24	28	10	9 000	1 3200	915	1 350	11 000	17 000	<b>K24×28×10</b>	0.0080
	28	13	10 800	16 800	1 100	1 710	11 000	17 000	<b>K24×28×13</b>	0.0100
	28	17 <sup>-0.2</sup>	14 300	23 900	1 460	2 440	11 000	17 000	<b>K24×28×17</b>	0.0130
	29	13 <sup>-0.55</sup>	12 300	16 900	1 250	1 720	11 000	17 000	<b>K24×29×13</b>	0.0120
	30	17	18 400	25 200	1 880	2 570	11 000	17 000	<b>K24×30×17</b>	0.0220
	30	31	27 900	43 000	2 840	4 350	11 000	17 000	<b>K24×30×31ZW</b>	0.0390
25	29	10	8 950	13 300	910	1 350	11 000	16 000	<b>K25×29×10</b>	0.0083
	29	13	10 800	16 900	1 100	1 720	11 000	16 000	<b>K25×29×13</b>	0.0100
	29	17	14 200	24 000	1 450	2 450	11 000	16 000	<b>K25×29×17S</b>	0.0140
	30	13	13 200	18 800	1 350	1 920	11 000	16 000	<b>K25×30×13</b>	0.0130
	30	17	17 400	2 6800	1 770	2 730	11 000	16 000	<b>K25×30×17S</b>	0.0170
	30	20	19 400	3 1000	1 980	3 150	11 000	16 000	<b>K25×30×20SV3</b>	0.0210
	30	22	22 300	3 7000	2 270	3 750	11 000	16 000	<b>KMJ25×30×21.8XS</b>	0.0200
	30	26 <sup>-0.2</sup>	36 500	7 1500	3 750	7 300	11 000	16 000	<b>K25×30×26ZW</b>	0.0270
	30	39 <sup>-0.55</sup>	29 800	5 3500	3 050	5 450	11 000	16 000	<b>K25×30×39ZW</b>	0.0400
	31	13	15 200	19 900	1 550	2 030	11 000	16 000	<b>K25×31×13V3</b>	0.0180
	31	14	16 500	22 100	1 680	2 250	11 000	16 000	<b>K25×31×14</b>	0.0180
	31	17	18 300	25 300	1 870	2 580	11 000	16 000	<b>K25×31×17</b>	0.0220
	31	18.5	21 000	30 000	2 140	3 050	11 000	16 000	<b>KMJ25×31×18.3X1SK</b>	0.0210
	31	21	22 500	33 000	2 290	3 350	11 000	16 000	<b>K25×31×21V3</b>	0.0283
	32	16	19 500	24 700	1 990	2 520	11 000	16 000	<b>K25×32×16</b>	0.0270
33	24	34 500	47 000	3 500	4 800	11 000	16 000	<b>KMJ25×33×24S</b>	0.040	

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

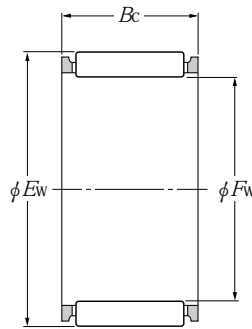


$F_w$  26~30mm

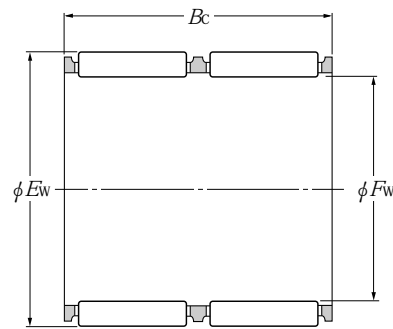
Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		(approx.)
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
26	30	13	11 800	19 200	1 200	1 960	10 000	15 000	<b>K26×30×13</b>	0.011
	30	17 <sup>-0.2</sup>	15 500	27 400	1 580	2 790	10 000	15 000	<b>K26×30×17</b>	0.015
	31	24 <sup>-0.55</sup>	21 400	35 500	2 180	3 600	10 000	15 000	<b>8E-K26×31×23.8X1ZW</b>	0.029
	34	22	24 200	30 000	2 470	3 050	10 000	15 000	<b>K26×34×22</b>	0.041
28	32	17	15 300	27 500	1 560	2 810	9 500	14 000	<b>K28×32×17</b>	0.017
	32	21	18 700	35 500	1 910	3 650	9 500	14 000	<b>K28×32×21</b>	0.020
	33	13	13 900	20 900	1 420	2 130	9 500	14 000	<b>K28×33×13</b>	0.015
	33	17	18 300	29 800	1 870	3 050	9 500	14 000	<b>K28×33×17S</b>	0.020
	33	26 <sup>-0.2</sup>	23 900	42 000	2 430	4 250	9 500	14 000	<b>K28×33×26ZW</b>	0.033
	33	27 <sup>-0.55</sup>	28 300	52 000	2 890	5 300	9 500	14 000	<b>K28×33×27</b>	0.032
	34	14	17 500	24 800	1 790	2 530	9 500	14 000	<b>K28×34×14</b>	0.020
	34	17	18 100	25 800	1 850	2 630	9 500	14 000	<b>K28×34×17V1</b>	0.025
	35	16	21 200	28 400	2 160	2 900	9 500	14 000	<b>K28×35×16</b>	0.029
35	18	21 500	28 900	2 190	2 950	9 500	14 000	<b>K28×35×18</b>	0.031	
29	34	17 <sup>-0.2</sup>	18 900	31 000	1 920	3 200	9 500	14 000	<b>K29×34×17S</b>	0.022
	34	27 <sup>-0.55</sup>	28 100	52 000	2 870	5 300	9 500	14 000	<b>K29×34×27</b>	0.033
30	34	14	12 400	21 500	1 260	2 190	8 500	13 000	<b>KV30×34×13.8XS</b>	0.014
	34	23	18 000	34 500	1 830	3 500	8 500	13 000	<b>K30×34×22.8X1T2</b>	0.013
	35	11	12 200	18 000	1 240	1 840	8 500	13 000	<b>K30×35×11S</b>	0.014
	35	13	14 700	22 900	1 500	2 340	8 500	13 000	<b>KV30×35×13S</b>	0.017
	35	17	18 800	31 500	1 910	3 200	8 500	13 000	<b>KJ30×35×17S</b>	0.021
	35	20	21 600	37 500	2 200	3 850	8 500	13 000	<b>K30×35×20S</b>	0.025
	35	26 <sup>-0.2</sup>	25 200	46 000	2 570	4 650	8 500	13 000	<b>K30×35×26ZWV1</b>	0.036
	35	27 <sup>-0.55</sup>	29 900	57 000	3 050	5 800	8 500	13 000	<b>K30×35×27S</b>	0.033
	36	14	18 600	27 400	1 900	2 790	8 500	13 000	<b>KMJ30×36×14V2</b>	0.021
	37	16	21 900	30 500	2 230	3 100	8 500	13 000	<b>K30×37×16</b>	0.029
	37	18	23 300	33 000	2 370	3 350	8 500	13 000	<b>K30×37×18</b>	0.034
	37	20	26 200	38 000	2 670	3 850	8 500	13 000	<b>KMJ30×37×20S</b>	0.032
	37	48	40 000	65 500	4 050	6 700	8 500	13 000	<b>K30×37×48ZW</b>	0.075
	38	18	25 000	33 000	2 550	3 350	8 500	13 000	<b>K30×38×18</b>	0.036

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

**Type K**  
**Type K··T2**  
**Type K··ZW**  
**Type KMJ**  
**Type KJ··S**  
**Type KV··S**



**Type K**  
**Type K··T2**

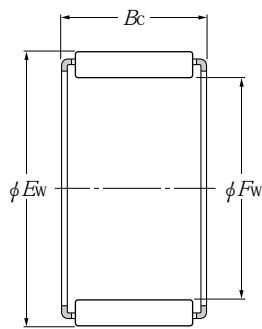


**Type K··ZW**

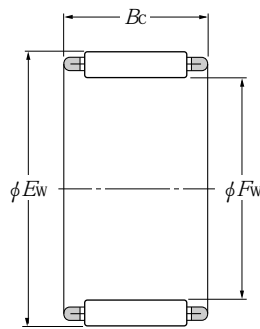
$F_w$  31~35mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	$\text{min}^{-1}$			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				(approx.)
<b>31</b>	35	24 <sup>-0.2</sup>	21 200	43 500	2 160	4 400	8 500	13 000	<b>KV31×35×23.8XS</b>	0.022
	36	14 <sup>-0.55</sup>	15 800	25 400	1 610	2 590	8 500	13 000	<b>KV31×36×13.8XS</b>	0.017
<b>32</b>	36	15	14 300	26 400	1 460	2 700	8 500	13 000	<b>K32×36×15S</b>	0.017
	37	13	14 500	23 000	1 480	2 350	8 500	13 000	<b>K32×37×13</b>	0.018
	37	17	19 200	33 000	1 950	3 350	8 500	13 000	<b>K32×37×17S</b>	0.022
	37	24	22 900	41 500	2 340	4 200	8 500	13 000	<b>K32×37×24.8X2</b>	0.018
	37	26	24 900	46 000	2 540	4 700	8 500	13 000	<b>K32×37×26ZWV3</b>	0.032
	37	27 <sup>-0.2</sup>	29 600	57 500	3 000	5 850	8 500	13 000	<b>K32×37×27</b>	0.037
	38	14 <sup>-0.55</sup>	19 800	30 500	2 020	3 100	8 500	13 000	<b>KMJ32×38×14</b>	0.022
	38	20	25 100	41 000	2 560	4 150	8 500	13 000	<b>KJ32×38×20S</b>	0.031
	38	26	31 500	54 000	3 200	5 550	8 500	13 000	<b>K32×38×26</b>	0.041
	39	16	22 600	32 000	2 310	3 300	8 500	13 000	<b>K32×39×16V1</b>	0.033
	39	18	24 000	35 000	2 450	3 550	8 500	13 000	<b>K32×39×18</b>	0.037
39	20	26 800	40 000	2 740	4 100	8 500	13 000	<b>KJ32×39×20S</b>	0.041	
<b>33</b>	38	30.5 <sup>-0.2</sup>	28 400	55 000	2 900	5 600	8 000	12 000	<b>K33×38×30.3X1T2</b>	0.026
<b>34</b>	40	39.5 <sup>-0.2</sup>	39 000	73 500	4 000	7 500	8 000	12 000	<b>KV34×40×39.3X1ZWS</b>	0.066
<b>35</b>	39	22.5	21 500	46 000	2 200	4 700	7 500	11 000	<b>KV35×39×22.3XS</b>	0.024
	39	24	21 300	45 000	2 170	4 600	7 500	11 000	<b>K35×39×23.8X1T2</b>	0.015
	40	13	15 200	25 100	1 550	2 560	7 500	11 000	<b>K35×40×13</b>	0.019
	40	17	20 000	36 000	2 040	3 650	7 500	11 000	<b>K35×40×17</b>	0.025
	40	19	22 300	41 000	2 270	4 200	7 500	11 000	<b>K35×40×19</b>	0.029
	40	26	44 000	100 000	4 450	10 200	7 500	11 000	<b>K35×40×26ZW</b>	0.037
	40	27 <sup>-0.2</sup>	32 000	65 000	3 250	6 600	7 500	11 000	<b>KJ35×40×27S</b>	0.039
	40	30 <sup>-0.55</sup>	26 100	50 000	2 660	5 100	7 500	11 000	<b>K35×40×30ZW</b>	0.043
	41	14	19 400	30 500	1 980	3 100	7 500	11 000	<b>K35×41×14</b>	0.026
	41	15	20 900	33 500	2 130	3 400	7 500	11 000	<b>K35×41×15</b>	0.027
	41	24	31 000	55 500	3 200	5 650	7 500	11 000	<b>K35×41×23.8X1</b>	0.042
	41	40	72 000	168 000	7 350	17 100	7 500	11 000	<b>K35×41×40ZW</b>	0.055
	42	16	24 100	36 000	2 450	3 650	7 500	11 000	<b>K35×42×16</b>	0.035
42	18	24 700	37 000	2 510	3 750	7 500	11 000	<b>K35×42×18</b>	0.039	

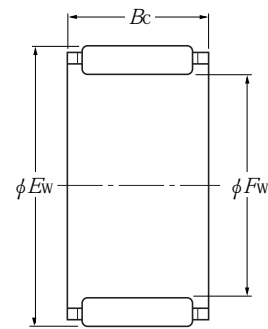
Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.



Type KMJ



Type KJ··S



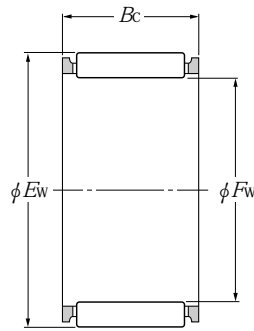
Type KV··S

 $F_w$  35~42mm

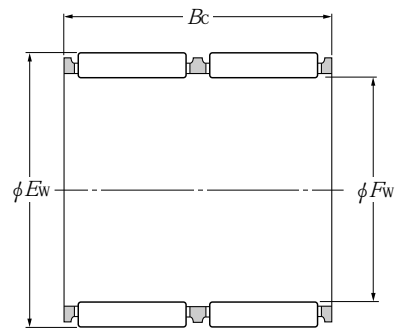
Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		(approx.)
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
35	42	20	26 500	40 500	2 700	4 100	7 500	11 000	<b>KV35×42×20SV2</b>	0.040
	42	30 <sup>-0.2</sup> -0.55	39 500	68 000	4 050	6 950	7 500	11 000	<b>K35×42×30</b>	0.062
	42	45	42 500	74 000	4 300	7 550	7 500	11 000	<b>K35×42×45ZW</b>	0.106
36	42	46 <sup>-0.2</sup> -0.55	51 000	106 000	5 200	10 800	7 500	11 000	<b>K36×42×46ZW</b>	0.086
37	42	13	15 900	27 100	1 620	2 770	7 500	11 000	<b>K37×42×13V4</b>	0.021
	42	17	21 000	38 500	2 140	3 950	7 500	11 000	<b>K37×42×17V2</b>	0.026
	42	27 <sup>-0.2</sup> -0.55	32 500	67 500	3 300	6 900	7 500	11 000	<b>KJ37×42×27S</b>	0.041
	43	33.5	39 000	76 000	4 000	7 750	7 500	11 000	<b>KV37×43×33.3XS</b>	0.062
	44	18	26 300	41 000	2 680	4 150	7 500	11 000	<b>K37×44×18</b>	0.042
	45	25	37 000	58 000	3 800	5 900	7 500	11 000	<b>K37×45×24.8XT2</b>	0.039
38	43	17	20 900	38 500	2 130	3 950	7 500	11 000	<b>8E-K38×43×17</b>	0.027
	43	27	32 000	67 500	3 300	6 900	7 500	11 000	<b>K38×43×27</b>	0.043
	43	29 <sup>-0.2</sup> -0.55	32 500	68 000	3 300	6 950	7 500	11 000	<b>K38×43×28.8X</b>	0.047
	46	20	34 000	52 000	3 450	5 350	7 500	11 000	<b>KMJ38×46×20</b>	0.046
	46	32	54 000	95 500	5 500	9 700	7 500	11 000	<b>K38×46×32</b>	0.073
40	45	13	16 500	29 200	1 680	2 980	6 500	10 000	<b>K40×45×13V2</b>	0.023
	45	17	21 800	41 500	2 220	4 250	6 500	10 000	<b>K40×45×17</b>	0.027
	45	21	26 700	54 000	2 720	5 500	6 500	10 000	<b>K40×45×21V2</b>	0.035
	45	27	33 500	72 500	3 400	7 400	6 500	10 000	<b>K40×45×27</b>	0.044
	46	17 <sup>-0.2</sup> -0.55	24 600	43 000	2 500	4 350	6 500	10 000	<b>K40×46×17</b>	0.030
	46	34	40 500	80 500	4 100	8 250	6 500	10 000	<b>KV40×46×33.8XS</b>	0.063
	47	18	27 700	45 000	2 820	4 550	6 500	10 000	<b>K40×47×18</b>	0.045
	47	20	31 000	51 500	3 150	5 250	6 500	10 000	<b>K40×47×20</b>	0.048
	48	20	33 000	51 000	3 350	5 200	6 500	10 000	<b>K40×48×20</b>	0.052
	48	25	41 000	68 000	4 200	6 900	6 500	10 000	<b>KV40×48×25SV1</b>	0.065
41	49	22 <sup>-0.2</sup> -0.55	30 500	46 000	3 100	4 700	6 500	9 500	<b>8E-KV41×49×21.8XS</b>	0.065
42	47	17	22 100	43 000	2 250	4 400	6 500	9 500	<b>K42×47×17</b>	0.028
	47	27 <sup>-0.2</sup> -0.55	34 000	75 500	3 450	7 700	6 500	9 500	<b>K42×47×27</b>	0.047
	48	17	25 700	46 000	2 630	4 700	6 500	9 500	<b>K42×48×17</b>	0.036
	50	20	34 000	53 500	3 450	5 500	6 500	9 500	<b>K42×50×20</b>	0.054

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

Type K  
 Type K · T2  
 Type K · ZW  
 Type KV · S



Type K  
 Type K · T2

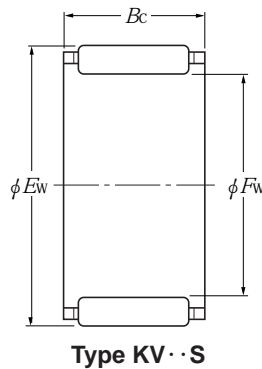


Type K · ZW

$F_w$  43~50mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		(approx.)
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
43	48	17	22 000	43 000	2 240	4 400	6 500	9 500	<b>K43×48×17</b>	0.029
	48	27 <sup>-0.2</sup>	34 000	75 500	3 450	7 700	6 500	9 500	<b>K43×48×27</b>	0.046
	48	38 <sup>-0.55</sup>	41 000	96 000	4 150	9 800	6 500	9 500	<b>KV43×48×37.8XZWS</b>	0.058
	50	18	29 100	49 000	2 960	5 000	6 500	9 500	<b>K43×50×18</b>	0.049
44	50	31 <sup>-0.2</sup> <sup>-0.55</sup>	43 500	91 500	4 400	9 300	6 500	9 500	<b>KV44×50×30.8XS</b>	0.067
45	49	19	22 100	52 000	2 260	5 300	6 000	9 000	<b>K45×49×19</b>	0.027
	50	17	22 300	44 500	2 280	4 550	6 000	9 000	<b>K45×50×17</b>	0.033
	50	25.8	30 500	66 500	3 100	6 750	6 000	9 000	<b>KV45×50×25.8XS</b>	0.045
	50	27	34 500	78 000	3 500	7 950	6 000	9 000	<b>K45×50×27</b>	0.050
	51	27 <sup>-0.2</sup>	34 500	68 000	3 500	6 950	6 000	9 000	<b>KV45×51×26.8XS</b>	0.058
	52	18 <sup>-0.55</sup>	29 700	51 000	3 000	5 200	6 000	9 000	<b>K45×52×18</b>	0.051
	52	21	32 000	56 500	3 300	5 750	6 000	9 000	<b>K45×52×21</b>	0.061
	53	20	36 000	59 000	3 650	6 000	6 000	9 000	<b>K45×53×20</b>	0.062
	53	25	46 500	82 000	4 700	8 400	6 000	9 000	<b>K45×53×25</b>	0.077
53	28	49 500	90 000	5 050	9 200	6 000	9 000	<b>KJ45×53×28S</b>	0.078	
47	52	15.5	19 400	38 000	1 980	3 900	5 500	8 500	<b>8E-K47×52×15.3X2</b>	0.031
	52	17	23 200	47 500	2 360	4 850	5 500	8 500	<b>K47×52×17</b>	0.033
	52	23 <sup>-0.2</sup>	29 600	65 500	3 000	6 650	5 500	8 500	<b>KV47×52×22.8XS</b>	0.044
	52	24 <sup>-0.55</sup>	33 500	76 500	3 400	7 800	5 500	8 500	<b>K47×52×23.8X</b>	0.044
	52	27	35 500	83 000	3 650	8 450	5 500	8 500	<b>K47×52×27</b>	0.051
	52	33	38 000	90 500	3 900	9 250	5 500	8 500	<b>KV47×52×32.8XZWS</b>	0.064
48	53	22.5	31 000	69 500	3 150	7 050	5 500	8 500	<b>KV48×53×22.3XS</b>	0.042
	53	26	36 500	86 500	3 750	8 850	5 500	8 500	<b>K48×53×25.8X3T2</b>	0.029
	53	30	36 500	85 500	3 700	8 750	5 500	8 500	<b>K48×53×29.8X1</b>	0.062
	53	37 <sup>-0.2</sup> <sup>-0.55</sup>	45 000	112 000	4 550	11 400	5 500	8 500	<b>KV48×53×36.8XZWS</b>	0.064
	53	37.5	41 500	101 000	4 200	10 300	5 500	8 500	<b>K48×53×37.5ZW</b>	0.072
	54	19	31 000	61 000	3 150	6 250	5 500	8 500	<b>K48×54×19</b>	0.044
	55	24.5	39 000	73 500	4 000	7 600	5 500	8 500	<b>KV48×55×24.3XS</b>	0.070
50	55	13.5 <sup>-0.2</sup>	18 100	35 500	1 850	3 600	5 500	8 000	<b>K50×55×13.5</b>	0.023
	55	20 <sup>-0.55</sup>	27 900	62 000	2 850	6 300	5 500	8 000	<b>KV50×55×20S</b>	0.040

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

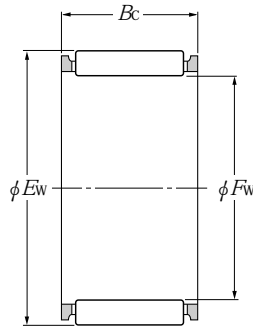


$F_w$  50~60mm

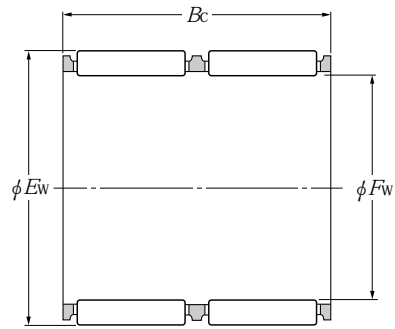
Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>50</b>	55	27	37 000	88 500	3 750	9 000	5 500	8 000	<b>K50×55×27</b>	0.053
	55	30	39 500	97 000	4 050	9 900	5 500	8 000	<b>K50×55×30</b>	0.059
	57	18 <sup>-0.2</sup>	31 500	57 000	3 200	5 800	5 500	8 000	<b>K50×57×18</b>	0.053
	58	20 <sup>-0.55</sup>	38 500	67 500	3 950	6 850	5 500	8 000	<b>K50×58×20</b>	0.065
	58	25	48 500	90 000	4 950	9 150	5 500	8 000	<b>K50×58×25</b>	0.081
	58	58	83 500	181 000	8 500	18 400	5 500	8 000	<b>KV50×58×57.8XZWS</b>	0.188
<b>52</b>	57	18	22 800	48 000	2 320	4 900	5 000	7 500	<b>KV52×57×17.8XS</b>	0.037
	57	23 <sup>-0.2</sup>	30 500	69 500	3 100	7 100	5 000	7 500	<b>KV52×57×22.8X1S</b>	0.048
	58	19 <sup>-0.55</sup>	32 000	65 500	3 250	6 650	5 000	7 500	<b>K52×58×19</b>	0.048
<b>54</b>	59	23 <sup>-0.2</sup>	31 500	73 500	3 200	7 500	5 000	7 500	<b>KV54×59×22.8XS</b>	0.049
<b>55</b>	60	17	25 800	58 000	2 630	5 900	5 000	7 500	<b>K55×60×17</b>	0.043
	60	20	28 800	66 500	2 940	6 750	5 000	7 500	<b>K55×60×20</b>	0.045
	60	30	42 000	108 000	4 300	11 000	5 000	7 500	<b>KV55×60×30S</b>	0.069
	60	37	47 500	127 000	4 850	12 900	5 000	7 500	<b>K55×60×36.8X</b>	0.086
	61	19	33 000	69 500	3 350	7 100	5 000	7 500	<b>K55×61×19</b>	0.051
	61	20 <sup>-0.2</sup>	33 000	69 500	3 350	7 100	5 000	7 500	<b>K55×61×20</b>	0.054
	61	30 <sup>-0.55</sup>	48 000	113 000	4 900	11 500	5 000	7 500	<b>K55×61×30</b>	0.081
	62	18	33 500	63 000	3 400	6 450	5 000	7 500	<b>K55×62×18</b>	0.054
	63	20	39 000	70 000	3 950	7 100	5 000	7 500	<b>K55×63×20</b>	0.073
	63	25	50 500	97 500	5 150	9 950	5 000	7 500	<b>K55×63×25</b>	0.088
<b>56</b>	66	41 <sup>-0.2</sup>	90 000	178 000	9 200	18 100	5 000	7 500	<b>K56×66×40.8XT2</b>	0.148
<b>57</b>	65	40 <sup>-0.2</sup>	66 000	140 000	6 750	14 300	4 700	7 000	<b>KV57×65×39.8XZWS</b>	0.145
<b>58</b>	64	19 <sup>-0.2</sup>	34 000	73 500	3 450	7 500	4 700	7 000	<b>K58×64×19</b>	0.052
<b>60</b>	65	20	29 800	71 500	3 050	7 300	4 300	6 500	<b>K60×65×20</b>	0.051
	65	27	40 000	104 000	4 050	10 600	4 300	6 500	<b>K60×65×26.8X</b>	0.067
	65	30 <sup>-0.2</sup>	43 500	116 000	4 450	11 800	4 300	6 500	<b>K60×65×30</b>	0.071
	66	19 <sup>-0.55</sup>	33 500	73 500	3 450	7 500	4 300	6 500	<b>K60×66×19</b>	0.053
	66	20	33 500	73 500	3 450	7 500	4 300	6 500	<b>K60×66×20</b>	0.056

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

**Type K**  
**Type K · T2**  
**Type K · ZW**  
**Type KV · S**



**Type K**  
**Type K · T2**

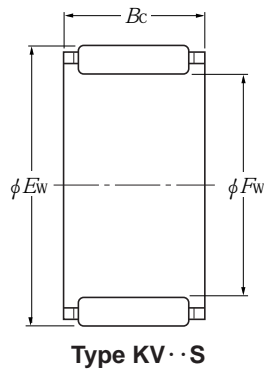


**Type K · ZW**

$F_w$  60~73mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		(approx.)
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>60</b>	66	30	49 000	119 000	5 000	12 200	4 300	6 500	<b>K60×66×30</b>	0.084
	68	15	27 200	45 500	2 780	4 650	4 300	6 500	<b>K60×68×15</b>	0.058
	68	20	40 000	75 000	4 100	7 650	4 300	6 500	<b>K60×68×20</b>	0.077
	68	23 <sup>-0.2</sup> -0.55	44 500	85 000	4 500	8 700	4 300	6 500	<b>K60×68×23</b>	0.092
	68	25	52 000	105 000	5 300	10 700	4 300	6 500	<b>K60×68×25</b>	0.097
	68	27	52 000	105 000	5 300	10 700	4 300	6 500	<b>K60×68×27</b>	0.098
	68	30	46 500	91 000	4 750	9 300	4 300	6 500	<b>K60×68×30ZW</b>	0.119
<b>61</b>	66	20 <sup>-0.2</sup> -0.55	29 700	71 500	3 050	7 300	4 300	6 500	<b>K61×66×20</b>	0.054
	66	30	43 500	116 000	4 400	11 900	4 300	6 500	<b>K61×66×30</b>	0.073
<b>63</b>	70	21 <sup>-0.2</sup> -0.55	44 500	95 500	4 500	9 700	4 300	6 500	<b>K63×70×21</b>	0.075
	71	50.5	74 500	167 000	7 600	17 000	4 300	6 500	<b>KV63×71×50.3XZWS</b>	0.193
<b>64</b>	70	16 <sup>-0.2</sup> -0.55	28 400	60 500	2 900	6 150	4 300	6 500	<b>K64×70×16</b>	0.053
<b>65</b>	70	20	30 500	75 000	3 100	7 650	4 000	6 000	<b>K65×70×20</b>	0.055
	70	21.5	30 500	75 000	3 100	7 650	4 000	6 000	<b>KV65×70×21.3X1S</b>	0.056
	70	30 <sup>-0.2</sup> -0.55	45 000	124 000	4 600	12 700	4 000	6 000	<b>K65×70×30</b>	0.083
	73	23	47 000	94 000	4 800	9 600	4 000	6 000	<b>K65×73×23</b>	0.100
	73	30	61 000	132 000	6 200	13 400	4 000	6 000	<b>K65×73×30</b>	0.126
<b>68</b>	74	20	36 000	83 500	3 700	8 550	4 000	6 000	<b>K68×74×20</b>	0.065
	74	30 <sup>-0.2</sup> -0.55	51 500	133 000	5 250	13 500	4 000	6 000	<b>K68×74×30</b>	0.097
	74	35	49 500	125 000	5 050	12 800	4 000	6 000	<b>K68×74×35ZW</b>	0.116
	75	21	45 500	101 000	4 600	10 300	4 000	6 000	<b>K68×75×21</b>	0.077
<b>70</b>	76	20	36 500	86 000	3 700	8 750	3 700	5 500	<b>K70×76×20</b>	0.070
	76	30	53 000	139 000	5 400	14 200	3 700	5 500	<b>K70×76×30</b>	0.100
	77	21 <sup>-0.2</sup> -0.55	45 000	101 000	4 600	10 300	3 700	5 500	<b>K70×77×21</b>	0.080
	78	23	49 500	103 000	5 050	10 500	3 700	5 500	<b>K70×78×23</b>	0.107
	78	30	65 500	149 000	6 700	15 200	3 700	5 500	<b>K70×78×30</b>	0.136
<b>72</b>	79	21 <sup>-0.2</sup> -0.55	46 500	106 000	4 750	10 800	3 700	5 500	<b>K72×79×21</b>	0.085
<b>73</b>	79	20 <sup>-0.2</sup> -0.55	37 500	90 000	3 800	9 150	3 700	5 500	<b>K73×79×20</b>	0.074
	79	30	54 500	146 000	5 550	14 900	3 700	5 500	<b>K73×79×30</b>	0.106
<b>74</b>	90	50 <sup>-0.2</sup> -0.55	157 000	287 000	16 000	29 200	3 700	5 500	<b>K74×90×49.8XT2</b>	0.380

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

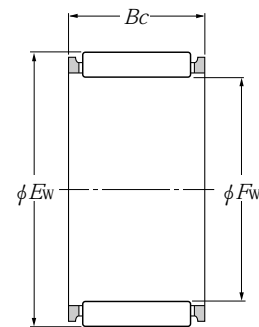


$F_w$  75~105mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>75</b>	81	20	40 000	99 500	4 100	10 200	3 700	5 500	<b>KV75×81×19.8X1S</b>	0.071
	81	30	56 000	152 000	5 700	15 500	3 700	5 500	<b>K75×81×30</b>	0.108
	82	21 <sup>-0.2</sup> -0.55	46 000	106 000	4 700	10 800	3 700	5 500	<b>K75×82×21</b>	0.088
	83	23	50 500	109 000	5 150	11 100	3 700	5 500	<b>K75×83×23</b>	0.113
	83	30	67 500	157 000	6 850	16 100	3 700	5 500	<b>K75×83×30</b>	0.147
<b>80</b>	86	20	39 000	98 000	4 000	10 000	3 300	5 000	<b>KV80×86×20SV1</b>	0.077
	86	30	57 000	159 000	5 800	16 200	3 300	5 000	<b>K80×86×30</b>	0.110
	88	23 <sup>-0.2</sup> -0.55	53 000	118 000	5 400	12 100	3 300	5 000	<b>K80×88×23</b>	0.125
	88	26	61 000	142 000	6 250	14 500	3 300	5 000	<b>K80×88×26</b>	0.131
	88	30	69 000	166 000	7 050	17 000	3 300	5 000	<b>K80×88×30</b>	0.157
<b>85</b>	92	20	47 500	115 000	4 850	11 700	3 100	4 700	<b>KMJ85×92×20</b>	0.083
	92	30 <sup>-0.2</sup> -0.55	66 000	176 000	6 750	18 000	3 100	4 700	<b>K85×92×30</b>	0.142
	93	27 <sup>-0.2</sup> -0.55	64 000	153 000	6 500	15 600	3 100	4 700	<b>K85×93×27</b>	0.145
	93	30	71 000	175 000	7 200	17 900	3 100	4 700	<b>8Q-K85×93×30</b>	0.174
<b>90</b>	97	20	46 000	113 000	4 700	11 500	2 900	4 400	<b>K90×97×20</b>	0.103
	97	30	67 500	184 000	6 850	18 700	2 900	4 400	<b>K90×97×30</b>	0.151
	98	26 <sup>-0.2</sup> -0.55	64 000	157 000	6 550	16 000	2 900	4 400	<b>K90×98×26</b>	0.148
	98	27	64 000	157 000	6 550	16 000	2 900	4 400	<b>K90×98×27</b>	0.150
	98	30	72 500	184 000	7 400	18 800	2 900	4 400	<b>K90×98×30</b>	0.172
<b>95</b>	102	21	48 000	122 000	4 900	12 400	2 800	4 200	<b>K95×102×21</b>	0.115
	102	31 <sup>-0.2</sup> -0.55	70 500	199 000	7 200	20 300	2 800	4 200	<b>K95×102×31</b>	0.172
	103	27 <sup>-0.2</sup> -0.55	65 500	165 000	6 700	16 800	2 800	4 200	<b>K95×103×27</b>	0.159
	103	30	74 000	193 000	7 550	19 600	2 800	4 200	<b>K95×103×30</b>	0.165
<b>100</b>	107	21	47 500	122 000	4 850	12 500	2 700	4 000	<b>KV100×107×21S</b>	0.120
	107	31 <sup>-0.3</sup> -0.65	71 500	207 000	7 300	21 100	2 700	4 000	<b>K100×107×31</b>	0.173
	108	27 <sup>-0.3</sup> -0.65	61 000	153 000	6 250	15 600	2 700	4 000	<b>K100×108×27</b>	0.176
	108	30	76 000	201 000	7 700	20 500	2 700	4 000	<b>K100×108×30</b>	0.190
<b>105</b>	112	21	48 500	127 000	4 950	12 900	2 500	3 800	<b>K105×112×21</b>	0.130
	112	31 <sup>-0.3</sup> -0.65	71 000	207 000	7 250	21 100	2 500	3 800	<b>K105×112×31</b>	0.176
	113	30	77 500	210 000	7 900	21 400	2 500	3 800	<b>K105×113×30</b>	0.198

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

## Type K Type K··L1



Type K  
Type K··L1

$F_w$  110~195mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass
mm			dynamic	static	dynamic	static	$\text{min}^{-1}$			kg
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		(approx.)
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
110	117	24	54 500	149 000	5 550	15 200	2 400	3 600	<b>K110×117×24</b>	0.145
	117	34 <sup>-0.3</sup> <sub>-0.65</sub>	77 500	235 000	7 900	24 000	2 400	3 600	<b>K110×117×34</b>	0.205
	118	30	79 000	219 000	8 050	22 300	2 400	3 600	<b>K110×118×30</b>	0.217
115	123	27 <sup>-0.3</sup> <sub>-0.65</sub>	64 000	170 000	6 550	17 300	2 300	3 500	<b>K115×123×27</b>	0.200
	125	34 <sup>-0.3</sup> <sub>-0.65</sub>	95 000	241 000	9 700	24 600	2 300	3 500	<b>K115×125×34</b>	0.330
120	127	24 <sup>-0.3</sup> <sub>-0.65</sub>	57 500	165 000	5 850	16 800	2 200	3 300	<b>K120×127×24</b>	0.160
	127	34 <sup>-0.3</sup> <sub>-0.65</sub>	82 000	260 000	8 350	26 600	2 200	3 300	<b>K120×127×34</b>	0.235
125	133	35 <sup>-0.3</sup> <sub>-0.65</sub>	87 000	260 000	8 900	26 500	2 100	3 200	<b>K125×133×35</b>	0.275
	135	34 <sup>-0.3</sup> <sub>-0.65</sub>	100 000	265 000	10 200	27 000	2 100	3 200	<b>K125×135×34</b>	0.350
130	137	24 <sup>-0.3</sup> <sub>-0.65</sub>	59 000	175 000	6 000	17 900	2 100	3 100	<b>K130×137×24</b>	0.170
	137	34 <sup>-0.3</sup> <sub>-0.65</sub>	84 500	277 000	8 600	28 300	2 100	3 100	<b>K130×137×34</b>	0.240
135	143	35 <sup>-0.3</sup> <sub>-0.65</sub>	92 500	288 000	9 450	29 400	2 000	3 000	<b>K135×143×35L1</b>	0.313
	150	38 <sup>-0.3</sup> <sub>-0.65</sub>	145 000	325 000	14 800	33 500	2 000	3 000	<b>K135×150×38</b>	0.590
145	153	26	72 000	214 000	7 350	21 800	1 900	2 800	<b>K145×153×26</b>	0.250
	153	28 <sup>-0.3</sup> <sub>-0.65</sub>	80 500	247 000	8 200	25 200	1 900	2 800	<b>K145×153×28</b>	0.252
	153	36	100 000	325 000	10 200	33 000	1 900	2 800	<b>K145×153×36</b>	0.335
150	160	46 <sup>-0.3</sup> <sub>-0.65</sub>	149 000	470 000	15 200	48 000	1 800	2 700	<b>K150×160×46</b>	0.550
155	163	26 <sup>-0.3</sup> <sub>-0.65</sub>	73 500	224 000	7 500	22 800	1 700	2 600	<b>K155×163×26</b>	0.270
	163	36 <sup>-0.3</sup> <sub>-0.65</sub>	102 000	340 000	10 400	34 500	1 700	2 600	<b>K155×163×36</b>	0.355
160	170	46 <sup>-0.3</sup> <sub>-0.65</sub>	155 000	505 000	15 800	51 500	1 700	2 500	<b>K160×170×46</b>	0.570
165	173	26	79 000	251 000	8 050	25 600	1 600	2 400	<b>K165×173×26</b>	0.290
	173	32 <sup>-0.3</sup> <sub>-0.65</sub>	97 000	330 000	9 900	33 500	1 600	2 400	<b>K165×173×32</b>	0.340
	173	36	109 000	380 000	11 100	39 000	1 600	2 400	<b>K165×173×36</b>	0.375
170	180	46 <sup>-0.3</sup> <sub>-0.65</sub>	160 000	540 000	16 400	55 000	1 600	2 400	<b>K170×180×46</b>	0.620
175	183	32 <sup>-0.3</sup> <sub>-0.65</sub>	101 000	350 000	10 300	35 500	1 500	2 300	<b>K175×183×32L1</b>	0.379
185	195	37 <sup>-0.3</sup> <sub>-0.65</sub>	131 000	425 000	13 300	43 500	1 500	2 200	<b>K185×195×37L1</b>	0.581
195	205	37 <sup>-0.3</sup> <sub>-0.65</sub>	135 000	450 000	13 800	46 000	1 400	2 100	<b>K195×205×37L1</b>	0.620

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

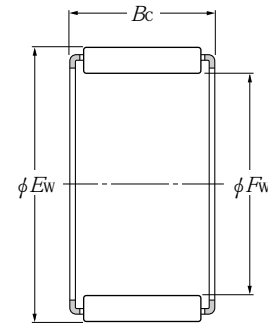
$F_w$  210~285mm

Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm			dynamic	static	dynamic	static	min <sup>-1</sup>			
$F_w$	$E_w$	$B_c$	N		kgf		grease	oil		
			$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>210</b>	220	42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$	156 000	560 000	15 900	57 000	1 300	1 900	<b>K210×220×42</b>	0.740
<b>220</b>	230	42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$	161 000	590 000	16 400	60 000	1 200	1 800	<b>K220×230×42</b>	0.790
<b>240</b>	250	42 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$	167 000	635 000	17 000	64 500	1 100	1 700	<b>K240×250×42L1</b>	0.849
<b>265</b>	280	50 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$	256 000	850 000	26 100	87 000	1 000	1 500	<b>K265×280×50L1</b>	1.768
<b>285</b>	300	50 $\begin{smallmatrix} -0.3 \\ -0.65 \end{smallmatrix}$	268 000	930 000	27 300	94 500	950	1 400	<b>K285×300×50</b>	1.970

Remarks: Even when an order is placed with reference to "Nominal bearing number" listed in this table, the ordered bearings are subject to being delivered with different cage type.

## Inch System

### Type PCJ



$F_w$  12.700~63.500mm

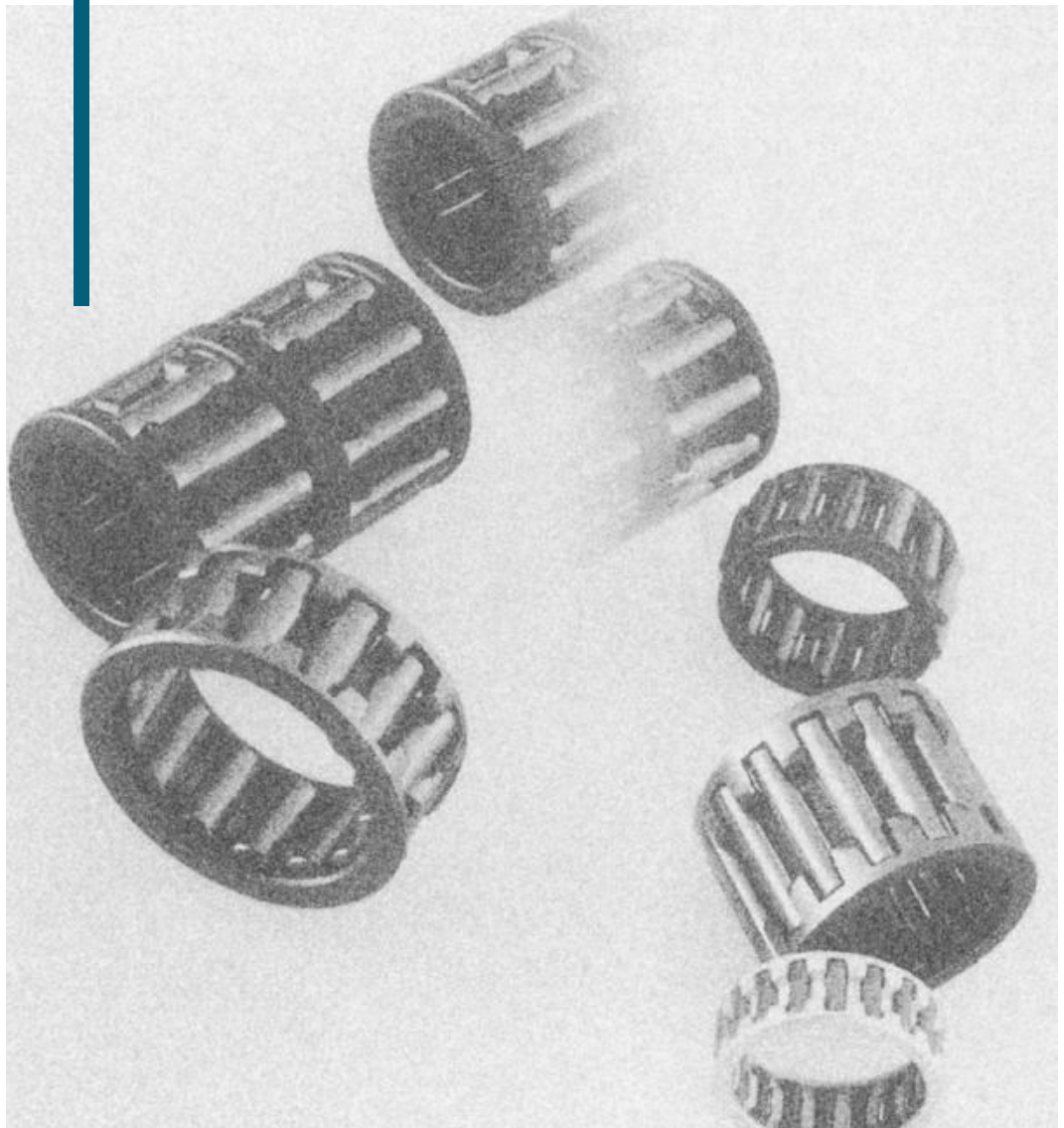
$F_w$	Boundary dimensions		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
	mm $E_w$	$B_c$ ${}^{-0}_{-0.35}({}^{-0}_{-0.014})$	dynamic N $C_r$	static $C_{or}$	dynamic kgf $C_r$	static $C_{or}$	grease min <sup>-1</sup>	oil		
<b>12.700</b> ( $\frac{1}{2}$ )	15.875( $\frac{5}{8}$ )	12.70( $\frac{1}{2}$ )	6 650	8 600	680	875	16 000	24 000	<b>PCJ081008</b>	0.003
<b>19.050</b> ( $\frac{3}{4}$ )	25.400(1)	25.40(1)	25 700	35 000	2 620	3 550	13 000	20 000	<b>PCJ121616</b>	0.023
<b>22.225</b> ( $\frac{7}{8}$ )	28.575( $1\frac{1}{8}$ )	25.40(1)	29 600	44 000	3 000	4 450	11 000	17 000	<b>PCJ141816</b>	0.028
<b>25.400</b> (1)	33.338( $1\frac{5}{16}$ )	19.05( $\frac{3}{4}$ )	29 200	38 500	2 980	3 950	10 000	15 000	<b>PCJ162112</b>	0.032
	33.338( $1\frac{5}{16}$ )	25.40(1)	38 000	54 000	3 850	5 500	10 000	15 000	<b>PCJ162116</b>	0.044
<b>28.575</b> ( $1\frac{1}{8}$ )	38.100( $1\frac{1}{2}$ )	25.40(1)	44 000	59 500	4 450	6 050	9 500	14 000	<b>PCJ182416</b>	0.058
	38.100( $1\frac{1}{2}$ )	31.75( $1\frac{1}{4}$ )	53 500	77 000	5 450	7 850	9 500	14 000	<b>PCJ182420</b>	0.073
<b>31.750</b> ( $1\frac{1}{4}$ )	41.275( $1\frac{5}{8}$ )	19.05( $\frac{3}{4}$ )	35 000	46 000	3 600	4 700	8 500	13 000	<b>PCJ202612</b>	0.045
	41.275( $1\frac{5}{8}$ )	25.40(1)	35 000	46 000	3 600	4 700	8 500	13 000	<b>PCJ202616</b>	0.062
	41.275( $1\frac{5}{8}$ )	38.10( $1\frac{1}{2}$ )	65 000	101 000	6 600	10 300	8 500	13 000	<b>PCJ202624</b>	0.096
<b>34.925</b> ( $1\frac{3}{8}$ )	44.450( $1\frac{3}{4}$ )	31.75( $1\frac{1}{4}$ )	60 000	94 500	6 150	9 650	7 500	11 000	<b>PCJ222820</b>	0.090
	47.625( $1\frac{7}{8}$ )	25.40(1)	51 000	78 000	5 200	7 950	6 500	10 000	<b>PCJ243016</b>	0.075
	47.625( $1\frac{7}{8}$ )	31.75( $1\frac{1}{4}$ )	62 000	101 000	6 300	10 300	6 500	10 000	<b>PCJ243020</b>	0.095
<b>38.100</b> ( $1\frac{1}{2}$ )	47.625( $1\frac{7}{8}$ )	38.10( $1\frac{1}{2}$ )	72 500	123 000	7 400	12 600	6 500	10 000	<b>PCJ243024</b>	0.114
	53.975( $2\frac{1}{8}$ )	25.40(1)	55 500	92 000	5 650	9 400	6 000	9 000	<b>PCJ283416</b>	0.086
	53.975( $2\frac{1}{8}$ )	31.75( $1\frac{1}{4}$ )	68 000	119 000	6 900	12 100	6 000	9 000	<b>PCJ283420</b>	0.110
<b>44.450</b> ( $1\frac{3}{4}$ )	53.975( $2\frac{1}{8}$ )	38.10( $1\frac{1}{2}$ )	79 000	145 000	8 050	14 800	6 000	9 000	<b>PCJ283424</b>	0.132
	60.325( $2\frac{3}{8}$ )	25.40(1)	58 000	102 000	5 950	10 400	5 000	7 500	<b>PCJ323816</b>	0.094
	60.325( $2\frac{3}{8}$ )	31.75( $1\frac{1}{4}$ )	71 000	131 000	7 250	13 400	5 000	7 500	<b>PCJ323820</b>	0.120
<b>50.800</b> (2)	60.325( $2\frac{3}{8}$ )	38.10( $1\frac{1}{2}$ )	83 000	160 000	8 450	16 300	5 000	7 500	<b>PCJ323824</b>	0.144
	<b>52.388</b> ( $2\frac{1}{16}$ )	61.913( $2\frac{7}{16}$ )	25.40(1)	55 000	95 500	5 600	9 750	5 000	7 500	<b>PCJ333916</b>
<b>53.975</b> ( $2\frac{1}{8}$ )	63.500( $2\frac{1}{2}$ )	25.40(1)	56 500	99 500	5 750	10 200	5 000	7 500	<b>PCJ344016</b>	0.091
	63.500( $2\frac{1}{2}$ )	38.10( $1\frac{1}{2}$ )	82 000	161 000	8 350	16 400	5 000	7 500	<b>PCJ344024</b>	0.144
<b>57.150</b> ( $2\frac{1}{4}$ )	66.675( $2\frac{5}{8}$ )	25.40(1)	57 500	104 000	5 900	10 600	4 300	6 500	<b>PCJ364216</b>	0.094
<b>60.325</b> ( $2\frac{3}{8}$ )	69.850( $2\frac{3}{4}$ )	38.10( $1\frac{1}{2}$ )	87 500	182 000	8 950	18 500	4 300	6 500	<b>PCJ384424</b>	0.161
<b>63.500</b> ( $2\frac{1}{2}$ )	73.025( $2\frac{7}{8}$ )	25.40(1)	61 500	117 000	6 250	11 900	4 000	6 000	<b>PCJ404616</b>	0.105

$F_w$  63.500~101.600mm

$F_w$	Boundary dimensions		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
	mm $E_w$	$B_c$ ${}^0_{-0.35}$ ( ${}^0_{-0.014}$ )	dynamic N $C_r$	static $C_{or}$	dynamic kgf $C_r$	static $C_{or}$	grease min <sup>-1</sup>	oil		
<b>63.500(2½)</b>	73.025(2⅞)	38.10(1½)	89 000	189 000	9 100	19 300	4 000	4 000	<b>PCJ404624</b>	0.167
<b>69.850(2¾)</b>	79.375(3⅛)	25.40(1)	65 000	130 000	6 650	13 200	3 700	5 500	<b>PCJ445016</b>	0.116
<b>76.200(3)</b>	85.725(3⅜)	25.40(1)	68 500	143 000	7 000	14 600	3 300	5 000	<b>PCJ485416</b>	0.127
	85.725(3⅜)	38.10(1½)	99 500	231 000	10 100	23 500	3 300	5 000	<b>PCJ485424</b>	0.201
<b>88.900(3½)</b>	98.425(3⅞)	25.40(1)	75 000	169 000	7 650	17 200	2 900	4 400	<b>PCJ566216</b>	0.149
	101.600(4)	25.40(1)	82 000	154 000	8 350	15 700	2 900	4 400	<b>PCJ566416</b>	0.187
	101.600(4)	38.10(1½)	121 000	253 000	12 300	25 800	2 900	4 400	<b>PCJ566424</b>	0.305
<b>101.600(4)</b>	114.300(4½)	25.40(1)	87 500	176 000	8 950	18 000	2 500	3 800	<b>PCJ647216</b>	0.212
	114.300(4½)	38.10(1½)	129 000	290 000	13 200	29 500	2 500	3 800	<b>PCJ647224</b>	0.345



## Needle Roller and Cage Assemblies for connecting rod bearings

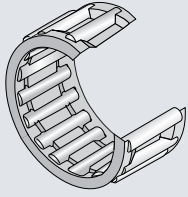
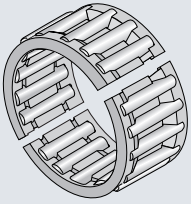
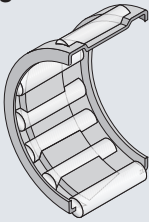
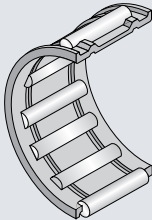
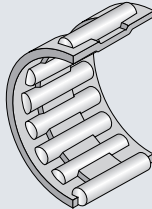


## Needle Roller and Cage Assemblies for connecting rod bearings

These needle roller and cage assemblies are specially designed so as to be adaptable to the operating environmental conditions for the connecting rods of small and medium reciprocal engines and compressors.

The connecting rods are used under a severe operating condition wherein acting load magnitude and

direction fluctuate rapidly as well as under an high temperature and strict lubrication environment. Therefore, special measures are mainly undertaken for the cage structure, material and machining method so that the needle roller and cage assemblies are resistible to the said operating condition and environment.

Type of needle roller and cage assembly	Location	Cage type	Applicable shaft diameter (mm)	Composition of bearing number
 <p><b>PK</b></p>	Large end side	Machined ring type	$\phi 10 - \phi 38$	<p><b>PK 20 × 26 × 13.8 X1</b></p> <ul style="list-style-type: none"> <li>— Type code</li> <li>— Roller set bore diameter</li> <li>— Roller set outer diameter</li> <li>— Width</li> <li>— Suffix</li> </ul>
 <p><b>GPK</b></p>		Machined type Split type	$\phi 10 - \phi 38$	<p><b>GPK 20 × 26 × 13.8 X</b></p> <ul style="list-style-type: none"> <li>— Type code</li> <li>— Roller set bore diameter</li> <li>— Roller set outer diameter</li> <li>— Width</li> <li>— Suffix</li> </ul>
 <p><b>KMJ·S</b></p>		Welded type	$\phi 10 - \phi 38$	<p><b>KMJ 10 × 14 × 8.8 S</b></p> <ul style="list-style-type: none"> <li>— Type code</li> <li>— Roller set bore diameter</li> <li>— Roller set outer diameter</li> <li>— Width</li> <li>— Suffix</li> </ul>
 <p><b>KBK</b></p>	Small end side	Machined ring type	$\phi 7 - \phi 25$	<p><b>KBK 14 × 18 × 17</b></p> <ul style="list-style-type: none"> <li>— Type code</li> <li>— Roller set bore diameter</li> <li>— Roller set outer diameter</li> <li>— Width</li> </ul>
 <p><b>KV·S</b></p>		Welded type	$\phi 7 - \phi 100$	<p><b>KV 8 × 11 × 8 S V4</b></p> <ul style="list-style-type: none"> <li>— Type code</li> <li>— Roller set bore diameter</li> <li>— Roller set outer diameter</li> <li>— Width</li> <li>— Suffix</li> <li>— Suffix</li> </ul>

Data for the GPK, KMJ·S, KV·S types are not included in the dimension table. For detailed information, contact NTN Engineering.

Bearing number	Code items and respective dimensions	Remarks
PK20×26×13.8×1	Roller set bore diameter : $\phi 20$ Roller set outer diameter : $\phi 26$ Width : 13.8 X1 : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
GPK20× 26 × 13.8X	Roller set bore diameter : $\phi 20$ Roller set outer diameter : $\phi 26$ Width :13.8 X : numbered entry	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.  Can be applied to a crank of integral structure.
KMJ10×14×8.8S	Roller set bore diameter : $\phi 10$ Roller set outer diameter : $\phi 14$ Width :8.8 S : welded type	Cage intended to guide outer ring, eventually surface- treated by non-ferrous plating, etc.
KBK14×18×17	Roller set bore diameter : $\phi 14$ Roller set outer diameter : $\phi 18$ Width : 17	Type KBK is intended to guide inner ring, which of the guide surface is designed as long as possible to thereby reduce the surface pressure. In addition, the roller length is so designed as to be maximum against the width of connecting rod, for high load capacity. On the other hand, Type V·S intended for outer ring guide needs a guide along the bore surface of connecting rod.
KV8×11×8SV4	Roller set bore diameter : $\phi 8$ Roller set outer diameter : $\phi 11$ Width : 8 S : welded type V4 : Special specification	

## Radial clearance

**Table 1** shows the recommended clearance values though the radial clearance differs depending on bearing clearance, load, revolutions and ambient temperature.

The proper radial clearance can be got by proper selection and combination of roller diameter, connecting rod hole diameter and pin diameter. **Table 2** shows the examples of selection and combination of those.

**Table 1 Recommended clearance values**

Unit :  $\mu\text{m}$

Pin diameter mm		Large end side	Small end side
Over	incl.		
6	10	9~23	5~17
10	18	10~24	5~17
18	30	10~24	5~17
30	40	18~33	—

**Table 2 Radial clearance values obtainable by selection and combination**

Case of needle roller and cage assembly Type PK for crank pin

Crank pin hole diameter 22mm H6 (0 to +13 $\mu\text{m}$ )

Crank pin diameter 14mm h5 (0 to -8 $\mu\text{m}$ )

Unit :  $\mu\text{m}$

Pin diameter sorting class	Hole diameter sorting class	0~+4	+4~+8	+8~+13
	Sorting class of needle roller used	-4~-6	-2~-4	0~-2
0~-3		10~17	10~17	10~18
-3~-6		13~20	13~20	13~21
-6~-8		16~22	16~22	16~23

## Connecting rod and pin specifications

Connecting rod (bore surface), crank pin and piston pin (outer surface) can be used as direct raceway surface. However, these surfaces must be resistible to great load while maintaining high accuracy. For that, connecting rods and pins acting as the direct raceway surface must comply with the specifications specified hereunder.

Any connecting rods shall be made of cement steel, e.g. chrome molybdenum steel (SCM415, etc.), nickel chrome molybdenum steel (SNCM420, etc.) and any crank pins and piston pins shall also be made of cement steel, e.g. chrome steel (SCr420, etc.), all of which shall be surface-hardened by carburizing.

The surface hardness of each shall range from HRC58 to 64 and adequate depth of effective carburizing-hardened layer shall be secured up to Hv550. The depth of effective carburizing-hardened layer differs depending on actual load and pin diameter.

Feel free to contact NTN for the more detailed information.

The respective profile accuracy of connecting rod hole, crank and piston pin outer surfaces shall be as specified in **Table 3**.

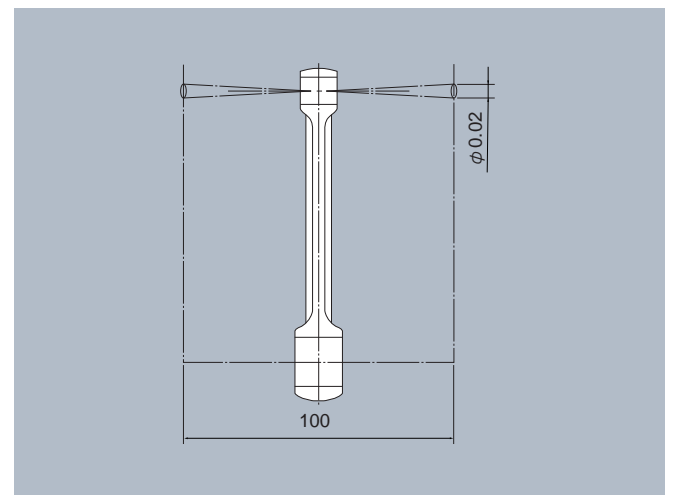
Furthermore, the parallelism of crank pin and piston pin shall be 0.02mm or less against 100mm. (**Fig. 1**)

The surface roughness shall be 0.2a for connecting rod and 0.1a for pin outer surface as a guideline.

**Table 3 Recommended accuracy of connecting rod and pin**

Unit :  $\mu\text{m}$

Parts	Characteristics	Pin diameter classification mm				
		~14	14~18	18~25	25~30	30~40
Connecting rod	Roundness (max)	3	4	4	5	5
	Cylindricity (max)	2	3	3	4	4
Pin	Roundness (max)	2	2	3	3	4
	Cylindricity (max)	1	1	2	2	3



**Fig. 1**

### Regulation to connecting rod

Two methods are available as follows to regulate axial motion of a connecting rod; one method is to make smaller a clearance between the rod and crank web at large end side (Method of regulating at large end side) and another method is to narrow a clearance between the rod and piston boss at the small end side (Method of regulating at small end side).

In general, the method of regulation at large end side is mostly adopted to get accurate motion of a connecting rod.

On the other hand, the method of regulation at small end side is adopted when regulation at large end side disables to secure good lubrication to the bearing and the guide surface at large end side due to short connecting rod and comparatively high revolutions.

#### Regulation at large end side

This method regulates axial motion of a connecting rod by forming a sliding surface between the large end of the connecting rod and the side face of crank web. For the use of this method, however, the connecting rod must be provided, on its bore surface, with oil hole, slot and oil groove to feed lubrication oil in and onto the bearing and guide surface at large end side.

The crank web end face shall be surface-hardened as necessary or otherwise a side washer of copper alloy or hardened steel shall be fitted on the guide surface.

On the other hand, the needle roller and cage assembly at small end side shall be guided in axial direction by the side face of piston boss. A great play shall be secured between the piston boss and the connecting rod.

#### Regulation at small end side

This method regulates axial motion at the small end face of a connecting rod and the side face of a piston rod. Generally a connecting rod is not provided with oil groove and slot to lubricate the guide surface at small end side, but on occasion it is surface-hardened and uses a side washer.

Usually a connecting rod shall be provided with a through-hole (at its small end side) to lubricate the bearing unit.

On the other hand, at the large end side a free clearance exists between the connecting rod and the crank web and, therefore, generally special measures such as oil groove to lubricate, etc.

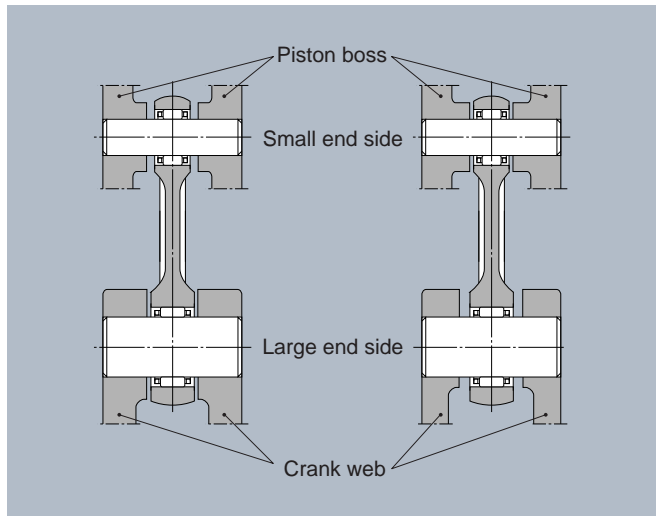
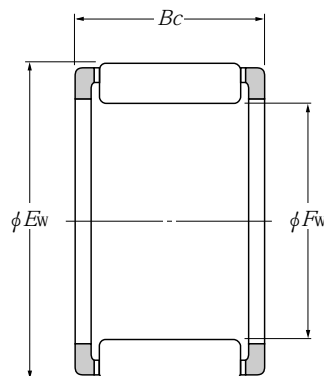


Fig. 2. Regulation at large end side Fig. 3 Regulation at small end side

## For crank-pin

## Type PK


 $F_w$  10~28mm

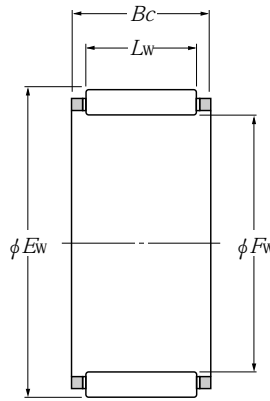
Boundary dimensions			Basic load ratings				Bearing numbers	Mass kg (approx.)
$F_w$	mm		dynamic	static	dynamic	static		
	$E_w$	$B_c$	N		kgf			
		$0$ $-0.2$	$C_r$	$C_{or}$	$C_r$	$C_{or}$		
<b>10</b>	14	9.8	5 050	4 900	515	500	<b>PK10×14×9.8X14</b>	0.0037
<b>12</b>	16	10	5 450	5 600	555	570	<b>PK12×16×10.2</b>	0.0044
	17	9.8	6 800	6 550	695	670	<b>PK12×17×9.8X15</b>	0.0053
<b>14</b>	19	9.7	7 300	7 400	745	755	<b>PK14×19×9.7X1</b>	0.0065
	19	11.8	8 200	8 600	840	880	<b>PK14×19×11.8X1</b>	0.0070
	20	11.8	19 100	10 000	1 030	1020	<b>PK14×20×11.8X3</b>	0.0091
<b>15</b>	20	9.8	7 250	7 450	740	760	<b>PK15×20×9.8X</b>	0.0067
	21	11.8	10 000	10 200	1 020	1 040	<b>PK15×21×11.8X8</b>	0.0095
<b>16</b>	22	11.8	10 000	10 300	1 020	1 050	<b>PK16×22×11.8X2</b>	0.0097
	22	13.2	10 900	11 500	1 110	1 170	<b>PK16×22×13.2X</b>	0.0110
<b>18</b>	24	11.8	11 300	12 400	1 150	1 260	<b>PK18×24×11.8X3</b>	0.0110
	24	13.3	13 300	15 300	1 360	1 560	<b>PK18×24×13.3X1</b>	0.0120
<b>19</b>	24	13.9	11 900	15 200	1 220	1 550	<b>PK19×24×13.9X</b>	0.0110
	25	15.8	14 300	17 000	1 460	1 730	<b>PK19×25×15.8X1</b>	0.0150
<b>20</b>	26	13.8	14 000	16 700	1 420	1 700	<b>PK20×26×13.8X6</b>	0.0140
<b>22</b>	28	15.8	15 900	20 200	1 620	2 060	<b>PK22×28×15.8X1</b>	0.0170
	29	17.8	18 800	22 800	1 920	2 320	<b>PK22×29×17.8X7</b>	0.0240
	30	14.7	16 900	18 200	1 720	1 860	<b>PK22×30×14.7X2</b>	0.0240
	30	17.8	21 900	25 400	2 230	2 590	<b>PK22×30×17.8X2</b>	0.0270
<b>24</b>	31	16.8	20 800	26 600	2 120	2 710	<b>PK24×31×16.8X7</b>	0.0240
	32	19.8	22 900	27 500	2 340	2 810	<b>PK24×32×19.8X6</b>	0.0330
<b>26</b>	31	13.8	14 200	20 900	1 450	2 130	<b>PK26×31×13.8X31</b>	0.0139
	32	13.8	16 400	22 200	1 670	2260	<b>PK26×32×13.8X</b>	0.0180
	34	16.8	21 600	26 100	2 200	2 660	<b>PK26×34×16.8X7</b>	0.0320
<b>27</b>	36	20.8	30 500	38 500	3 150	3 950	<b>PK27×36×20.8X1</b>	0.0440
<b>28</b>	35	14	18 400	23 700	1 880	2 420	<b>PK28×35×13.8X1</b>	0.0226
	36	14	20 600	25 100	2 100	2 560	<b>PK28×36×13.8X4</b>	0.0250

$F_w$  28~38mm

Boundary dimensions			Basic load ratings				Bearing numbers	Mass kg (approx.)
$F_w$	mm		dynamic	static	dynamic	static		
	$E_w$	$B_c$	N		kgf			
		$0$ $-0.2$	$C_r$	$C_{or}$	$C_r$	$C_{or}$		
<b>28</b>	36	15.8	23 700	30 000	2 410	3 050	<b>PK28×36×15.8X6</b>	0.0310
	37	20.8	32 500	41 500	3 300	4 250	<b>PK28×37×20.8X</b>	0.0480
<b>29</b>	39	21.4	32 500	39 500	3 300	4 000	<b>PK29×39×21.4X2</b>	0.0550
<b>30</b>	37	15.9	21 900	30 500	2 230	3 100	<b>PK30×37×15.9X</b>	0.0280
	38	13.8	21 400	26 900	2 180	2 750	<b>PK30×38×13.8X1</b>	0.0294
	38	15.8	24 600	32 000	2 510	3 300	<b>PK30×38×15.8X</b>	0.0320
	38	17.8	27 700	37 500	2 820	3 800	<b>PK30×38×17.8X1</b>	0.037
<b>31</b>	41	21.4	34 000	43 000	3 500	4 350	<b>PK31×41×21.4X</b>	0.057
<b>32</b>	43	22.4	40 000	49 500	4 100	5 050	<b>PK32×43×22.4X</b>	0.069
<b>34</b>	42	19.8	31 500	45 500	3 200	4 650	<b>PK34×42×19.8X</b>	0.046
<b>38</b>	47	19.8	35 500	51 000	3 600	5 200	<b>PK38×47×19.8X1</b>	0.056

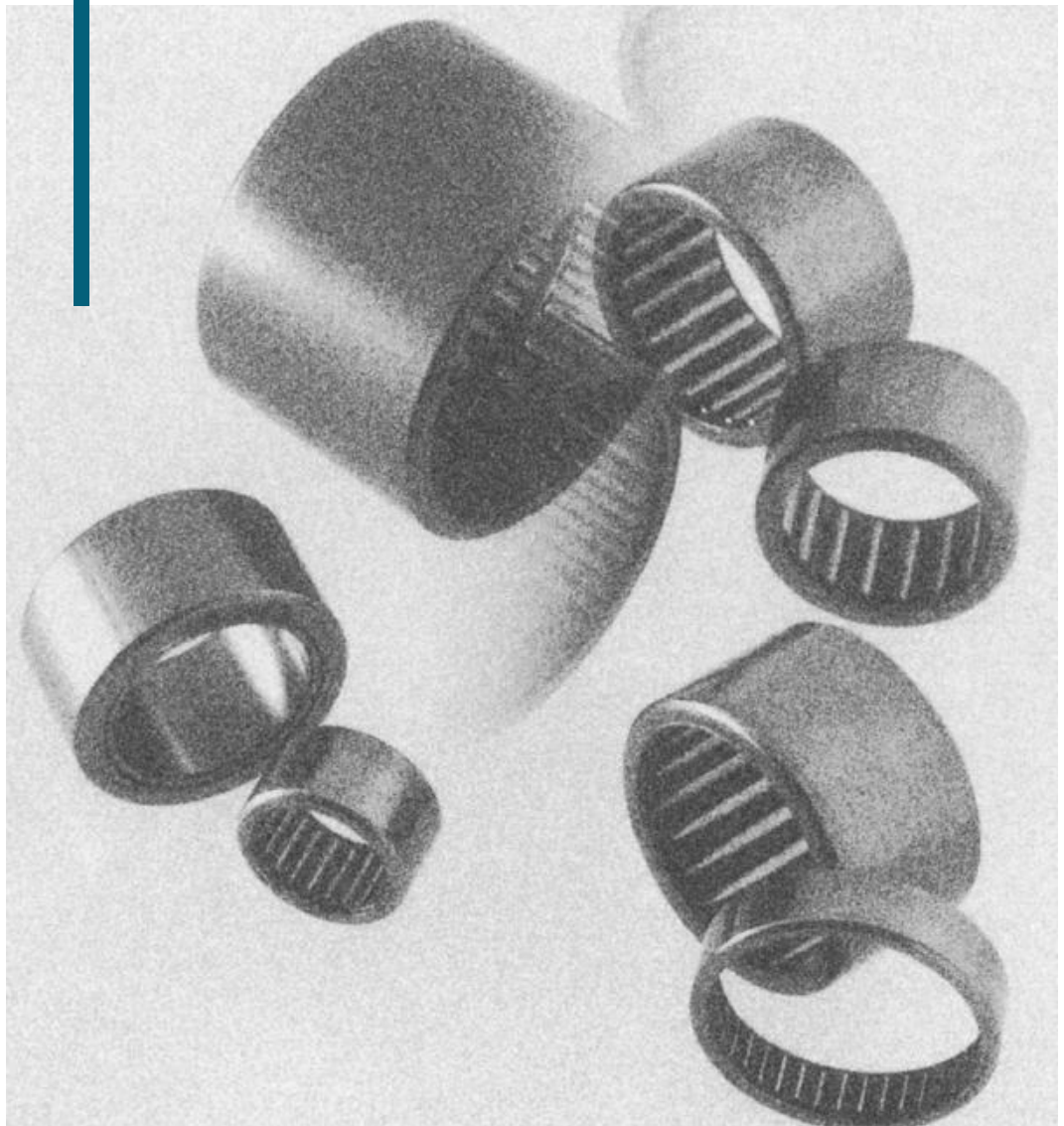
## For piston-pin

## Type KBK


 $F_w$  7~22mm

Boundary dimensions				Basic load ratings				Bearing numbers	Mass kg (approx.)
$F_w$	$E_w$	$B_c$ mm 0 -0.2	$L_w$	dynamic N	static	dynamic kgf	static		
				$C_r$	$C_{or}$	$C_r$	$C_{or}$		
7	10	9.8	6.8	3 050	2 780	310	284	<b>KBK 7×10× 9.8X</b>	0.0022
8	11	11.8	8.8	4 100	4 200	415	430	<b>KBK 8×11× 11.8X1</b>	0.0028
9	12	11.5	8.8	4 400	4 750	450	485	<b>KBK9×12× 11.7V2</b>	0.0030
	14	9.8	6.8	4 500	4 200	460	430	<b>KBK10×14× 9.8X</b>	0.0042
10	14	12.5	9.8	6 100	6 200	620	635	<b>KBK10×14× 12.5X1</b>	0.0053
	14	14.8	9.8	6 100	6 200	620	635	<b>KBK10×14× 14.8X</b>	0.0064
11	14	13.5	10.8	5 850	7 250	595	740	<b>KBK11×14× 13.5X1</b>	0.0044
	15	12.3	9.8	7 050	7 700	720	785	<b>KBK11×15× 12.3X5</b>	0.0049
	15	15.8	11.8	7 050	7 650	720	780	<b>KBK11×15× 15.8X2</b>	0.0069
12	15	16.4	13.8	7 500	10200	765	1040	<b>KBK12×15× 16.6V1</b>	0.0056
	16	14.8	11.8	7 600	8 600	775	875	<b>KBK12×16× 14.8X1</b>	0.0062
	16	15.4	9.8	7 000	7 800	715	795	<b>KBK12×16× 15.6</b>	0.0079
	16	15.8	12.8	8 100	9 350	825	955	<b>KBK12×16× 16</b>	0.0073
	17	14.8	9.8	8 400	8 550	855	875	<b>KBK12×17× 14.8X</b>	0.0094
14	18	16.8	13.8	9 750	12 400	995	1 260	<b>KBK14×18× 17</b>	0.0089
	18	19.8	13.8	9 150	11 300	930	1 160	<b>KBK14×18× 20</b>	0.0130
	19	17.1	12.8	11 100	12 700	1 130	1 300	<b>KBK14×19× 17.1X</b>	0.0120
15	19	17.3	13.8	10 900	14 600	1 110	1 490	<b>KBK15×19× 17.3X</b>	0.0100
16	20	16.8	13.8	10 800	14 700	1 100	1 500	<b>KBK16×20× 17</b>	0.0100
	20	19.6	13.8	10 200	13 600	1 040	1 390	<b>KBK16×20× 19.8</b>	0.0130
	20	23.8	19.8	13 600	19 700	1 390	2 010	<b>KBK16×20× 23.8X</b>	0.0150
	21	19.6	15.8	13 900	17 600	1 420	1 790	<b>KBK16×21× 19.6X</b>	0.0160
17	21	23	15.8	13 200	19 400	1 340	1 980	<b>KBK17×21× 23.2</b>	0.0160
	21	25	17.8	13 100	19 200	1 340	1 960	<b>KBK17×21× 25X</b>	0.0170
	22	22	18.8	16 900	22 900	1 720	2 340	<b>KBK17×22× 22X1</b>	0.0170
18	22	21.8	15.8	12 500	18 300	1 270	1 870	<b>KBK18×22× 21.8X3</b>	0.0150
	22	23.8	17.8	13 000	19 300	1 330	1 970	<b>KBK18×22× 23.8X1</b>	0.0160
20	25	27.9	21.8	20 800	31 500	2 120	3 200	<b>KBK20×25× 27.9X</b>	0.0270
22	28	29.9	23.8	26 000	38 000	2 650	3 900	<b>KBK22×28× 29.9X4</b>	0.038

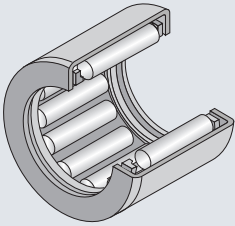
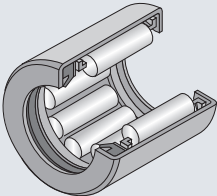
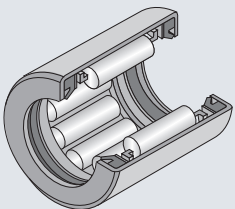
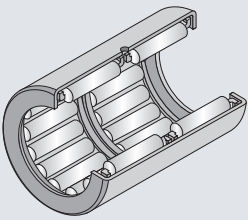
## Drawn Cup Needle Roller Bearings



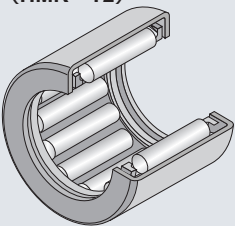
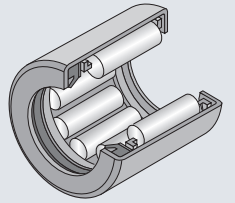
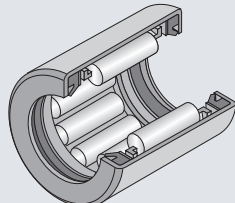
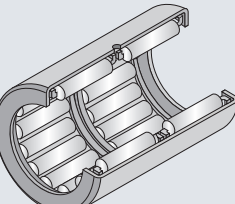
## Drawn Cup Needle Roller Bearings

This bearing type is composed of an outer ring drawn from a thin steel plate by precision drawing, needle rollers and a cage assembled in the outer ring after the raceway surface thereof was hardened (A bearing marked with a suffix including "M" is subjected to heat-treatment after assembly.). Of the bearings with outer ring, this bearing type is a bearing with the smallest section height which enables space-saving and cost-saving.

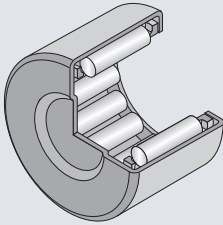
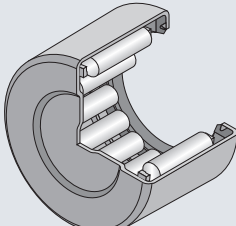
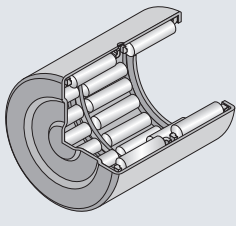
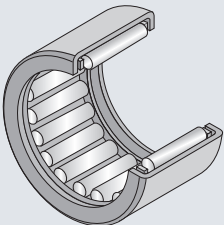
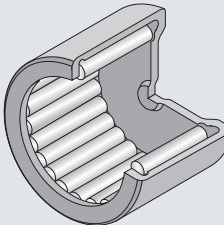
Usually design is so made as to use a shaft as the direct raceway surface without using inner ring. The outer ring of this bearing type is of such a construction that the needle rollers and the cage are not separated from one another, so that the bearing is only press-fitted in a rigid housing with proper fit torque. Thus, this bearing type needs no snap ring, etc. to fix itself in axial direction and, in addition, is easy to handle.

Type of bearing	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks			
<b>HK (HK·T2)</b> 	Open end $\phi 3 - \phi 50$	<b>HK 06 09 T2</b> Suffix Width Roller set bore diameter Type code  [Suffix] T2 : Resin cage C : Welding cage	HK0609T2	Roller set bore diameter : $\phi 6$ Width : 9 T2 : Resin cage	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less. A bearing marked with a suffix including "F" is a Premium Shell bearing. For detailed information about Premium Shell bearings, refer to NTN CAT. NO. 3029 (Premium Shell Bearings). A bearing marked with a suffix including "M" is a drawn cup bearing that is heat-treated after assembly ("pre-bent" specification).			
<b>HK·L</b> 	Standard series Open end single side seal $\phi 12 - \phi 50$	<b>HK 20 18 L / 3AS</b> Suffix Suffix Width Roller set bore diameter Type code	HK2018L/3AS	Roller set bore diameter : $\phi 20$ Width : 18 L : single side seal 3AS : grease	This seal type (Tail code : L or LL) synthetic rubber seal built in at its single side or double sides is internally filled with lithium soap base grease.  To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100°C.			
<b>HK·LL</b> 		<b>HK 20 20 LL / 3AS</b> Suffix Suffix Width Roller set bore diameter Type code				HK2020LL/3AS	Roller set bore diameter : $\phi 20$ Width : 20 LL: Double-side seal 3AS : grease	The roller length and rated load of this bearing type are shorter and smaller than those of the open type of same dimension.
<b>HK·ZWD</b> 		<b>HK 20 30 ZW D</b> Suffix Suffix Width Roller set bore diameter Type code						

The lower limit of safety factor  $S_0$  for NTN drawn cup needle roller bearings shall be 3. The lower limit for NTN Premium Shell bearings shall be 2.

Type of bearing	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks	
 <p><b>HMK</b> (HMK·T2)</p>	Open end	$\phi 8 - \phi 50$	<p><b>HMK 20 15</b></p> <p>Type code Roller set bore diameter Width</p>	HMK2015	Roller set bore diameter : $\phi 20$ Width : 15	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.
 <p><b>HMK·L</b></p>	Open end single side seal	$\phi 8 - \phi 50$	<p><b>HMK 20 18 L / 3AS</b></p> <p>Type code Roller set bore diameter Width Suffix Suffix</p>	HMK2018L/3AS	Roller set bore diameter : $\phi 20$ Width : 18 L : single side seal 3AS : Grease	This seal type (Tail code : L or LL) synthetic rubber seal built in at its single side or double sides is internally filled with lithium soap base grease.  To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C.
 <p><b>HMK·LL</b></p>	Open end double-side seal	$\phi 8 - \phi 50$	<p><b>HMK 20 20 LL / 3AS</b></p> <p>Type code Roller set bore diameter Width Suffix Suffix</p>	HMK2020LL/3AS	Roller set bore diameter : $\phi 20$ Width : 20 LL: Double-side seal 3AS : Grease	For continuous machine operation, limit the maximum permissible operating temperature to 100°C.  The roller length and rated load of this bearing type are shorter and smaller than those of the open type of same dimension.
 <p><b>HMK·ZWD</b></p>	Open end double-row type	$\phi 38 - \phi 50$	<p><b>HMK 38 45 ZW D</b></p> <p>Type code Roller set bore diameter Width Suffix Suffix</p>	HK3845ZWD	Roller set bore diameter : $\phi 38$ Width : 45 ZW : Double-row cage D : Outer ring with oil hole	This type is provided with oil hole on its outer ring.

Heavy load series

Type of bearing		Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Code items and dimensions	Remarks	
<b>BK</b> <b>(BK·T2)</b> 	Standard series	Closed end	$\phi 3 - \phi 50$ <b>BK 20 20 C</b> Type code Roller set bore diameter Width Suffix	BK2020C	Roller set bore diameter : $\phi 20$ Width : 20 C : Welding cage	The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.	
<b>BK·L</b> 		Closed end single side seal	$\phi 12 - \phi 50$ <b>BK 20 18 L / 3AS</b> Type code Roller set bore diameter Width Suffix Suffix	BK2018L/3AS	Roller set bore diameter : $\phi 20$ Width : 18 L : single side seal 3AS : greas code	This seal type (Tail code: L) is internally filled up with lithium soap base grease. To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100°C.	
<b>BK·ZWD</b> 		Closed end double-row type	$\phi 15 - \phi 30$ <b>BK 20 30 ZW D</b> Type code Roller set bore diameter Width Suffix Suffix	BK2030ZWD	Roller set bore diameter : $\phi 20$ Width : 30 ZW : Double-row cage D : Outer ring with oil hole	Inscribed circle diameter	
<b>DCL</b> 		Inch series	Open end	$\phi 6.35 - \phi 50.8$ <b>DCL 16 20</b> Type code Roller set bore diameter code Width code	DCL1620	Roller set bore diameter : $\phi 25.4$ Width : 31.75	
<b>HCK</b> 			Bearing series for universal joints	Closed end	$\phi 10 - \phi 20$ <b>HCK 16 22 Vn</b> Type code Roller set bore diameter Outer diameter Suffix	HCK1622Vn	Roller set bore diameter : $\phi 16$ Width : $\phi 22$ Vn : Special specification

## Bearing Fits

It is common that drawn cup needle bearing is press-fitted in a housing by shrinkage fit so post press-fit inscribed circle diameter ( $F_w$ ) comes to ISO Tolerance Rang Class F8. The post press-fit inscribed circle diameter ( $F_w$ ) depends on the housing material and rigidity. It is therefore desirable to decide the interference based on the data measured in pre-testing.

Where the housing rigidity is adequately high, the post press-fit inscribed circle diameter ( $F_w$ ) is secured in nearly F8 range and nearly ordinary radial clearance can be got by adopting the data of bearing fit in housing and on shaft as shown in **Table-1**.

**Table 1 Bearing fit in housing and on shaft (recommended)**

Bearing type	Housing		Shaft	
	Iron series	Light alloy	Without inner ring	With inner ring
HK,BK	N6 (N7)	R6 (R7)	h5 (h6)	k5 (j6)
HMK,DCL	J6 (J7)	M6 (M7)	h5 (h6)	k5 (j6)
HCK	F7	—	k6	—

## Accuracy of housing and shaft

Since the outer ring of drawn cup needle roller bearing is thin-walled, the bearing performance is significantly affected by the dimensional accuracy, profile accuracy and bore surface roughness of the housing into which the bearing is press-fitted. Therefore, the housing bore should satisfy the accuracy levels summarized in **Table 2**. For accuracy of a shaft that uses an inner ring, refer to **Table 8.3** in Sec. 8.3 “Accuracy of shaft and housing” (page A-40); for accuracy of a shaft that is directly used as a raceway surface, refer to **Table 8.4** in Sec. 8.4 “Accuracy of raceway surface” (page A-40).

**Table 2 Accuracy of housing bore (recommended)**

Property	Tolerance
Roundness (Max)	IT4 or less
Cylindricity (Max)	IT4 or less
Surface roughness (Max)	1.6a

## Oil hole dimension in outer ring

The outer rings of double-row (Tail code : ZW) needle roller and cage assembly Type HK and Type BK are provided with an oil hole to facilitate oil lubrication to the bearing. **Table 3** shows the nominal oil hole diameter.

**Table 3 Diameter of oil hole in outer ring (Metric system)** Unit : mm

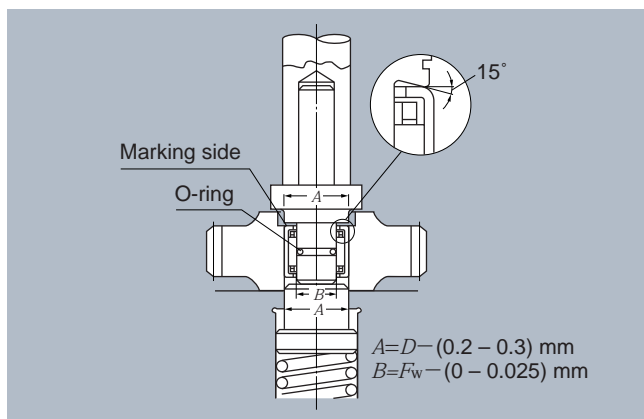
Outer ring diameter over	incl.	Nominal oil hole diameter
5	10	1.5
10	20	2.0
20	40	2.5
40	80	3.0
80	200	3.5

## Bearing installation

When installing a drawn cup needle roller bearing to a housing, place the jig on the marking side of the bearing, and then press-fit the bearing into the correct location in the housing bore. (A “pre-bent” bearing marked with a suffix including “M” has no directivity for installation.)

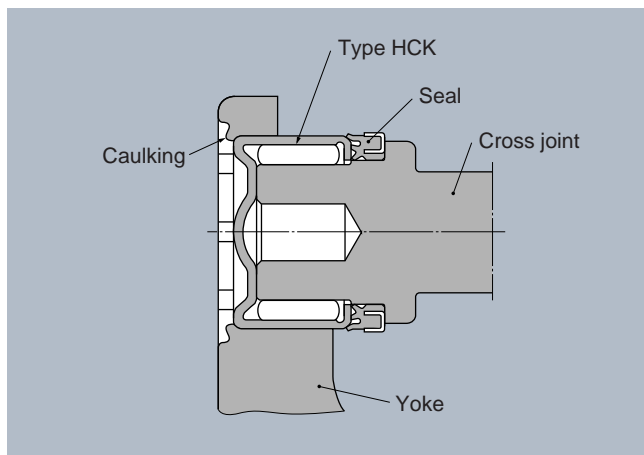
**Further, hammering directly the bearing ring in installing (press-fitting) is not allowed absolutely.** In installing, it is recommended to use a mandrel with O-ring as illustrated in **Fig.1** as a press-fitting jig. The use of this mandrel would enable to insert easily any drawn cup needle bearing in a housing without risk of twisting and fall-down.

Drawn cup needle roller bearing needs no a snap ring and a shoulder for positioning itself in a housing, **but the bearing must be press-fitted so carefully as not to allow its side face to strike the shoulder for preventing it from deforming, where press-fitted in a housing with shoulder.**



**Fig. 1**

The Type HCK for application to universal joints is fixed to the joint yoke by caulking, using a special-purposed assembler. Feel free to contact NTN for any inquiry about the special-purposed assembler (IPH Machine).



**Fig. 2**

## Bearing Tolerances and Measuring Methods

The outer ring of drawn cup needle roller bearing is so thin-walled that deformation thereof to a certain extent is unavoidable in the manufacturing processes, particularly in the heat-treating process. However, the outer ring is so designed that it is reformed normally from such deformation when being press-fitted in a housing with specific dimensional accuracy and, as a result, it can have the accuracy required to fulfill its specific function.

**Table 4 Dimensional tolerance for inscribed circle diameter (Type HK and BK)** Unit : mm

Nominal inscribed circle dia. $F_w$	Nominal outer ring outer dia. $D$	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.010
5	9	8.984	5.022	5.010
6	10	9.984	6.022	6.010
7	11	10.980	7.028	7.013
8	12	11.980	8.028	8.013
9	13	12.980	9.028	9.013
10	14	13.980	10.028	10.013
12	16	15.980	12.034	12.016
12	18	17.980	12.034	12.016
13	19	18.976	13.034	13.016
14	20	19.976	14.034	14.016
15	21	20.976	15.034	15.016
16	22	21.976	16.034	16.016
17	23	22.976	17.034	17.016
18	24	23.976	18.034	18.016
20	26	25.976	20.041	20.020
22	28	27.976	22.041	22.020
25	32	31.972	25.041	25.020
28	35	34.972	28.041	28.020
30	37	36.972	30.041	30.020
35	42	41.972	35.050	35.025
40	47	46.972	40.050	40.025
45	52	51.967	45.050	45.025
50	58	57.967	50.050	50.025

**Table 5 Dimensional tolerance for inscribed circle diameter (Type HMK)** Unit : mm

Nominal inscribed circle dia. $F_w$	Nominal outer ring outer dia. $D$	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	16.034	16.016
17	24	23.995	17.034	17.016
18	25	24.995	18.034	18.016
19	27	26.995	19.041	19.020
20	27	26.995	20.041	20.020
21	29	28.995	21.041	21.020
22	29	28.995	22.041	22.020
24	31	30.994	24.041	24.020
25	33	32.994	25.041	25.020
26	34	33.994	26.041	26.020
28	37	36.994	28.041	28.020
29	38	37.994	29.041	29.020
30	40	39.994	30.041	30.020
32	42	41.994	32.050	32.025
35	45	44.994	35.050	35.025
37	47	46.994	37.050	37.025
38	48	47.994	38.050	38.025
40	50	49.994	40.050	40.025
45	55	54.994	45.050	45.025
50	62	61.994	50.050	50.025

Hence, it is meaningless to measure the dimensional accuracy of bearing itself before being press-fitted. So, the following measuring method is used; a bearing to be measured is press-fitted in a linkage of specific dimension (20mm or more in wall thickness) and thereafter the inscribed circle diameter ( $F_w$ ) is measured using a plug gauge or a taper gauge to evaluate the bearing accuracy.

Tables 4 to 7 show the dimensional tolerances for the bore diameter of each ring gauge and the roller set bore diameter ( $F_w$ ) each of standard metric series drawn cup needle roller bearings Type HK and BK, heavy load series Type HMK (metric series), inch series Type DCL, and inch series HCK for application to universal joints.

When measuring the roller set bore diameter ( $F_w$ ) of a drawn cup needle roller bearing, the GO side dimension shall be the lower limit of dimensional tolerance of the roller set bore diameter; and the NOT GO side dimension shall be a sum of the upper limit of dimensional tolerance of the roller set bore diameter and  $2\mu\text{m}$ .

**When measuring the roller set bore diameter of a drawn cup needle roller bearing, do not repeat insertion/removal with the ring gage. Also, do not install a bearing, which has been press-fitted into the ring gage for inspection, to an actual machine product.**

**Table 6 Dimensional tolerance for inscribed circle diameter (Type DCL)** Unit : mm

Nominal inscribed circle dia. $F_w$	Nominal outer ring outer dia. $D$	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
6.350	11.112	11.125	6.411	6.388
7.938	12.700	12.713	7.998	7.976
9.525	14.288	14.300	9.586	9.563
11.112	15.875	15.888	11.173	11.151
12.700	17.462	17.475	12.761	12.738
14.288	19.050	19.063	14.348	14.326
15.875	20.638	20.650	15.936	15.913
17.462	22.225	22.238	17.523	17.501
19.050	25.400	25.387	19.086	19.063
20.638	26.988	26.975	20.673	20.650
22.225	28.575	28.562	22.261	22.238
23.812	30.162	30.150	23.848	23.825
25.400	31.750	31.737	25.436	25.413
26.988	33.338	33.325	27.023	27.000
28.575	34.925	34.912	28.611	28.588
30.162	38.100	38.087	30.198	30.175
31.750	38.100	38.087	31.786	31.763
34.925	41.275	41.262	34.963	34.938
38.100	47.625	47.612	38.141	38.113
41.275	50.800	50.787	41.316	41.288
44.450	53.975	53.962	44.493	44.463
47.625	57.150	57.137	47.668	47.638
50.800	60.325	60.312	50.846	50.815

**Table 7 Dimensional tolerance for inscribed circle diameter (Type HCK)** Unit : mm

Nominal inscribed circle dia. $F_w$	Nominal outer ring outer dia. $D$	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
10	15	15.016	10.026	10.011
11.656	17.1	17.116	11.687	11.669
13	19	19.020	13.031	13.013
14	20	20.020	14.031	14.013
16	22	22.020	16.031	16.013
18	24	24.020	18.031	18.013
18	24.6	24.620	18.031	18.013
20	27.9	27.920	20.038	20.017

## Calculation Examples

### Shrinkage factor and post-installation clearance of drawn cup needle roller bearing

The recommended fit data for the standard bearings is as described in **Table 1** on page B-35. This paragraph describes hereunder the calculation methods to be used when the bearing fit conditions are reviewed in detail.

#### 1) Calculation of bearing shrinkage factor

For the drawn cup bearings, the shrinkage factor is calculated using the following method.

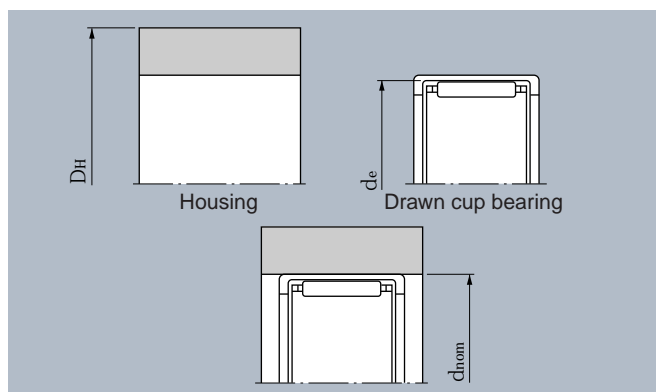


Fig. 3

$$\lambda = \frac{2t}{E_2} \cdot \frac{1 - S^2}{\frac{(0.7S^2 + 1.3)(1 - \lambda^2)}{E_1} + \frac{(0.7 + 1.3\lambda^2)(1 - S^2)}{E_2}} \dots (1)$$

Where,

- $\lambda$  : Outer ring shrinkage factor
- $D_H$  : Housing outer diameter mm
- $d_{nom}$  : Nominal diameter of fitting portion mm
- $d_e$  : Rolling surface diameter of outer ring mm
- $E_1$  : Modulus of housing vertical elasticity (Young's modulus) MPa (kgf/mm<sup>2</sup>)
- $E_2$  : Modulus of outer ring vertical elasticity (Young's modulus) 2.07 × 10<sup>6</sup>MPa (21 200kgf/mm<sup>2</sup>)

$$S = \frac{d_{nom}}{D_H}$$

$$t = \frac{d_e}{d_{nom}}$$

#### 2) Inscribed circle diameter after complete bearing fit in the housing on actual machine

[1] Inscribed circle diameter in press-fitting of master ring

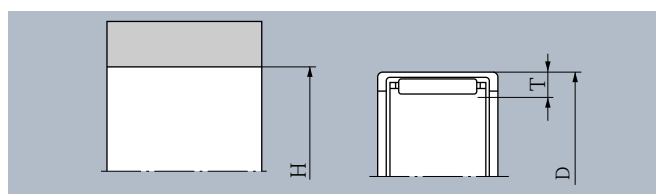


Fig. 4

- $H$  : Housing inner diameter mm
- $T$  : Roller diameter + plate thickness mm
- $D$  : Outer diameter of drawn cup needle roller bearing mm
- $L_i$  : Post press-fit inscribed circle diameter mm

When the master ring is press-fitted, the dimension of "roller diameter + plate thickness" remains unchanged. Hence, the inscribed circle diameter  $L_i$  is determined by the following **formula**.

$$L_i = D - 2T - \lambda(D - H) = (1 - \lambda)D - 2T + \lambda H \dots (2)$$

Determine the mean value of "roller diameter + plate thickness" (=  $T$ ) and standard deviation from **formula (2)**. The mean value of **formula (2)** is determined as follows.

$$m_{L_i} = (1 - \lambda) m_D - m_{2T} + \lambda m_H \dots (3)$$

Standard deviation of **formula (2)**

$$\sigma_{L_i} = (1 - \lambda) \sigma_D + \sigma_{2T} + \lambda \sigma_H \dots (4)$$

In the case of master ring, due to  $\sigma_{H_2} = 0$  the **formula (4)** is expressed as follows.

$$\sigma_{L_i} = (1 - \lambda) \sigma_D + \sigma_{2T} \dots (5)$$

The unknown values in **formulas (3), (5)** are only  $m_{2T}$  and  $\sigma_{2T}$ . Hence, substitute the known numerical values for **formulas (3), (5)** to determine  $m_{2T}$  and  $\sigma_{2T}$ .

[2] Even when bearing ring is press-fitted in the housing on actual machine, consider the inscribed circle diameter similarly to the master ring press-fit. Herein, the calculation formulas for press-fit in the housing on actual machine can be discriminated as follows from **formula (3), (4)** by adding " ' " to each formula.

$$m_{L_i'} = (1 - \lambda') m_D - m_{2T} + \lambda' m_H \dots (6)$$

$$\sigma_{L_i'} = (1 - \lambda') \sigma_D + \sigma_{2T} + \lambda' \sigma_H \dots (7)$$

[3] For  $m_{2T}$  and  $\sigma_{2T}$  in **formula (6), (7)**, substitute the values determined previously for the respective formula.

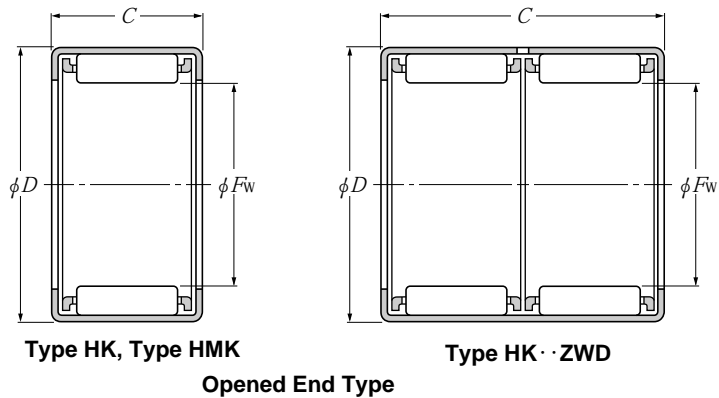
[4] From the calculations, the inscribed circle diameter in press-fitting in the housing on actual machine can be expressed in the following **formula**

$$L_i' = m_{L_i'} \pm 3 \sigma_{L_i'} \dots (8)$$

[5] Radial internal clearance can be determined considering the mean value and standard deviation of shaft in **formulas (6), (7)**.

[6] The aiming radial internal clearance value is generally set up so an ordinary clearance can be got. However, the recommended clearance values are available every the individual portions in the case of bearing application to automobile. Feel free to contact NTN for the detail.

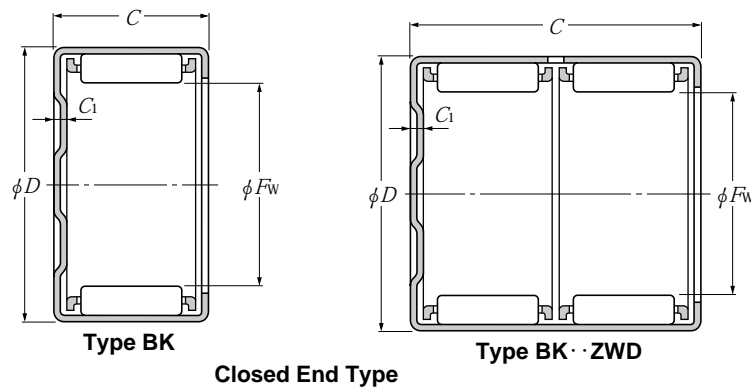
Type HK, Type HK · · ZWD  
 Type HMK  
 Type BK, Type BK · · ZWD



$F_w$  3~10mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate <sup>1)</sup> inner ring
$F_w$	mm			dynamic	static	dynamic	static	grease	oil	open end design	closed end design	kg (approx.)	(as a reference)
	$D$	$C$ 0 -0.2	$C_1$ max	N	N	kgf	kgf						
3	6.5	6	—	925	565	94	58	33 000	50 000	HK0306FT2	—	0.0006	—
	6.5	6	0.8	925	565	94	58	33 000	50 000	—	BK0306T2	0.0007	—
4	8	8	—	1 770	1 270	180	129	30 000	45 000	HK0408FT2	—	0.0016	—
	8	8	1.6	1 770	1 270	180	129	30 000	45 000	—	BK0408T2	0.0018	—
5	9	9	—	2 450	1 990	349	203	27 000	40 000	HK0509FM	—	0.0019	—
	9	9	1.6	2 640	2 190	269	224	27 000	40 000	—	BK0509T2	0.0021	—
6	10	9	—	2 920	2 590	298	264	25 000	37 000	HK0609FM	—	0.0022	—
	10	9	1.6	2 660	2 280	272	233	25 000	37 000	—	BK0609T2	0.0024	—
7	11	9	—	3 150	2 930	320	299	23 000	34 000	HK0709FM	—	0.0025	—
	11	9	1.6	3 150	2 930	320	299	23 000	34 000	—	BK0709CT	0.0027	—
8	12	10	—	3 850	3 950	395	400	20 000	30 000	HK0810FM	—	0.0032	IR 5× 8×12
	12	10	1.6	3 850	3 950	395	400	20 000	30 000	—	BK0810CT	0.0034	IR 5× 8×12
	15	10	—	4 200	3 300	430	335	20 000	30 000	HMK0810C	—	0.0067	IR 5× 8×12
	15	15	—	6 600	5 800	675	590	20 000	30 000	HMK0815	—	0.0100	IR 5× 8×16
	15	20	—	9 050	8 750	925	890	20 000	30 000	HMK0820T2	—	0.0130	—
9	13	10	—	4 300	4 650	440	475	18 000	27 000	HK0910FM	—	0.0035	IR 6× 9×12
	13	10	1.6	4 750	5 300	485	540	18 000	27 000	—	BK0910	0.0039	IR 6× 9×12
	13	12	—	5 400	6 250	550	640	18 000	27 000	HK0912F	—	0.0042	IR 6× 9×12
	13	12	1.6	5 650	6 650	575	680	18 000	27 000	—	BK0912	0.0045	IR 6× 9×12
	16	12	—	5 300	4 450	540	455	18 000	27 000	HMK0912	—	0.0087	IR 6× 9×16
	16	16	—	7 400	6 850	755	700	18 000	27 000	HMK0916	—	0.0120	—
10	14	10	—	4 500	5 100	460	520	16 000	24 000	HK1010FM	—	0.0038	IR 7×10×10.5
	14	10	1.6	4 500	5 100	460	520	16 000	24 000	—	BK1010	0.0042	IR 7×10×10.5
	14	12	—	5 650	6 800	575	695	16 000	24 000	HK1012F	—	0.0045	IR 7×10×16
	14	12	1.6	5 900	7 250	605	735	16 000	24 000	—	BK1012	0.0050	IR 7×10×16
	14	15	—	7 250	9 400	740	955	16 000	24 000	HK1015F	—	0.0056	IR 7×10×16
	14	15	1.6	7 100	9 150	725	935	16 000	24 000	—	BK1015	0.0062	IR 7×10×16
	17	10	—	4 250	3 450	435	350	16 000	24 000	HMK1010	—	0.0079	IR 7×10×10.5
	17	12	—	5 600	4 850	570	495	16 000	24 000	HMK1012	—	0.0094	IR 7×10×16

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129.)  
 EX. HK1012 + IR7×10×16

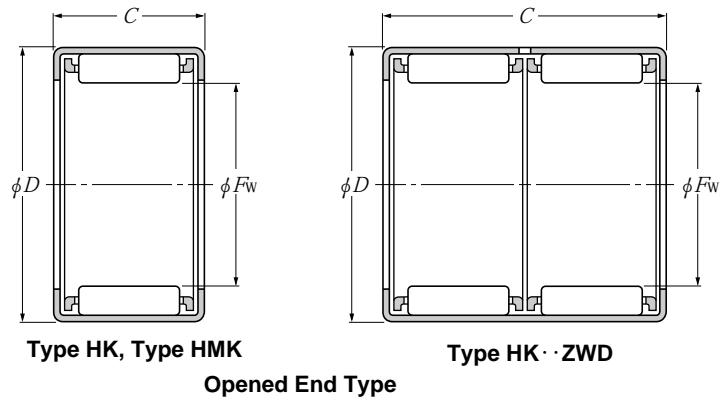


$F_w$  10~16mm

Boundary dimensions	Basic load ratings				Limiting speeds		Bearing numbers		Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)			
	mm				min <sup>-1</sup>		open end design	closed end design					
	$F_w$	$D$	$C$ 0 -0.2	$G_1$ max	dynamic N	static kgf					grease	oil	
				$C_r$	$C_{or}$	$C_r$	$C_{or}$						
<b>10</b>	17	15	—	7 400	6 950	755	710	16 000	24 000	<b>HMK1015</b>	—	0.0120	IR 7×10×16
	17	20	—	10 200	10 500	1 040	1 070	16 000	24 000	<b>HMK1020</b>	—	0.0160	—
<b>12</b>	16	10	—	5 050	6 250	515	635	13 000	20 000	<b>HK1210FM</b>	—	0.0046	IR 8×12×10.5
	16	10	1.6	5 050	6 250	515	635	13 000	20 000	—	<b>BK1210</b>	0.0052	IR 8×12×10.5
	18	12	—	6 600	7 300	675	745	13 000	20 000	<b>HK1212FM</b>	—	0.0091	IR 8×12×12.5
	18	12	2.7	6 600	7 300	675	745	13 000	20 000	—	<b>BK1212</b>	0.0100	IR 8×12×12.5
	19	12	—	7 100	6 900	725	705	13 000	20 000	<b>HMK1212</b>	—	0.0110	IR 8×12×12.5
	19	15	—	9 400	9 900	955	1 010	13 000	20 000	<b>HMK1215</b>	—	0.0140	IR 9×12×16
	19	20	—	12 300	14 000	1 260	1 430	13 000	20 000	<b>HMK1220</b>	—	0.0180	—
<b>13</b>	19	12	—	6 950	7 900	705	805	12 000	18 000	<b>HK1312FM</b>	—	0.0100	IR10×13×12.5
	19	12	2.7	6 950	7 900	705	805	12 000	18 000	—	<b>BK1312</b>	0.0110	IR10×13×12.5
<b>14</b>	20	12	—	7 200	8 500	735	865	11 000	17 000	<b>HK1412FM</b>	—	0.0110	IR10×14×13
	20	12	2.7	7 200	8 500	735	865	11 000	17 000	—	<b>BK1412</b>	0.0120	IR10×14×13
	20	16	—	10 300	13 400	1 050	1 370	11 000	17 000	<b>HK1416F</b>	—	0.0150	—
	20	16	2.7	10 700	14 000	1 090	1 430	11 000	17 000	—	<b>BK1416</b>	0.0160	—
	22	16	—	11 500	12 000	1 180	1 220	11 000	17 000	<b>HMK1416C</b>	—	0.0190	IR10×14×20
<b>15</b>	22	20	—	14 600	16 200	1 490	1 650	11 000	17 000	<b>HMK1420C</b>	—	0.0240	—
	21	12	—	7 500	9 100	765	930	11 000	16 000	<b>HK1512FM</b>	—	0.0110	IR12×15×12.5
	21	12	2.7	7 500	9 100	765	930	11 000	16 000	—	<b>BK1512</b>	0.0130	IR12×15×12.5
	21	16	—	10 700	14 400	1 090	1 470	11 000	16 000	<b>HK1516F</b>	—	0.0150	IR12×15×16.5
	21	16	2.7	10 700	14 400	1 090	1 470	11 000	16 000	—	<b>BK1516</b>	0.0170	IR12×15×16.5
	21	22	—	12 900	18 200	1 310	1 860	11 000	16 000	<b>HK1522ZWFD</b>	—	0.0200	IR12×15×22.5
	21	22	2.7	12 900	18 200	1 310	1 860	11 000	16 000	—	<b>BK1522ZWD</b>	0.0220	IR12×15×22.5
	22	10	—	6 100	6 000	620	610	11 000	16 000	<b>HMK1510</b>	—	0.0110	IR10×15×12.5
	22	12	—	7 950	8 450	810	860	11 000	16 000	<b>HMK1512</b>	—	0.0130	IR12×15×12.5
	22	15	—	10 500	12 100	1 070	1 240	11 000	16 000	<b>HMK1515C</b>	—	0.0160	IR12×15×16
	22	20	—	14 900	18 900	1 510	1 920	11 000	16 000	<b>HMK1520</b>	—	0.0220	IR12×15×22.5
22	25	—	18 500	25 000	1 880	2 550	11 000	16 000	<b>HMK1525</b>	—	0.0270	—	
<b>16</b>	22	12	—	7 750	9 700	795	990	10 000	15 000	<b>HK1612FM</b>	—	0.0120	IR12×16×13

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129, B130.)  
EX. HK1312FM + IR10×13×12.5

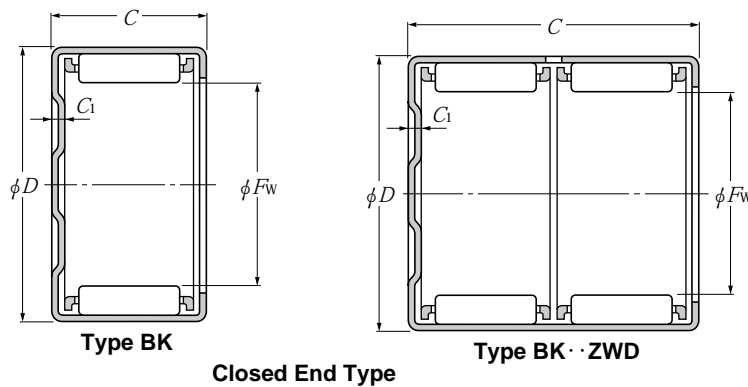
Type HK, Type HK · · ZWD  
 Type HMK  
 Type BK, Type BK · · ZWD



$F_w$  16~20mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate <sup>1)</sup> inner ring
$F_w$	mm			dynamic	static	dynamic	static	grease	oil	open end design	closed end design	kg (approx.)	(as a reference)
	$D$	$C$ 0 -0.2	$C_1$ max	N	N	kgf	kgf						
16	22	12	2.7	7 750	9 700	795	990	10 000	15 000	—	BK1612	0.014	IR12×16×13
	22	16	—	11 100	15 300	1 130	1 560	10 000	15 000	HK1616F	—	0.016	IR12×16×20
	22	16	2.7	11 100	15 300	1 130	1 560	10 000	15 000	—	BK1616	0.018	IR12×16×20
	22	22	—	13 300	19 400	1 360	1 980	10 000	15 000	HK1622ZWFD	—	0.022	—
	22	22	2.7	13 300	19 400	1 360	1 980	10 000	15 000	—	BK1622ZWD	0.023	—
	24	16	—	12 400	13 500	1 260	1 370	10 000	15 000	HMK1616	—	0.021	IR12×16×20
	24	20	—	15 600	18 200	1 590	1 860	10 000	15 000	HMK1620CT	—	0.027	IR12×16×22
17	23	12	—	8 050	10 300	820	1 050	9 500	14 000	HK1712FM	—	0.012	—
	23	12	2.7	8 500	11 100	865	1 130	9 500	14 000	—	BK1712	0.015	—
	24	15	—	12 100	15 000	1 230	1 530	9 500	14 000	HMK1715	—	0.018	IR14×17×17
	24	20	—	15 200	20 000	1 540	2 040	9 500	14 000	HMK1720CT	—	0.024	IR12×17×20.5
	24	25	—	19 3000	26 700	1 930	2 720	9 500	14 000	7E-HMK1725CT	—	0.030	IR12×17×25.5
18	24	12	—	8 300	10 900	845	1 110	8 500	13 000	HK1812FM	—	0.013	IR15×18×12.5
	24	12	2.7	8 300	10 900	845	1 110	8 500	13 000	—	BK1812	0.015	IR15×18×12.5
	24	16	—	11 800	17 300	1 210	1 760	8 500	13 000	HK1816F	—	0.018	IR15×18×16.5
	24	16	2.7	11 800	17 300	1 210	1 760	8 500	13 000	—	BK1816	0.020	IR15×18×16.5
	25	13	—	10 200	12 200	1 040	1 240	8 500	13 000	HMK1813	—	0.016	IR15×18×16
	25	15	—	12 000	15 100	1 220	1 540	8 500	13 000	HMK1815	—	0.019	IR15×18×16
	25	17	—	13 300	17 200	1 360	1 760	8 500	13 000	HMK1817C	—	0.021	IR15×18×17.5
	25	19	—	15 500	20 900	1 580	2 130	8 500	13 000	HMK1819	—	0.024	IR15×18×20.5
	25	20	—	16 300	22 300	1 660	2 280	8 500	13 000	HMK1820	—	0.025	IR15×18×20.5
25	25	—	20 300	29 600	2 070	3 000	8 500	13 000	HMK1825	—	0.031	IR15×18×25.5	
19	27	16	—	13 900	16 300	1 410	1 660	8 500	13 000	HMK1916	—	0.025	IR15×19×20
	27	20	—	17 500	22 100	1 790	2 250	8 500	13 000	HMK1920	—	0.031	—
20	26	12	—	8 750	12 100	895	1 240	8 000	12 000	HK2012FM	—	0.014	IR15×20×13
	26	12	2.7	9 250	13 000	945	1 330	8 000	12 000	—	BK2012	0.017	IR15×20×13
	26	16	—	12 500	19 200	1 280	1 960	8 000	12 000	HK2016F	—	0.019	IR17×20×16.5
	26	16	2.7	13 000	20 100	1 320	2 050	8 000	12 000	—	BK2016	0.022	IR17×20×16.5
	26	20	—	16 000	26 200	1 630	2 670	8 000	12 000	HK2020F	—	0.024	IR17×20×20.5
	26	20	2.7	16 400	27 100	1 670	2 760	8 000	12 000	—	BK2020	0.027	IR17×20×20.5

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-130, B131.)  
 EX. HK1812FM + IR15×18×12.5

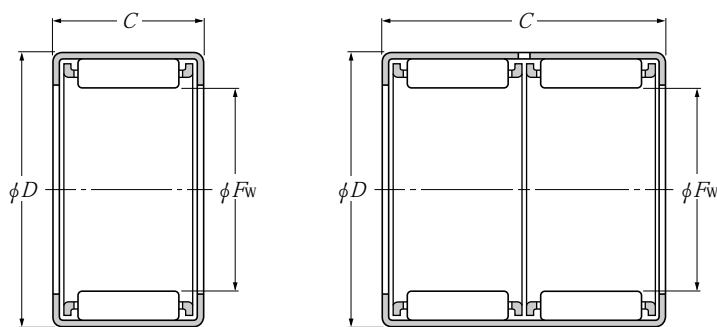


$F_w$  20~25mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate <sup>1)</sup> inner ring
$F_w$	mm			N		kgf		grease	oil	open end design	closed end design	kg (approx.)	(as a reference)
	$D$	$C$ 0 -0.2	$G_1$ max	$C_r$	$C_{or}$	$C_r$	$C_{or}$						
20	26	30	—	21 500	38 500	2 190	3 900	8 000	12 000	HK2030ZWFD	—	0.035	IR17×20×30.5
	26	30	2.7	22 200	40 000	2 270	4 100	8 000	12 000	—	BK2030ZWD	0.037	IR17×20×30.5
	27	15	—	13 000	17 300	1 330	1 760	8 000	12 000	HMK2015	—	0.021	IR17×20×16.5
	27	20	—	17 700	25 600	1 800	2 610	8 000	12 000	HMK2020	—	0.027	IR17×20×20.5
	27	25	—	22 000	34 000	2 240	3 450	8 000	12 000	HMK2025	—	0.034	IR15×20×26
	27	30	—	26 100	42 000	2 660	4 300	8 000	12 000	HMK2030	—	0.041	IR17×20×30.5
21	29	16	—	15 300	19 100	1 560	1 940	7 500	11 000	HMK2116	—	0.027	IR17×21×20
	29	20	—	19 400	25 800	1 970	2 630	7 500	11 000	HMK2120	—	0.033	—
22	28	12	—	9 200	13 400	940	1 360	7 500	11 000	HK2212FM	—	0.013	IR17×22×13
	28	12	2.7	9 750	14 300	995	1 460	7 500	11 000	—	BK2212	0.015	IR17×22×13
	28	16	—	13 200	21 100	1 340	2 150	7 500	11 000	HK2216F	—	0.021	IR17×22×18
	28	16	2.7	13 600	22 100	1 390	2 250	7 500	11 000	—	BK2216	0.024	IR17×22×18
	28	20	—	16 800	28 800	1 710	2 940	7 500	11 000	HK2220F	—	0.026	IR17×22×20.5
	28	20	2.7	17 200	29 800	1 760	3 050	7 500	11 000	—	BK2220	0.030	IR17×22×20.5
	29	10	—	8 400	10 100	855	1 030	7 500	11 000	HMK2210	—	0.015	IR17×22×13
	29	15	—	13 400	18 500	1 370	1 890	7 500	11 000	HMK2215	—	0.022	IR17×22×16D
	29	20	—	18 200	27 400	1 860	2 790	7 500	11 000	HMK2220	—	0.030	IR17×22×20.5
	29	25	—	23 600	38 500	2 410	3 900	7 500	11 000	HMK2225	—	0.037	IR17×22×26
29	30	—	26 900	45 000	2 740	4 600	7 500	11 000	HMK2230	—	0.045	IR17×22×32	
24	31	20	—	18 300	28 200	1 860	2 880	6 500	10 000	HMK2420CT	—	0.032	—
	31	28	—	26 000	44 500	2 650	4 500	6 500	10 000	HMK2428	—	0.045	IR20×24×28.5
25	32	12	—	11 100	15 200	1 140	1 550	6 500	9 500	HK2512F	—	0.021	IR20×25×12.5
	32	12	2.7	11 800	16 300	1 200	1 660	6 500	9 500	—	BK2512	0.023	IR20×25×12.5
	32	16	—	15 900	24 000	1 620	2 450	6 500	9 500	HK2516F	—	0.027	IR20×25×17
	32	16	2.7	15 900	24 000	1 620	2 450	6 500	9 500	—	BK2516	0.031	IR20×25×17
	32	20	—	20 300	33 000	2 070	3 350	6 500	9 500	HK2520	—	0.034	IR20×25×20.5
	32	20	2.7	20 300	33 000	2 070	3 350	6 500	9 500	—	BK2520	0.039	IR20×25×20.5
	32	26	—	26 400	46 000	2 690	4 700	6 500	9 500	HK2526	—	0.045	IR20×25×26.5
	32	26	2.7	26 400	46 000	2 690	4 700	6 500	9 500	—	BK2526	0.049	IR20×25×26.5
	32	38	—	35 000	65 500	3 550	6 700	6 500	9 500	HK2538ZWD	—	0.065	IR20×25×38.5

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131, B132.)  
EX. HK2512F + IR20×25×12.5

Type HK, Type HK · · ZWD  
 Type HMK, Type HMK · · ZWD  
 Type BK, Type BK · · ZWD



Type HK, Type HMK

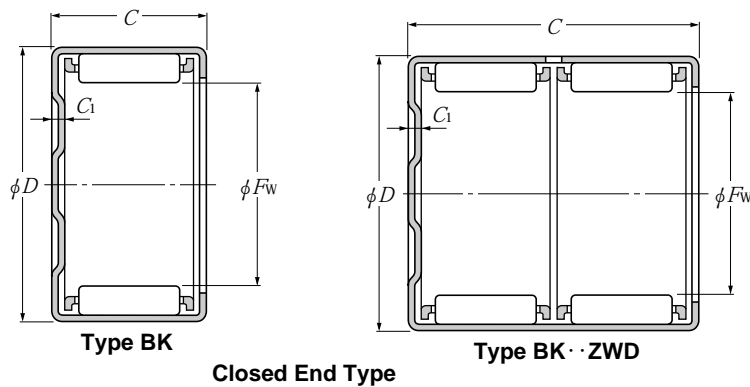
Type HK · · ZWD  
 Type HMK · · ZWD

Opened End Type

$F_w$  25~30mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers		Mass	Appropriate <sup>1)</sup> inner ring
$F_w$	mm			dynamic	static	dynamic	static	grease	oil	open end design	closed end design	kg (approx.)	(as a reference)
	$D$	$C$ 0 -0.2	$C_1$ max	N	N	kgf	kgf						
				$C_r$	$C_{or}$	$C_r$	$C_{or}$						
25	32	38	2.7	35 000	65 500	3 550	6 700	6 500	9 500	—	BK2538ZWD	0.069	IR20×25×38.5
	33	10	—	9 150	10 400	935	1 060	6 500	9 500	HMK2510	—	0.019	IR20×25×12.5
	33	15	—	15 200	19 900	1 550	2 030	6 500	9 500	HMK2515CT	—	0.029	IR20×25×16
	33	20	—	21 800	31 500	2 220	3 200	6 500	9 500	HMK2520	—	0.039	IR20×25×20.5
	33	25	—	26 700	41 000	2 720	4 200	6 500	9 500	HMK2525	—	0.048	IR20×25×26.5
	33	30	—	32 500	53 000	3 300	5 400	6 500	9 500	HMK2530	—	0.058	IR20×25×32
26	34	16	—	17 100	23 400	1 740	2 390	6 000	9 000	HMK2616	—	0.032	IR22×26×20
	34	20	—	21 100	30 500	2 150	3 150	6 000	9 000	7E-HMK2620CT	—	0.040	—
28	35	16	—	16 700	26 400	1 700	2 690	5 500	8 500	HK2816C	—	0.030	IR22×28×17
	35	16	2.7	17 300	27 600	1 760	2 820	5 500	8 500	—	BK2816	0.034	IR22×28×17
	35	20	—	21 300	36 000	2 170	3 700	5 500	8 500	HK2820	—	0.038	IR22×28×20.5
	35	20	2.7	21 300	36 000	2 170	3 700	5 500	8 500	—	BK2820	0.043	IR22×28×20.5
	37	20	—	23 600	32 500	2 410	3 350	5 500	8 500	HMK2820	—	0.049	IR22×28×20.5
	37	30	—	35 000	54 500	3 600	5 550	5 500	8 500	HMK2830	—	0.073	—
29	38	20	—	24 600	35 000	2 510	3 550	5 500	8 500	HMK2920	—	0.050	—
	38	30	—	34 500	54 000	3 550	5 550	5 500	8 500	HMK2930	—	0.075	—
30	37	12	—	13 000	19 500	1 320	1 990	5 500	8 000	HK3012	—	0.024	IR25×30×12.5
	37	12	2.7	13 000	19 500	1 320	1 990	5 500	8 000	—	BK3012	0.028	IR25×30×12.5
	37	16	—	18 100	30 000	1 850	3 050	5 500	8 000	HK3016	—	0.032	IR25×30×17
	37	16	2.7	18 100	30 000	1 850	3 050	5 500	8 000	—	BK3016	0.037	IR25×30×17
	37	20	—	22 300	39 500	2 280	4 000	5 500	8 000	HK3020F	—	0.040	IR25×30×20.5
	37	20	2.7	22 300	39 500	2 280	4 000	5 500	8 000	—	BK3020	0.047	IR25×30×20.5
	37	26	—	28 500	54 000	2 910	5 500	5 500	8 000	HK3026F	—	0.053	IR25×30×26.5
	37	26	2.7	28 500	54 000	2 910	5 500	5 500	8 000	—	BK3026	0.059	IR25×30×26.5
	37	38	—	38 500	78 500	3 900	8 000	5 500	8 000	HK3038ZWD	—	0.076	IR25×30×38.5
	37	38	2.7	38 500	78 500	3 900	8 000	5 500	8 000	—	BK3038ZWD	0.083	IR25×30×38.5
	40	13	—	14 100	17 100	1 430	1 750	5 500	8 000	HMK3013	—	0.040	IR25×30×16
	40	15	—	17 100	22 100	1 750	2 250	5 500	8 000	HMK3015	—	0.044	IR25×30×16
40	20	—	24 200	34 500	2 470	3 500	5 500	8 000	HMK3020	—	0.058	IR25×30×20.5	
40	25	—	31 000	47 000	3 150	4 800	5 500	8 000	HMK3025	—	0.073	IR25×30×26.5	

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131, B-132.)  
 EX. HK2820 + IR22×28×20.5

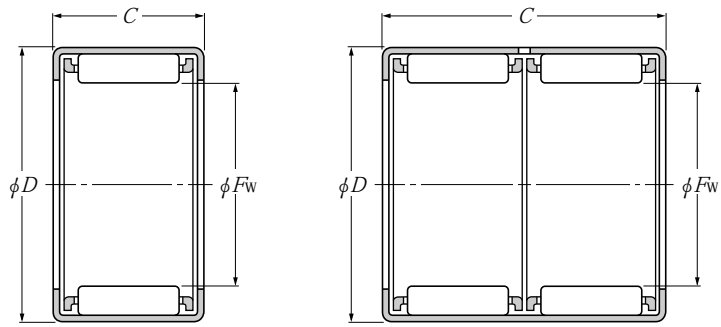


$F_w$  30~40mm

Boundary dimensions	Basic load ratings				Limiting speeds		Bearing numbers		Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)			
	mm				min <sup>-1</sup>		open end design	closed end design					
	$F_w$	$D$	$C$ 0 -0.2	$G_1$ max	dynamic N	static kgf					grease	oil	
				$C_r$	$C_{or}$	$C_r$	$C_{or}$						
<b>30</b>	40	30	—	36 000	57 500	3 700	5 850	5 500	8 000	<b>HMK3030</b>	—	0.087	IR25×30×32
<b>32</b>	42	20	—	27 500	38 000	2 800	3 850	5 000	7 500	<b>HMK3220</b>	—	0.062	—
	42	30	—	41 500	64 500	4 250	6 550	5 000	7 500	<b>HMK3230</b>	—	0.092	—
<b>35</b>	42	12	—	14 000	22 800	1 430	2 320	4 700	7 000	<b>HK3512</b>	—	0.028	—
	42	12	2.7	14 000	22 800	1 430	2 320	4 700	7 000	—	<b>BK3512</b>	0.033	—
	42	16	—	19 000	33 500	1 940	3 400	4 700	7 000	<b>HK3516C</b>	—	0.037	—
	42	16	2.7	19 700	35 000	2 000	3 600	4 700	7 000	—	<b>BK3516</b>	0.044	—
	42	20	—	24 800	47 500	2 530	4 850	4 700	7 000	<b>HK3520</b>	—	0.046	—
	42	20	2.7	24 800	47 500	2 530	4 850	4 700	7 000	—	<b>BK3520</b>	0.055	—
	45	12	—	14 900	17 600	1 520	1 800	4 700	7 000	<b>HMK3512</b>	—	0.040	—
	45	15	—	20 200	26 200	2 060	2 670	4 700	7 000	<b>HMK3515</b>	—	0.050	—
	45	20	—	28 400	40 500	2 890	4 100	4 700	7 000	<b>HMK3520</b>	—	0.067	—
	45	25	—	36 000	54 500	3 650	5 550	4 700	7 000	<b>HMK3525</b>	—	0.083	—
<b>37</b>	47	20	—	29 300	43 000	2 990	4 350	4 300	6 500	<b>HMK3720</b>	—	0.070	—
	47	30	—	44 500	73 000	4 550	7 450	4 300	6 500	<b>HMK3730</b>	—	0.105	—
<b>38</b>	48	15	—	21 700	29 300	2 210	2 990	4 300	6 500	<b>HMK3815</b>	—	0.054	—
	48	20	—	30 500	45 000	3 100	4 600	4 300	6 500	<b>HMK3820</b>	—	0.072	—
	48	25	—	38 500	61 000	3 900	6 250	4 300	6 500	<b>HMK3825</b>	—	0.090	—
	48	30	—	46 000	77 000	4 700	7 850	4 300	6 500	<b>HMK3830</b>	—	0.107	IR32×38×32
	48	45	—	62 000	113 000	6 300	11 500	4 300	6 500	<b>HMK3845ZWD</b>	—	0.161	—
<b>40</b>	47	12	—	15 100	26 000	1 540	2 660	4 000	6 000	<b>HK4012</b>	—	0.031	IR35×40×12.5
	47	12	2.7	15 100	26 000	1 540	2 660	4 000	6 000	—	<b>BK4012</b>	0.038	IR35×40×12.5
	47	16	—	20 300	38 500	2 070	3 900	4 000	6 000	<b>HK4016C</b>	—	0.041	IR35×40×17
	47	16	2.7	21 100	40 000	2 150	4 100	4 000	6 000	—	<b>BK4016</b>	0.051	IR35×40×17
	47	20	—	25 900	52 500	2 650	5 350	4 000	6 000	<b>HK4020</b>	—	0.052	IR35×40×20.5
	47	20	2.7	25 900	52 500	2 650	5 350	4 000	6 000	—	<b>BK4020</b>	0.064	IR35×40×20.5
	50	15	—	23 100	32 500	2 350	3 300	4 000	6 000	<b>HMK4015</b>	—	0.056	IR35×40×17
	50	20	—	32 500	50 000	3 300	5 100	4 000	6 000	<b>HMK4020</b>	—	0.075	IR35×40×20.5
	50	25	—	41 000	67 500	4 150	6 900	4 000	6 000	<b>HMK4025</b>	—	0.094	—

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-132 to B134.)  
EX. HK4012 + IR35×40×12.5

Type HK  
 Type HMK, Type HMK · ZWD  
 Type BK



Type HK, Type HMK

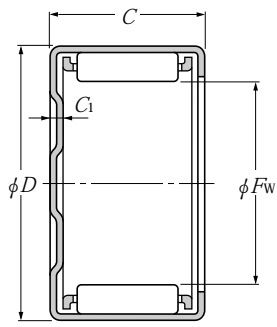
Type HMK · ZWD

Opened End Type

$F_w$  40~50mm

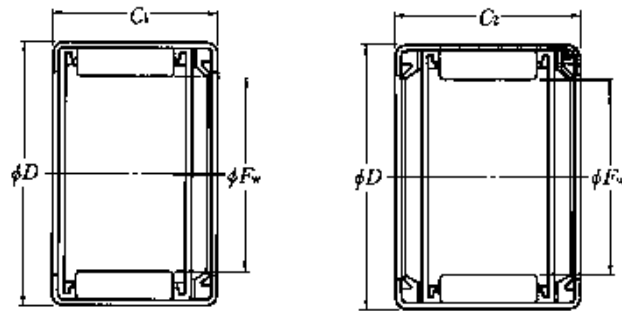
Boundary dimensions	Basic load ratings				Limiting speeds		Bearing numbers		Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)			
	mm				min <sup>-1</sup>		open end design	closed end design					
	$F_w$	$D$	$C$ 0 -0.2	$C_1$ max	dynamic N	static kgf					grease	oil	
				$C_r$	$C_{or}$	$C_r$	$C_{or}$						
<b>40</b>	50	30	—	49 000	85 000	5 000	8 700	4 000	6 000	<b>HMK4030</b>	—	0.112	IR35×40×34
	50	40	—	58 500	107 000	5 950	10 900	4 000	6 000	<b>HMK4040ZWD</b>	—	0.150	—
<b>45</b>	52	16	—	21 600	43 000	2 210	4 400	3 700	5 500	<b>HK4516</b>	—	0.046	IR40×45×17
	52	16	2.7	21 600	43 000	2 210	4 400	3 700	5 500	—	<b>BK4516</b>	0.058	IR40×45×17
	52	20	—	27 600	59 000	2 810	6 000	3 700	5 500	<b>HK4520</b>	—	0.058	IR40×45×20.5
	52	20	2.7	27 600	59 000	2 810	6 000	3 700	5 500	—	<b>BK4520</b>	0.072	IR40×45×20.5
	55	20	—	32 000	51 000	3 250	5 200	3 700	5 500	<b>HMK4520CT</b>	—	0.083	IR40×45×20.5
	55	25	—	41 500	71 500	4 250	7 300	3 700	5 500	<b>HMK4525</b>	—	0.104	IR40×45×26.5
	55	30	—	49 500	90 000	5 050	9 150	3 700	5 500	<b>HMK4530</b>	—	0.125	IR40×45×34
	55	40	—	59 500	113 000	6 050	11 500	3 700	5 500	<b>HMK4540ZWD</b>	—	0.167	—
<b>50</b>	58	20	—	31 500	63 000	3 200	6 450	3 200	4 800	<b>HK5020</b>	—	0.072	IR40×50×22
	58	20	2.7	31 500	63 000	3 200	6 450	3 200	4 800	—	<b>BK5020</b>	0.087	IR40×50×22
	58	25	—	38 500	82 000	3 900	8 400	3 200	4 800	<b>HK5025</b>	—	0.090	IR45×50×25.5
	58	25	2.7	38 500	82 000	3 900	8 400	3 200	4 800	—	<b>BK5025</b>	0.109	IR45×50×25.5
	62	12	—	18 200	23 600	1 860	2 410	3 200	4 800	<b>HMK5012</b>	—	0.067	—
	62	15	—	25 900	37 000	2 650	3 800	3 200	4 800	<b>HMK5015</b>	—	0.084	—
	62	20	—	37 500	60 000	3 850	6 100	3 200	4 800	<b>HMK5020</b>	—	0.112	IR40×50×22
	62	25	—	48 000	82 500	4 900	8 450	3 200	4 800	<b>HMK5025</b>	—	0.140	IR45×50×25.5
	62	30	—	58 500	105 000	5 950	10 700	3 200	4 800	<b>HMK5030B</b>	—	0.168	IR45×50×32
	62	40	—	70 000	134 000	7 150	13 600	3 200	4 800	<b>HMK5040ZWD</b>	—	0.224	—
	62	45	—	79 000	156 000	8 050	15 900	3 200	4 800	<b>HMK5045ZWB</b>	—	0.252	—

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-134, B135.)  
 EX. HK4516 + IR40×45×17



**Type BK**  
**Closed End Type**

- Type HK···L
- Type HMK···L
- Type HK···LL
- Type HMK···LL
- Type BK···L

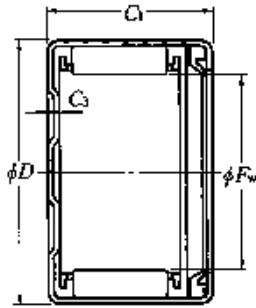


**Type HK···L, Type HMK···L** (Opened end and single-side seal type)      **Type HK···LL, Type HMK···LL** (Opened end and double-side seal type)

$F_w$  8~25mm

Boundary dimensions					Basic load ratings				Limiting speeds min <sup>-1</sup> grease	Bearing numbers		
$F_w$	$D$	$C_1$ 0 -0.2	$C_2$ 0 -0.2	$C_3$ max	dynamic N	static	dynamic kgf	static		open end single seal	open end double seal	closed end single seal
8	15	12	14	—	3 800	2 870	390	293	10 000	HMK0812L/3AS	HMK0814LL/3AS	—
10	17	12	14	—	4 250	3 450	435	350	10 000	HMK1012L/3AS	HMK1014LL/3AS	—
12	18	14	16	2.7	6 600	7 300	675	745	10 000	HK 1214L/3AS	HK 1216LL/3AS	BK1214L/3AS
	19	14	16	—	7 100	6 900	725	705	10 000	HMK1214L/3AS	HMK1216LL/3AS	—
14	20	14	16	2.7	7 200	8 500	735	865	10 000	HK 1414L/3AS	HK 1416LL/3AS	BK1414L/3AS
	22	19	22	—	11 500	12 000	1 180	1 220	10 000	HMK1419L/3AS	HMK1422LL/3AS	—
15	21	14	16	2.7	7 500	9 100	765	930	10 000	HK 1514L/3AS	HK 1516LL/3AS	BK1514L/3AS
	22	13	16	—	6 100	6 000	620	610	10 000	HMK1513L/3AS	HMK1516LL/3AS	—
	22	18	21	—	10 900	12 700	1 120	1 300	10 000	HMK1518L/3AS	HMK1521LL/3AS	—
16	22	14	16	2.7	7 750	9 700	795	990	10 000	HK 1614L/3AS	HK 1616LL/3AS	BK1614L/3AS
	24	23	26	—	15 600	18 200	1 590	1 860	10 000	HMK1623CLT/3AS	HMK1626CLLT/3AS	—
17	24	18	21	—	12 100	15 000	1 230	1 530	9 500	HMK1718L/3AS	HMK1721LL/3AS	—
18	24	14	16	2.7	8 300	10 900	845	1 110	9 000	HK 1814L/3AS	HK 1816LL/3AS	BK1814L/3AS
	25	18	21	—	12 000	15 100	1 220	1 540	9 000	HMK1818L/3AS	HMK1821LL/3AS	—
	25	20	23	—	13 800	18 000	1 400	1 830	9 000	HMK1820L/3AS	HMK1823LL/3AS	—
19	27	19	22	—	13 900	16 300	1 410	1 660	8 500	HMK1919L/3AS	HMK1922LL/3AS	—
20	26	—	16	—	9 250	13 000	945	1 330	8 000	—	HK 2016LL/3AS	—
	26	18	20	2.7	13 000	20 100	1 320	2 050	8 000	HK 2018L/3AS	HK 2020LL/3AS	BK2018L/3AS
	27	18	21	—	13 000	17 300	1 330	1 760	8 000	HMK2018L/3AS	HMK2021LL/3AS	—
	27	23	26	—	17 700	25 600	1 800	2 610	8 000	HMK2023L/3AS	HMK2026LL/3AS	—
22	28	—	16	—	9 750	14 300	995	1 460	7 500	—	HK 2216LL/3AS	—
	28	18	20	2.7	13 600	22 100	1 390	2 250	7 500	HK 2218L/3AS	HK 2220LL/3AS	BK2218L/3AS
	29	18	21	—	13 400	18 500	1 370	1 890	7 500	HMK2218L/3AS	HMK2221LL/3AS	—
	29	23	26	—	18 200	27 400	1 860	2 790	7 500	HMK2223L/3AS	HMK2226LL/3AS	—
24	31	23	26	—	18 300	28 200	1 860	2 880	6 500	HMK2423CLT/3AS	HMK2426CLLT/3AS	—
25	32	—	16	—	11 800	16 300	1 200	1 660	6 500	—	HK 2516LL/3AS	—
	32	18	20	2.7	15 900	24 000	1 620	2 450	6 500	HK 2518L/3AS	HK 2520LL/3AS	BK2518L/3AS

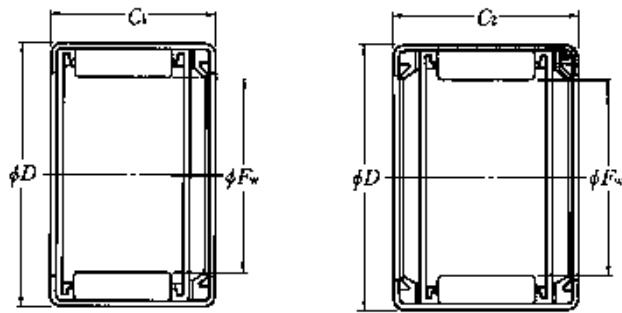
Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-129 to B131.)  
EX. HK1416LL/3AS + IR10×14×20



**Type BK·L**  
(Closed end and single-side seal type)

Mass kg (approx.)			Appropriate <sup>1)</sup> inner ring (as a reference)	
open end single seal	open end double seal	closed end single seal	single seal	double seal
0.0071	0.0075	—	IR 5×8×16	IR 5× 8×16
0.0084	0.0089	—	IR 7×10×16	IR 7×10×16
0.011	0.0120	0.012	IR 9×12×16	—
0.011	0.0120	—	IR 9×12×16	—
0.012	0.0140	0.014	IR10×14×16	IR10×14×20
0.020	0.0210	—	IR10×14×20	—
0.013	0.0140	0.014	IR12×15×16.5	IR12×15×16.5
0.014	0.0150	—	IR12×15×16	IR12×15×16.5
0.017	0.0180	—	IR12×15×22.5	IR12×15×22.5
0.013	0.0150	0.015	IR12×16×16	IR12×16×20
0.028	0.0290	—	—	—
0.019	0.0200	—	IR12×17×20.5	IR12×17×25.5
0.015	0.0170	0.017	IR15×18×16	IR15×18×17.5
0.020	0.0210	—	IR15×18×20.5	IR15×18×25.5
0.023	0.0240	—	IR15×18×20.5	IR15×18×25.5
0.027	0.0290	—	IR15×19×20	—
—	0.0190	—	—	IR15×20×18
0.021	0.0240	0.024	IR17×20×20	IR17×20×20.5
0.022	0.0240	—	IR17×20×20	IR15×20×23
0.029	0.0310	—	IR15×20×26	IR17×20×30.5
—	0.0200	—	—	IR17×22×18
0.024	0.0260	0.027	IR17×22×20.5	IR17×22×23
0.024	0.0260	—	IR17×22×20.5	IR17×22×23
0.032	0.0330	—	IR17×22×26	—
0.035	0.0370	—	—	IR20×24×28.5
—	0.0270	—	—	IR20×25×18D
0.031	0.0330	0.035	IR20×25×20	IR20×25×23

- Type HK··L
- Type HMK··L
- Type HK··LL
- Type HMK··LL
- Type BK··L



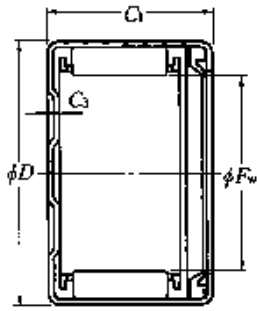
Type HK··L, Type HMK··L  
(Opened end and single-side seal type)

Type HK··LL, Type HMK··LL  
(Opened end and double-side seal type)

$F_w$  25~50mm

Boundary dimensions					Basic load ratings				Limiting speeds min <sup>-1</sup> grease	Bearing numbers		
$F_w$	$D$	$C_1$ 0 -0.2	$C_2$ 0 -0.2	$C_3$ max	dynamic N	static	dynamic kgf	static		open end single seal	open end double seal	closed end single seal
					$C_r$	$C_{or}$	$C_r$	$C_{or}$				
25	33	18	21	—	15 200	19 900	1 550	2 030	6 500	HMK2518CLT/3AS	HMK2521CLLT/3AS	—
	33	23	26	—	21 800	31 500	2 220	3 200	6 500	HMK2523L/3AS	HMK2526LL/3AS	—
28	35	—	20	—	17 300	27 600	1 760	2 820	5 500	—	HK 2820LL/3AS	—
	37	23	26	—	23 600	32 500	2 410	3 350	5 500	HMK2823L/3AS	HMK2826LL/3AS	—
30	37	—	16	—	13 000	19 500	1 320	1 990	5 500	—	HK 3016LL/3AS	—
	37	18	20	2.7	18 100	30 000	1 850	3 050	5 500	HK 3018L/3AS	HK 3020LL/3AS	BK3018L/3AS
	40	23	26	—	24 200	34 500	2 470	3 500	5 500	HMK3023L/3AS	HMK3026LL/3AS	—
	40	28	31	—	31 000	47 000	3 150	4 800	5 500	HMK3028L/3AS	HMK3031LL/3AS	—
32	42	23	26	—	27 500	38 000	2 800	3 850	5 000	HMK3223L/3AS	HMK3226LL/3AS	—
35	42	—	16	—	14 000	22 800	1 430	2 320	4 600	—	HK 3516LL/3AS	—
	42	18	20	2.7	19 700	35 000	2 000	3 600	4 600	HK 3518L/3AS	HK 3520LL/3AS	BK3518L/3AS
	45	18	21	—	20 200	26 200	2 060	2 670	4 600	HMK3518L/3AS	HMK3521LL/3AS	—
	45	28	31	—	36 000	54 500	3 650	5 550	4 600	HMK3528L/3AS	HMK3531LL/3AS	—
38	48	28	31	—	38 500	61 000	3 900	6 250	4 200	HMK3828L/3AS	HMK3831LL/3AS	—
40	47	—	16	—	15 100	26 000	1 540	2 660	4 000	—	HK 4016LL/3AS	—
	47	18	20	2.7	21 100	40 000	2 150	4 100	4 000	HK 4018L/3AS	HK 4020LL/3AS	BK4018L/3AS
	50	18	21	—	23 100	32 500	2 350	3 300	4 000	HMK4018L/3AS	HMK4021LL/3AS	—
	50	28	31	—	41 000	67 500	4 150	6 900	4 000	HMK4028L/3AS	HMK4031LL/3AS	—
45	52	18	20	2.7	21 600	43 000	2 210	4 400	3 600	HK 4518L/3AS	HK 4520LL/3AS	BK4518L/3AS
	55	23	26	—	32 000	51 000	3 250	5 200	3 600	HMK4523CLT/3AS	HMK4526CLLT/3AS	—
50	58	22	24	2.7	31 500	63 000	3 200	6 450	3 200	HK 5022L/3AS	HK 5024LL/3AS	BK5022L/3AS
	62	28	31	—	48 000	82 500	4 900	8 450	3 200	HMK5028L/3AS	HMK5031LL/3AS	—

Note 1) Bearing with inner ring is represented by HK+IR. (Refer to "Inner Ring Dimensions Table" on page B-131 to B135.)  
EX. HK5022L/3AS + IR45×50×25

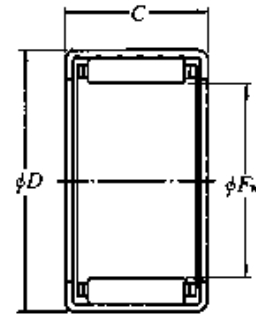


**Type BK·L**  
(Closed end and single-side seal type)

Mass kg (approx.)			Appropriate <sup>1)</sup> inner ring (as a reference)	
open end single seal	open end double seal	closed end single seal	single seal	double seal
0.031	0.034	—	IR20×25×20	IR20×25×23
0.041	0.043	—	IR20×25×26.5	IR20×25×26.5
—	0.037	—	—	IR22×28×23
0.051	0.054	—	—	IR22×28×30
—	0.027	—	—	IR25×30×18D
0.037	0.039	0.045	IR25×30×20	IR25×30×23
0.061	0.064	—	IR25×30×26	IR25×30×26.5
0.076	0.078	—	IR25×30×30	IR25×30×32
0.065	0.069	—	—	IR28×32×30
—	0.036	—	—	—
0.037	0.040	0.047	—	—
0.053	0.056	—	—	—
0.086	0.089	—	—	—
0.094	0.098	—	IR32×38×32	IR32×38×32
—	0.041	—	—	IR35×40×17
0.047	0.050	0.062	IR35×40×20	—
0.060	0.063	—	IR35×40×20	—
0.097	0.100	—	IR35×40×30	IR32×40×36
0.054	0.057	0.072	IR40×45×20	—
0.087	0.091	—	IR40×45×26.5	IR40×45×26.5
0.086	0.089	0.104	IR45×50×25	IR45×50×25.5
0.144	0.149	—	IR45×50×32	IR45×50×32

## Inch series

### Type DCL



$F_w$  6.350~15.875mm

$F_w$	Boundary dimensions		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)
	mm ( $\frac{1}{25.4}$ mm)		dynamic	static	dynamic	static	min <sup>-1</sup>				
	$D$	$C$ -0.2	N	N	kgf	kgf	grease	oil			
<b>6.350</b> ( $\frac{1}{4}$ )	11.112( $\frac{7}{16}$ )	6.350( $\frac{1}{4}$ )	1 580	1 110	161	113	25 000	38 000	<b>DCL 44T2</b>	0.0022	—
	11.112( $\frac{7}{16}$ )	7.938( $\frac{5}{16}$ )	2 160	1 670	221	170	25 000	38 000	<b>DCL 45T2</b>	0.0033	—
	11.112( $\frac{7}{16}$ )	11.112( $\frac{7}{16}$ )	3 550	3 150	360	320	25 000	38 000	<b>DCL 47T2</b>	0.0038	—
<b>7.938</b> ( $\frac{5}{16}$ )	12.700( $\frac{1}{2}$ )	7.938( $\frac{5}{16}$ )	2 940	2 610	300	266	20 000	30 000	<b>DCL 55</b>	0.0032	—
	12.700( $\frac{1}{2}$ )	9.525( $\frac{3}{8}$ )	3 900	3 750	400	385	20 000	30 000	<b>DCL 56</b>	0.0039	—
	12.700( $\frac{1}{2}$ )	11.112( $\frac{7}{16}$ )	4 800	4 950	490	505	20 000	30 000	<b>DCL 57</b>	0.0048	—
	12.700( $\frac{1}{2}$ )	14.288( $\frac{9}{16}$ )	6 500	7 250	665	740	20 000	30 000	<b>DCL 59</b>	0.0058	—
<b>9.525</b> ( $\frac{3}{8}$ )	14.288( $\frac{9}{16}$ )	7.938( $\frac{5}{16}$ )	3 100	2 910	315	297	17 000	25 000	<b>DCL 65</b>	0.0037	—
	14.288( $\frac{9}{16}$ )	9.525( $\frac{3}{8}$ )	4 100	4 200	420	430	17 000	25 000	<b>DCL 66</b>	0.0045	—
	14.288( $\frac{9}{16}$ )	12.700( $\frac{1}{2}$ )	5 900	6 650	600	675	17 000	25 000	<b>DCL 68</b>	0.0065	—
	14.288( $\frac{9}{16}$ )	15.875( $\frac{5}{8}$ )	7 500	9 050	765	925	17 000	25 000	<b>DCL 610</b>	0.0075	—
<b>11.112</b> ( $\frac{7}{16}$ )	15.875( $\frac{5}{8}$ )	12.700( $\frac{1}{2}$ )	6 450	7 800	660	795	15 000	22 000	<b>DCL 78</b>	0.0068	—
<b>12.700</b> ( $\frac{1}{2}$ )	17.462( $\frac{11}{16}$ )	7.938( $\frac{5}{16}$ )	3 550	3 700	360	380	13 000	19 000	<b>DCL 85</b>	0.0047	—
	17.462( $\frac{11}{16}$ )	9.525( $\frac{3}{8}$ )	4 700	5 350	480	550	13 000	19 000	<b>DCL 86</b>	0.0057	—
	17.462( $\frac{11}{16}$ )	11.112( $\frac{7}{16}$ )	5 800	7 050	590	715	13 000	19 000	<b>DCL 87</b>	0.0066	—
	17.462( $\frac{11}{16}$ )	12.700( $\frac{1}{2}$ )	6 700	8 500	685	865	13 000	19 000	<b>DCL 88</b>	0.0080	—
	17.462( $\frac{11}{16}$ )	15.875( $\frac{5}{8}$ )	8 550	11 600	870	1 180	13 000	19 000	<b>DCL 810</b>	0.0095	—
	17.462( $\frac{11}{16}$ )	19.050( $\frac{3}{4}$ )	10 400	14 900	1 060	1 520	13 000	19 000	<b>DCL 812</b>	0.0120	—
<b>14.288</b> ( $\frac{9}{16}$ )	19.050( $\frac{3}{4}$ )	7.938( $\frac{5}{16}$ )	3 800	4 250	390	430	11 000	17 000	<b>DCL 95</b>	0.0052	—
	19.050( $\frac{3}{4}$ )	9.525( $\frac{3}{8}$ )	5 050	6 100	515	625	11 000	17 000	<b>DCL 96</b>	0.0063	MI-060908
	19.050( $\frac{3}{4}$ )	11.112( $\frac{7}{16}$ )	6 250	8 000	635	815	11 000	17 000	<b>DCL 97</b>	0.0073	MI-060908
	19.050( $\frac{3}{4}$ )	12.700( $\frac{1}{2}$ )	7 200	9 650	735	985	11 000	17 000	<b>DCL 98</b>	0.0086	MI-060908
	19.050( $\frac{3}{4}$ )	15.875( $\frac{5}{8}$ )	9 200	13 200	935	1 350	11 000	17 000	<b>DCL 910</b>	0.0110	—
	19.050( $\frac{3}{4}$ )	19.050( $\frac{3}{4}$ )	11 200	17 000	1 140	1 730	11 000	17 000	<b>DCL 912</b>	0.0130	—
<b>15.875</b> ( $\frac{5}{8}$ )	20.638( $\frac{13}{16}$ )	7.938( $\frac{5}{16}$ )	4 050	4 750	415	485	10 000	15 000	<b>DCL 105</b>	0.0075	—
	20.638( $\frac{13}{16}$ )	11.112( $\frac{7}{16}$ )	6 650	9 000	680	915	10 000	15 000	<b>DCL 107</b>	0.0080	—
	20.638( $\frac{13}{16}$ )	12.700( $\frac{1}{2}$ )	7 700	10 800	785	1 110	10 000	15 000	<b>DCL 108</b>	0.0091	—
	20.638( $\frac{13}{16}$ )	15.875( $\frac{5}{8}$ )	9 800	14 800	1 000	1 510	10 000	15 000	<b>DCL1010</b>	0.0130	MI-061012
	20.638( $\frac{13}{16}$ )	19.050( $\frac{3}{4}$ )	11 900	19 000	1 220	1 940	10 000	15 000	<b>DCL1012</b>	0.0140	MI-061012

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)  
EX. DCL96 + MI-060908

Remarks: Manufacture of the closed end type bearings under this Table is also available.

$F_w$  15.875~25.400mm

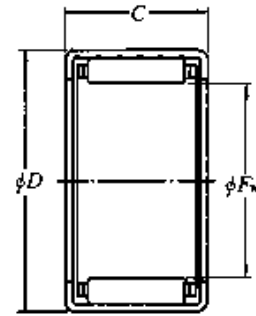
$F_w$	Boundary dimensions		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)
	mm ( $\frac{1}{25.4}$ mm)		dynamic	static	dynamic	static	min <sup>-1</sup>				
	$D$	$C$ 0 -0.2	N	N	kgf	kgf	grease	oil			
			$C_r$	$C_{or}$	$C_r$	$C_{or}$					
<b>15.875</b> ( $\frac{5}{8}$ )	20.638( $\frac{13}{16}$ )	22.225( $\frac{7}{8}$ )	14 100	23 500	1 430	2 400	10 000	15 000	<b>DCL1014</b>	0.0160	MI-061016
<b>17.462</b> ( $\frac{11}{16}$ )	22.225( $\frac{7}{8}$ )	9.525( $\frac{3}{8}$ )	5 700	7 650	585	780	9 500	14 000	<b>DCL 116</b>	0.0075	—
	22.225( $\frac{7}{8}$ )	12.700( $\frac{1}{2}$ )	8 150	12 000	830	1 230	9 500	14 000	<b>DCL 118</b>	0.0110	—
	22.225( $\frac{7}{8}$ )	15.875( $\frac{5}{8}$ )	10 400	16 400	1 060	1 680	9 500	14 000	<b>DCL1110</b>	0.0130	—
	22.225( $\frac{7}{8}$ )	19.050( $\frac{3}{4}$ )	12 600	21 100	1 290	2 150	9 500	14 000	<b>DCL1112</b>	0.0160	—
<b>19.050</b> ( $\frac{3}{4}$ )	25.400(1)	9.525( $\frac{3}{8}$ )	6 450	6 950	660	705	8 500	13 000	<b>DCL 126</b>	0.0110	—
	25.400(1)	12.700( $\frac{1}{2}$ )	9 800	11 900	1 000	1 210	8 500	13 000	<b>DCL 128</b>	0.0140	MI-081210
	25.400(1)	15.875( $\frac{5}{8}$ )	12 900	16 800	1 310	1 720	8 500	13 000	<b>DCL1210</b>	0.0170	MI-081210
	25.400(1)	19.050( $\frac{3}{4}$ )	15 900	22 100	1 620	2 250	8 500	13 000	<b>DCL1212</b>	0.0210	MI-081212
	25.400(1)	22.225( $\frac{7}{8}$ )	19 000	27 700	1 930	2 830	8 500	13 000	<b>DCL1214</b>	0.0260	MI-081216
	25.400(1)	25.400(1)	21 700	33 000	2 210	3 350	8 500	13 000	<b>DCL1216</b>	0.0300	MI-081216
<b>20.638</b> ( $\frac{13}{16}$ )	26.988( $1\frac{1}{16}$ )	9.525( $\frac{3}{8}$ )	6 950	7 800	710	795	8 000	12 000	<b>DCL 136</b>	0.0120	—
	26.988( $1\frac{1}{16}$ )	12.700( $\frac{1}{2}$ )	10 600	13 400	1 080	1 370	8 000	12 000	<b>DCL 138</b>	0.0160	—
	26.988( $1\frac{1}{16}$ )	15.875( $\frac{5}{8}$ )	13 900	19 000	1 410	1 930	8 000	12 000	<b>DCL1310</b>	0.0200	—
	26.988( $1\frac{1}{16}$ )	19.050( $\frac{3}{4}$ )	17 100	24 900	1 750	2 540	8 000	12 000	<b>DCL1312</b>	0.0230	—
	26.988( $1\frac{1}{16}$ )	22.225( $\frac{7}{8}$ )	20 400	31 500	2 080	3 200	8 000	12 000	<b>DCL1314</b>	0.0280	—
	26.988( $1\frac{1}{16}$ )	25.400(1)	23 400	37 000	2 380	3 800	8 000	12 000	<b>DCL1316</b>	0.0320	—
	26.988( $1\frac{1}{16}$ )	31.750( $1\frac{1}{4}$ )	29 000	49 000	2 960	5 000	8 000	12 000	<b>DCL1320</b>	0.0400	—
<b>22.225</b> ( $\frac{7}{8}$ )	28.575( $1\frac{1}{8}$ )	9.525( $\frac{3}{8}$ )	7 150	8 300	730	845	7 500	11 000	<b>DCL 146</b>	0.0130	MI-101406
	28.575( $1\frac{1}{8}$ )	12.700( $\frac{1}{2}$ )	10 900	14 200	1 110	1 450	7 500	11 000	<b>DCL 148</b>	0.0170	MI-101408
	28.575( $1\frac{1}{8}$ )	19.050( $\frac{3}{4}$ )	17 600	26 400	1 800	2 700	7 500	11 000	<b>DCL1412</b>	0.0250	MI-101412
	28.575( $1\frac{1}{8}$ )	22.225( $\frac{7}{8}$ )	21 000	33 000	2 140	3 400	7 500	11 000	<b>DCL1414</b>	0.0340	MI-101416
	28.575( $1\frac{1}{8}$ )	25.400(1)	24 100	39 500	2 450	4 000	7 500	11 000	<b>DCL1416</b>	0.0340	MI-101416
<b>23.812</b> ( $\frac{15}{16}$ )	30.162( $1\frac{3}{16}$ )	15.875( $\frac{5}{8}$ )	14 600	21 300	1 490	2 170	6 500	10 000	<b>DCL1510</b>	0.0230	—
	30.162( $1\frac{3}{16}$ )	25.400(1)	24 700	41 500	2 520	4 250	6 500	10 000	<b>DCL1516</b>	0.0360	—
<b>25.400</b> (1)	31.750( $1\frac{1}{4}$ )	9.525( $\frac{3}{8}$ )	7 550	9 250	770	940	6 500	9 500	<b>DCL 166</b>	0.0140	—
	31.750( $1\frac{1}{4}$ )	12.700( $\frac{1}{2}$ )	11 500	15 800	1 170	1 610	6 500	9 500	<b>DCL 168</b>	0.0190	—
	31.750( $1\frac{1}{4}$ )	19.050( $\frac{3}{4}$ )	18 600	29 500	1 890	3 000	6 500	9 500	<b>DCL1612</b>	0.0310	MI-121612
	31.750( $1\frac{1}{4}$ )	22.225( $\frac{7}{8}$ )	22 100	37 000	2 260	3 750	6 500	9 500	<b>DCL1614</b>	0.0340	MI-121616

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)  
EX. DCL128 + MI-081210

Remarks: Manufacture of the closed end type bearings under this Table is also available.

## Inch series

### Type DCL



$F_w$  25.400~41.275mm

$F_w$	Boundary dimensions mm ( $\frac{1}{25.4}$ mm)		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)
	$D$	$C$ $0$ $-0.2$	dynamic N	static $C_{or}$	dynamic kgf	static $C_{or}$	grease min <sup>-1</sup>	oil			
<b>25.400(1)</b>	31.750(1 $\frac{1}{4}$ )	25.400(1)	25 400	44 000	2 590	4 500	6 500	9 500	<b>DCL1616</b>	0.038	MI-121616
	31.750(1 $\frac{1}{4}$ )	31.750(1 $\frac{1}{4}$ )	31 500	58 000	3 200	5 900	6 500	9 500	<b>DCL1620</b>	0.048	—
<b>26.988(1 <math>\frac{1}{16}</math>)</b>	33.338(1 $\frac{5}{16}$ )	15.875( $\frac{5}{8}$ )	15 900	24 600	1 620	2 510	6 000	9 000	<b>DCL1710</b>	0.025	—
<b>28.575(1 <math>\frac{1}{8}</math>)</b>	34.925(1 $\frac{3}{8}$ )	9.525( $\frac{3}{8}$ )	8 150	10 600	830	1 080	5 500	8 500	<b>DCL 186</b>	0.016	MI-141808
	34.925(1 $\frac{3}{8}$ )	12.700( $\frac{1}{2}$ )	12 400	18 200	1 260	1 850	5 500	8 500	<b>DCL 188</b>	0.021	MI-141808
	34.925(1 $\frac{3}{8}$ )	19.050( $\frac{3}{4}$ )	20 100	34 000	2 050	3 450	5 500	8 500	<b>DCL1812</b>	0.032	MI-141812
	34.925(1 $\frac{3}{8}$ )	25.400(1)	27 400	50 500	2 790	5 150	5 500	8 500	<b>DCL1816</b>	0.043	MI-141816
	34.925(1 $\frac{3}{8}$ )	31.750(1 $\frac{1}{4}$ )	34 000	66 500	3 450	6 800	5 500	8 500	<b>DCL1820</b>	0.053	MI-141820
<b>30.162(1 <math>\frac{3}{16}</math>)</b>	38.100(1 $\frac{1}{2}$ )	25.400(1)	33 000	54 000	3 350	5 500	5 500	8 000	<b>DCL1916</b>	0.057	—
<b>31.750(1 <math>\frac{1}{4}</math>)</b>	38.100(1 $\frac{1}{2}$ )	12.700( $\frac{1}{2}$ )	12 500	19 000	1 280	1 940	5 000	7 500	<b>DCL 208</b>	0.023	—
	38.100(1 $\frac{1}{2}$ )	15.875( $\frac{5}{8}$ )	16 400	27 000	1 670	2 750	5 000	7 500	<b>DCL2010</b>	0.029	—
	38.100(1 $\frac{1}{2}$ )	19.050( $\frac{3}{4}$ )	20 300	35 500	2 070	3 600	5 000	7 500	<b>DCL2012</b>	0.036	—
	38.100(1 $\frac{1}{2}$ )	25.400(1)	27 700	53 000	2 830	5 400	5 000	7 500	<b>DCL2016</b>	0.047	—
	38.100(1 $\frac{1}{2}$ )	31.750(1 $\frac{1}{4}$ )	34 500	70 000	3 500	7 100	5 000	7 500	<b>DCL2020</b>	0.058	—
<b>34.925(1 <math>\frac{3}{8}</math>)</b>	41.275(1 $\frac{5}{8}$ )	12.700( $\frac{1}{2}$ )	13 400	21 400	1 360	2 180	4 700	7 000	<b>DCL 228</b>	0.027	—
	41.275(1 $\frac{5}{8}$ )	19.050( $\frac{3}{4}$ )	21 700	40 000	2 210	4 050	4 700	7 000	<b>DCL2212</b>	0.038	—
	41.275(1 $\frac{5}{8}$ )	25.400(1)	29 600	59 500	3 000	6 050	4 700	7 000	<b>DCL2216</b>	0.051	—
	41.275(1 $\frac{5}{8}$ )	31.750(1 $\frac{1}{4}$ )	36 500	78 500	3 750	8 000	4 700	7 000	<b>DCL2220</b>	0.064	—
<b>38.100(1 <math>\frac{1}{2}</math>)</b>	47.625(1 $\frac{7}{8}$ )	12.700( $\frac{1}{2}$ )	17 100	22 800	1 750	2 320	4 300	6 500	<b>DCL 248</b>	0.043	—
	47.625(1 $\frac{7}{8}$ )	15.875( $\frac{5}{8}$ )	21 000	29 700	2 150	3 050	4 300	6 500	<b>DCL2410</b>	0.054	—
	47.625(1 $\frac{7}{8}$ )	19.050( $\frac{3}{4}$ )	26 600	40 000	2 710	4 100	4 300	6 500	<b>DCL2412</b>	0.065	—
	47.625(1 $\frac{7}{8}$ )	22.225( $\frac{7}{8}$ )	32 000	50 500	3 250	5 150	4 300	6 500	<b>DCL2414</b>	0.076	MI-202416
	47.625(1 $\frac{7}{8}$ )	25.400(1)	36 500	60 500	3 750	6 200	4 300	6 500	<b>DCL2416</b>	0.087	MI-202416
	47.625(1 $\frac{7}{8}$ )	31.750(1 $\frac{1}{4}$ )	46 500	82 000	4 750	8 350	4 300	6 500	<b>DCL2420</b>	0.107	MI-202420
<b>41.275(1 <math>\frac{5}{8}</math>)</b>	50.800(2)	12.700( $\frac{1}{2}$ )	18 000	24 900	1 840	2 540	4 000	6 000	<b>DCL 268</b>	0.046	MI-222610
	50.800(2)	15.875( $\frac{5}{8}$ )	22 100	32 500	2 260	3 300	4 000	6 000	<b>DCL2610</b>	0.058	MI-222610
	50.800(2)	25.400(1)	38 500	66 500	3 950	6 800	4 000	6 000	<b>DCL2616</b>	0.106	—
	50.800(2)	31.750(1 $\frac{1}{4}$ )	49 000	90 000	5 000	9 150	4 000	6 000	<b>DCL2620</b>	0.116	MI-212620

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-141.)  
EX. DCL2414 + MI-202416

Remarks: Manufacture of the closed end type bearings under this Table is also available.

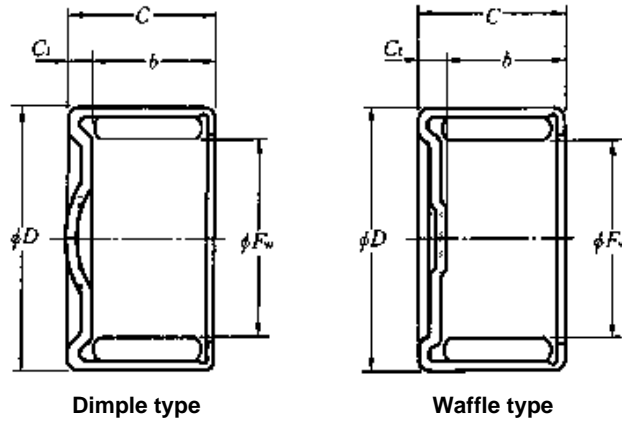
$F_w$  44.450~50.800mm

$F_w$	Boundary dimensions		Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)	Appropriate <sup>1)</sup> inner ring (as a reference)
	mm ( $\frac{1}{25.4}$ mm)		dynamic	static	dynamic	static	min <sup>-1</sup>				
	$D$	$C$ -0.2	N		kgf		grease	oil			
			$C_r$	$C_{or}$	$C_r$	$C_{or}$					
<b>44.450(1 <math>\frac{3}{4}</math>)</b>	53.975(2 $\frac{1}{8}$ )	19.050( $\frac{3}{4}$ )	29 200	47 500	2 980	4 850	3 700	5 500	<b>DCL2812</b>	0.074	MI-242812
	53.975(2 $\frac{1}{8}$ )	25.400(1)	40 500	72 000	4 100	7 350	3 700	5 500	<b>DCL2816</b>	0.099	MI-242816
	53.975(2 $\frac{1}{8}$ )	38.100(1 $\frac{1}{2}$ )	62 000	126 000	6 350	12 800	3 700	5 500	<b>DCL2824</b>	0.149	—
<b>47.625(1 <math>\frac{7}{8}</math>)</b>	57.150(2 $\frac{1}{4}$ )	12.700( $\frac{1}{2}$ )	19 700	29 200	2 000	2 980	3 300	5 000	<b>DCL 308</b>	0.053	—
	57.150(2 $\frac{1}{4}$ )	15.875( $\frac{5}{8}$ )	24 200	38 000	2 460	3 900	3 300	5 000	<b>DCL3010</b>	0.066	—
	57.150(2 $\frac{1}{4}$ )	25.400(1)	42 000	78 000	4 300	7 950	3 300	5 000	<b>DCL3016</b>	0.106	—
<b>50.800(2)</b>	60.325(2 $\frac{3}{8}$ )	12.700( $\frac{1}{2}$ )	20 400	31 500	2 080	3 200	3 100	4 700	<b>DCL 328</b>	0.056	—
	60.325(2 $\frac{3}{8}$ )	25.400(1)	44 000	83 500	4 450	8 550	3 100	4 700	<b>DCL3216</b>	0.112	—
	60.325(2 $\frac{3}{8}$ )	31.750(1 $\frac{1}{4}$ )	55 500	113 000	5 650	11 500	3 100	4 700	<b>DCL3220</b>	0.140	—
	60.325(2 $\frac{3}{8}$ )	38.100(1 $\frac{1}{2}$ )	67 500	146 000	6 850	14 800	3 100	4 700	<b>DCL3224</b>	0.168	—

Note 1) Bearing with inner ring is represented by DCL-MI. (Refer to Inner Ring Dimension Table on page B-142.)  
EX. DCL2816 + MI-242816

Remarks: Manufacture of the closed end type bearings under this Table is also available.

## Type HCK

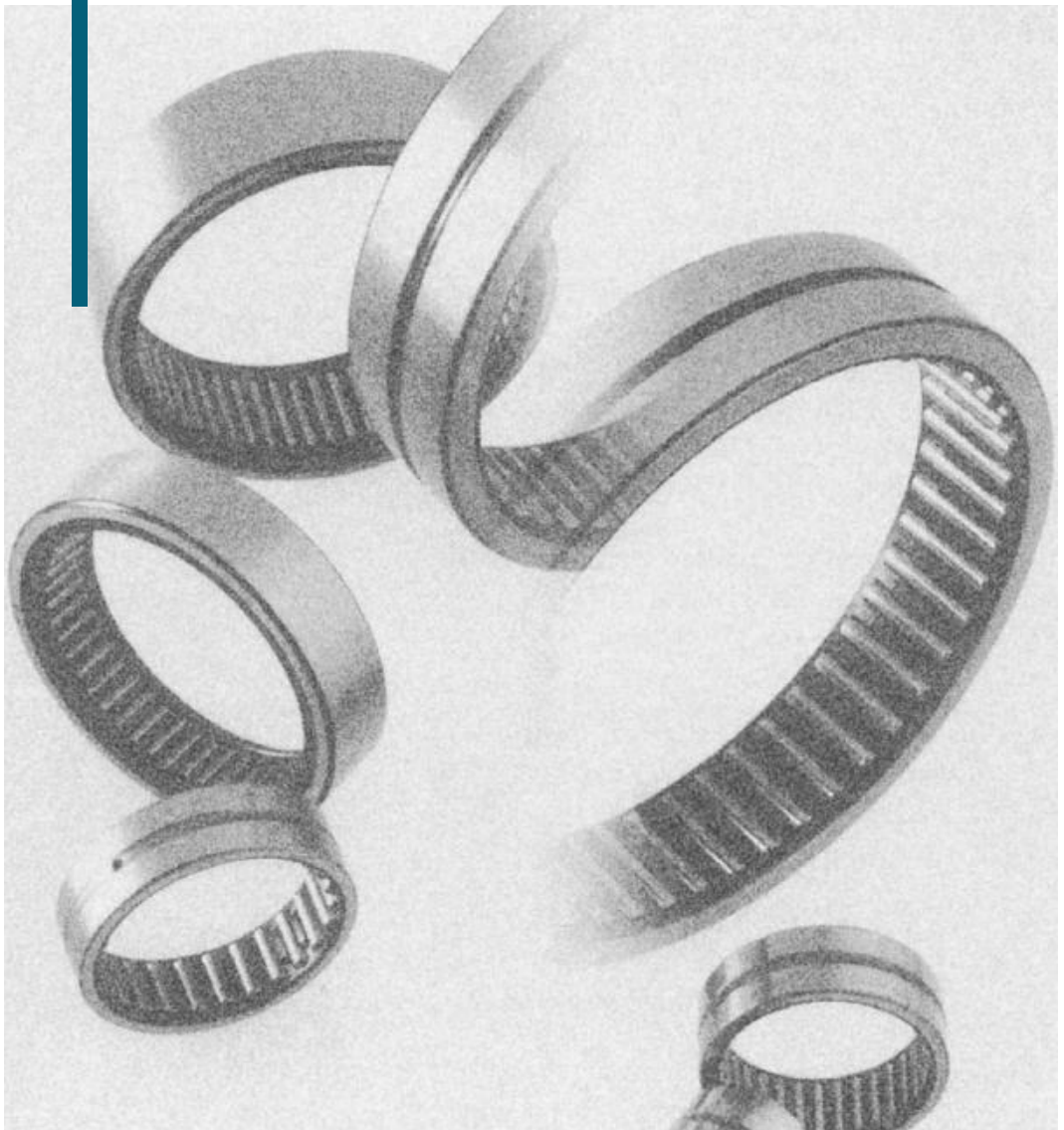


$F_w$  10~20mm

Boundary dimensions					Basic load ratings				Bearing numbers		Mass	
mm					dynamic	static	dynamic	static	standard type	waffle type	kg	
$F_w$	$D$	$C$	$b$	$C_i$	N		kgf				(approx.)	
					$C_r$	$C_{or}$	$C_r$	$C_{or}$				
10	15	9.35	7.6	1.75	6 200	9 250	635	940	HCK1015Vn	—	○	0.007
11.656	17.1	11.85	9.6	2.25	8 850	13 800	905	1 400	HCK1217Vn	○	—	0.013
13	19	11.85	9.6	2.25	10 000	15 000	1 020	1 530	HCK1319Vn	○	—	0.013
14	20	11.85	9.6	2.25	10 500	16 600	1 070	1 690	HCK1420Vn	○	○	0.014
16	22	12.85	10.6	2.25	12 200	20 700	1 240	2 110	HCK1622Vn	○	○	0.017
18	24	13.85	11.6	2.25	13 900	25 300	1 420	2 580	HCK1824Vn	○	—	0.021
18	24.6	13.85	11.6	2.25	13 900	25 300	1 420	2 580	HCK1825Vn	○	○	0.025
20	27.9	15.82	13.1	2.72	17 800	31 000	1 810	3 150	HCK2028Vn	○	—	0.037

Suffix (Vn) is different from the Dimple type and the Waffle type. For more informations, contact NTN engineering.

## Machined Ring Needle Roller Bearings

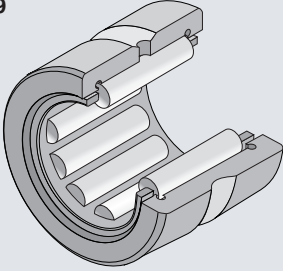
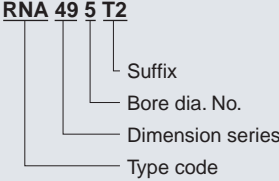
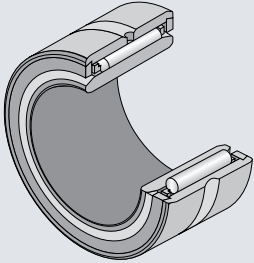
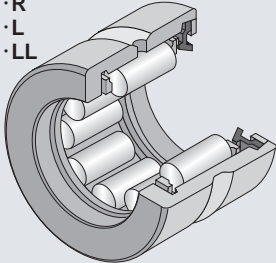
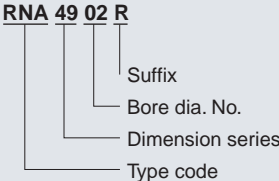
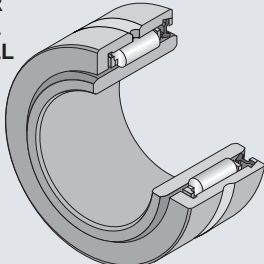


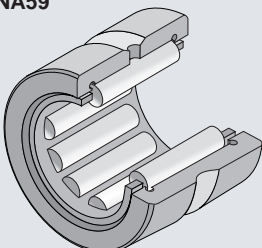
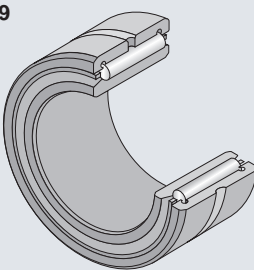
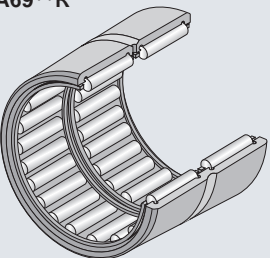
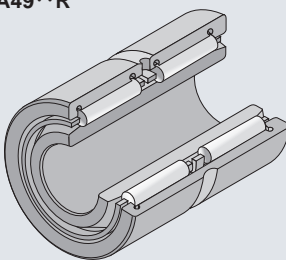
## Machined Ring Needle Roller Bearings

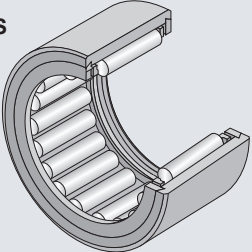
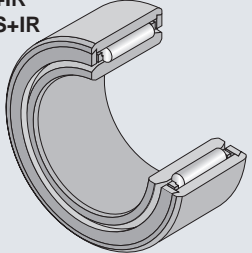
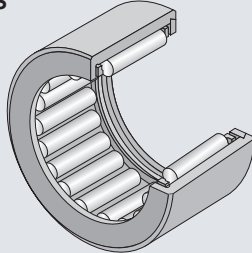
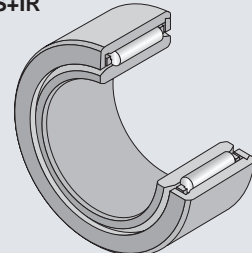
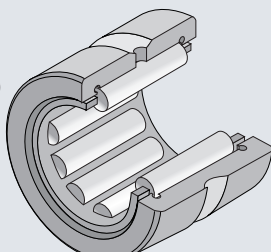
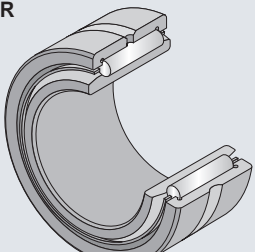
The machined ring of this bearing type contains needle rollers and a cage. The outer ring and the needle rollers are inseparable from each other by means of double-side ribs on the outer ring or side plates.

Because of its machined (solid) outer ring enabling to make it more rigid and upgrade the bearing accuracy, this

bearing type is suitable for an application requiring high speed, high load and high running accuracy. These machined ring needle roller bearings are available in two types -- one without inner ring and another with inner ring -- considering the case of using a shaft as the direct raceway surface without using inner ring.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
<b>Type RNA49</b> 	$\phi 7 - \phi 12$	<b>RNA 49 5 T2</b> 	<p>The bearings with suffix T2 using polyamide resin cage shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.</p>
<b>Type NA49</b> 	$\phi 5 - \phi 9$	<b>[Suffix]</b> T2: Resin cage	<p>The dimension series is in compliance with JIS B 1512 or ISO 15.</p>
<b>Type RNA49·R</b> <b>Type RNA49·L</b> <b>Type RNA49·LL</b> 	Type RNA49·R $\phi 14 - \phi 490$  Sealed type Type RNA49·L Type RNA49·LL $\phi 14 - \phi 58$	<b>RNA 49 02 R</b> 	<p>Bearing with seal type (Suffix: L or LL) - synthetic rubber seal built in at single side or double sides is internally filled up with lithium soap base grease.</p> <p>To avoid deterioration of seal and grease in a sealed bearing, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100°C.</p>
<b>Type NA49·R</b> <b>Type NA49·L</b> <b>Type NA49·LL</b> 	Type NA49·R $\phi 10 - \phi 440$  Sealed type Type NA49·L Type NA49·LL $\phi 10 - \phi 50$	<b>[Suffix]</b> R: Ribbed type L: Single-side seal type LL: Double-side seal type	<p>The dimension series is in compliance with JIS B 15 or ISO 15.</p>

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
<b>Type RNA59</b> 	$\phi 20 - \phi 160$	<b>RNA 59 02</b> — Bore dia. No. — Dimension series — Type code	The dimension series is in compliance with JIS B 1512 or ISO 15.
<b>Type NA59</b> 	$\phi 15 - \phi 140$	<b>NA 59 / 22</b> — Dimension code — Dimension series — Type code	
<b>Type RNA69 · R</b> 	$\phi 16 - \phi 35$ Built-in cage single-row type	<b>RNA 69 01 R</b> — Suffix — Bore dia. No. — Dimension series — Type code	
	$\phi 40 - \phi 110$ Built-in cage double-row type		
<b>Type NA49 · R</b> 	$\phi 12 - \phi 30$ Built-in cage single-row type	<b>NA 69 / 22</b> — Dimension code — Dimension series — Type code	
	$\phi 32 - \phi 95$ Built-in cage double-row type		

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
Type NK Type NKS 	NK $\phi 5 - \phi 12$  NKS $\phi 8 - \phi 40$	<b>NK 7 / 10 T2</b> Type code Roller set bore diameter Width Suffix	Bearing with suffix T2 uses a polyamide resin cage and, therefore, it shall be used at allowable temperature 120°C and, under continuous running, at 100°C and lower.
Type NK+IR Type NKS+IR 	NK $\phi 5 - \phi 9$  NKS+IR $\phi 6 - \phi 30$	<b>NKS 16</b> Type code Roller set bore diameter	
Type NKS 	$\phi 43 - \phi 110$	<b>NK24 / 16R + IR 20 × 24 × 16</b> Type code Bore diameter Outer diameter Width	
Type NKS+IR 	$\phi 35 - \phi 95$	[Suffix] R: Ribbed type T2: Resin cage	
Type NK · R Type NKS Type MR (Inch series) 	NK · R $\phi 14 - \phi 165$  NKS $\phi 115 - \phi 170$  MR $\phi 15.875 - \phi 234.95$	<b>MR 10 18 12</b> Type code Roller set bore diameter code Outer diameter code Width code	
Type NK · R+IR Type NKS+IR Type MR+IR (Inch series) 	NK · R+IR $\phi 10 - \phi 150$  NKS+IR $\phi 100 - \phi 150$  MR+MI $\phi 9.525 - \phi 203.2$	<b>MR101812+ MI- 06 10 12</b> Type code Bore diameter code Outer diameter code Width code	

## Bearing Tolerances

The dimensional accuracy, profile accuracy and running accuracy of machined ring needle roller bearings are specified in JIS B 1514 (Accuracy of Rolling Bearings). (Refer to Section 4 "Bearing Tolerances", **Table 4.3** on page A-26.) Although the accuracy of NTN standard bearings conforms to JIS Class-0, NTN can also supply bearings conforming to JIS Class-6, -5 and -4.

The dimensional tolerances for the roller set bore diameter ( $F_w$ ) of **Types NK, RNA, NKS, and MR** each lacking an inner ring fall in the ISO tolerance class F6.

Feel free to contact NTN for the further detail of these bearings.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, NTN will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact NTN Engineering.

## Radial internal clearance and bearing fits

NTN machined ring needle roller bearings (with inner ring) are manufactured to the tolerance range of radial internal clearance in **Table 5.1** in Sec. 5.1 "Bearing radial internal clearance" (page A-30). Because of the narrow non-interchangeable clearance range, the bearings shipped after adjusted to a specific non-interchangeable clearance must be installed with the clearance remained unchanged.

The dimensional tolerances (fits) of a shaft and housing bore to which the bearing with inner ring is installed should be in accordance with type and magnitude of load, and dimensions of the shaft and housing bore. For information about the dimensional tolerances of a shaft and housing bore, refer to Sec. 6.4 "Recommended internal fits" (page A-33). For the profile accuracy and surface roughness of the shaft and housing bore corresponding to the recommended internal fits in **Table 8.3** in Sec. 8.3 "Shaft and housing accuracy" (page A-40).

A bearing not having an inner ring directly uses the shaft as raceway surface, and the dimensional tolerances of the shaft diameter (raceway diameter) can vary depending on the operating internal clearance of the bearing as summarized in **Table 1** below. For this type of bearing usage, the dimensional tolerance class for the

**Table 1 Shaft diameter (raceway diameter) tolerance (recommended)**

Roller inscribed circle dia.		Tolerance range class for shaft		
$F_w$ mm		Smaller than ordinary clearance	Ordinary class	Larger than ordinary clearance
Over	incl.			
	80	k5	h5	f6
80	160	k5	g5	f6
160	180	k5	g5	e6
180	200	j5	g5	e6
200	250	j5	f6	e6
250	315	h5	f6	e6
315	400	g5	f6	d6

housing bore is K7, which is most commonly adopted tolerance class. When wishing to adopt a dimensional tolerance class other than K7 for the housing bore, contact NTN Engineering for technical assistance.

For the profile accuracy, surface roughness and surface hardness of the shaft that functions as raceway surface, refer to Sec. 8.4 "Raceway surface accuracy" (page A-40) and Sec. 8.5 "Material and hardness of raceway" (page A-40).

## Oil hole dimension of the outer ring

The outer ring is provided with an oil hole and an oil groove to facilitate oil lubrication to bearing. (However, the description above does not apply to the **Type NK** bearings whose roller set bore diameter ( $F_w$ ) measures 12 mm or less and the **Type NKS** bearing whose roller set bore diameter ( $F_w$ ) measures 110 mm or less.)

**Table 2** shows the oil hole dimension every outer ring diameter.

**Table 2 Oil hole dimension**

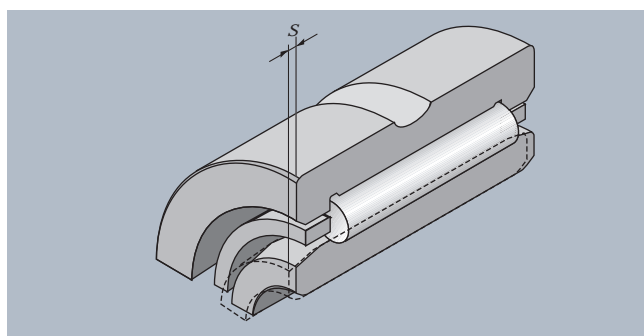
Outer ring outer diameter Over	incl.	Oil hole dia. (mm)	Number of oil hole
—	20	2.0	1
20	40	2.5	1
40	80	3.0	1
80	200	3.5	1
200	350	4.0	1
350	—	5.0	1

## Mounting relations

In the case of raceway with an oil hole, **the bearing must be installed so that the oil hole can locate on the non-load area.** In addition, any bearing with inner ring **must be used within the allowable stroking value (s) (with the rollers retained within the effective contact length range of inner ring).**

For the allowable stroking value (s), refer to **Fig. 1** and applicable "Dimensions Table".

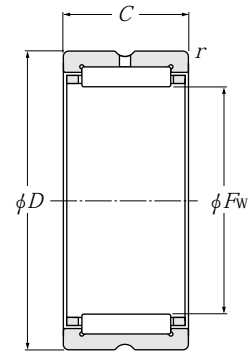
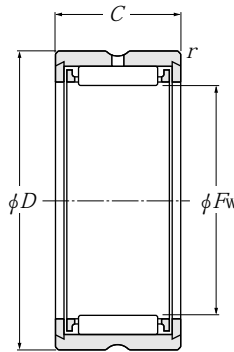
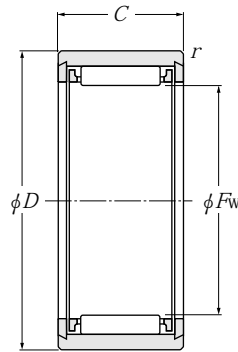
The inner ring and outer ring of machined ring needle roller bearing must be positioned in axial direction by shoulder or snap ring in this case. The mounting relation dimensions about the shaft and housing bore for this case are found in the relevant dimension table.



**Fig. 1**

## Without Inner Ring

Type RNA49  
Type RNA59  
Type RNA69  
Type NK  
Type NKS



Type NK ( $\phi F_w \leq 12\text{mm}$ )  
Type NKS

Type RNA49 ( $\phi F_w \leq 12\text{mm}$ )

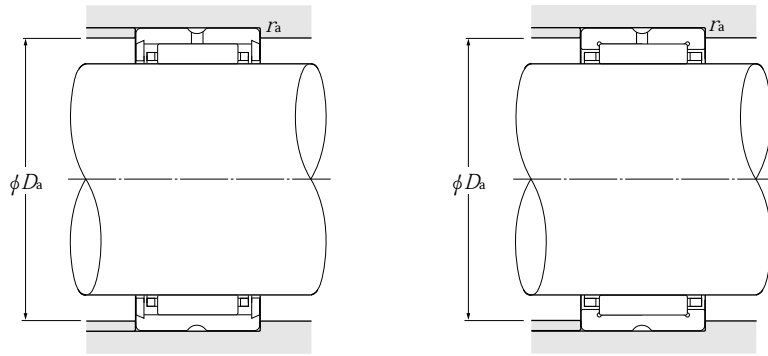
Type RNA49 · R ( $\phi F_w \geq 14\text{mm}$ )  
Type RNA59  
Type RNA69 · R  
Type NK · R ( $\phi F_w \geq 14\text{mm}$ )

$F_w$  5~15mm

$F_w$	Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
	mm			dynamic	static	dynamic	static	$\text{min}^{-1}$			$D_a$	$r_{as}$	
	$r_s$	$D$	$C$	N	N	kgf	kgf	grease	oil		max	max	
5 <sup>+0.018 +0.010</sup>	10	10	0.15	2 640	2 190	269	224	27 000	40 000	NK5/10T2	6.5	0.15	0.0031
	10	12	0.15	2 720	2 250	277	230	27 000	40 000	NK5/12T2	6.5	0.15	0.0037
6 <sup>+0.018 +0.010</sup>	12	10	0.15	2 660	2 280	272	233	25 000	37 000	NK6/10T2	7.5	0.15	0.0047
	12	12	0.15	3 400	3 150	345	320	25 000	37 000	NK6/12T2	7.5	0.15	0.0057
7 <sup>+0.022 +0.013</sup>	13	10	0.15	2 670	2 350	272	239	23 000	34 000	RNA495T2	8.5	0.15	0.0055
	14	10	0.3	2 670	2 350	272	239	23 000	34 000	NK7/10T2	8.5	0.3	0.0069
	14	12	0.3	3 400	3 200	345	330	23 000	34 000	NK7/12T2	8.5	0.3	0.0082
8 <sup>+0.022 +0.013</sup>	15	10	0.15	3 150	3 000	320	305	21 000	32 000	RNA496T2T	9.5	0.15	0.0073
	15	12	0.3	4 000	4 100	410	420	21 000	32 000	NK8/12T2	9.5	0.3	0.0087
	15	16	0.3	4 850	5 200	495	535	21 000	32 000	NK8/16	9.5	0.3	0.0120
	16	13	0.3	4 650	4 150	475	425	21 000	32 000	NKS8T2	10	0.3	0.011
9 <sup>+0.022 +0.013</sup>	16	12	0.3	4 550	5 000	465	510	20 000	30 000	NK9/12T2	10.5	0.3	0.0100
	16	16	0.3	5 500	6 400	560	650	20 000	30 000	NK9/16T2	10.5	0.3	0.0130
	17	10	0.15	3 600	3 650	365	375	20 000	30 000	RNA497	10.5	0.15	0.0095
10 <sup>+0.022 +0.013</sup>	17	12	0.3	4 550	5 100	460	520	19 000	28 000	NK10/12T2	11.5	0.3	0.0100
	17	16	0.3	5 450	6 450	555	660	19 000	28 000	8E-NK10/16CT	11.5	0.3	0.0130
	19	11	0.15	5 250	5 150	535	525	19 000	28 000	RNA498CT	12	0.15	0.0130
	19	13	0.3	5 500	5 450	560	555	19 000	28 000	NKS10	12	0.3	0.015
12 <sup>+0.027 +0.016</sup>	19	12	0.3	5 000	6 100	510	620	17 000	26 000	NK12/12	13.5	0.3	0.0130
	19	16	0.3	6 000	7 700	615	785	17 000	26 000	NK12/16	13.5	0.3	0.0160
	20	11	0.3	4 850	4 900	495	500	17 000	26 000	RNA499	14	0.3	0.0130
	22	16	0.3	9 000	9 400	920	960	17 000	26 000	NKS12	14.5	0.3	0.026
14 <sup>+0.027 +0.016</sup>	22	13	0.3	8 600	9 200	875	935	16 000	24 000	RNA4900R	20	0.3	0.0170
	22	16	0.3	10 300	11 500	1 050	1 170	16 000	24 000	NK14/16R	20	0.3	0.0210
	22	20	0.3	13 000	15 600	1 330	1 590	16 000	24 000	NK14/20R	20	0.3	0.0260
	25	16	0.3	8 950	9 650	915	985	16 000	24 000	NKS14	16.5	0.3	0.035
15 <sup>+0.027 +0.016</sup>	23	16	0.3	10 900	12 700	1 110	1 290	15 000	23 000	NK15/16R	21	0.3	0.0220
	23	20	0.3	13 800	17 200	1 410	1 750	15 000	23 000	NK15/20R	21	0.3	0.0270
	26	16	0.3	10 100	11 500	1 030	1 170	15 000	23 000	NKS15	17.5	0.3	0.028

Note 1) Allowable minimum chamfer dimension  $r_s$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$F_w$  16~24mm

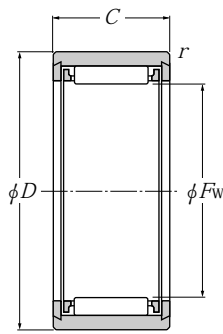
Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	grease	oil		$D_a$ max	$r_{as}$ max	
$F_w$	$D$	$C$	$r_s$ min <sup>1)</sup>	N	N	kgf	kgf			min <sup>-1</sup>			
16 <sup>+0.027</sup> <sub>+0.016</sub>	24	13	0.3	9 550	10 900	975	1 110	15 000	23 000	RNA4901R	22	0.3	0.0170
	24	16	0.3	12 200	14 900	1 240	1 520	15 000	23 000	NK16/16R	22	0.3	0.0220
	24	20	0.3	14 600	18 800	1 490	1 920	15 000	23 000	NK16/20R	22	0.3	0.0280
	24	22	0.3	15 400	20 000	1 570	2 040	15 000	23 000	RNA6901R	22	0.3	0.0310
	28	16	0.3	12 600	13 900	1 290	1 410	15 000	23 000	NKS16	19	0.3	0.039
17 <sup>+0.027</sup> <sub>+0.016</sub>	25	16	0.3	12 100	15 000	1 240	1 530	15 000	22 000	NK17/16R	23	0.3	0.024
	25	20	0.3	15 400	20 400	1 570	2 080	15 000	22 000	NK17/20R	23	0.3	0.030
18 <sup>+0.027</sup> <sub>+0.016</sub>	26	16	0.3	12 700	16 200	1 300	1 650	14 000	21 000	NK18/16R	24	0.3	0.025
	26	20	0.3	16 100	22 000	1 640	2 250	14 000	21 000	NK18/20RCT	24	0.3	0.031
	30	16	0.3	11 600	12 800	1 180	1 300	14 000	21 000	NKS18	21	0.3	0.038
19 <sup>+0.033</sup> <sub>+0.020</sub>	27	16	0.3	13 300	17 400	1 350	1 780	14 000	21 000	NK19/16R	25	0.3	0.026
	27	20	0.3	16 000	22 200	1 630	2 260	14 000	21 000	NK19/20R	25	0.3	0.032
20 <sup>+0.033</sup> <sub>+0.020</sub>	28	13	0.3	10 300	12 800	1 050	1 310	13 000	20 000	RNA4902R	26	0.3	0.022
	28	16	0.3	13 200	17 500	1 340	1 790	13 000	20 000	NK20/16RCT	26	0.3	0.027
	28	18	0.3	14 100	19 100	1 440	1 950	13 000	20 000	RNA5902CT	26	0.3	0.033
	28	20	0.3	16 700	23 800	1 700	2 420	13 000	20 000	NK20/20R	26	0.3	0.034
	28	23	0.3	17 600	25 300	1 790	2 580	13 000	20 000	RNA6902R	26	0.3	0.040
	32	20	0.3	17 800	22 800	1 810	2 330	13 000	20 000	NKS20	23	0.3	0.049
21 <sup>+0.033</sup> <sub>+0.020</sub>	29	16	0.3	13 700	18 700	1 400	1 910	13 000	19 000	NK21/16R	27	0.3	0.028
	29	20	0.3	17 400	25 400	1 770	2 590	13 000	19 000	NK21/20R	27	0.3	0.035
22 <sup>+0.033</sup> <sub>+0.020</sub>	30	16	0.3	14 200	19 900	1 450	2 030	12 000	18 000	NK22/16R	28	0.3	0.034
	30	20	0.3	18 000	27 000	1 840	2 760	12 000	18 000	NK22/20R	28	0.3	0.037
	30	13	0.3	11 200	14 600	1 140	1 490	12 000	18 000	RNA4903R	28	0.3	0.022
	30	18	0.3	15 200	21 700	1 550	2 210	12 000	18 000	RNA5903	28	0.3	0.035
	30	23	0.3	18 200	27 200	1 850	2 770	12 000	18 000	RNA6903R	28	0.3	0.042
	35	20	0.6	17 700	23 300	1 810	2 380	12 000	18 000	NKS22	25	0.6	0.062
24 <sup>+0.033</sup> <sub>+0.020</sub>	32	16	0.3	15 200	22 300	1 550	2 280	11 000	170 00	NK24/16R	30	0.3	0.032
	32	20	0.3	18 600	28 800	1 890	2 930	11 000	17 000	NK24/20R	30	0.3	0.040
	37	20	0.6	18 400	25 200	1 880	2 570	11 000	17 000	NKS24	27	0.6	0.066

Note 1) Allowable minimum chamfer dimension  $r_s$ .

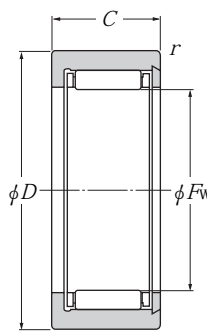
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## Without Inner Ring

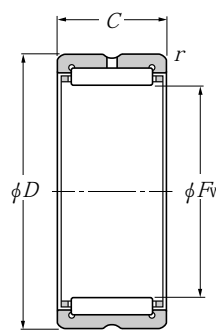
Type RNA49  
Type RNA59  
Type RNA69  
Type NK  
Type NKS



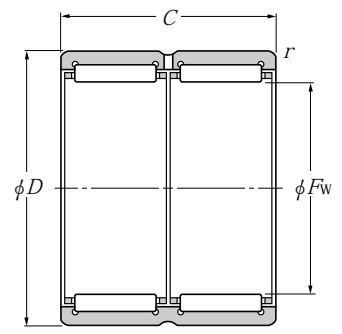
**Type NKS**  
( $\phi F_w \leq 40\text{mm}$ )



**Type NKS**  
( $\phi F_w > 43\text{mm}$ )



**Type RNA49··R, Type RNA59  
Type RNA69··R** ( $\phi F_w \geq 35\text{mm}$ )  
**Type NK··R**



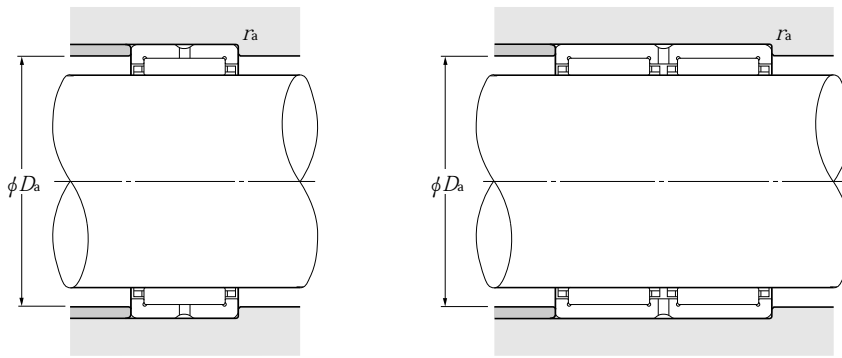
**Type RNA69··R**  
( $\phi F_w \geq 40\text{mm}$ )

$F_w$  25~32mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	grease	oil		$D_a$ max	$r_{as}$ max	
$F_w$	$D$	$C$	$r_s$ min <sup>1)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$			min <sup>-1</sup>			
25 <sup>+0.033</sup> <sub>+0.020</sub>	33	16	0.3	15 100	22 400	1 540	2 280	11 000	16 000	NK25/16R	31	0.3	0.033
	33	20	0.3	19 200	30 500	1 960	3 100	11 000	16 000	NK25/20RCT	31	0.3	0.042
	37	17	0.3	21 300	25 500	2 170	2 600	11 000	16 000	RNA4904RCT	35	0.3	0.052
	37	23	0.3	28 400	37 000	2 900	3 750	11 000	16 000	RNA5904	35	0.3	0.084
	37	30	0.3	36 500	50 500	3 700	5 150	11 000	16 000	RNA6904R	35	0.3	0.100
	38	20	0.6	18 300	25 300	1 870	2 580	11 000	16 000	NKS25	28	0.6	0.068
26 <sup>+0.033</sup> <sub>+0.020</sub>	34	16	0.3	15 600	23 600	1 590	2 410	10 000	15 000	NK26/16R	32	0.3	0.034
	34	20	0.3	19 100	30 500	1 940	3 100	10 000	15 000	NK26/20R	32	0.3	0.042
28 <sup>+0.033</sup> <sub>+0.020</sub>	37	20	0.3	22 300	34 000	2 280	3 450	9 500	14 000	NK28/20R	35	0.3	0.052
	37	30	0.3	26 700	48 000	2 720	4 900	9 500	14 000	NK28/30RCT	35	0.3	0.082
	39	17	0.3	23 200	29 300	2 360	2 990	9 500	14 000	RNA49/22R	37	0.3	0.050
	39	23	0.3	26 400	37 500	2 690	3 850	9 500	14 000	RNA59/22	37	0.3	0.092
	39	30	0.3	40 000	58 500	4 050	6 000	9 500	14 000	RNA69/22R	37	0.3	0.100
	42	20	0.6	18 100	25 800	1 850	2 630	9 500	14 000	NKS28	31	0.6	0.084
29 <sup>+0.033</sup> <sub>+0.020</sub>	38	20	0.3	22 200	34 000	2 270	3 450	9 500	14 000	NK29/20R	36	0.3	0.054
	38	30	0.3	27 500	50 500	2 810	5 150	9 500	14 000	NK29/30R	36	0.3	0.084
30 <sup>+0.033</sup> <sub>+0.020</sub>	40	20	0.3	22 100	34 000	2 260	3 500	8 500	13 000	NK30/20R	38	0.3	0.065
	40	30	0.3	33 000	57 000	3 350	5 800	8 500	13 000	NK30/30R	38	0.3	0.098
	42	17	0.3	24 000	31 500	2 450	3 200	8 500	13 000	RNA4905R	40	0.3	0.061
	42	23	0.3	30 500	43 000	3 150	4 350	8 500	13 000	RNA5905	40	0.3	0.101
	42	30	0.3	41 500	63 000	4 200	6 400	8 500	13 000	RNA6905R	40	0.3	0.112
	45	22	0.6	23 300	33 000	2 370	3 350	8 500	13 000	NKS30	33.5	0.6	0.104
32 <sup>+0.041</sup> <sub>+0.025</sub>	42	20	0.3	23 500	37 500	2 400	3 850	8 500	13 000	NK32/20R	40	0.3	0.068
	42	30	0.3	34 000	60 500	3 450	6 150	8 500	13 000	NK32/30R	40	0.3	0.102
	45	17	0.3	24 800	33 500	2 530	3 400	8 500	13 000	RNA49/28RCT	43	0.3	0.073
	45	23	0.3	32 000	45 500	3 250	4 650	8 500	13 000	RNA59/28	43	0.3	0.108
	45	30	0.3	43 000	67 000	4 350	6 850	8 500	13 000	RNA69/28R	43	0.3	0.135
	47	22	0.6	24 000	35 000	2 450	3 550	8 500	13 000	NKS32	35.5	0.6	0.11

Note 1) Allowable minimum chamfer dimension  $r_s$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$F_w$  35~45mm

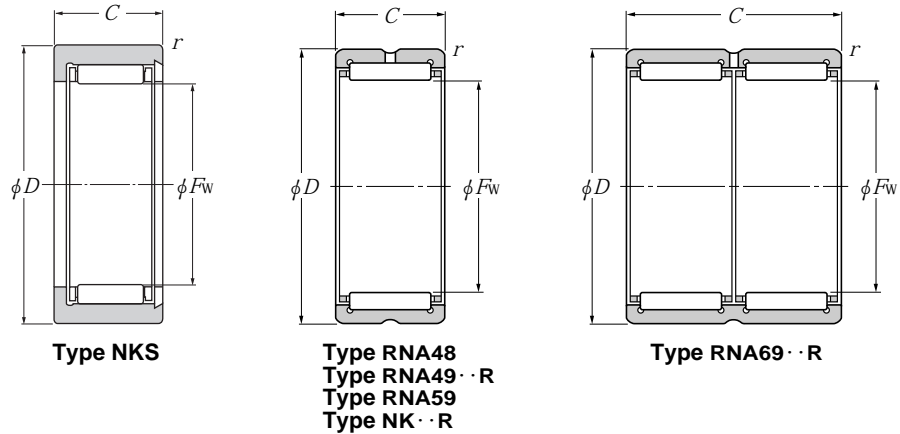
Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	$\text{min}^{-1}$			$D_a$	$r_{as}$	
$F_w$	$D$	$C$	$r_3 \text{ min}^1)$	$C_r$	$C_{or}$	$C_r$	$C_{or}$	grease	oil		max	max	
35 <sup>+0.041</sup> <sub>+0.025</sub>	45	20	0.3	24 800	41 500	2 520	4 250	7 500	11 000	NK35/20RCT	43	0.3	0.074
	45	30	0.3	36 000	66 500	3 650	6 800	7 500	11 000	NK35/30R	43	0.3	0.112
	47	17	0.3	25 500	35 500	2 600	3 600	7 500	11 000	RNA4906R	45	0.3	0.069
	47	23	0.3	32 500	48 500	3 350	4 950	7 500	11 000	RNA5906	45	0.3	0.108
	47	30	0.3	42 500	67 500	4 300	6 900	7 500	11 000	RNA6906R	45	0.3	0.126
	50	22	0.6	24 700	37 000	2 510	3 750	7 500	11 000	NKS35	38.5	0.6	0.118
37 <sup>+0.041</sup> <sub>+0.025</sub>	47	20	0.3	25 300	43 500	2 580	4 400	7 500	11 000	NK37/20R	45	0.3	0.077
	47	30	0.3	36 500	69 500	3 750	7 100	7 500	11 000	NK37/30R	45	0.3	0.107
	52	22	0.6	26 300	41 000	2 680	4 150	7 500	11 000	NKS37	40.5	0.6	0.123
38 <sup>+0.041</sup> <sub>+0.025</sub>	48	20	0.3	25 900	45 000	2 640	4 600	7 500	11 000	NK38/20R	46	0.3	0.079
	48	30	0.3	37 500	73 000	3 850	7 400	7 500	11 000	NK38/30R	46	0.3	0.107
40 <sup>+0.041</sup> <sub>+0.025</sub>	50	20	0.3	26 400	47 000	2 700	4 800	6 500	10 000	NK40/20R	48	0.3	0.083
	50	30	0.3	38 500	76 000	3 900	7 750	6 500	10 000	NK40/30R	48	0.3	0.125
	52	20	0.6	31 500	47 500	3 200	4 850	6 500	10 000	RNA49/32R	48	0.6	0.089
	52	27	0.6	38 000	61 000	3 850	6 250	6 500	10 000	RNA59/32	48	0.6	0.149
	52	36	0.6	47 500	82 000	4 850	8 350	6 500	10 000	RNA69/32R	48	0.6	0.162
	55	22	0.6	27 700	45 000	2 820	4 550	6 500	10000	NKS40	43.5	0.6	0.129
42 <sup>+0.041</sup> <sub>+0.025</sub>	52	20	0.3	26 900	49 000	2 750	5 000	6 500	9 500	NK42/20R	50	0.3	0.086
	52	30	0.3	39 000	79 000	4 000	8 050	6 500	9 500	NK42/30R	50	0.3	0.130
	55	20	0.6	32 000	50 000	3 300	5 100	6 500	9 500	RNA4907R	51	0.6	0.107
	55	27	0.6	39 000	64 500	3 950	6 550	6 500	9 500	RNA5907	51	0.6	0.176
	55	36	0.6	49 000	86 500	5 000	8 800	6 500	9 500	RNA6907R	51	0.6	0.193
43 <sup>+0.041</sup> <sub>+0.025</sub>	53	20	0.3	27 500	51 000	2 810	5 200	6 500	9 500	NK43/20R	51	0.3	0.086
	53	30	0.3	40 000	82 000	4 100	8 400	6 500	9 500	NK43/30R	51	0.3	0.133
	58	22	0.6	29 100	49 000	2 960	5 000	6 500	9 500	NKS43	46.5	0.6	0.14
45 <sup>+0.041</sup> <sub>+0.025</sub>	55	20	0.3	28 000	52 500	2 860	5 400	6 000	9 000	NK45/20R	53	0.3	0.092
	55	30	0.3	41 000	85 500	4 150	8 700	6 000	9 000	NK45/30RCT	53	0.3	0.139
	60	22	0.6	29 700	51 000	3 000	5 200	6 000	9 000	NKS45	48.5	0.6	0.16

Note 1) Allowable minimum chamfer dimension  $r$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## Without Inner Ring

Type RNA49  
Type RNA59  
Type RNA69  
Type NK  
Type NKS

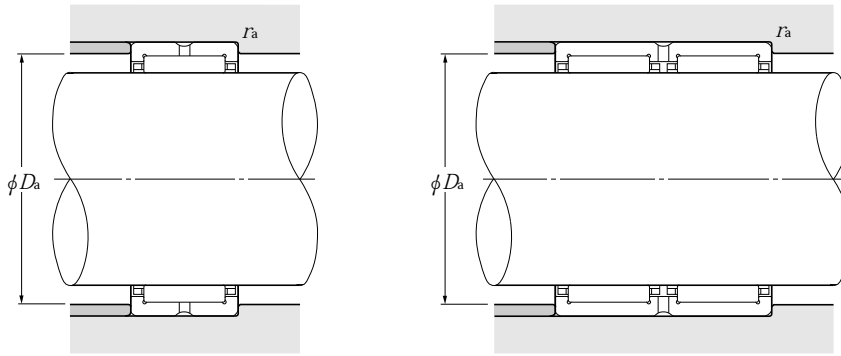


$F_w$  47~68mm

$F_w$	Boundary dimensions			Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
	mm			dynamic	static	dynamic	static	$\text{min}^{-1}$			$D_a$	$r_{as}$	
	$F_w$	$D$	$C$	$r_{s \min}^1)$	N	kgf	kgf	grease	oil		max	max	
47 <sup>+0.041</sup> / <sub>+0.025</sub>	57	20	0.3	28 800	55 500	2 940	5 650	5 500	8 500	NK47/20RCT	55	0.3	0.095
	57	30	0.3	42 500	91 500	4 350	9 350	5 500	8 500	NK47/30R	55	0.3	0.142
48 <sup>+0.041</sup> / <sub>+0.025</sub>	62	22	0.6	43 500	66 500	4 450	6 800	5 500	8 500	RNA4908R	58	0.6	0.140
	62	30	0.6	53 000	92 500	5 450	9 450	5 500	8 500	RNA5908	58	0.6	0.225
	62	40	0.6	67 000	116 000	6 850	11 800	5 500	8 500	RNA6908R	58	0.6	0.256
50 <sup>+0.041</sup> / <sub>+0.025</sub>	62	25	0.6	38 500	74 500	3 950	7 550	5 500	8 000	NK50/25RCT	58	0.6	0.158
	62	35	0.6	51 000	106 000	5 200	10 800	5 500	8 000	NK50/35R	58	0.6	0.221
	65	22	1	31 500	57 000	3 200	5 800	5 500	8 000	NKS50	53.5	1	0.157
52 <sup>+0.049</sup> / <sub>+0.030</sub>	68	22	0.6	46 000	73 000	4 700	7 450	5 000	7 500	RNA4909R	64	0.6	0.182
	68	30	0.6	56 000	101 000	5 700	10 300	5 000	7 500	RNA5909	64	0.6	0.232
	68	40	0.6	70 500	127 000	7 200	13 000	5 000	7 500	RNA6909R	64	0.6	0.273
55 <sup>+0.049</sup> / <sub>+0.030</sub>	68	25	0.6	41 000	82 000	4 150	8 400	5 000	7 500	NK55/25R	64	0.6	0.193
	68	35	0.6	54 000	118 000	5 500	12 000	5 000	7 500	NK55/35R	64	0.6	0.26
	72	22	1	33 500	63 000	3 400	6 450	5 000	7 500	NKS55	58.5	1	0.221
58 <sup>+0.049</sup> / <sub>+0.030</sub>	72	22	0.6	48 000	80 000	4 900	8 150	4 700	7 000	RNA4910R	68	0.6	0.163
	72	30	0.6	58 000	110 000	5 950	11 200	4 700	7 000	RNA5910	68	0.6	0.289
	72	40	0.6	74 000	139 000	7 500	14 200	4 700	7 000	RNA6910R	68	0.6	0.320
60 <sup>+0.049</sup> / <sub>+0.030</sub>	72	25	0.6	41 000	85 000	4 200	8 700	4 300	6 500	NK60/25R	68	0.6	0.185
	72	35	0.6	57 000	130 000	5 800	13 200	4 300	6 500	NK60/35R	68	0.6	0.258
	80	28	1.1	44 500	85 000	4 500	8 700	4 300	6 500	NKS60	64	1.1	0.335
63 <sup>+0.049</sup> / <sub>+0.030</sub>	80	25	1	58 500	99 500	6 000	10 100	4 300	6 500	RNA4911R	75	1	0.255
	80	34	1	76 500	140 000	7 800	14 300	4 300	6 500	RNA5911	75	1	0.367
	80	45	1	94 000	183 000	9 600	18 600	4 300	6 500	RNA6911R	75	1	0.470
65 <sup>+0.049</sup> / <sub>+0.030</sub>	78	25	0.6	45 000	98 000	4 550	10 000	4 000	6 000	NK65/25R	74	0.6	0.221
	78	35	0.6	60 000	142 000	6 100	14 400	4 000	6 000	NK65/35R	74	0.6	0.310
	85	28	1.1	47 000	94 000	4 800	9 600	4 000	6 000	NKS65	69	1.1	0.356
68 <sup>+0.049</sup> / <sub>+0.030</sub>	82	25	1	44 500	89 000	4 500	9 050	4 000	6 000	NK68/25R	77	0.6	0.241
	82	35	0.6	63 000	139 000	6 400	14 200	4 000	6 000	NK68/35R	78	0.6	0.338
	85	25	1	61 500	108 000	6 250	11 000	4 000	6 000	RNA4912R	80	1	0.275

Note 1) Allowable minimum chamfer dimension  $r$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$F_w$  68~90mm

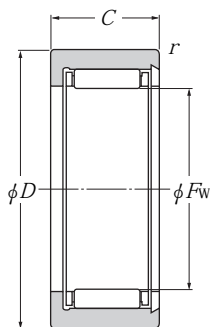
Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	grease	oil		$D_a$ max	$r_{as}$ max	
$F_w$	$D$	$C$	$r_3$ min <sup>1)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$			min <sup>-1</sup>			
<b>68</b> <sup>+0.049 +0.030</sup>	85	34	1	80 500	153 000	8 200	15 600	4 000	6 000	<b>RNA5912</b>	80	1	0.408
	85	45	1	95 500	191 000	9 750	19 400	4 000	6 000	<b>RNA6912R</b>	80	1	0.488
<b>70</b> <sup>+0.049 +0.030</sup>	85	25	0.6	45 000	91 500	4 600	9 350	3 700	5 500	<b>NK70/25R</b>	81	0.6	0.275
	85	35	0.6	64 000	144 000	6 550	14 700	3 700	5 500	<b>NK70/35R</b>	81	0.6	0.386
	90	28	1.1	49 500	103 000	5 050	10 500	3 700	5 500	<b>NKS70</b>	74	1.1	0.38
<b>72</b> <sup>+0.049 +0.030</sup>	90	25	1	62 500	112 000	6 350	11 400	3 700	5 500	<b>RNA4913R</b>	85	1	0.312
	90	34	1	84 000	165 000	8 600	16 800	3 700	5 500	<b>RNA5913</b>	85	1	0.462
	90	45	1	97 000	198 000	9 900	20 200	3 700	5 500	<b>RNA6913R</b>	85	1	0.520
<b>73</b> <sup>+0.049 +0.030</sup>	90	25	0.6	54 000	100 000	5 500	10 200	3 700	5 500	<b>NK73/25R</b>	86	0.6	0.302
	90	35	0.6	76 500	156 000	7 800	16 000	3 700	5 500	<b>NK73/35R</b>	86	0.6	0.428
<b>75</b> <sup>+0.049 +0.030</sup>	92	25	0.6	55 000	104 000	5 600	10 600	3 700	5 500	<b>NK75/25R</b>	88	0.6	0.315
	92	35	0.6	78 000	162 000	7 950	16 500	3 700	5 500	<b>NK75/35R</b>	88	0.6	0.492
	95	28	1.1	50 500	109 000	5 150	11 100	3 700	5 500	<b>NKS75</b>	79	1.1	0.402
<b>80</b> <sup>+0.049 +0.030</sup>	95	25	1	57 000	119 000	5 800	12 200	3 300	5 000	<b>NK80/25R</b>	90	1	0.301
	95	35	1	79 500	184 000	8 150	18 700	3 300	5 000	<b>NK80/35R</b>	90	1	0.425
	100	28	1.1	53 000	118 000	5 400	12 100	3 300	5 000	<b>NKS80</b>	84	1.1	0.413
	100	30	1	85 500	156 000	8 750	15 900	3 300	5 000	<b>RNA4914R</b>	95	1	0.460
	100	40	1	103 000	187 000	10 500	19 100	3 300	5 000	<b>RNA5914</b>	95	1	0.706
	100	54	1	130 000	267 000	13 300	27 200	3 300	5 000	<b>RNA6914R</b>	95	1	0.857
<b>85</b> <sup>+0.058 +0.036</sup>	105	25	1	70 500	123 000	7 200	12 600	3 100	4 700	<b>NK85/25R</b>	100	1	0.404
	105	30	1	87 000	162 000	8 900	16 500	3 100	4 700	<b>RNA4915R</b>	100	1	0.489
	105	32	1.1	64 000	153 000	6 500	15 600	3 100	4 700	<b>NKS85</b>	89	1.1	0.475
	105	35	1	100 000	193 000	10 200	19 700	3 100	4 700	<b>NK85/35R</b>	100	1	0.517
	105	40	1	109 000	205 000	11 100	20 900	3 100	4 700	<b>RNA5915</b>	100	1	0.745
	105	54	1	132 000	277 000	13 500	28 300	3 100	4 700	<b>RNA6915R</b>	100	1	0.935
<b>90</b> <sup>+0.058 +0.036</sup>	110	25	1	71 500	128 000	7 300	13 100	2 900	4 400	<b>NK90/25R</b>	105	1	0.426
	110	30	1	90 500	174 000	9 250	17 700	2 900	4 400	<b>RNA4916R</b>	105	1	0.516
	110	32	1.1	64 000	157 000	6 550	16 000	2 900	4 400	<b>NKS90</b>	94	1.1	0.714
	110	35	1	104 000	208 000	10 600	21 200	2 900	4 400	<b>NK90/35R</b>	105	1	0.604

Note 1) Allowable minimum chamfer dimension  $r_3$ .

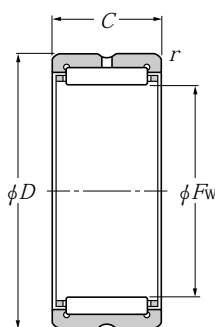
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## Without Inner Ring

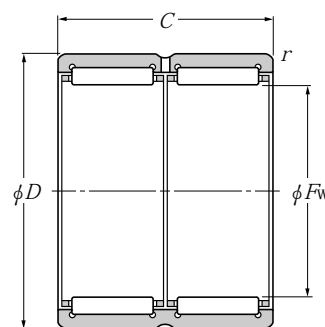
Type RNA49  
Type RNA59  
Type RNA69  
Type NK  
Type NKS



**Type NKS**  
( $\phi F_w \leq 110\text{mm}$ )



**Type RNA48**  
**Type RNA49 · R, Type RNA49**  
**Type RNA59**  
**Type NK · R, Type NK**  
**Type NKS** ( $\phi F_w \geq 115\text{mm}$ )



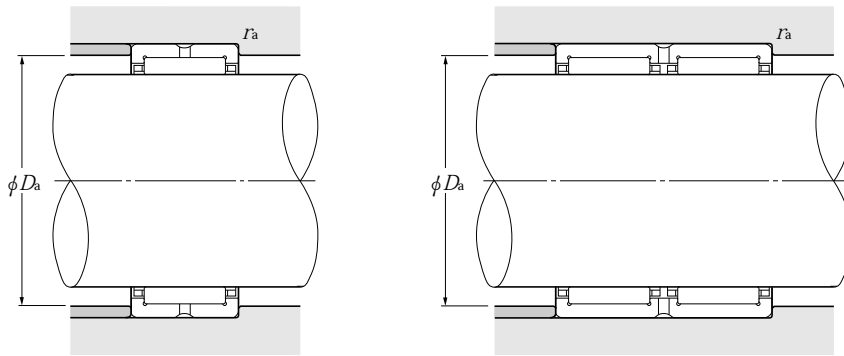
**Type RNA69 · R**

$F_w$  90~125mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	grease	oil		$D_a$ max	$r_{as}$ max	
$F_w$	$D$	$C$	$r_s$ min <sup>1)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$			min <sup>-1</sup>			
<b>90</b> <sup>+0.058</sup> / <sub>+0.036</sub>	110	40	1	115 000	223 000	11 700	22 700	2 900	4 400	<b>RNA5916</b>	105	1	0.787
	110	54	1	138 000	298 000	14 000	30 500	2 900	4 400	<b>RNA6916R</b>	105	1	0.987
<b>95</b> <sup>+0.058</sup> / <sub>+0.036</sub>	115	26	1	74 500	137 000	7 600	14 000	2 800	4 200	<b>NK95/26R</b>	110	1	0.364
	115	32	1.1	65 500	165 000	6 700	16 800	2 800	4 200	<b>NKS95</b>	99	1.1	0.765
	115	36	1	108 000	223 000	11 100	22 700	2 800	4 200	<b>NK95/36R</b>	110	1	0.652
<b>100</b> <sup>+0.058</sup> / <sub>+0.036</sub>	120	26	1	73 500	137 000	7 500	14 000	2 700	4 000	<b>NK100/26R</b>	115	1	0.487
	120	32	1.1	61 000	153 000	6 250	15 600	2 700	4 000	<b>NKS100</b>	104	1.1	0.67
	120	35	1.1	112 000	237 000	11 500	24 200	2 700	4 000	<b>RNA4917R</b>	113.5	1	0.657
	120	36	1	107 000	223 000	11 000	22 800	2 700	4 000	<b>NK100/36R</b>	115	1	0.679
	120	46	1.1	137 000	290 000	14 000	29 600	2 700	4 000	<b>RNA5917</b>	113.5	1	1.00
	120	63	1.1	169 000	400 000	17 300	41 000	2 700	4 000	<b>RNA6917R</b>	113.5	1	1.20
<b>105</b> <sup>+0.058</sup> / <sub>+0.036</sub>	125	26	1	76 500	147 000	7 800	14 900	2 500	3 800	<b>NK105/26R</b>	120	1	0.506
	125	32	1.1	67 500	176 000	6 850	18 000	2 500	3 800	<b>NKS105</b>	109	1.1	0.68
	125	35	1.1	116 000	252 000	11 900	25 700	2 500	3 800	<b>RNA4918R</b>	118.5	1	0.697
	125	36	1	111 000	238 000	11 400	24 300	2 500	3 800	<b>NK105/36R</b>	120	1	0.713
	125	46	1.1	143 000	310 000	14 600	32 000	2 500	3 800	<b>RNA5918</b>	118.5	1	1.04
	125	63	1.1	175 000	425 000	17 900	43 500	2 500	3 800	<b>RNA6918R</b>	118.5	1	1.33
<b>110</b> <sup>+0.058</sup> / <sub>+0.036</sub>	130	30	1.1	97 500	204 000	9 950	20 800	2 400	3 600	<b>NK110/30R</b>	123.5	1	0.612
	130	32	1.1	64 500	170 000	6 600	17 300	2 400	3 600	<b>NKS110</b>	114	1.1	0.695
	130	35	1.1	118 000	260 000	12 000	26 500	2 400	3 600	<b>RNA4919R</b>	123.5	1	0.719
	130	40	1.1	129 000	292 000	13 100	29 700	2 400	3 600	<b>NK110/40R</b>	123.5	1	0.830
	130	46	1.1	149 000	335 000	15 200	34 000	2 400	3 600	<b>RNA5919</b>	123.5	1	1.13
	130	63	1.1	177 000	440 000	18 100	45 000	2 400	3 600	<b>RNA6919R</b>	123.5	1	1.46
<b>115</b> <sup>+0.058</sup> / <sub>+0.036</sub>	135	32	1.1	90 500	199 000	9 250	20 300	2 300	3 500	<b>NKS115</b>	128.5	1.1	0.7
	140	40	1.1	127 000	260 000	12 900	26 500	2 300	3 500	<b>RNA4920</b>	133.5	1	1.15
	140	54	1.1	182 000	395 000	18 600	40 500	2 300	3 500	<b>RNA5920</b>	133.5	1	1.76
<b>120</b> <sup>+0.058</sup> / <sub>+0.036</sub>	140	30	1	93 500	210 000	9 550	21 400	2 200	3 300	<b>RNA4822</b>	135	1	0.670
	140	40	1.1	113 000	268 000	11 500	27 300	2 200	3 300	<b>NK120/40</b>	133.5	1	0.910
<b>125</b> <sup>+0.068</sup> / <sub>+0.043</sub>	150	40	1.1	131 000	279 000	13 300	28 400	2 100	3 200	<b>RNA4922</b>	143.5	1	1.24

Note 1) Allowable minimum chamfer dimension  $r_s$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$F_w$  125~190mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	min <sup>-1</sup>			D <sub>a</sub> max	r <sub>as</sub> max	
$F_w$	D	C	r <sub>s</sub> min <sup>1)</sup>	C <sub>r</sub>	C <sub>or</sub>	C <sub>r</sub>	C <sub>or</sub>	grease	oil				
<b>125</b> <sup>+0.068 +0.043</sup>	150	54	1.1	193 000	440 000	19 700	45 000	2 100	3 200	<b>RNA5922</b>	143.5	1	1.89
<b>130</b> <sup>+0.068 +0.043</sup>	150	30	1	99 500	233 000	10 100	23 800	2 100	3 100	<b>RNA4824</b>	145	1	0.730
	150	40	1.1	116 000	283 000	11 800	28 800	2 100	3 100	<b>NK130/40</b>	143.5	1	0.98
<b>135</b> <sup>+0.068 +0.043</sup>	160	40	2	135 000	298 000	13 800	30 500	2 000	3 000	<b>NKS135</b>	151	2	1.32
	165	45	1.1	180 000	380 000	18 300	38 500	2 000	3 000	<b>RNA4924</b>	158.5	1	1.86
	165	60	1.1	246 000	530 000	25 100	54 000	2 000	3 000	<b>RNA5924</b>	158.5	1	2.67
<b>145</b> <sup>+0.068 +0.043</sup>	165	35	1.1	118 000	305 000	12 100	31 000	1 900	2 800	<b>RNA4826</b>	158.5	1	0.95
	170	32	1.5	111 000	238 000	11 300	24 300	1 900	2 800	<b>NK145/32</b>	162.5	1.5	1.12
	170	42	1.5	153 000	360 000	15 600	36 500	1 900	2 800	<b>NK145/42</b>	162.5	1.5	1.49
<b>150</b> <sup>+0.068 +0.043</sup>	180	50	1.5	202 000	455 000	20 600	46 500	1 800	2 700	<b>RNA4926</b>	172	1.5	2.21
	180	52	2	202 000	455 000	20 600	46 500	1 800	2 700	<b>NKS150</b>	171	2	2.32
	180	67	1.5	296 000	690 000	30 000	70 500	1 800	2 700	<b>RNA5926</b>	172	1.5	3.21
<b>155</b> <sup>+0.068 +0.043</sup>	175	35	1.1	121 000	315 000	12 300	32 500	1 700	2 600	<b>RNA4828</b>	168.5	1	1.02
	180	32	1.5	114 000	252 000	11 600	25 700	1 700	2 600	<b>NK155/32</b>	172	1.5	1.20
	180	42	1.5	156 000	380 000	16 000	38 500	1 700	2 600	<b>NK155/42</b>	172	1.5	1.59
<b>160</b> <sup>+0.068 +0.043</sup>	190	50	1.5	209 000	485 000	21 300	49 500	1 700	2 500	<b>RNA4928</b>	182	1.5	2.35
	190	52	2	209 000	485 000	21 300	49 500	1 700	2 500	<b>NKS160</b>	181	2	2.45
	190	67	1.5	315 000	760 000	32 000	77 500	1 700	2 500	<b>RNA5928</b>	182	1.5	3.48
<b>165</b> <sup>+0.068 +0.043</sup>	190	32	1.5	117 000	265 000	11 900	27 000	1 600	2 400	<b>NK165/32</b>	182	1.5	1.42
	190	40	1.1	152 000	390 000	15 500	40 000	1 600	2 400	<b>RNA4830</b>	183.5	1	1.60
	190	42	1.5	160 000	400 000	16 300	40 500	1 600	2 400	<b>NK165/42</b>	182	1.5	1.66
<b>170</b> <sup>+0.068 +0.043</sup>	200	52	2	215 000	515 000	21 900	52 500	1 600	2 400	<b>NKS170</b>	191	2	2.59
	210	60	2	261 000	610 000	26 600	62 500	1 600	2 400	<b>RNA4930</b>	201	2	2.98
<b>175</b> <sup>+0.068 +0.043</sup>	200	40	1.1	160 000	425 000	16 300	43 500	1 500	2 300	<b>RNA4832</b>	193.5	1	1.70
<b>180</b> <sup>+0.068 +0.043</sup>	220	60	2	270 000	650 000	27 600	66 500	1 500	2 200	<b>RNA4932</b>	211	2	3.10
<b>185</b> <sup>+0.079 +0.050</sup>	215	45	1.1	185 000	495 000	18 800	50 500	1 500	2 200	<b>RNA4834</b>	208.5	1	2.54
<b>190</b> <sup>+0.079 +0.050</sup>	230	60	2	279 000	690 000	28 500	70 500	1 400	2 100	<b>RNA4934</b>	221	2	3.22

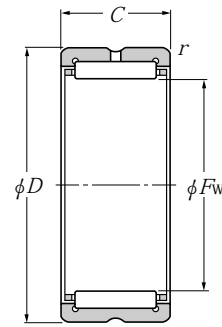
Note 1) Allowable minimum chamfer dimension  $r$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## Without Inner Ring

Type RNA48

Type RNA49

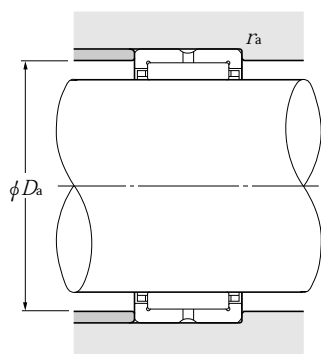


$F_w$  195~450mm

Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	min <sup>-1</sup>			$D_a$ max	$r_{as}$ max	
$F_w$	$D$	$C$	$r_a$ min <sup>1)</sup>	N		kgf		grease	oil				
				$C_r$	$C_{or}$	$C_r$	$C_{or}$						
195 <sup>+0.079</sup> / <sub>+0.050</sub>	225	45	1.1	195 000	540 000	19 800	55 000	1 400	2 100	RNA4836	218.5	1	2.68
205 <sup>+0.079</sup> / <sub>+0.050</sub>	250	69	2	375 000	890 000	38 500	90 500	1 300	2 000	RNA4936	241	2	4.48
210 <sup>+0.079</sup> / <sub>+0.050</sub>	240	50	1.5	227 000	680 000	23 200	69 000	1 300	1 900	RNA4838	232	1.5	3.21
215 <sup>+0.079</sup> / <sub>+0.050</sub>	260	69	2	390 000	945 000	40 000	96 500	1 300	1 900	RNA4938	251	2	4.53
220 <sup>+0.079</sup> / <sub>+0.050</sub>	250	50	1.5	231 000	705 000	23 600	71 500	1 200	1 800	RNA4840	242	1.5	3.35
225 <sup>+0.079</sup> / <sub>+0.050</sub>	280	80	2.1	505 000	1 180 000	51 500	120 000	1 200	1 800	RNA4940	269	2	7.20
240 <sup>+0.079</sup> / <sub>+0.050</sub>	270	50	1.5	244 000	780 000	24 900	79 500	1 100	1 700	RNA4844	262	1.5	3.62
245 <sup>+0.079</sup> / <sub>+0.050</sub>	300	80	2.1	525 000	1 270 000	53 500	129 000	1 100	1 600	RNA4944	289	2	7.81
265 <sup>+0.088</sup> / <sub>+0.056</sub>	300	60	2	360 000	1 080 000	37 000	110 000	1 000	1 500	RNA4848	291	2	5.40
	320	80	2.1	540 000	1 350 000	55 000	138 000	1 000	1 500	RNA4948	309	2	8.40
285 <sup>+0.088</sup> / <sub>+0.056</sub>	320	60	2	375 000	1 160 000	38 000	119 000	950	1 400	RNA4852	311	2	5.80
290 <sup>+0.088</sup> / <sub>+0.056</sub>	360	100	2.1	805 000	1 900 000	82 000	193 000	950	1 400	RNA4952	349	2	15.90
305 <sup>+0.088</sup> / <sub>+0.056</sub>	350	69	2	455 000	1 300 000	46 500	133 000	850	1 300	RNA4856	341	2	9.30
310 <sup>+0.088</sup> / <sub>+0.056</sub>	380	100	2.1	835 000	2 030 000	85 000	207 000	850	1 300	RNA4956	369	2	16.70
330 <sup>+0.098</sup> / <sub>+0.062</sub>	380	80	2.1	625 000	1 770 000	64 000	180 000	800	1 200	RNA4860	369	2	12.70
340 <sup>+0.098</sup> / <sub>+0.062</sub>	420	118	3	1 080 000	2 640 000	110 000	269 000	800	1 200	RNA4960	407	2.5	24.00
350 <sup>+0.098</sup> / <sub>+0.062</sub>	400	80	2.1	640 000	1 850 000	65 500	189 000	750	1 100	RNA4864	389	2	13.40
360 <sup>+0.098</sup> / <sub>+0.062</sub>	440	118	3	1 120 000	2 820 000	114 000	288 000	750	1 100	RNA4964	427	2.5	25.20
370 <sup>+0.098</sup> / <sub>+0.062</sub>	420	80	2.1	655 000	1 940 000	66 500	197 000	750	1 100	RNA4868	409	2	14.00
380 <sup>+0.098</sup> / <sub>+0.062</sub>	460	118	3	1 160 000	3 000 000	118 000	305 000	750	1 100	RNA4968	447	2.5	26.50
390 <sup>+0.098</sup> / <sub>+0.062</sub>	440	80	2.1	665 000	2 020 000	68 000	206 000	650	1 000	RNA4872	429	2	14.80
400 <sup>+0.108</sup> / <sub>+0.068</sub>	480	118	3	1 200 000	3 200 000	122 000	325 000	650	1 000	RNA4972	467	2.5	28.20
415 <sup>+0.108</sup> / <sub>+0.068</sub>	480	100	2.1	1 000 000	2 840 000	102 000	289 000	650	950	RNA4876	469	2	26.00
430 <sup>+0.108</sup> / <sub>+0.068</sub>	520	140	4	1 400 000	3 750 000	143 000	385 000	650	950	RNA4976	504	3	38.60
450 <sup>+0.108</sup> / <sub>+0.068</sub>	540	140	4	1 450 000	4 000 000	148 000	410 000	600	900	RNA4980	524	3	40.10

Note 1) Allowable minimum chamfer dimension  $r_a$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$F_w$  470~490mm

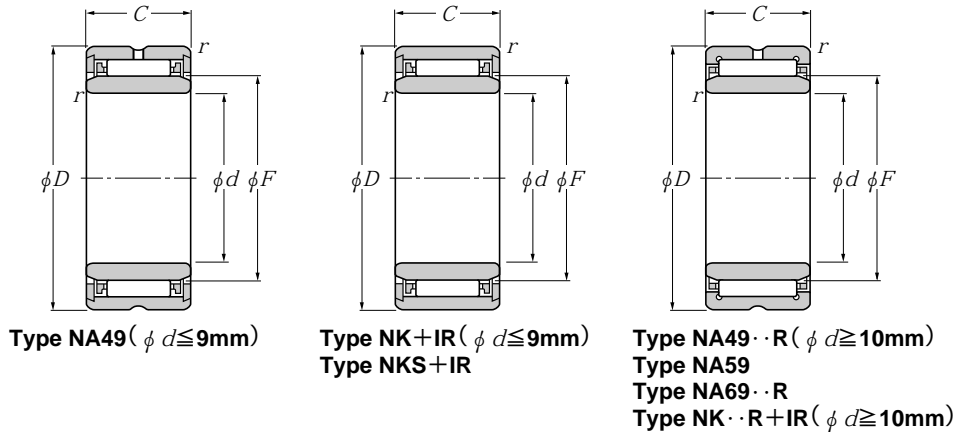
Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm				dynamic	static	dynamic	static	grease	oil		mm	mm	
$F_w$	$D$	$C$	$r_s$ min <sup>1)</sup>	N		kgf				$D_a$ max			$r_{as}$ max
<b>470</b> <sup>+0.108</sup> <sub>+0.068</sub>	560	140	4	1 500 000	4 250 000	153 000	430 000	550	850	<b>RNA4984</b>	544	3	51.60
<b>490</b> <sup>+0.108</sup> <sub>+0.068</sub>	600	160	4	1 750 000	4 600 000	179 000	470 000	550	800	<b>RNA4988</b>	584	3	66.90

Note 1) Allowable minimum chamfer dimension  $r_s$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## With inner ring

Type NA49  
Type NA59  
Type NA69  
Type NK+IR  
Type NKS+IR



Type NA49 ( $\phi d \leq 9\text{mm}$ )

Type NK+IR ( $\phi d \leq 9\text{mm}$ )  
Type NKS+IR

Type NA49·R ( $\phi d \geq 10\text{mm}$ )  
Type NA59  
Type NA69·R  
Type NK·R+IR ( $\phi d \geq 10\text{mm}$ )

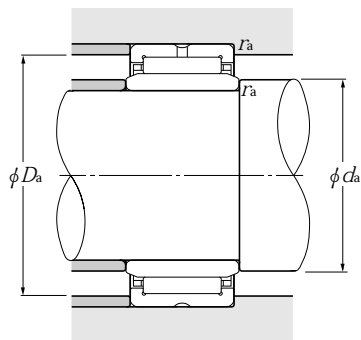
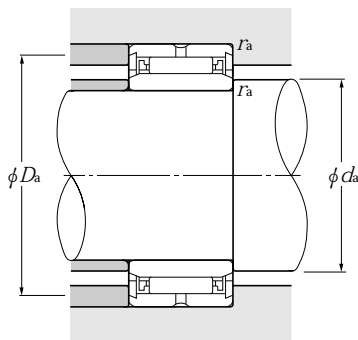
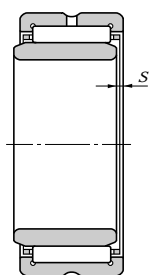
$d$  5~15mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
$d$	$D$	$C$	$r_{\text{min}}^{1)}$	$F$	$s^{2)}$	$C_r$	$C_{or}$	$C_r$	$C_{or}$			
						N						
						kgf						
5	13	10	0.15	7	—	2 670	2 350	272	239	23 000	34 000	NA495T2
	15	12	0.3	8	1.5	4 000	4 100	410	420	21 000	32 000	NK8/12T2+IR5×8×12
	15	16	0.3	8	2	4 850	5 200	495	535	21 000	32 000	NK8/16T2+IR5×8×16
6	15	10	0.15	8	—	3 150	3 000	320	305	21 000	32 000	NA496T2T
	16	12	0.3	9	1.5	4 550	5 000	465	510	20 000	30 000	NK9/12T2+IR6×9×12
	16	16	0.3	9	2	5 500	6 400	560	650	20 000	30 000	NK9/16T2+IR6×9×16
	19	13	0.3	10	1.5	5 500	5 450	560	555	19 000	28 000	NKS10+IR6×10×13
7	17	10	0.15	9	—	3 600	3 650	365	375	20 000	30 000	NA497
	17	12	0.3	10	1.5	4 550	5 100	460	520	19 000	28 000	NK10/12T2+IR7×10×12
	17	16	0.3	10	2	5 450	6 450	555	660	19 000	28 000	8E-NK10/16CT+IR7×10×16
	22	16	0.3	12	2	9 000	9 400	920	960	17 000	26 000	NKS12+IR7×12×16
8	19	11	0.15	10	—	5 250	5 150	535	525	19 000	28 000	NA498CT
	25	16	0.3	14	2	8 950	9 650	915	985	16 000	24 000	NKS14+IR8×14×16
9	19	12	0.3	12	1.5	5 000	6 100	510	620	17 000	26 000	NK12/12+IR9×12×12
	19	16	0.3	12	2	6 000	7 700	615	785	17 000	26 000	NK12/16+IR9×12×16
	20	11	0.3	12	—	4 850	4 900	495	500	17 000	26 000	NA499
	26	16	0.3	15	2	10 100	11 500	1 030	1 170	15 000	23 000	NKS15+IR9×15×16
10	22	13	0.3	14	0.5	8 600	9 200	875	935	16 000	24 000	NA4900R
	22	16	0.3	14	0.5	10 300	11 500	1 050	1 170	16 000	24 000	NK14/16R+IR10×14×16
	22	20	0.3	14	0.5	13 000	15 600	1 330	1 590	16 000	24 000	NK14/20R+IR10×14×20
	28	16	0.3	16	1.5	12 600	13 900	1 290	1 410	15 000	23 000	NKS16+IR10×16×16
12	24	13	0.3	16	0.5	9 550	10 900	975	1 110	15 000	23 000	NA4901R
	24	16	0.3	16	0.5	12 200	14 900	1 240	1 520	15 000	23 000	NK16/16R+IR12×16×16
	24	20	0.3	16	0.5	14 600	18 800	1 490	1 920	15 000	23 000	NK16/20R+IR12×16×20
	24	22	0.3	16	1	15 400	20 000	1 570	2 040	15 000	23 000	NA6901R
	30	16	0.3	18	1.5	11 600	12 800	1 180	1 300	14 000	21 000	NKS18+IR12×18×16
15	27	16	0.3	19	0.5	13 300	17 400	1 350	1 780	14 000	21 000	NK19/16R+IR15×19×16
	27	20	0.3	19	0.5	16 000	22 200	1 630	2 260	14 000	21 000	NK19/20R+IR15×19×20
	28	13	0.3	20	0.5	10 300	12 800	1 050	1 310	13 000	20 000	NA4902R

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

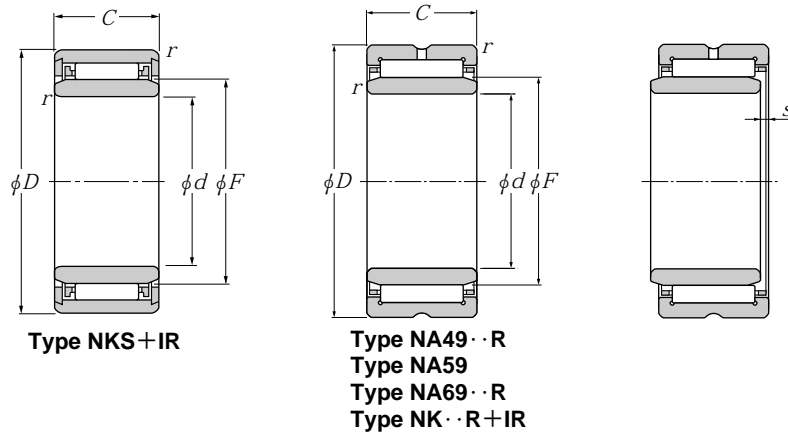
Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



Abutment dimensions			Mass kg (approx.)
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	
6.2	8.5	0.15	0.007
7	9.5	0.3	0.012
7	9.5	0.3	0.016
8	9.5	0.15	0.009
8	10.5	0.3	0.013
8	10.5	0.3	0.017
8	12	0.3	0.02
9	10.5	0.15	0.010
9	11.5	0.3	0.014
9	11.5	0.3	0.018
9	14.5	0.3	0.035
10	12	0.15	0.016
10	16.5	0.3	0.048
11	13.5	0.3	0.018
11	13.5	0.3	0.022
11	14	0.3	0.017
11	17.5	0.3	0.042
12	20	0.3	0.024
12	20	0.3	0.030
12	20	0.3	0.038
12	19	0.3	0.054
14	22	0.3	0.026
14	22	0.3	0.033
14	22	0.3	0.042
14	22	0.3	0.046
14	21	0.3	0.056
17	25	0.3	0.039
17	25	0.3	0.045
17	26	0.3	0.036

## With inner ring

Type NA49  
 Type NA59  
 Type NA69  
 Type NK+IR  
 Type NKS+IR



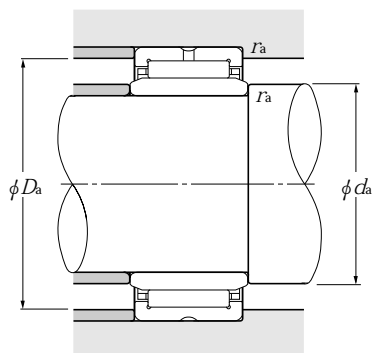
$d$  15~28mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
$d$	$D$	$C$	$r_{\min}^{1)}$	$F$	$s^{2)}$	N		kgf				
						$C_r$	$C_{or}$	$C_r$	$C_{or}$			
15	28	18	0.3	20	0.5	14 100	19 100	1 440	1 950	13 000	20 000	NA5902CT
	28	23	0.3	20	1	17 600	25 300	1 790	2 580	13 000	20 000	NA6902R
	35	20	0.6	22	1.5	17 700	23 300	1 810	2 380	12 000	18 000	NKS22+IR15×22×20
17	29	16	0.3	21	0.5	13 700	18 700	1 400	1 910	13 000	19 000	NK21/16R+IR17×21×16
	29	20	0.3	21	0.5	17 400	25 400	1 770	2 590	13 000	19 000	NK21/20R+IR17×21×20
	30	13	0.3	22	0.5	11 200	14 600	1 140	1 490	12 000	18 000	NA4903R
	30	18	0.3	22	0.5	15 200	21 700	1 550	2 210	12 000	18 000	NA5903
	30	23	0.3	22	1	18 200	27 200	1 850	2 770	12 000	18 000	NA6903R
	37	20	0.6	24	1.5	18 400	25 200	1 880	2 570	11 000	17 000	NKS24+IR17×24×20
20	32	16	0.3	24	0.5	15 200	22 300	1 550	2 280	11 000	17 000	NK24/16R+IR20×24×16
	32	20	0.3	24	0.5	18 600	28 800	1 890	2 930	11 000	17 000	NK24/20R+IR20×24×20
	37	17	0.3	25	0.8	21 300	25 500	2 170	2 600	11 000	16 000	NA4904RCT
	37	23	0.3	25	0.8	28 400	37 000	2 900	3 750	11 000	16 000	NA5904
	37	30	0.3	25	1	36 500	50 500	3 700	5 150	11 000	16 000	NA6904R
	42	20	0.6	28	2	18 100	25 800	1 850	2 630	9 500	14 000	NKS28+IR20×28×20
22	34	16	0.3	26	0.5	15 600	23 600	1 590	2 410	10 000	15 000	NK26/16R+IR22×26×16
	34	20	0.3	26	0.5	19 100	30 500	1 940	3 100	10 000	15 000	NK26/20R+IR22×26×20
	39	17	0.3	28	0.8	23 200	29 300	2 360	2 990	9 500	14 000	NA49/22R
	39	23	0.3	28	0.8	26 400	37 500	2 690	3 850	9 500	14 000	NA59/22
	39	30	0.3	28	0.5	40 000	58 500	4 050	6 000	9 500	14 000	NA69/22R
25	38	20	0.3	29	1	22 200	34 000	2 270	3 450	9 500	14 000	NK29/20R+IR25×29×20
	38	30	0.3	29	1.5	27 500	50 500	2 810	5 150	9 500	14 000	NK29/30R+IR25×29×30
	42	17	0.3	30	0.8	24 000	31 500	2 450	3 200	8 500	13 000	NA4905R
	42	23	0.3	30	0.8	30 500	43 000	3 150	4 350	8 500	13 000	NA5905
	42	30	0.3	30	1	41 500	63 000	4 200	6 400	8 500	13 000	NA6905R
	47	22	0.6	32	2	24 000	35 000	2 450	3 550	8 500	13 000	NKS32+IR25×32×22
28	42	20	0.3	32	1	23 500	37 500	2 400	3 850	8 500	13 000	NK32/20R+IR28×32×20
	42	30	0.3	32	1.5	34 000	60 500	3 450	6 150	8 500	13 000	NK32/30R+IR28×32×30
	45	17	0.3	32	0.8	24 800	33 500	2 530	3 400	8 500	13 000	NA49/28RCT
	45	23	0.3	32	0.8	32 000	45 500	3 250	4 650	8 500	13 000	NA59/28

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



Abutment dimensions			Mass
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	kg (approx.)
17	26	0.3	0.052
17	26	0.3	0.064
19	25	0.6	0.094
19	27	0.3	0.042
19	27	0.3	0.053
19	28	0.3	0.037
19	28	0.3	0.056
19	28	0.3	0.069
21	27	0.6	0.1
22	30	0.3	0.049
22	30	0.3	0.061
22	35	0.3	0.074
22	35	0.3	0.115
22	35	0.3	0.141
24	31	0.6	0.129
24	32	0.3	0.046
24	32	0.3	0.064
24	37	0.3	0.080
24	37	0.3	0.134
24	37	0.3	0.154
27	36	0.3	0.079
27	36	0.3	0.123
27	40	0.3	0.088
27	40	0.3	0.139
27	40	0.3	0.162
29	35.5	0.6	0.162
30	40	0.3	0.096
30	40	0.3	0.146
30	43	0.3	0.098
30	43	0.3	0.142

## With inner ring

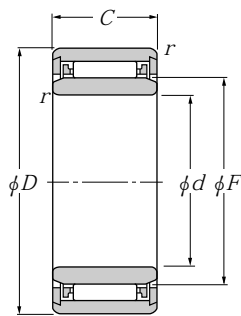
Type NA49

Type NA59

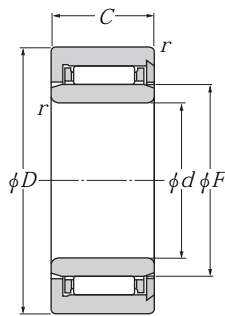
Type NA69

Type NK+IR

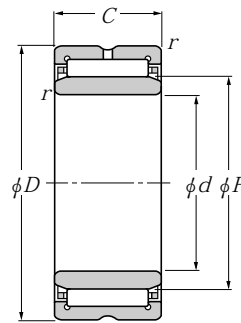
Type NKS+IR



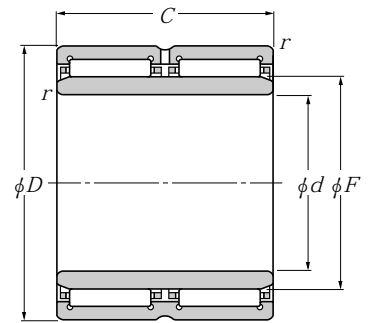
Type NKS+IR  
( $\phi d \leq 30\text{mm}$ )



Type NKS+IR  
( $\phi d \geq 35\text{mm}$ )



Type NA49·R  
Type NA59  
Type NA69·R ( $\phi d \leq 30\text{mm}$ )  
Type NK·R+IR



Type NA69·R  
( $\phi d \geq 32\text{mm}$ )

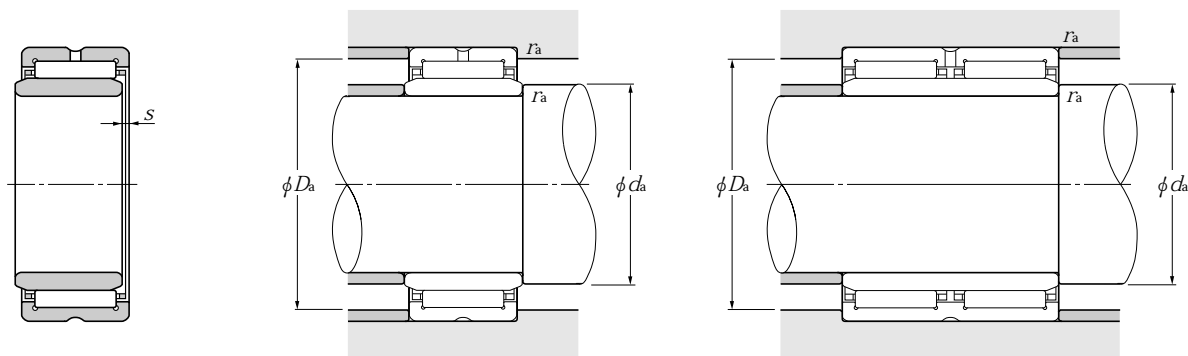
d 28~45mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
d	D	C	r <sub>3 min</sub> <sup>1)</sup>	F	s <sup>2)</sup>	C <sub>r</sub>	C <sub>0r</sub>	C <sub>r</sub>	C <sub>0r</sub>			min <sup>-1</sup>
						N						
						kgf						
28	45	30	0.3	32	1	43 000	67 000	4 350	6 850	8 500	13 000	NA69/28R
	45	20	0.3	35	0.5	24 800	41 500	2 520	4 250	7 500	11 000	NK35/20RCT+IR30×35×20
30	45	30	0.3	35	1	36 000	66 500	3 650	6 800	7 500	11 000	NK35/30R+IR30×35×30
	47	17	0.3	35	0.8	25 500	35 500	2 600	3 600	7 500	11 000	NA4906R
	47	23	0.3	35	0.8	32 500	48 500	3 350	4 950	7 500	11 000	NA5906
	47	30	0.3	35	1	42 500	67 500	4 300	6 900	7 500	11 000	NA6906R
	52	22	0.6	37	2	26 300	41 000	2 680	4 150	7 500	11 000	NKS37+IR30×37×22
32	47	20	0.3	37	0.5	25 300	43 500	2 580	4 400	7 500	11 000	NK37/20R+IR32×37×20
	47	30	0.3	37	1	36 500	69 500	3 750	7 100	7 500	11 000	NK37/30R+IR32×37×30
	52	20	0.6	40	0.8	31 500	47 500	3 200	4 850	6 500	10 000	NA49/32R
	52	27	0.6	40	0.8	38 000	61 000	3 850	6 250	6 500	10 000	NA59/32
	52	36	0.6	40	0.5	47 500	82 000	4 850	8 350	6 500	10 000	NA69/32R
35	50	20	0.3	40	0.5	26 400	47 000	2 700	4 800	6 500	10 000	NK40/20R+IR35×40×20
	50	30	0.3	40	1	38 500	76 000	3 900	7 750	6 500	10 000	NK40/30R+IR35×40×30
	55	20	0.6	42	0.8	32 000	50 000	3 300	5 100	6 500	9 500	NA4907R
	55	27	0.6	42	0.8	39 000	64 500	3 950	6 550	6 500	9 500	NA5907
	55	36	0.6	42	0.5	49 000	86 500	5 000	8 800	6 500	9 500	NA6907R
	58	22	0.6	43	1.5	29 100	49 000	2 960	5 000	6 500	9 500	NKS43+IR35×43×22
38	53	20	0.3	43	0.5	27 500	51 000	2 810	5 200	6 500	9 500	NK43/20R+IR38×43×20
	53	30	0.3	43	1	40 000	82 000	4 100	8 400	6 500	9 500	NK43/30R+IR38×43×30
40	55	20	0.3	45	0.5	28 000	52 500	2 860	5 400	6 000	9 000	NK45/20R+IR40×45×20
	55	30	0.3	45	1	41 000	85 500	4 150	8 700	6 000	9 000	NK45/30R+IR40×45×30
	62	22	0.6	48	1	43 500	66 500	4 450	6 800	5 500	8 500	NA4908RCT
	62	30	0.6	48	1	53 000	92 500	5 450	9 450	5 500	8 500	NA5908
	62	40	0.6	48	0.5	67 000	116 000	6 850	11 800	5 500	8 500	NA6908R
	65	22	1	50	1.5	31 500	57 000	3 200	5 800	5 500	8 000	NKS50+IR40×50×22
42	57	20	0.3	47	0.5	28 800	55 500	2 940	5 650	5 500	8 500	NK47/20RCT+IR42×47×20
	57	30	0.3	47	1	42 500	91 500	4 350	9 350	5 500	8 500	NK47/30R+IR42×47×30
45	62	25	0.6	50	1.5	38 500	74 500	3 950	7 550	5 500	8 000	NK50/25RCT+IR45×50×25

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

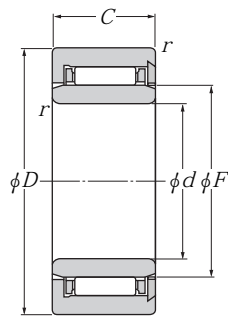
Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



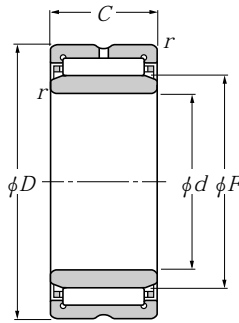
Abutment dimensions			Mass kg (approx.)
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	
30	43	0.3	0.179
32	43	0.3	0.112
32	43	0.3	0.171
32	45	0.3	0.101
32	45	0.3	0.152
32	45	0.3	0.185
34	40.5	0.6	0.184
34	45	0.3	0.117
34	45	0.3	0.170
36	48	0.6	0.157
36	48	0.6	0.241
36	48	0.6	0.286
37	48	0.3	0.130
37	48	0.3	0.193
39	51	0.6	0.171
39	51	0.6	0.256
39	51	0.6	0.310
39	46.5	0.6	0.229
40	51	0.3	0.134
40	51	0.3	0.207
42	53	0.3	0.143
42	53	0.3	0.216
44	58	0.6	0.232
44	58	0.6	0.348
44	58	0.6	0.426
45	53.5	1	0.263
44	55	0.3	0.148
44	55	0.3	0.222
48	58	0.6	0.229

## With inner ring

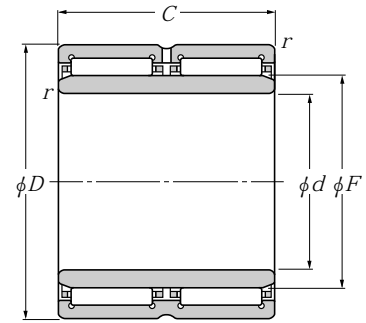
Type NA49  
 Type NA59  
 Type NA69  
 Type NK+IR  
 Type NKS+IR



Type NKS+IR



Type NA49·R  
 Type NA59  
 Type NK·R+IR



Type NA69·R

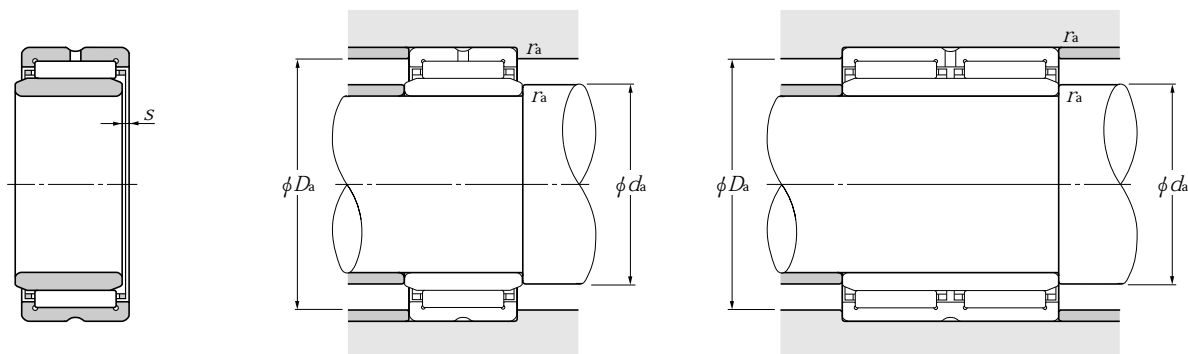
d 45~70mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
d	D	C	r <sub>3 min</sub> <sup>1)</sup>	F	s <sup>2)</sup>	C <sub>r</sub>	C <sub>0r</sub>	C <sub>r</sub>	C <sub>0r</sub>			min <sup>-1</sup>
						N						
						kgf						
45	62	35	0.6	50	2	51 000	106 000	5 200	10 800	5 500	8 000	NK50/35R+IR45×50×35
	68	22	0.6	52	1	46 000	73 000	4 700	7 450	5 000	7 500	NA4909R
	68	30	0.6	52	1	56 000	101 000	5 700	10 300	5 000	7 500	NA5909
	68	40	0.6	52	0.5	70 500	127 000	7 200	13 000	5 000	7 500	NA6909R
	72	22	1	55	1.5	33 500	63 000	3 400	6 450	5 000	7 500	NKS55+IR45×55×22
50	68	25	0.6	55	1.5	41 000	82 000	4 150	8 400	5 000	7 500	NK55/25R+IR50×55×25
	68	35	0.6	55	2	54 000	118 000	5 500	12 000	5 000	7 500	NK55/35R+IR50×55×35
	72	22	0.6	58	1	48 000	80 000	4 900	8 150	4 700	7 000	NA4910R
	72	30	0.6	58	1	58 000	110 000	5 950	11 200	4 700	7 000	NA5910
	72	40	0.6	58	0.5	74 000	139 000	7 500	14 200	4 700	7 000	NA6910R
55	80	28	1.1	60	2.5	44 500	85 000	4 500	8 700	4 300	6 500	NKS60+IR50×60×28
	72	25	0.6	60	1.5	41 000	85 000	4 200	8 700	4 300	6 500	NK60/25R+IR55×60×25
	72	35	0.6	60	2	57 000	130 000	5 800	13 200	4 300	6 500	NK60/35R+IR55×60×35
	80	25	1	63	1.5	58 500	99 500	6 000	10 100	4 300	6 500	NA4911R
	80	34	1	63	1.5	76 500	140 000	7 800	14 300	4 300	6 500	NA5911
	80	45	1	63	1.5	94 000	183 000	9 600	18 600	4 300	6 500	NA6911R
60	85	28	1.1	65	2.5	47 000	94 000	4 800	9 600	4 000	6 000	NKS65+IR55×65×28
	82	25	1	68	1	44 500	89 000	4 500	9 050	4 000	6 000	NK68/25R+IR60×68×25
	82	35	0.6	68	1	63 000	139 000	6 400	14 200	4 000	6 000	NK68/35R+IR60×68×35
	85	25	1	68	1.5	61 500	108 000	6 250	11 000	4 000	6 000	NA4912R
	85	34	1	68	1.5	80 500	153 000	8 200	15 600	4 000	6 000	NA5912
	85	45	1	68	1.5	95 500	191 000	9 750	19 400	4 000	6 000	NA6912R
65	90	28	1.1	70	2.5	49 500	103 000	5 050	10 500	3 700	5 500	NKS70+IR60×70×28
	90	25	0.6	73	1	54 000	100 000	5 500	10 200	3 700	5 500	NK73/25R+IR65×73×25
	90	25	1	72	1.5	62 500	112 000	6 350	11 400	3 700	5 500	NA4913R
	90	34	1	72	1.5	84 000	165 000	8 600	16 800	3 700	5 500	NA5913
	90	35	0.6	73	1	76 500	156 000	7 800	16 000	3 700	5 500	NK73/35R+IR65×73×35
	90	45	1	72	1.5	97 000	198 000	9 900	20 200	3 700	5 500	NA6913R
70	95	25	1	80	0.8	50 500	109 000	5 150	11 100	3 700	5 500	NKS75+IR65×75×28
70	95	25	1	80	0.8	57 000	119 000	5 800	12 200	3 300	5 000	NK80/25R+IR70×80×25

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



Abutment dimensions			Mass kg (approx.)
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	
48	58	0.6	0.322
49	64	0.6	0.270
49	64	0.6	0.396
49	64	0.6	0.437
50	58.5	1	0.351
<hr/>			
53	64	0.6	0.271
53	64	0.6	0.379
54	68	0.6	0.276
54	68	0.6	0.498
54	68	0.6	0.529
56.5	64	1.1	0.518
<hr/>			
58	68	0.6	0.271
58	68	0.6	0.379
60	75	1	0.396
60	75	1	0.559
60	75	1	0.726
61.5	69	1.1	0.562
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65	77	0.6	0.393
64	78	0.6	0.551
65	80	1	0.427
65	80	1	0.614
65	80	1	0.758
66.5	74	1.1	0.591
<hr/>			
69	86	0.6	0.466
70	85	1	0.454
70	85	1	0.655
69	86	0.6	0.660
70	85	1	0.779
71.5	79	1.1	0.642
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75	90	1	0.525

## With inner ring

Type NA48

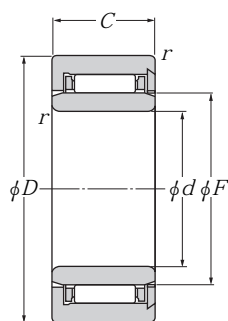
Type NA49

Type NA59

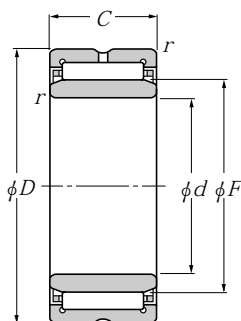
Type NA69

Type NK+IR

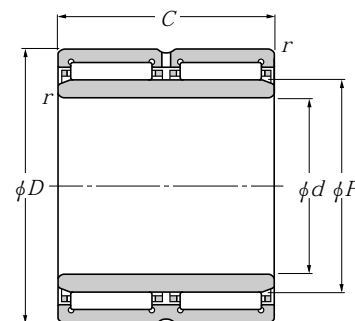
Type NKS+IR



Type NKS+IR



Type NA49·R  
Type NA59  
Type NK·R+IR



Type NA69·R

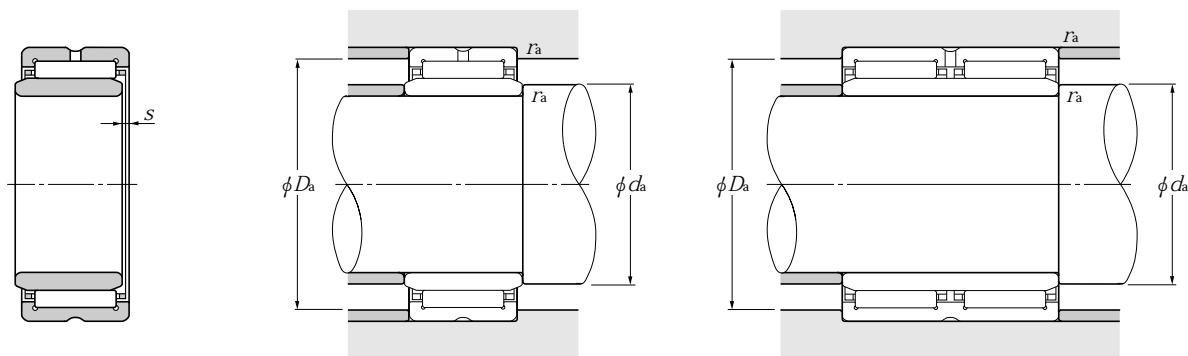
d 70~95mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	min <sup>-1</sup>		
d	D	C	r <sub>3 min</sub> <sup>1)</sup>	F	s <sup>2)</sup>	C <sub>r</sub>	C <sub>0r</sub>	C <sub>r</sub>	C <sub>0r</sub>	grease	oil	
70	95	35	1	80	0.8	79 500	184 000	8 150	18 700	3 300	5 000	NK80/35R+IR70×80×35
	100	28	1.1	80	2.5	53 000	118 000	5 400	12 100	3 300	5 000	NKS80+IR70×80×28
	100	30	1	80	1.5	85 500	156 000	8 750	15 900	3 300	5 000	NA4914R
	100	40	1	80	1.5	103 000	187 000	10 500	19 100	3 300	5 000	NA5914
	100	54	1	80	1	130 000	267 000	13 300	27 200	3 300	5 000	NA6914R
75	105	25	1	85	1	70 500	123 000	7 200	12 600	3 100	4 700	NK85/25R+IR75×85×25
	105	30	1	85	1.5	87 000	162 000	8 900	16 500	3 100	4 700	NA4915R
	105	35	1	85	1	100 000	193 000	10 200	19 700	3 100	4 700	NK85/35R+IR75×85×35
	105	40	1	85	1.5	109 000	205 000	11 100	20 900	3 100	4 700	NA5915
	105	54	1	85	1	132 000	277 000	13 500	28 300	3 100	4 700	NA6915R
80	110	32	1.1	90	1.5	64 000	157 000	6 550	16 000	2 900	4 400	NKS90+IR75×90×32
	110	25	1	90	1	71 500	128 000	7 300	13 100	2 900	4 400	NK90/25R+IR80×90×25
	110	30	1	90	1.5	90 500	174 000	9 250	17 700	2 900	4 400	NA4916R
	110	35	1	90	1	104 000	208 000	10 600	21 200	2 900	4 400	NK90/35R+IR80×90×35
	110	40	1	90	1.5	115 000	223 000	11 700	22 700	2 900	4 400	NA5916
	110	54	1	90	1.5	138 000	298 000	14 000	30 500	2 900	4 400	NA6916R
85	115	32	1.1	95	2.5	65 500	165 000	6 700	16 800	2 800	4 200	NKS95+IR80×95×32
	115	26	1	95	1.5	74 500	137 000	7 600	14 000	2 800	4 200	NK95/26R+IR85×95×26
	115	36	1	95	1.5	108 000	223 000	11 100	22 700	2 800	4 200	NK95/36R+IR85×95×36
	120	32	1.1	100	3	61 000	153 000	6 250	15 600	2 700	4 000	NKS100+IR85×100×32
	120	35	1.1	100	1	112 000	237 000	11 500	24 200	2 700	4 000	NA4917R
	120	46	1.1	100	1.5	137 000	290 000	14 000	29 600	2 700	4 000	NA5917
90	120	63	1.1	100	1	169 000	400 000	17 300	41 000	2 700	4 000	NA6917R
	120	26	1	100	1.5	73 500	137 000	7 500	14 000	2 700	4 000	NK100/26R+IR90×100×26
	120	36	1	100	1.5	107 000	223 000	11 000	22 800	2 700	4 000	NK100/36R+IR90×100×36
	125	32	1.1	105	2	67 500	176 000	6 850	18 000	2 500	3 800	NKS105+IR90×105×32
	125	35	1.1	105	1	116 000	252 000	11 900	25 700	2 500	3 800	NA4918R
	125	46	1.1	105	1	143 000	310 000	14 600	32 000	2 500	3 800	NA5918
95	125	63	1.1	105	1	175 000	425 000	17 900	43 500	2 500	3 800	NA6918R
	125	26	1	105	1.5	76 500	147 000	7 800	14 900	2 500	3 800	NK105/26R+IR95×105×26

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

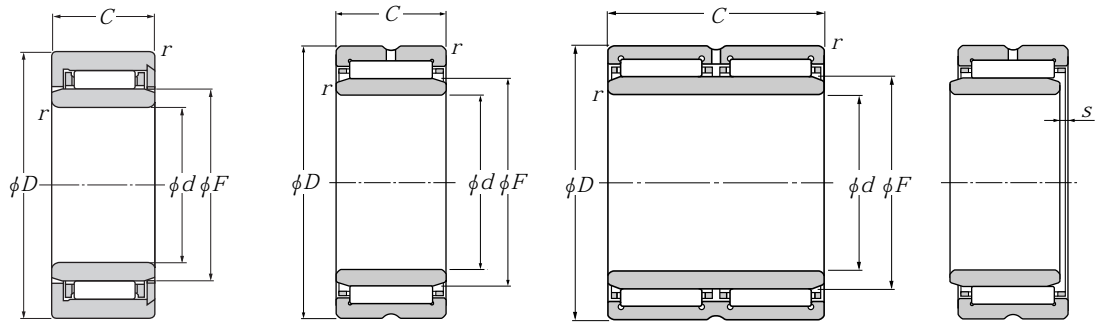
Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



Abutment dimensions			Mass kg (approx.)
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	
75	90	1	0.738
76.5	84	1.1	0.663
75	95	1	0.727
75	95	1	1.06
75	95	1	1.34
<hr/>			
80	100	1	0.642
80	100	1	0.776
80	100	1	0.853
80	100	1	1.13
80	100	1	1.45
81.5	94	1.1	1.19
<hr/>			
85	105	1	0.680
85	105	1	0.820
85	105	1	0.959
85	105	1	1.15
85	105	1	1.53
86.5	99	1.1	1.28
<hr/>			
90	110	1	0.644
90	110	1	1.05
91.5	104	1.1	1.2
91.5	113.5	1	1.24
91.5	113.5	1	1.76
91.5	104	1.1	2.25
<hr/>			
95	115	1	0.781
95	115	1	1.09
96.5	109	1.1	1.24
96.5	118.5	1	1.84
96.5	118.5	1	2.44
96.5	109	1.1	2.37
<hr/>			
100	120	1	0.819

## With inner ring

Type NA48  
 Type NA49  
 Type NA59  
 Type NA69  
 Type NK+IR  
 Type NKS+IR



Type NKS+IR  
( $\phi d \leq 95\text{mm}$ )

Type NA48  
 Type NA49·R, Type NA49  
 Type NA59  
 Type NK·R+IR, Type NK+IR  
 Type NKS+IR ( $\phi d \geq 100\text{mm}$ )

Type NA69·R

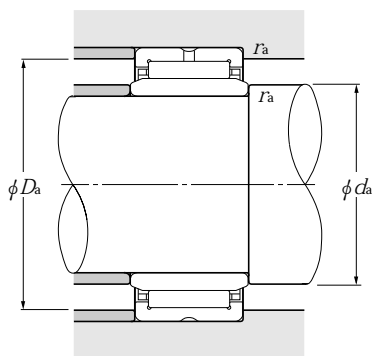
$d$  95~140mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
$d$	$D$	$C$	$r_{3\text{min}}^{1)}$	$F$	$s^{2)}$	$C_r$	$C_{or}$	$C_r$	$C_{or}$			
95	125	36	1	105	1.5	111 000	238 000	11 400	24 300	2 500	3 800	NK105/36R+IR95×105×36
	130	32	1.1	110	3	64 500	170 000	6 600	17 300	2 400	3 600	NKS110+IR95×110×32
	130	35	1.1	110	1	118 000	260 000	12 000	26 500	2 400	3 600	NA4919R
	130	46	1.1	110	1	149 000	335 000	15 200	34 000	2 400	3 600	NA5919
	130	63	1.1	110	1	177 000	440 000	18 100	45 000	2 400	3 600	NA6919R
100	130	30	1.1	110	1.5	97 500	204 000	9 950	20 800	2 400	3 600	NK110/30R+IR100×110×30
	130	40	1.1	110	2	129 000	292 000	13 100	29 700	2 400	3 600	NK110/40R+IR100×110×40
	135	32	1.1	115	1.5	90 500	199 000	9 250	20 300	2 300	3 500	NKS115+IR100×115×32
	140	40	1.1	115	2	127 000	260 000	12 900	26 500	2 300	3 500	NA4920
	140	54	1.1	115	2	182 000	395 000	18 600	40 500	2 300	3 500	NA5920
110	140	30	1	120	0.8	93 500	210 000	9 550	21 400	2 200	3 300	NA4822
	140	40	1.1	120	—	113 000	268 000	11 500	27 300	2 200	3 300	NK120/40+IR110×120×40
	150	40	1.1	125	2	131 000	279 000	13 300	28 400	2 100	3 200	NA4922
	150	54	1.1	125	2	193 000	440 000	19 700	45 000	2 100	3 200	NA5922
120	150	30	1	130	0.8	99 500	233 000	10 100	23 800	2 100	3 100	NA4824
	150	40	1.1	130	—	116 000	283 000	11 800	28 800	2 100	3 100	NK130/40+IR120×130×40
	160	40	2	135	2.5	135 000	298 000	13 800	30 500	2 000	3 000	NKS135+IR120×135×40
	165	45	1.1	135	2	180 000	380 000	18 300	38 500	2 000	3 000	NA4924
	165	60	1.1	135	2	246 000	530 000	25 100	54 000	2 000	3 000	NA5924
130	165	35	1.1	145	1	118 000	305 000	12 100	31 000	1 900	2 800	NA4826
	170	32	1.5	145	—	111 000	238 000	11 300	24 300	1 900	2 800	NK145/32+IR130×145×32
	170	42	1.5	145	—	153 000	360 000	15 600	36 500	1 900	2 800	NK145/42+IR130×145×42
	180	50	1.5	150	1.5	202 000	455 000	20 600	46 500	1 800	2 700	NA4926
	180	52	2	150	3	202 000	455 000	20 600	46 500	1 800	2 700	NKS150+IR130×150×52
	180	67	1.5	150	1.5	296 000	690 000	30 000	70 500	1 800	2 700	NA5926
140	175	35	1.1	155	1	121 000	315 000	12 300	32 500	1 700	2 600	NA4828
	180	32	1.5	155	—	114 000	252 000	11 600	25 700	1 700	2 600	NK155/32+IR140×155×32
	180	42	1.5	155	—	156 000	380 000	16 000	38 500	1 700	2 600	NK155/42+IR140×155×42
	190	50	1.5	160	1.5	209 000	485 000	21 300	49 500	1 700	2 500	NA4928
	190	52	2	160	3	209 000	485 000	21 300	49 500	1 700	2 500	NKS160+IR140×160×52

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.



Abutment dimensions			Mass
$d_a$	mm		kg
min	max	$r_{as}^{3)}$ max	(approx.)
100	120	1	1.15
101.5	114	1.1	1.29
101.5	123.5	1	1.36
101.5	123.5	1	1.98
101.5	123.5	1	2.63
106.5	123.5	1	0.990
106.5	123.5	1	1.34
106.5	128.5	1.1	1.32
106.5	133.5	1	1.93
106.5	133.5	1	2.85
115	135	1	1.11
116.5	133.5	1	1.49
116.5	143.5	1	2.08
116.5	143.5	1	2.98
125	145	1	1.17
126.5	143.5	1	1.57
129	151	2	2.2
126.5	158.5	1	2.84
126.5	158.5	1	3.92
136.5	158.5	1	1.60
138	162.5	1.5	1.90
138	162.5	1.5	2.54
138	172	1.5	3.90
139	171	2	4.07
138	172	1.5	5.60
146.5	168.5	1	1.82
148	172	1.5	2.04
148	172	1.5	2.69
148	182	1.5	4.05
149	181	2	4.23

## With inner ring

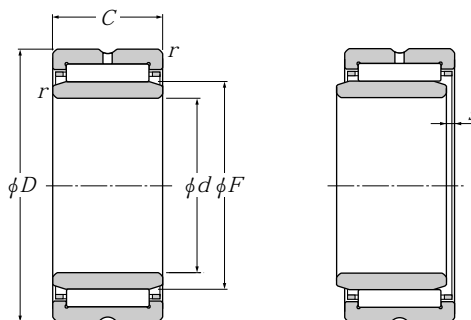
Type NA48

Type NA49

Type NA59

Type NK+IR

Type NKS+IR



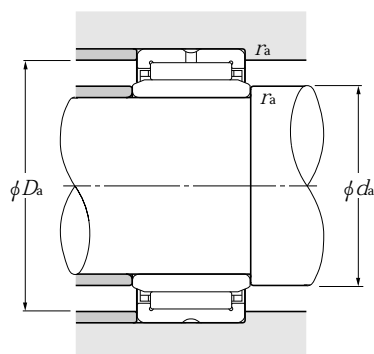
$d$  140~320mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
$d$	$D$	$C$	$r_{3\min}^{1)}$	$F$	$s^{2)}$	N	N	kgf	kgf			
						$C_r$	$C_{or}$	$C_r$	$C_{or}$			
140	190	67	1.5	160	1.5	315 000	760 000	32 000	77 500	1 700	2 500	NA5928
	190	32	1.5	165	—	117 000	265 000	11 900	27 000	1 600	2 400	NK165/32+IR150×165×32
	190	40	1.1	165	1.5	152 000	390 000	15 500	40 000	1 600	2 400	NA4830
150	190	42	1.5	165	—	160 000	400 000	16 300	40 500	1 600	2 400	NK165/42+IR150×165×42
	200	52	2	170	3	215 000	515 000	21 900	52 500	1 600	2 400	NKS170+IR150×170×52
	210	60	2	170	1.5	261 000	610 000	26 600	62 500	1 600	2 400	NA4930
160	200	40	1.1	175	1.5	160 000	425 000	16 300	43 500	1 500	2 300	NA4832
	220	60	2	180	1.5	270 000	650 000	27 600	66 500	1 500	2 200	NA4932
170	215	45	1.1	185	1.5	185 000	495 000	18 800	50 500	1 500	2 200	NA4834
	230	60	2	190	1.5	279 000	690 000	28 500	70 500	1 400	2 100	NA4934
180	225	45	1.1	195	1.5	195 000	540 000	19 800	55 000	1 400	2 100	NA4836
	250	69	2	205	1.5	375 000	890 000	38 500	90 500	1 300	2 000	NA4936
190	240	50	1.5	210	1.5	227 000	680 000	23 200	69 000	1 300	1 900	NA4838
	260	69	2	215	1.5	390 000	945 000	40 000	96 500	1 300	1 900	NA4938
200	250	50	1.5	220	1.5	231 000	705 000	23 600	71 500	1 200	1 800	NA4840
	280	80	2.1	225	1.5	505 000	1 180 000	51 500	120 000	1 200	1 800	NA4940
220	270	50	1.5	240	1.5	244 000	780 000	24 900	79 500	1 100	1 700	NA4844
	300	80	2.1	245	1.5	525 000	1 270 000	53 500	129 000	1 100	1 600	NA4944
240	300	60	2	265	2	360 000	1 080 000	37 000	110 000	1 000	1 500	NA4848
	320	80	2.1	265	2	540 000	1 350 000	55 000	138 000	1 000	1 500	NA4948
260	320	60	2	285	2	375 000	1 160 000	38 000	119 000	950	1 400	NA4852
	360	100	2.1	290	2	805 000	1 900 000	82 000	193 000	950	1 400	NA4952
280	350	69	2	305	2.5	455 000	1 300 000	46 500	133 000	850	1 300	NA4856
	380	100	2.1	310	2.5	835 000	2 030 000	85 000	207 000	850	1 300	NA4956
300	380	80	2.1	330	2	625 000	1 770 000	64 000	180 000	800	1 200	NA4860
	420	118	3	340	2	1 080 000	2 640 000	110 000	269 000	800	1 200	NA4960
320	400	80	2.1	350	2	640 000	1 850 000	65 500	189 000	750	1 100	NA4864
	440	118	3	360	2	1 120 000	2 820 000	114 000	288 000	750	1 100	NA4964

Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.

3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: Nominal code number of inner ring (IR) comprises the codes of IR bore diameter×outer diameter×width.

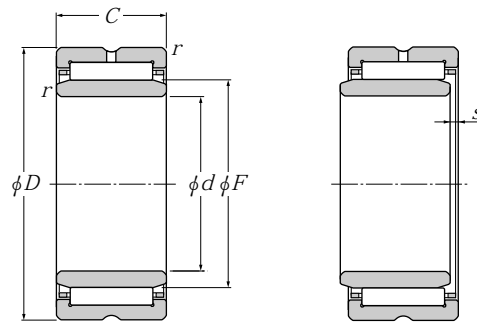


Abutment dimensions			Mass
$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	kg (approx.)
148	182	1.5	6.18
158	182	1.5	2.32
156.5	183.5	1	2.72
158	182	1.5	2.84
159	191	2	4.59
159	201	2	5.33
166.5	193.5	1	2.90
169	211	2	5.60
176.5	208.5	1	3.99
179	221	2	5.87
186.5	218.5	1	4.19
189	241	2	8.58
198	232	1.5	5.62
199	251	2	8.68
208	242	1.5	5.84
211	269	2	12.2
228	262	1.5	6.37
231	289	2	13.5
249	291	2	10.0
251	309	2	14.7
269	311	2	10.8
271	349	2	25.9
289	341	2	15.5
291	369	2	27.5
311	369	2	22.0
313	407	2.5	42.5
331	389	2	23.2
333	427	2.5	45.2

## With inner ring

Type NA48

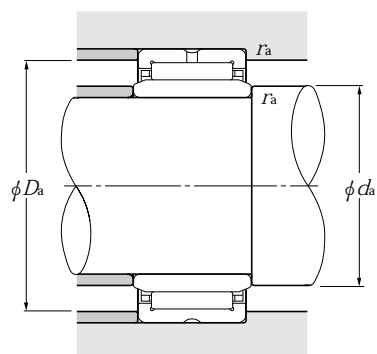
Type NA49



$d$  340~440mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
$d$	$D$	$C$	$r_{3\min}^{1)}$	$F$	$s^{2)}$	N		kgf				
						$C_r$	$C_{or}$	$C_r$	$C_{or}$			
<b>340</b>	420	80	2.1	370	2	655 000	1 940 000	66 500	197 000	750	1 100	<b>NA4868</b>
	460	118	3	380	2	1 160 000	3 000 000	118 000	305 000	750	1 100	<b>NA4968</b>
<b>360</b>	440	80	2.1	390	2	665 000	2 020 000	68 000	206 000	650	1 000	<b>NA4872</b>
	480	118	3	400	2	1 200 000	3 200 000	122 000	325 000	650	1 000	<b>NA4972</b>
<b>380</b>	480	100	2.1	415	2	1 000 000	2 840 000	102 000	289 000	650	950	<b>NA4876</b>
	520	140	4	430	2	1 400 000	3 750 000	143 000	385 000	650	950	<b>NA4976</b>
<b>400</b>	540	140	4	450	2.5	1 450 000	4 000 000	148 000	410 000	600	900	<b>NA4980</b>
<b>420</b>	560	140	4	470	2.5	1 500 000	4 250 000	153 000	430 000	550	850	<b>NA4984</b>
<b>440</b>	600	160	4	490	2.5	1 750 000	4 600 000	179 000	470 000	550	800	<b>NA4988</b>

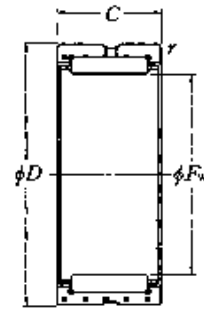
Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.  
3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Abutment dimensions			Mass
$d_a$	mm		kg
min	max	$r_{as}^{3)}$ max	(approx.)
351	409	2	24.1
353	447	2.5	47.3
371	429	2	25.7
373	467	2.5	49.0
391	469	2	44.5
396	504	3	73.6
416	524	3	76.6
436	544	3	89.8
456	584	3	123

## Inch series Without inner ring

### Type MR

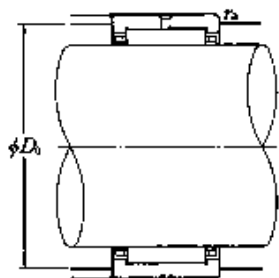


$F_w$  15.875~63.500mm

$F_w$	Boundary dimensions				dynamic N	Basic load ratings				Limiting speeds	
	mm ( $\frac{1}{25.4}$ mm)					static	dynamic	static	dynamic	grease	oil
		$D$	$C$	$r_3$ min <sup>1)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$	r/min (approx.)		
<b>15.875</b> ( $\frac{5}{8}$ )	+0.027 +0.016	28.575( $1\frac{1}{8}$ )	19.05( $\frac{3}{4}$ )	0.6	16 700	16 700	1 700	1 700	17 000	25 000	
		28.575( $1\frac{1}{8}$ )	25.40(1)	0.6	21 500	23 000	2 190	2 350	17 000	25 000	
<b>19.050</b> ( $\frac{3}{4}$ )	+0.033 +0.020	31.750( $1\frac{1}{4}$ )	19.05( $\frac{3}{4}$ )	1	19 500	21 100	1 980	2 150	14 000	21 000	
		31.750( $1\frac{1}{4}$ )	25.40(1)	1	25 000	29 100	2 550	2 970	14 000	21 000	
<b>22.225</b> ( $\frac{7}{8}$ )	+0.033 +0.020	34.925( $1\frac{3}{8}$ )	19.05( $\frac{3}{4}$ )	1	21 900	25 600	2 240	2 610	12 000	18 000	
		34.925( $1\frac{3}{8}$ )	25.40(1)	1	28 200	35 500	2 870	3 600	12 000	18 000	
<b>25.400</b> (1)	+0.033 +0.020	38.100( $1\frac{1}{2}$ )	19.05( $\frac{3}{4}$ )	1	23 000	28 100	2 340	2 870	11 000	16 000	
		38.100( $1\frac{1}{2}$ )	25.40(1)	1	29 500	38 500	3 000	3 950	11 000	16 000	
<b>28.575</b> ( $1\frac{1}{8}$ )	+0.033 +0.020	41.275( $1\frac{5}{8}$ )	25.40(1)	1	32 500	45 000	3 300	4 600	9 500	14 000	
		41.275( $1\frac{5}{8}$ )	31.75( $1\frac{1}{4}$ )	1	40 500	60 000	4 100	6 100	9 500	14 000	
<b>31.750</b> ( $1\frac{1}{4}$ )	+0.041 +0.025	44.450( $1\frac{3}{4}$ )	25.40(1)	1	35 000	51 000	3 550	5 200	8 500	13 000	
		44.450( $1\frac{3}{4}$ )	31.75( $1\frac{1}{4}$ )	1	43 500	68 000	4 450	6 950	8 500	13 000	
<b>34.925</b> ( $1\frac{3}{8}$ )	+0.041 +0.025	47.625( $1\frac{7}{8}$ )	25.40(1)	1	37 000	57 500	3 800	5 850	7 500	11 000	
		47.625( $1\frac{7}{8}$ )	31.75( $1\frac{1}{4}$ )	1	46 500	76 500	4 750	7 800	7 500	11 000	
<b>38.100</b> ( $1\frac{1}{2}$ )	+0.041 +0.025	52.388( $2\frac{1}{16}$ )	25.40(1)	1.5	41 000	61 000	4 150	6 250	7 500	11 000	
		52.388( $2\frac{1}{16}$ )	31.75( $1\frac{1}{4}$ )	1.5	51 000	81 500	5 200	8 300	7 500	11 000	
<b>41.275</b> ( $1\frac{5}{8}$ )	+0.041 +0.025	55.562( $2\frac{3}{16}$ )	25.40(1)	1.5	43 500	68 000	4 450	6 950	6 500	9 500	
		55.562( $2\frac{3}{16}$ )	31.75( $1\frac{1}{4}$ )	1.5	54 500	90 500	5 550	9 250	6 500	9 500	
<b>44.450</b> ( $1\frac{3}{4}$ )	+0.041 +0.025	58.738( $2\frac{5}{16}$ )	25.40(1)	1.5	44 500	72 000	4 550	7 350	6 000	9 000	
		58.738( $2\frac{5}{16}$ )	31.75( $1\frac{1}{4}$ )	1.5	55 500	95 500	5 700	9 750	6 000	9 000	
<b>47.625</b> ( $1\frac{7}{8}$ )	+0.041 +0.025	61.912( $2\frac{7}{16}$ )	31.75( $1\frac{1}{4}$ )	1.5	59 000	105 000	6 000	10 700	5 500	8 500	
<b>50.800</b> (2)	+0.049 +0.030	65.088( $2\frac{9}{16}$ )	25.40(1)	1.5	49 500	86 000	5 050	8 800	5 500	8 000	
		65.088( $2\frac{9}{16}$ )	31.75( $1\frac{1}{4}$ )	1.5	62 000	114 000	6 300	11 700	5 500	8 000	
<b>57.150</b> ( $2\frac{1}{4}$ )	+0.049 +0.030	76.200(3)	38.10( $1\frac{1}{2}$ )	1.5	83 500	142 000	8 500	14 500	4 700	7 000	
		76.200(3)	44.45( $1\frac{3}{4}$ )	1.5	97 000	173 000	9 850	17 600	4 700	7 000	
<b>63.500</b> ( $2\frac{1}{2}$ )	+0.049 +0.030	82.550( $3\frac{1}{4}$ )	38.10( $1\frac{1}{2}$ )	2	88 000	158 000	8 950	16 100	4 300	6 500	

Note 1) Allowable minimum chamfer dimension  $r_3$ .

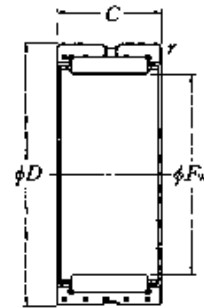
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Bearing numbers	Abutment dimensions mm		Mass kg (approx.)
	$D_a$ max	$r_{as}^{(2)}$ max	
<b>MR101812</b>	24.5	0.6	0.050
<b>MR101816</b>	24.5	0.6	0.068
<b>MR122012</b>	26.5	1	0.055
<b>MR122016</b>	26.5	1	0.073
<b>MR142212</b>	30	1	0.059
<b>MR142216</b>	30	1	0.082
<b>MR162412</b>	33	1	0.068
<b>MR162416</b>	33	1	0.091
<b>MR182616</b>	36.5	1	0.100
<b>MR182620</b>	36.5	1	0.127
<b>MR202816</b>	39.5	1	0.109
<b>MR202820</b>	39.5	1	0.136
<b>MR223016</b>	42.5	1	0.118
<b>MR223020</b>	42.5	1	0.150
<b>MR243316</b>	46	1.5	0.143
<b>MR243320</b>	46	1.5	0.180
<b>MR263516</b>	49	1.5	0.153
<b>MR263520</b>	49	1.5	0.191
<b>MR283716</b>	52	1.5	0.163
<b>MR283720</b>	52	1.5	0.204
<b>MR303920</b>	55.5	1.5	0.216
<b>MR324116</b>	58.5	1.5	0.183
<b>MR324120</b>	58.5	1.5	0.227
<b>MR364824</b>	69.5	1.5	0.422
<b>MR364828</b>	69.5	1.5	0.493
<b>MR405224</b>	74.5	2	0.472

## Inch series Without inner ring

### Type MR

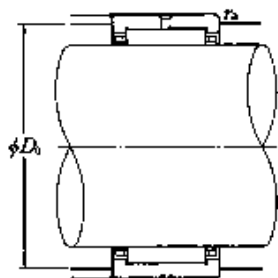


$F_w$  63.500~184.150mm

Boundary dimensions				Basic load ratings				Limiting speeds		
$F_w$	mm			dynamic	static	dynamic	static	r/min		
	$D$	$C$	$r_3$ (min <sup>1)</sup> )	$C_r$	$C_{or}$	$C_r$	$C_{or}$	grease	oil	
63.500(2 1/2)	+0.049 +0.030	82.550(3 1/4)	44.45(1 3/4)	2	102 000	191 000	10 400	19 500	4 300	6 500
		88.900(3 1/2)	25.40(1)	2	66 000	112 000	6 700	11 400	3 700	5 500
69.850(2 3/4)	+0.049 +0.030	88.900(3 1/2)	38.10(1 1/2)	2	92 000	173 000	9 400	17 600	3 700	5 500
		88.900(3 1/2)	44.45(1 3/4)	2	107 000	209 000	10 900	21 300	3 700	5 500
76.200(3)	+0.049 +0.030	95.250(3 3/4)	38.10(1 1/2)	2	96 000	188 000	9 800	19 100	3 300	5 000
		95.250(3 3/4)	44.45(1 3/4)	2	112 000	227 000	11 400	23 200	3 300	5 000
82.550(3 1/4)	+0.058 +0.036	107.950(4 1/4)	44.45(1 3/4)	2	134 000	240 000	13 600	24 500	3 300	5 000
		107.950(4 1/4)	50.80(2)	2	146 000	268 000	14 900	27 400	3 300	5 000
88.900(3 1/2)	+0.058 +0.036	114.300(4 1/2)	44.45(1 3/4)	2	141 000	264 000	14 400	26 900	3 000	4 500
		114.300(4 1/2)	50.80(2)	2	154 000	295 000	15 700	30 000	3 000	4 500
95.250(3 3/4)	+0.058 +0.036	120.650(4 3/4)	50.80(2)	2.5	162 000	320 000	16 500	32 500	2 800	4 200
101.600(4)	+0.058 +0.036	127.000(5)	50.80(2)	2.5	169 000	345 000	17 200	35 500	2 600	3 900
107.950(4 1/4)	+0.058 +0.036	133.350(5 1/4)	50.80(2)	2.5	172 000	360 000	17 500	37 000	2 500	3 700
114.300(4 1/2)	+0.058 +0.036	152.400(6)	57.15(2 1/4)	2.5	238 000	435 000	24 300	44 500	2 300	3 500
		152.400(6)	63.50(2 1/2)	2.5	260 000	485 000	26 500	49 500	2 300	3 500
127.000(5)		165.100(6 1/2)	50.80(2)	2.5	227 000	425 000	23 200	43 000	2 100	3 100
	+0.068 +0.043	165.100(6 1/2)	57.15(2 1/4)	2.5	250 000	480 000	25 500	49 000	2 100	3 100
		165.100(6 1/2)	63.50(2 1/2)	2.5	273 000	535 000	27 800	54 500	2 100	3 100
139.700(5 1/2)	+0.068 +0.043	177.800(7)	63.50(2 1/2)	2.5	285 000	585 000	29 100	59 500	1 900	2 900
		177.800(7)	76.20(3)	2.5	345 000	740 000	35 000	75 500	1 900	2 900
146.050(5 3/4)	+0.068 +0.043	184.150(7 1/4)	76.20(3)	3	360 000	775 000	36 500	79 000	1 800	2 700
152.400(6)	+0.068 +0.043	190.500(7 1/2)	63.50(2 1/2)	3	310 000	630 000	31 500	64 000	1 700	2 600
		190.500(7 1/2)	76.20(3)	3	375 000	800 000	38 000	81 500	1 700	2 600
165.100(6 1/2)	+0.068 +0.043	203.200(8)	63.50(2 1/2)	3	325 000	680 000	33 000	69 500	1 600	2 400
		203.200(8)	76.20(3)	3	390 000	870 000	39 500	88 500	1 600	2 400
184.150(7 1/4)	+0.079 +0.050	231.775(9 1/8)	76.20(3)	3	435 000	915 000	44 500	93 000	1 500	2 200

Note 1) Allowable minimum chamfer dimension  $r_3$ .

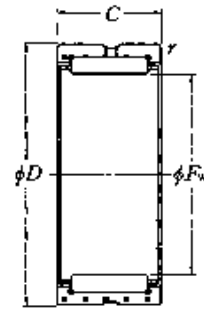
2) Max. allowable dimension of radius  $r_3$  for corner roundness on shaft/housing.



Bearing numbers	Abutment dimensions mm		Mass kg (approx.)
	$D_b$ max	$r_{as}^{(2)}$ max	
MR405228	74.5	2	0.533
MR445616	81	2	0.343
MR445624	81	2	0.504
MR445628	81	2	0.580
MR486024	87	2	0.558
MR486028	87	2	0.651
MR526828	100	2	1.02
MR526832	100	2	1.17
MR567228	106.5	2	1.08
MR567232	106.5	2	1.27
MR607632	111.5	2.5	1.28
MR648032	118	2.5	1.29
MR688432	124.5	2.5	1.36
MR729636	143.5	2.5	2.62
MR729640	143.5	2.5	2.91
MR8010432	156	2.5	2.53
MR8010436	156	2.5	2.87
MR8010440	156	2.5	3.19
MR8811240	169	2.5	3.46
MR8811248	169	2.5	4.16
MR9211648	172	3	4.30
MR9612040	177.5	3	3.74
MR9612048	177.5	3	4.49
MR10412840	190	3	4.02
MR10412848	190	3	4.82
MR11614648	219	3	7.36

## Inch series Without inner ring

### Type MR

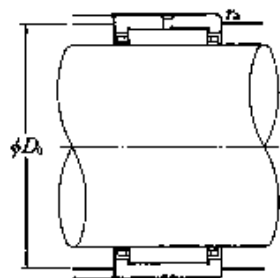


$F_w$  196.850~234.950mm

Boundary dimensions					Basic load ratings				Limiting speeds	
mm					dynamic	static	dynamic	static	r/min	
$F_w$	$D$	$C$	$r_a$ min <sup>1)</sup>		N		kgf		grease	oil
					$C_r$	$C_{or}$	$C_r$	$C_{or}$	(approx.)	
<b>196.850(7 3/4)</b>	$^{+0.079}_{+0.050}$ 244.475(9 5/8)	76.20(3)	3		455 000	990 000	46 500	101 000	1 300	2 000
<b>209.550(8 1/4)</b>	$^{+0.079}_{+0.050}$ 257.175(10 1/8)	76.20(3)	3		475 000	1 060 000	48 500	109 000	1 300	1 900
<b>222.250(8 3/4)</b>	$^{+0.079}_{+0.050}$ 269.875(10 5/8)	76.20(3)	4		495 000	1 140 000	50 500	116 000	1 200	1 800
<b>234.950(9 1/4)</b>	$^{+0.079}_{+0.050}$ 282.575(11 1/8)	76.20(3)	4		510 000	1 210 000	52 000	124 000	1 100	1 700

Note 1) Allowable minimum chamfer dimension  $r_a$ .

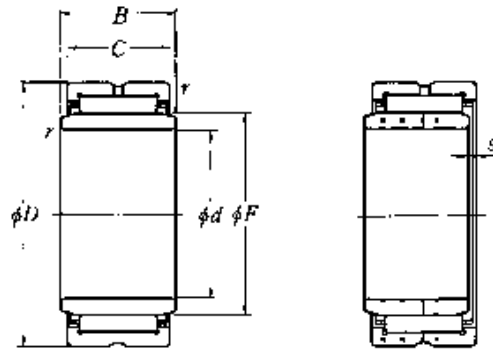
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Bearing numbers	Abutment dimensions mm		Mass kg (approx.)
	$D_s$ max	$r_{as}^{(2)}$ max	
<b>MR12415448</b>	231.5	3	7.80
<b>MR13216248</b>	244	3	8.36
<b>MR14017048</b>	254	4	8.81
<b>MR14817848</b>	266.5	4	9.27

**Inch series**  
**With inner ring**

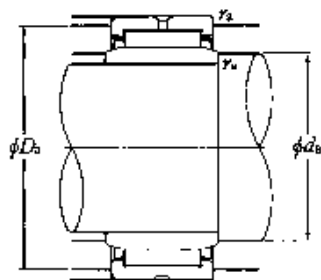
**Type MR + MI**



**d** 9.525~34.925mm

d	Boundary dimensions						Basic load ratings			
	D	B	C	$r_3$ min <sup>1)</sup>	F	$s$ <sup>2)</sup>	dynamic N	static N	dynamic kgf	static kgf
9.525( $\frac{3}{8}$ )	28.575( $1\frac{1}{8}$ )	19.30	19.05( $\frac{3}{4}$ )	0.6	15.875	2	16 700	16 700	1 700	1 700
	28.575( $1\frac{1}{8}$ )	25.65	25.40(1)	0.6	15.875	3	21 500	23 000	2 190	2 350
12.700( $\frac{1}{2}$ )	31.750( $1\frac{1}{4}$ )	19.30	19.05( $\frac{3}{4}$ )	1	19.050	4	19 500	21 100	1 980	2 150
	31.750( $1\frac{1}{4}$ )	25.65	25.40(1)	1	19.050	2	25 000	29 100	2 550	2 970
15.875( $\frac{5}{8}$ )	34.925( $1\frac{3}{8}$ )	19.30	19.05( $\frac{3}{4}$ )	1	22.225	1	21 900	25 600	2 240	2 610
	34.925( $1\frac{3}{8}$ )	25.65	25.40(1)	1	22.225	2	28 200	35 500	2 870	3 600
17.462( $1\frac{1}{16}$ )	34.925( $1\frac{3}{8}$ )	19.30	19.05( $\frac{3}{4}$ )	1	22.225	1.5	21 900	25 600	2 240	2 610
	38.100( $1\frac{1}{2}$ )	19.30	19.05( $\frac{3}{4}$ )	1	25.400	1	23 000	28 100	2 340	2 870
19.050( $\frac{3}{4}$ )	38.100( $1\frac{1}{2}$ )	25.65	25.40(1)	1	25.400	1.5	29 500	38 500	3 000	3 950
	20.638( $1\frac{1}{16}$ )	38.100( $1\frac{1}{2}$ )	25.65	25.40(1)	1	25.400	2	29 500	38 500	3 000
22.225( $\frac{7}{8}$ )	41.275( $1\frac{5}{8}$ )	25.65	25.40(1)	1	28.575	1.5	32 500	45 000	3 300	4 600
	41.275( $1\frac{5}{8}$ )	32.00	31.75( $1\frac{1}{4}$ )	1	28.575	2	40 500	60 000	4 100	6 100
23.812( $1\frac{15}{16}$ )	41.275( $1\frac{5}{8}$ )	25.65	25.40(1)	1	28.575	2	32 500	45 000	3 300	4 600
	41.275( $1\frac{5}{8}$ )	32.00	31.75( $1\frac{1}{4}$ )	1	28.575	2	40 500	60 000	4 100	6 100
25.400(1)	44.450( $1\frac{3}{4}$ )	25.65	25.40(1)	1	31.750	1.5	35 000	51 000	3 550	5 200
	44.450( $1\frac{3}{4}$ )	32.00	31.75( $1\frac{1}{4}$ )	1	31.750	2	43 500	68 000	4 450	6 950
28.575( $1\frac{1}{8}$ )	47.625( $1\frac{7}{8}$ )	25.65	25.40(1)	1	34.925	3	37 000	57 500	3 800	5 850
	47.625( $1\frac{7}{8}$ )	32.00	31.75( $1\frac{1}{4}$ )	1	34.925	2	46 500	76 500	4 750	7 800
30.162( $1\frac{3}{16}$ )	52.388( $2\frac{1}{16}$ )	32.00	31.75( $1\frac{1}{4}$ )	1	38.100	2	51 000	81 500	5 200	8 300
31.750( $1\frac{1}{4}$ )	52.388( $2\frac{1}{16}$ )	25.65	25.40(1)	1.5	38.100	0.5	41 000	61 000	4 150	6 250
	52.388( $2\frac{1}{16}$ )	32.00	31.75( $1\frac{1}{4}$ )	1.5	38.100	1	51 000	81 500	5 200	8 300
33.338( $1\frac{5}{16}$ )	55.562( $2\frac{3}{16}$ )	25.65	25.40(1)	1.5	41.275	0.5	43 500	68 000	4 450	6 950
	55.562( $2\frac{3}{16}$ )	32.00	31.75( $1\frac{1}{4}$ )	1.5	41.275	1	54 500	90 500	5 550	9 250
34.925( $1\frac{3}{8}$ )	55.562( $2\frac{3}{16}$ )	32.00	31.75( $1\frac{1}{4}$ )	1.5	41.275	0.5	54 500	90 500	5 550	9 250
	58.738( $2\frac{5}{16}$ )	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738( $2\frac{5}{16}$ )	32.00	31.75( $1\frac{1}{4}$ )	1.5	44.450	1	55 500	95 500	5 700	9 750

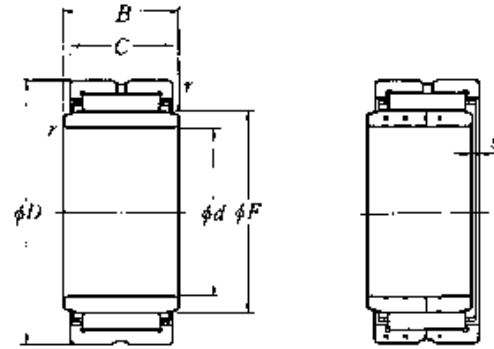
Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.  
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Limiting speeds		Bearing numbers	Abutment dimensions			Mass kg (approx.)
min <sup>-1</sup> grease	oil		$d_a$ min	mm $D_a$ max	$r_{as}^{3)}$ max	
17 000	25 000	<b>MR101812 + MI-061012</b>	13.5	24.5	0.6	0.069
17 000	25 000	<b>MR101816 + MI-061016</b>	13.5	24.5	0.6	0.093
14 000	21 000	<b>MR122012 + MI-081212</b>	17.5	26.5	1	0.079
14 000	21 000	<b>MR122016 + MI-081216</b>	17.5	26.5	1	0.105
12 000	18 000	<b>MR142212 + MI-101412</b>	21	30	1	0.086
12 000	18 000	<b>MR142216 + MI-101416</b>	21	30	1	0.118
12 000	18 000	<b>MR142212 + MI-111412</b>	21	30	1	0.079
11 000	16 000	<b>MR162412 + MI-121612</b>	24	33	1	0.102
11 000	16 000	<b>MR162416 + MI-121616</b>	24	33	1	0.136
11 000	16 000	<b>MR162416 + MI-131616</b>	24	33	1	0.125
9 500	14 000	<b>MR182616 + MI-141816</b>	27	36.5	1	0.152
9 500	14 000	<b>MR182620 + MI-141820</b>	27	36.5	1	0.193
9 500	14 000	<b>MR182616 + MI-151816</b>	27	36.5	1	0.139
9 500	14 000	<b>MR182620 + MI-151820</b>	27	36.5	1	0.176
8 500	13 000	<b>MR202816 + MI-162016</b>	30.5	39.5	1	0.161
8 500	13 000	<b>MR202820 + MI-162020</b>	30.5	39.5	1	0.201
7 500	11 000	<b>MR223016 + MI-182216</b>	33.5	42.5	1	0.181
7 500	11 000	<b>MR223020 + MI-182220</b>	33.5	42.5	1	0.229
7 500	11 000	<b>MR243320 + MI-192420</b>	35	46	1.5	0.286
7 500	11 000	<b>MR243316 + MI-202416</b>	37	46	1.5	0.230
7 500	11 000	<b>MR243320 + MI-202420</b>	37	46	1.5	0.285
6 500	9 500	<b>MR263516 + MI-212616</b>	40	49	1.5	0.257
6 500	9 500	<b>MR263520 + MI-212620</b>	40	49	1.5	0.325
6 500	9 500	<b>MR263520 + MI-222620</b>	40	49	1.5	0.286
6 000	9 000	<b>MR283716 + MI-222816</b>	41.5	52	1.5	0.294
6 000	9 000	<b>MR283720 + MI-222820</b>	41.5	52	1.5	0.364

## Inch series With inner ring

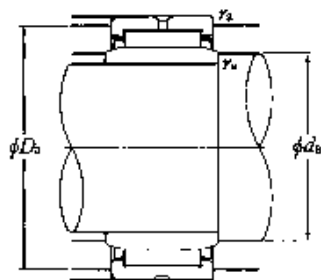
### Type MR + MI



$d$  36.512~66.675mm

Boundary dimensions							Basic load ratings			
mm ( $\frac{1}{25.4}$ mm)							dynamic	static	dynamic	static
$d$	$D$	$B$	$C$	$r_3$ min <sup>1)</sup>	$F$	$S$ <sup>2)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$
							N		kgf	
<b>36.512</b> (1 $\frac{7}{16}$ )	58.738(2 $\frac{5}{16}$ )	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738(2 $\frac{5}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	44.450	0.5	55 500	95 500	5 700	9 750
<b>38.100</b> (1 $\frac{1}{2}$ )	58.738(2 $\frac{5}{16}$ )	25.65	25.40(1)	1.5	44.450	0.5	44 500	72 000	4 550	7 350
	58.738(2 $\frac{5}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	44.450	0.5	55 500	95 500	5 700	9 750
<b>39.688</b> (1 $\frac{9}{16}$ )	65.088(2 $\frac{9}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	50.800	0.5	62 000	114 000	6 300	11 700
	65.088(2 $\frac{9}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	50.800	0.5	62 000	114 000	6 300	11 700
<b>41.275</b> (1 $\frac{5}{8}$ )	61.912(2 $\frac{7}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	47.625	1	59 000	105 000	6 000	10 700
	65.088(2 $\frac{9}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	50.800	0.5	62 000	114 000	6 300	11 700
<b>42.682</b> (1 $\frac{11}{16}$ )	65.088(2 $\frac{9}{16}$ )	25.65	25.40(1)	1.5	50.800	0.5	49 500	86 000	5 050	8 800
	65.088(2 $\frac{9}{16}$ )	32.00	31.75(1 $\frac{1}{4}$ )	1.5	50.800	0.5	62 000	114 000	6 300	11 700
<b>44.450</b> (1 $\frac{3}{4}$ )	76.200(3)	38.35	38.10(1 $\frac{1}{2}$ )	1.5	57.150	3.5	83 500	142 000	8 500	14 500
	76.200(3)	44.70	44.45(1 $\frac{3}{4}$ )	1.5	57.150	3.5	97 000	173 000	9 850	17 600
<b>49.212</b> (1 $\frac{15}{16}$ )	82.550(3 $\frac{1}{4}$ )	38.35	38.10(1 $\frac{1}{2}$ )	2	63.500	1.5	88 000	158 000	8 950	16 100
	82.550(3 $\frac{1}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	63.500	2	102 000	191 000	10 400	19 500
<b>50.800</b> (2)	82.550(3 $\frac{1}{4}$ )	38.35	25.40(1)	2	63.500	2.5	88 000	158 000	8 950	16 100
	82.550(3 $\frac{1}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	63.500	3	102 000	191 000	10 400	19 500
<b>55.562</b> (2 $\frac{3}{8}$ )	88.900(3 $\frac{1}{2}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	69.850	1.5	107 000	209 000	10 900	21 300
	88.900(3 $\frac{1}{2}$ )	25.65	25.40(1)	2	69.850	0.5	66 000	112 000	6 700	11 400
<b>57.150</b> (2 $\frac{1}{4}$ )	88.900(3 $\frac{1}{2}$ )	38.35	38.10(1 $\frac{1}{2}$ )	2	69.850	2.5	92 000	173 000	9 400	17 600
	88.900(3 $\frac{1}{2}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	69.850	3	107 000	209 000	10 900	21 300
<b>60.325</b> (2 $\frac{3}{8}$ )	95.250(3 $\frac{3}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	76.200	1.5	112 000	227 000	11 400	23 200
<b>63.500</b> ( $\frac{1}{2}$ )	95.250(3 $\frac{3}{4}$ )	38.35	38.10(1 $\frac{1}{2}$ )	2	76.200	2.5	96 000	188 000	9 800	19 100
	95.250(3 $\frac{3}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	76.200	3	112 000	227 000	11 400	23 200
<b>66.675</b> (2 $\frac{5}{8}$ )	107.950(4 $\frac{1}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	82.550	3	134 000	240 000	13 600	24 500
	107.950(4 $\frac{1}{4}$ )	51.05	50.80(2)	2	82.550	5.5	146 000	268 000	14 900	27 400

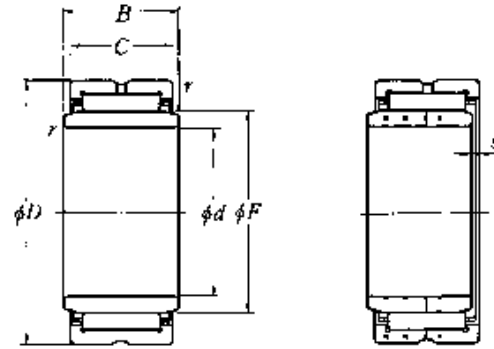
Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.  
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Limiting speeds		Bearing numbers	Abutment dimensions			Mass kg (approx.)
min <sup>-1</sup> grease	oil		d <sub>a</sub> min	mm D <sub>a</sub> max	r <sub>as</sub> <sup>3)</sup> max	
6 000	9 000	<b>MR283716 + MI-232816</b>	43	52	1.5	0.264
6 000	9 000	<b>MR283720 + MI-232820</b>	43	52	1.5	0.330
6 000	9 000	<b>MR283716 + MI-242816</b>	43	52	1.5	0.246
6 000	9 000	<b>MR283720 + MI-242820</b>	43	52	1.5	0.307
5 500	8 000	<b>MR324120 + MI-243220</b>	44.5	58.5	1.5	0.448
5 500	8 500	<b>MR303920 + MI-253020</b>	46.5	55.5	1.5	0.368
5 500	8 000	<b>MR324120 + MI-253220</b>	46	58.5	1.5	0.424
5 500	8 000	<b>MR324116 + MI-263216</b>	48	58.5	1.5	0.317
5 500	8 000	<b>MR324120 + MI-263220</b>	48	58.5	1.5	0.402
5 500	8 000	<b>MR324116 + MI-273216</b>	49.5	58.5	1.5	0.300
5 500	8 000	<b>MR324120 + MI-273220</b>	49.5	58.5	1.5	0.373
4 700	7 000	<b>MR364824 + MI-283624</b>	51	69.5	1.5	0.732
4 700	7 000	<b>MR364828 + MI-283628</b>	51	69.5	1.5	0.853
4 300	6 500	<b>MR405224 + MI-314024</b>	56	74.5	2	0.848
4 300	6 500	<b>MR405228 + MI-314028</b>	56	74.5	2	0.975
4 300	6 500	<b>MR405224 + MI-324024</b>	59	74.5	2	0.812
4 300	6 500	<b>MR405228 + MI-324028</b>	59	74.5	2	0.923
3 700	5 500	<b>MR445628 + MI-354428</b>	63.5	81	2	1.07
3 700	5 500	<b>MR445616 + MI-364416</b>	65	81	2	0.594
3 700	5 500	<b>MR445624 + MI-364424</b>	65	81	2	0.884
3 700	5 500	<b>MR445628 + MI-364428</b>	65	81	2	1.02
3 300	5 000	<b>MR486028 + MI-384828</b>	68	87	2	1.25
3 300	5 000	<b>MR486024 + MI-404824</b>	71.5	87	2	0.978
3 300	5 000	<b>MR486028 + MI-404828</b>	71.5	87	2	1.14
3 300	5 000	<b>MR526828 + MI-425228</b>	74.5	100	2	1.67
3 300	5 000	<b>MR526832 + MI-425232</b>	74.5	100	2	1.92

## Inch series With inner ring

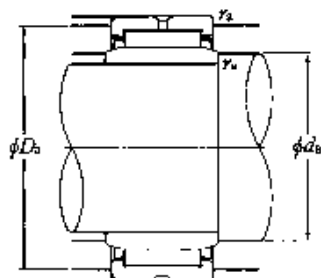
### Type MR + MI



$d$  69.850~127.000mm

Boundary dimensions							Basic load ratings			
mm ( $\frac{1}{25.4}$ mm)							dynamic	static	dynamic	static
$d$	$D$	$B$	$C$	$r_{3 \text{ min}}^{1)}$	$F$	$s^{2)}$	$C_r$	$C_{or}$	$C_r$	$C_{or}$
							N		kgf	
69.850(2 $\frac{3}{4}$ )	107.950(4 $\frac{1}{4}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	82.550	1.5	134 000	240 000	13 600	24 500
	107.950(4 $\frac{1}{4}$ )	51.05	50.80(2)	2	82.550	3	146 000	268 000	14 900	27 400
74.612(2 $\frac{15}{16}$ )	114.300(4 $\frac{1}{2}$ )	51.05	50.80(2)	2	88.900	3	154 000	295 000	15 700	30 000
76.200(3)	114.300(4 $\frac{1}{2}$ )	44.70	44.45(1 $\frac{3}{4}$ )	2	88.900	3	141 000	264 000	14 400	26 900
	114.300(4 $\frac{1}{2}$ )	51.05	50.80(2)	2	88.900	5.5	154 000	295 000	15 700	30 000
79.375(3 $\frac{1}{8}$ )	120.650(4 $\frac{3}{4}$ )	51.05	50.80(2)	2.5	95.250	5.5	162 000	320 000	16 500	32 500
82.550(3 $\frac{1}{4}$ )	120.650(4 $\frac{3}{4}$ )	51.05	50.80(2)	2.5	95.250	2.5	162 000	320 000	16 500	32 500
	127.000(5)	51.05	50.80(2)	2.5	101.600	2.5	169 000	345 000	17 200	35 500
85.725(3 $\frac{3}{8}$ )	127.000(5)	51.05	50.80(2)	2.5	101.600	4.5	169 000	345 000	17 200	35 500
88.900(3 $\frac{1}{2}$ )	127.000(5)	51.05	50.80(2)	2.5	101.600	2.5	169 000	345 000	17 200	35 500
	133.350(5 $\frac{1}{4}$ )	51.05	50.80(2)	2.5	107.950	2.5	172 000	360 000	17 500	37 000
92.075(3 $\frac{5}{8}$ )	133.350(5 $\frac{1}{4}$ )	51.05	50.80(2)	2.5	107.950	4.5	172 000	360 000	17 500	37 000
	133.350(5 $\frac{1}{4}$ )	51.05	50.80(2)	2.5	107.950	2.5	172 000	360 000	17 500	37 000
95.250(3 $\frac{3}{4}$ )	152.400(6)	57.40	57.15(2 $\frac{1}{4}$ )	2.5	114.300	3	238 000	435 000	24 300	44 500
	152.400(6)	63.88	63.50(2 $\frac{1}{2}$ )	2.5	114.300	4	260 000	485 000	26 500	49 500
98.425(3 $\frac{7}{8}$ )	152.400(6)	57.40	57.15(2 $\frac{1}{4}$ )	2.5	114.300	5.5	238 000	435 000	24 300	44 500
	152.400(6)	63.88	63.50(2 $\frac{1}{2}$ )	2.5	114.300	7	260 000	485 000	26 500	49 500
101.600(4)	165.100(6 $\frac{1}{2}$ )	51.05	50.80(2)	2.5	127.000	2.5	227 000	425 000	23 200	43 000
	165.100(6 $\frac{1}{2}$ )	57.40	57.15(2 $\frac{1}{4}$ )	2.5	127.000	5.5	250 000	480 000	25 500	49 000
	165.100(6 $\frac{1}{2}$ )	63.88	57.15(2 $\frac{1}{4}$ )	2.5	127.000	7	273 000	535 000	27 800	54 500
107.950(4 $\frac{1}{4}$ )	165.100(6 $\frac{1}{2}$ )	57.40	57.15(2 $\frac{1}{4}$ )	2.5	127.000	3	250 000	480 000	25 500	49 000
114.300(4 $\frac{1}{2}$ )	177.800(7)	63.88	63.50(2 $\frac{1}{2}$ )	2.5	139.700	5.5	285 000	585 000	29 100	59 500
	177.800(7)	76.58	76.20(3)	2.5	139.700	7	345 000	740 000	35 000	75 500
120.650(4 $\frac{3}{4}$ )	184.150(7 $\frac{1}{4}$ )	82.55	76.20(3)	3	146.050	3	360 000	775 000	36 500	79 000
127.000(5)	190.500(7 $\frac{1}{2}$ )	63.88	63.50(2 $\frac{1}{2}$ )	3	152.400	7	310 000	630 000	31 500	64 000
	190.500(7 $\frac{1}{2}$ )	76.58	76.20(3)	3	152.400	5.5	375 000	800 000	38 000	81 500

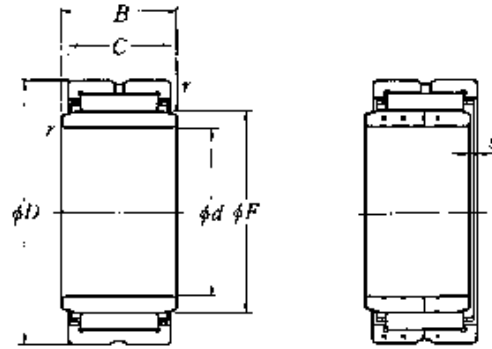
Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.  
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



Limiting speeds		Bearing numbers	Abutment dimensions			Mass kg (approx.)
grease	oil		$d_a$ min	mm $D_a$ max	$r_{as}^{3)}$ max	
3 300	5 000	<b>MR526828 + MI-445228</b>	78	100	2	1.55
3 300	5 000	<b>MR526832 + MI-445232</b>	78	100	2	1.77
3 000	4 500	<b>MR567232 + MI-475632</b>	83	106.5	2	2.00
3 000	4 500	<b>MR567228 + MI-485628</b>	84	106.5	2	1.65
3 000	4 500	<b>MR567232 + MI-485632</b>	84	106.5	2	1.92
2 800	4 200	<b>MR607632 + MI-506032</b>	88.5	111.5	2.5	2.15
2 800	4 200	<b>MR607632 + MI-526032</b>	91.5	111.5	2.5	1.99
2 600	3 900	<b>MR648032 + MI-526432</b>	91.5	118	2.5	2.39
2 600	3 900	<b>MR648032 + MI-546432</b>	94.5	118	2.5	2.22
2 600	3 900	<b>MR648032 + MI-566432</b>	98	118	2.5	2.05
2 500	3 700	<b>MR688432 + MI-566832</b>	98	124.5	2.5	2.53
2 500	3 700	<b>MR688432 + MI-586832</b>	101	124.5	2.5	2.36
2 500	3 700	<b>MR688432 + MI-606832</b>	104.5	124.5	2.5	2.17
2 300	3 500	<b>MR729636 + MI-607236</b>	104.5	143.5	2.5	4.02
2 300	3 500	<b>MR729640 + MI-607240</b>	104.5	143.5	2.5	4.47
2 300	3 500	<b>MR729636 + MI-627236</b>	107.5	143.5	2.5	3.77
2 300	3 500	<b>MR729640 + MI-627240</b>	107.5	143.5	2.5	4.19
2 100	3 100	<b>MR8010432 + MI-648032</b>	110.5	156	2.5	3.60
2 100	3 100	<b>MR8010436 + MI-648036</b>	110.5	156	2.5	4.92
2 100	3 100	<b>MR8010440 + MI-648040</b>	110.5	156	2.5	5.47
2 100	3 100	<b>MR8010436 + MI-688036</b>	117	156	2.5	4.44
1 900	2 900	<b>MR8811240 + MI-728840</b>	123.5	169	2.5	6.04
1 900	2 900	<b>MR8811248 + MI-728848</b>	123.5	169	2.5	7.26
1 800	2 700	<b>MR9211648 + MI-769248</b>	132	172	3	7.48
1 700	2 600	<b>MR9612040 + MI-809640</b>	140	177.5	3	6.54
1 700	2 600	<b>MR9612048 + MI-809648</b>	140	177.5	3	7.84

## Inch series With inner ring

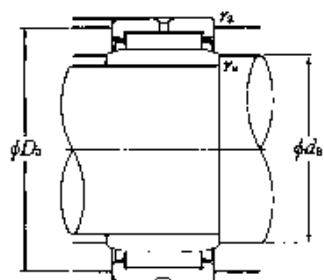
### Type MR + MI



$d$  139.700~203.200mm

$d$	$D$	Boundary dimensions					Basic load ratings			
		$B$	$C$	$r_{3 \text{ min}}^{1)}$	$F$	$S^{2)}$	dynamic N	static N	dynamic kgf	static kgf
mm ( $\frac{1}{25.4}$ mm)										
<b>139.700(5 1/2)</b>	203.200( 8)	63.88	63.50(2 1/2)	3	165.100	6	325 000	680 000	33 000	69 500
	203.200( 8)	76.58	76.20(3)	3	165.100	5.5	390 000	870 000	39 500	88 500
<b>152.400(6)</b>	231.775( 9 1/8)	76.58	76.20(3)	3	184.150	8.5	435 000	915 000	44 500	93 000
<b>165.100(6 1/2)</b>	244.475( 9 5/8)	76.58	76.20(3)	3	196.850	8.5	455 000	990 000	46 500	101 000
<b>177.800(7)</b>	257.175(10 1/8)	76.58	76.20(3)	3	209.550	8.5	475 000	1 060 000	48 500	109 000
<b>190.500(7 1/2)</b>	269.875(10 5/8)	76.58	76.20(3)	4	222.250	7	495 000	1 140 000	50 500	116 000
<b>203.200(8)</b>	282.575(11 1/8)	76.58	76.20(3)	4	234.950	7	510 000	1 210 000	52 000	124 000

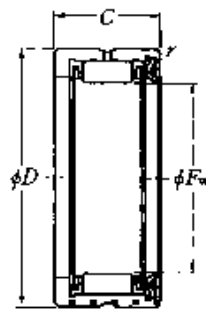
Note 1) Allowable minimum chamfer dimension  $r$ . 2) Allowable axial stroking value of inner ring against outer ring.  
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



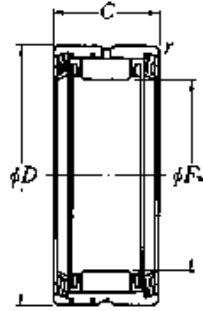
Limiting speeds		Bearing numbers	Abutment dimensions			Mass kg (approx.)
min <sup>-1</sup> grease	oil		$d_a$ min	mm $D_a$ max	$r_{as}$ <sup>3)</sup> max	
1 600	2 400	<b>MR10412840 + MI-8810440</b>	152.5	190	3	6.86
1 600	2 400	<b>MR10412848 + MI-8810448</b>	152.5	190	3	8.22
1 500	2 200	<b>MR11614648 + MI-9611648</b>	165.5	219	3	12.2
1 300	2 000	<b>MR12415448 + MI-10412448</b>	178	231.5	3	13.1
1 300	1 900	<b>MR13216248 + MI-11213248</b>	191	244	3	14.0
1 200	1 800	<b>MR14017048 + MI-12014048</b>	206.5	254	4	15.0
1 100	1 700	<b>MR14817848 + MI-12814848</b>	219	266.5	4	15.8

## Without inner ring

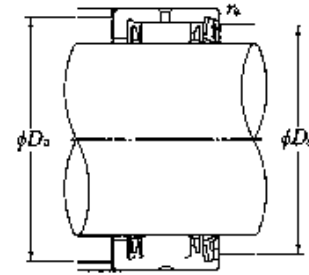
Type RNA49··L  
Type RNA49··LL



Type RNA49··L  
(With single seal)



Type RNA49··LL  
(With double seal)



$F_w$  14~58mm

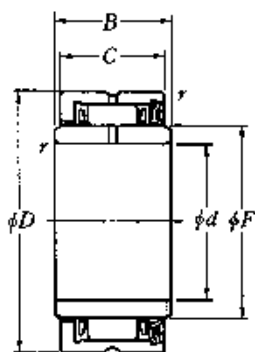
Boundary dimensions				Basic load ratings				Limiting speeds min <sup>-1</sup> grease	Bearing numbers		Abutment dimensions			Mass kg (approx.)	
mm				dynamic	static	dynamic	static		Type	Type	mm				
$F_w$	$D$	$C$	$I_s$ min <sup>1)</sup>	$C_r$	$C_{or}$	$C_r$	$C_{or}$		RNA49··L	RNA49··LL	$D_a$ max	$D_b$ max	$r_{as}$ <sup>2)</sup> max		
14	$+0.027$ $+0.016$	22	13	0.3	7 200	8 500	735	865	10 000	RNA4900L/3AS	RNA4900LL/3AS	16	20	0.3	0.016
16	$+0.027$ $+0.016$	24	13	0.3	7 750	9 700	795	990	10 000	RNA4901L/3AS	RNA4901LL/3AS	18	22	0.3	0.018
20	$+0.033$ $+0.020$	28	13	0.3	8 300	11 200	845	1 150	10 000	RNA4902L/3AS	RNA4902LL/3AS	22	26	0.3	0.022
22	$+0.033$ $+0.020$	30	13	0.3	8 500	11 900	865	1 220	9 000	RNA4903L/3AS	RNA4903LL/3AS	24	28	0.3	0.022
25	$+0.033$ $+0.020$	37	17	0.3	15 200	19 900	1 550	2 030	8 000	RNA4904L/3AS	RNA4904LL/3AS	28	35	0.3	0.055
30	$+0.033$ $+0.020$	42	17	0.3	16 000	22 600	1 640	2 300	6 500	RNA4905L/3AS	RNA4905LL/3AS	33	40	0.3	0.063
35	$+0.041$ $+0.025$	47	17	0.3	18 000	27 400	1 830	2 800	5 500	RNA4906L/3AS	RNA4906LL/3AS	38	45	0.3	0.072
42	$+0.041$ $+0.025$	55	20	0.6	22 700	39 500	2 320	4 000	4 800	RNA4907L/3AS	RNA4907LL/3AS	45	51	0.6	0.113
48	$+0.041$ $+0.025$	62	22	0.6	27 800	53 500	2 830	5 450	4 200	RNA4908L/3AS	RNA4908LL/3AS	51	58	0.6	0.154
52	$+0.049$ $+0.030$	68	22	0.6	28 600	57 000	2 920	5 800	3 800	RNA4909L/3AS	RNA4909LL/3AS	55	64	0.6	0.157
58	$+0.049$ $+0.030$	72	22	0.6	30 500	64 000	3 100	6 500	3 400	RNA4910L/3AS	RNA4910LL/3AS	61	68	0.6	0.160

Note 1) Allowable minimum chamfer dimension  $r$ .

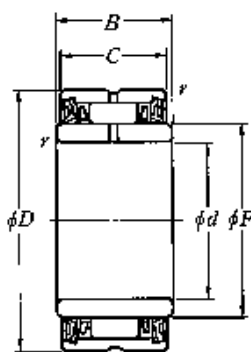
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## With inner ring

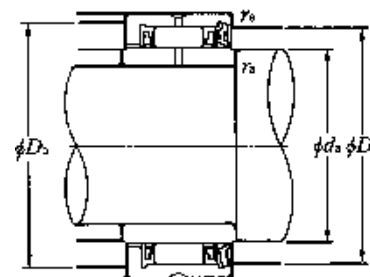
Type NA49··L  
Type NA49··LL



Type NA49··L  
(With single seal)



Type NA49··LL  
(With double seal)



d 10~50mm

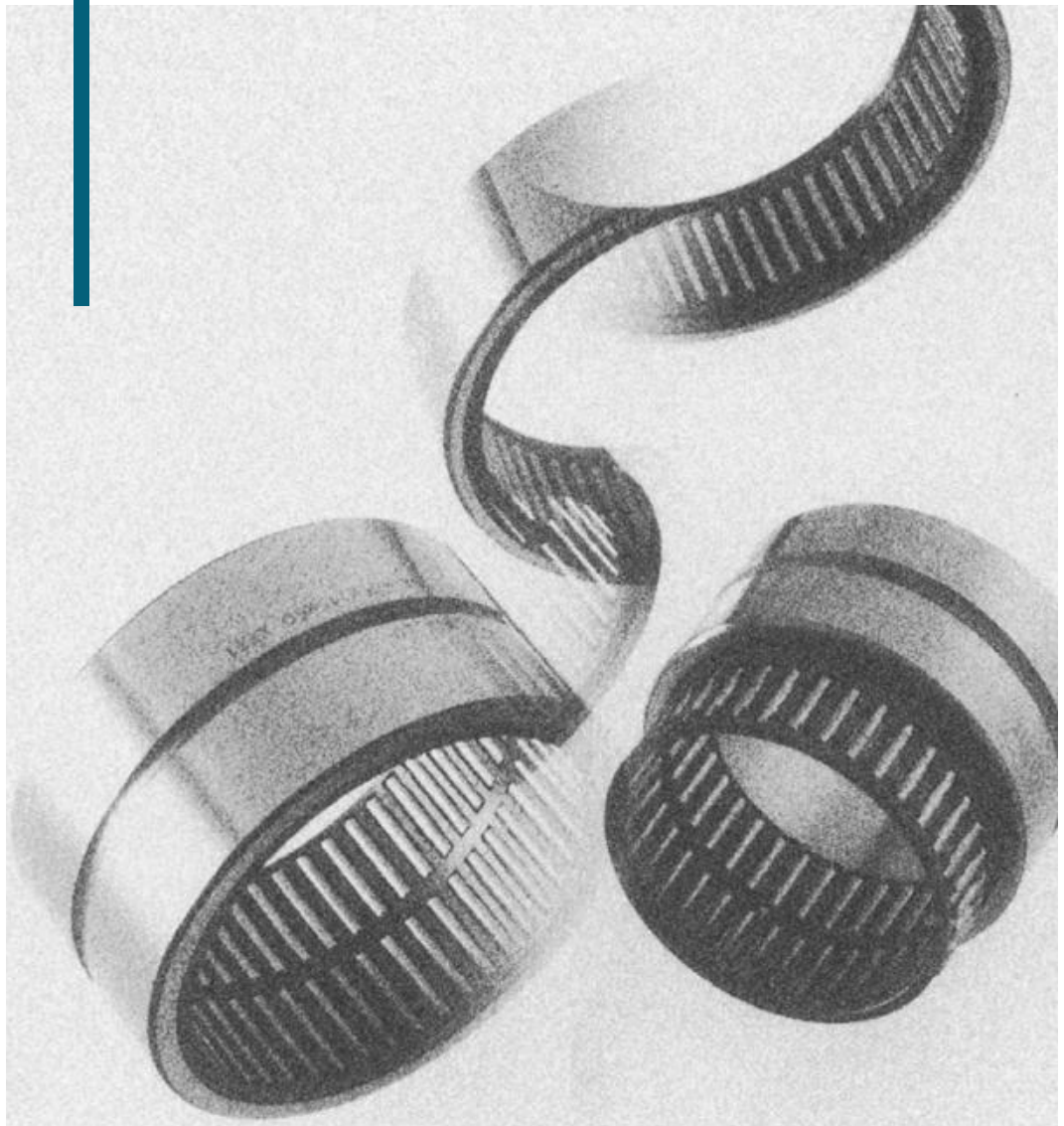
Boundary dimensions						Basic load ratings				Limiting speeds min <sup>-1</sup> grease	Bearing numbers		Abutment dimensions				Mass kg (approx.)
mm						dynamic N	static N	dynamic kgf	static kgf		Type NA49··L	Type RNA49··LL	da min	Da max	Db max	ras <sup>2)</sup> max	
d	D	B	C	r <sup>1)</sup>	F	Cr	Cor	Cr	Cor								
10	22	14	13	0.3	14	7 200	8 500	735	865	10 000	NA4900L/3AS	NA4900LL/3AS	12	16	20	0.3	0.025
12	24	14	13	0.3	16	7 750	9 700	795	990	10 000	NA4901L/3AS	NA4901LL/3AS	14	18	22	0.3	0.028
15	28	14	13	0.3	20	8 300	11 200	845	1 150	10 000	NA4902L/3AS	NA4902LL/3AS	17	22	26	0.3	0.036
17	30	14	13	0.3	22	8 500	11 900	865	1 220	9 000	NA4903L/3AS	NA4903LL/3AS	19	24	28	0.3	0.039
20	37	18	17	0.3	25	15 200	19 900	1 550	2 030	8 000	NA4904L/3AS	NA4904LL/3AS	22	28	35	0.3	0.080
25	42	18	17	0.3	30	16 000	22 600	1 640	2 300	6 500	NA4905L/3AS	NA4905LL/3AS	27	33	40	0.3	0.093
30	47	18	17	0.3	35	18 000	27 400	1 830	2 800	5 500	NA4906L/3AS	NA4906LL/3AS	32	38	45	0.3	0.107
35	55	21	20	0.6	42	22 700	39 500	2 320	4 000	4 800	NA4907L/3AS	NA4907LL/3AS	39	45	51	0.6	0.175
40	62	23	22	0.6	48	27 800	53 500	2 830	5 450	4 200	NA4908L/3AS	NA4908LL/3AS	44	51	58	0.6	0.252
45	68	23	22	0.6	52	28 600	57 000	2 920	5 800	3 800	NA4909L/3AS	NA4909LL/3AS	49	55	64	0.6	0.290
50	72	23	22	0.6	58	30 500	64 000	3 100	6 500	3 400	NA4910L/3AS	NA4910LL/3AS	54	61	68	0.6	0.295

Note 1) Allowable minimum chamfer dimension  $r^1$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



## Machined Ring Needle Roller Bearings, Separable Type



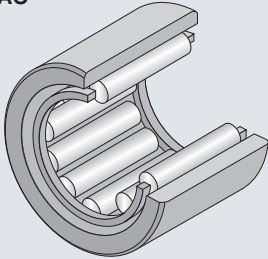
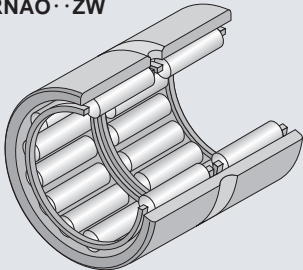
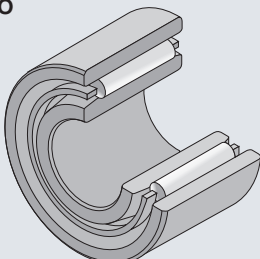
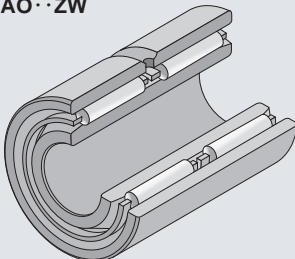
## Machined Ring Needle Roller Bearings, Separable Type

The machined ring of this bearing type has no rib or side plate and, hence, the outer ring and the needle roller and cage assembly are separable from each other.

The outer ring can't regulate axial displacement of the needle roller and cage assembly and, therefore, the bearing construction must be designed so that the needle roller and cage assembly can be guided by a shaft or a housing. Furthermore, the needle roller and cage assembly can be separated from the outer ring so that the

cage and roller assembly, and the outer and the inner ring can be mounted on a shaft or a housing independent. This could facilitate the bearing mounting work.

This bearing type is suitable for an application requiring high running accuracy because the radial clearance can be selected to a narrow range by combining appropriate inner ring, outer ring and needle roller and cage assembly.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
<p><b>Type RNAO</b></p> 	$\phi 5 - \phi 100$	<p><b>RNAO-10×17×10 T2</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— Width</li> <li>— Outer diameter</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>	<p>Bearing with suffix T2 uses a polyamide resin cage and, therefore, it shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.</p> <p>For applications required high running accuracy, manufacture of the bearings conforming to JIS Class-6, -5 and -4 is also available on special request.</p>
<p><b>Type RNAO·ZW</b></p> 	$\phi 8 - \phi 80$	<p><b>[Suffix]</b> T2 : Resin cage ZW: Double-row type</p>	
<p><b>Type NAO</b></p> 	$\phi 8 - \phi 90$	<p><b>NAO-10×17×10 ZW</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— Width</li> <li>— Outer diameter</li> <li>— Bore diameter</li> <li>— Type code</li> </ul>	
<p><b>Type NAO·ZW</b></p> 	$\phi 10 - \phi 70$	<p><b>[Suffix]</b> T2 : Resin cage ZW: Double-row type</p>	

### Accuracy of bearing

The dimensional accuracy, profile accuracy and running accuracy of machined ring needle roller bearing, separate type (with inner ring) are specified in JIS B 1514 (Accuracy of Rolling Bearings). (Refer to **Table 4.3** of Section 4. "Bearing Tolerances" on page A-26.) Although the accuracy of NTN standard bearings conforms to JIS Class-0, NTN can also supply bearings conforming to JIS Class-6, -5 and -4. Feel free to contact NTN for the further detail of these bearings.

The dimensional tolerances for the roller inscribed circle diameters ( $F_w$ ) of the bearing type without inner ring conform to ISO Tolerance Range Class-F6. The outer ring and the needle roller and cage assembly are supplied in set and, therefore, the bearing must be installed with the combination of these two in set remained unchanged.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, NTN will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact NTN Engineering.

### Radial internal clearance and bearing fits

For information about radial internal clearance of NTN machined ring needle roller bearings, separable type (with inner ring), refer to **Table 5.1** in Sec. 5.1 "Bearing radial internal clearance" (page A-30). Because of the narrow non-interchangeable clearance range, the bearings shipped after adjusted to a specific non-interchangeable clearance must be installed with the clearance remained unchanged.

The dimensional tolerances (fits) of a shaft and housing bore to which the bearing with inner ring is installed should be in accordance with type and magnitude of load, and dimensions of the shaft and housing bore. For information about the dimensional tolerances of a shaft and housing bore, refer to Sec. 6.4 "Recommended internal fits" (page A-33). For the profile accuracy and surface roughness of the shaft and housing bore corresponding to the recommended internal fits in Table 8.3 in Sec. 8.3 "Shaft and housing accuracy" (page A-40).

A bearing not having an inner ring directly uses the shaft as raceway surface, and the dimensional tolerances of the shaft diameter (raceway diameter) can vary depending on the operating internal clearance of the bearing as summarized in **Table 1** in page B-57. For this type of bearing usage, the dimensional tolerance class for the housing bore is K7, which is most commonly adopted tolerance class. When wishing to adopt a dimensional tolerance class other than K7 for the housing bore, contact NTN Engineering for technical assistance.

For the profile accuracy, surface roughness and surface hardness of the shaft that functions as raceway surface, refer to Sec. 8.4 "Raceway surface accuracy" (page A-40) and Sec. 8.5 "Material and hardness of raceway" (page A-40).

### Oil hole dimension of the outer ring

The outer ring of bearing Type ZW is provided with an oil hole and an oil groove to facilitate oil lubrication to bearing.

**Table 1** shows the oil hole dimension.

**Table 1 Oil hole dimension**

Outer ring outer diameter		Oil hole dia. (mm)	Number of oil hole
over	incl.		
—	20	2.0	1
20	40	2.5	1
40	80	3.0	1
80	200	3.5	1

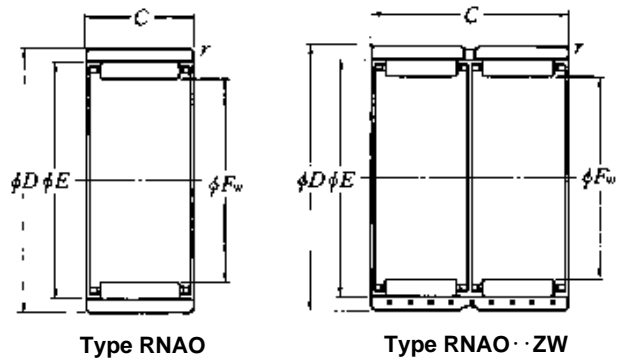
### Mounting relations

The inner ring and outer ring of any machined ring needle roller bearing, separable type must be positioned in axial direction by shoulder or a snap ring.

The mounting relation dimensions about the shaft and housing bore for this case are found in the relevant dimension table. The cage must be guided by the shaft or the side face of the housing shoulder, but the guide surface must be finished by, at least, grinding for deburring.

Without inner ring

Type RNAO  
Type RNAO · ZW

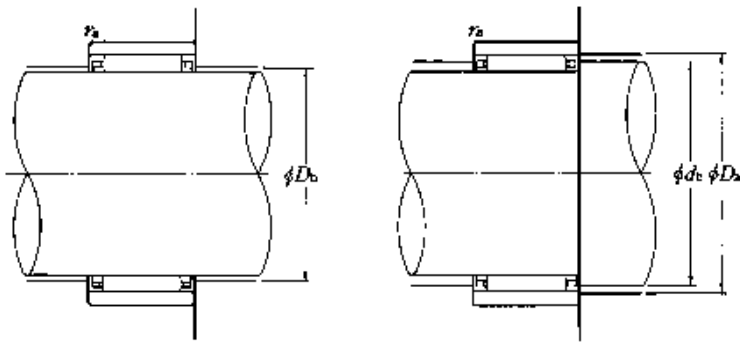


$F_w$  5~20mm

	Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	
	mm				dynamic	static	dynamic	static	grease	oil		
$F_w$	$D$	$C$	$r_{\min}^1)$	$E$	N		kgf		min <sup>-1</sup>			
					$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>5</b>	$\begin{matrix} +0.018 \\ +0.010 \end{matrix}$	10	8	0.15	8	2 640	2 190	269	224	27 000	40 000	<b>RNAO- 5×10×8T2</b>
<b>6</b>	$\begin{matrix} +0.018 \\ +0.010 \end{matrix}$	13	8	0.3	9	2 660	2 280	272	233	25 000	37 000	<b>RNAO- 6×13×8T2</b>
<b>7</b>	$\begin{matrix} +0.022 \\ +0.013 \end{matrix}$	14	8	0.3	10	2 670	2 350	272	239	23 000	34 000	<b>RNAO- 7×14×8T2</b>
<b>8</b>	$\begin{matrix} +0.022 \\ +0.013 \end{matrix}$	15	10	0.3	11	4 000	4 100	410	420	21 000	32 000	<b>RNAO -8×15×10T2</b>
		16	20	0.3	12	7 950	8 350	810	850	21 000	32 000	<b>RNAO- 8×16×20ZWT2</b>
<b>10</b>	$\begin{matrix} +0.022 \\ +0.013 \end{matrix}$	17	10	0.3	13	4 550	5 100	460	520	19 000	28 000	<b>RNAO-10×17×10T2</b>
		20	12	0.3	16	7 100	5 950	720	610	19 000	28 000	<b>RNAO-10×20×12</b>
<b>12</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	19	13.5	0.3	15	6 000	7 700	615	785	17 000	26 000	<b>RNAO-12×19×13.5</b>
		22	12	0.3	18	8 650	8 000	880	815	17 000	26 000	<b>RNAO-12×22×12</b>
<b>14</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	22	13	0.3	18	8 300	10 100	845	1 030	16 000	24 000	<b>RNAO-14×22×13</b>
		22	20	0.3	18	11 800	16 000	1 210	1 630	16 000	24 000	<b>RNAO-14×22×20ZW</b>
		26	12	0.3	20	9 350	9 150	955	930	16 000	24 000	<b>RNAO-14×26×12</b>
<b>15</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	23	13	0.3	19	8 250	10 200	840	1 040	15 000	23 000	<b>RNAO-15×23×13</b>
		23	20	0.3	19	11 700	16 100	1 200	1 640	15 000	23 000	<b>RNAO-15×23×20ZW</b>
<b>16</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	24	13	0.3	20	9 050	11 800	925	1 200	15 000	23 000	<b>RNAO-16×24×13</b>
		24	20	0.3	20	12 900	18 500	1 310	1 890	15 000	23 000	<b>RNAO-16×24×20ZW</b>
		28	12	0.3	22	11 700	12 500	1 190	1 280	15 000	23 000	<b>RNAO-16×28×12</b>
<b>17</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	25	13	0.3	21	9 400	12 600	960	1 280	15 000	22 000	<b>RNAO-17×25×13</b>
		25	20	0.3	21	12 800	18 600	1 300	1 900	15 000	22 000	<b>RNAO-17×25×20ZW</b>
		25	26	0.3	21	16 100	25 200	1 640	2 570	15 000	22 000	<b>RNAO-17×25×26ZW</b>
<b>18</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	26	13	0.3	22	8 900	11 900	910	1 210	14 000	21 000	<b>RNAO-18×26×13</b>
		26	20	0.3	22	12 700	18 800	1 290	1 910	14 000	21 000	<b>RNAO-18×26×20ZW</b>
		30	12	0.3	24	12 300	13 800	1 250	1 410	14 000	21 000	<b>RNAO-18×30×12</b>
		30	24	0.3	24	21 100	27 700	2 150	2 820	14 000	21 000	<b>RNAO-18×30×24ZW</b>
<b>20</b>	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	28	13	0.3	24	10 000	14 300	1 020	1 460	13 000	20 000	<b>RNAO-20×28×13</b>
		28	26	0.3	24	17 100	28 600	1 750	2 910	13 000	20 000	<b>RNAO-20×28×26ZW</b>
		32	12	0.3	26	12 900	15 100	1 320	1 540	13 000	20 000	<b>RNAO-20×32×12</b>

Note 1) Allowable minimum chamfer dimension  $r$ .

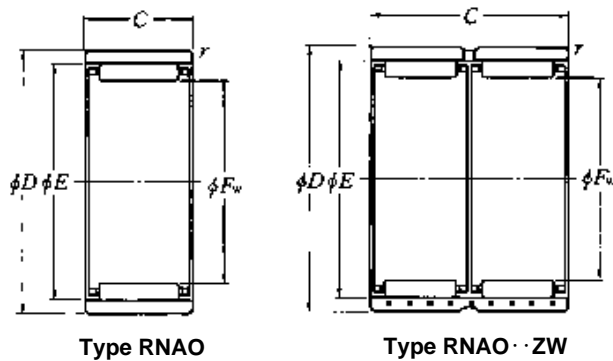
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$d_b$	Abutment dimensions mm			Mass kg (approx.)
	$D_a$ max	$D_b$	$r_{as}^{(2)}$ max	
7.7	8.8	5.3	0.15	0.003
8.7	11	6.3	0.3	0.006
9.7	12	7.3	0.3	0.006
10.7	13	8.3	0.3	0.008
11.7	14	8.3	0.3	0.017
12.7	15	10.3	0.3	0.010
15.7	18	10.3	0.3	0.018
14.7	17	12.3	0.3	0.015
17.6	20	12.3	0.3	0.019
17.6	20	14.4	0.3	0.018
17.6	20	14.4	0.3	0.027
19.6	24	14.4	0.3	0.029
18.6	21	15.4	0.3	0.020
18.6	21	15.4	0.3	0.031
19.6	22	16.4	0.3	0.021
19.6	22	16.4	0.3	0.032
21.6	26	16.4	0.3	0.032
20.6	23	17.4	0.3	0.022
20.6	23	17.4	0.3	0.034
20.6	23	17.4	0.3	0.044
21.6	24	18.4	0.3	0.022
21.6	24	18.4	0.3	0.033
23.6	28	18.4	0.3	0.035
23.6	28	18.4	0.3	0.069
23.6	26	20.4	0.3	0.025
23.6	26	20.4	0.3	0.050
25.6	30	20.4	0.3	0.038

Without inner ring

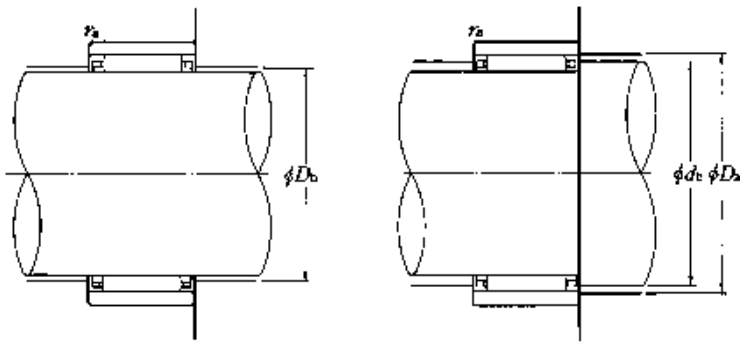
Type RNAO  
Type RNAO · ZW



$F_w$  20~40mm

	Boundary dimensions					Basic load ratings				Limiting speeds		Bearing numbers
	mm					dynamic	static	dynamic	static	grease	oil	
	$F_w$	$D$	$C$	$r_a$ min <sup>1)</sup>	$E$	N		kgf				
					$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>20</b>	+0.033 +0.020	32	24	0.3	26	22 100	30 000	2 260	3 100	13 000	20 000	<b>RNAO-20×32×24ZW</b>
<b>22</b>	+0.033 +0.020	30	13	0.3	26	10 200	15 200	1 040	1 550	12 000	18 000	<b>RNAO-22×30×13</b>
		30	26	0.3	26	17 500	30 500	1 790	3 100	12 000	18 000	<b>RNAO-22×30×26ZW</b>
		35	16	0.3	29	18 700	22 700	1 910	2 310	12 000	18 000	<b>RNAO-22×35×16</b>
		35	32	0.3	29	32 000	45 500	3 300	4 650	12 000	18 000	<b>RNAO-22×35×32ZW</b>
<b>25</b>	+0.033 +0.020	35	17	0.3	29	14 200	24 000	1 450	2 450	11 000	16 000	<b>RNAO-25×35×17</b>
		35	26	0.3	29	18 400	33 500	1 880	3 450	11 000	16 000	<b>RNAO-25×35×26ZW</b>
		37	16	0.3	32	19 500	24 700	1 990	2 520	11 000	16 000	<b>RNAO-25×37×16</b>
		37	32	0.3	32	33 500	49 500	3 400	5 050	11 000	16 000	<b>RNAO-25×37×32ZW</b>
<b>26</b>	+0.033 +0.020	39	13	0.3	30	11 800	19 200	1 200	1 960	10 000	15 000	<b>RNAO-26×39×13</b>
<b>28</b>	+0.033 +0.020	40	16	0.3	35	21 200	28 400	2 160	2 900	9 500	14 000	<b>RNAO-28×40×16</b>
		40	32	0.3	35	36 500	57 000	3 700	5 800	9 500	14 000	<b>RNAO-28×40×32ZW</b>
<b>30</b>	+0.033 +0.020	40	17	0.3	35	19 400	32 500	1 970	3 350	9 000	13 000	<b>RNAO-30×40×17</b>
		40	26	0.3	35	25 200	46 000	2 570	4 650	9 000	13 000	<b>RNAO-30×40×26ZW</b>
		42	16	0.3	37	21 900	30 500	2 230	3 100	9 000	13 000	<b>RNAO-30×42×16</b>
		42	32	0.3	37	37 500	60 500	3 850	6 200	9 000	13 000	<b>RNAO-30×42×32ZW</b>
<b>32</b>	+0.041 +0.025	42	13	0.3	37	14 500	23 000	1 480	2 350	8 500	13 000	<b>RNAO-32×42×13</b>
<b>35</b>	+0.041 +0.025	45	13	0.3	40	15 200	25 100	1 550	2 560	7 500	11 000	<b>RNAO-35×45×13</b>
		45	17	0.3	40	20 000	36 000	2 040	3 650	7 500	11 000	<b>RNAO-35×45×17</b>
		45	26	0.3	40	26 100	50 000	2 660	5 100	7 500	11 000	<b>RNAO-35×45×26ZW</b>
		47	16	0.3	42	24 100	36 000	2 450	3 650	7 500	11 000	<b>RNAO-35×47×16</b>
		47	18	0.3	42	24 700	37 000	2 510	3 750	7 500	11 000	<b>RNAO-35×47×18</b>
		47	32	0.3	42	41 500	71 500	4 200	7 300	7 500	11 000	<b>RNAO-35×47×32ZW</b>
<b>37</b>	+0.041 +0.025	47	13	0.3	42	15 900	27 100	1 620	2 770	7 000	11 000	<b>RNAO-37×47×13</b>
		52	18	0.3	44	26 300	41 000	2 680	4 150	7 000	11 000	<b>RNAO-37×52×18</b>
<b>40</b>	+0.041 +0.025	50	17	0.3	45	21 800	41 500	2 220	4 250	6 500	10 000	<b>RNAO-40×50×17</b>
		50	34	0.3	45	37 500	83 000	3 800	8 500	6 500	10 000	<b>RNAO-40×50×34ZW</b>
		55	20	0.3	47	31 000	51 500	3 150	5 250	6 500	10 000	<b>RNAO-40×55×20</b>

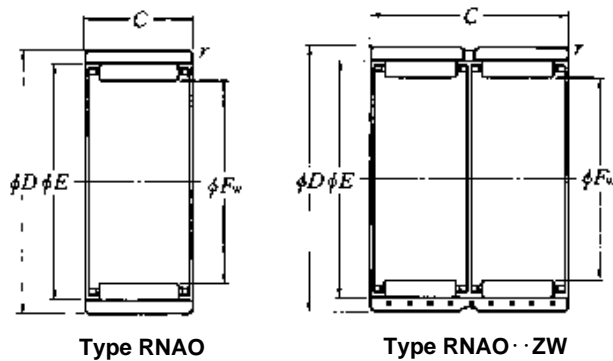
Note 1) Allowable minimum chamfer dimension  $r_a$ .  
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$d_b$	Abutment dimensions mm			Mass kg (approx.)
	$D_a$ max	$D_b$	$r_{as}^{(2)}$ max	
25.6	30	20.4	0.3	0.080
25.6	28	22.4	0.3	0.027
25.6	28	22.4	0.3	0.054
28.4	33	22.4	0.3	0.059
28.4	33	22.4	0.3	0.118
28.4	33	25.6	0.3	0.053
28.4	33	25.6	0.3	0.076
31.4	35	25.6	0.3	0.060
31.4	35	25.6	0.3	0.119
29.4	37	26.6	0.3	0.060
34.4	38	28.6	0.3	0.061
34.4	38	28.6	0.3	0.122
34.4	38	30.6	0.3	0.060
34.4	38	30.6	0.3	0.094
36.4	40	30.6	0.3	0.069
36.4	40	30.6	0.3	0.137
36.4	40	32.6	0.3	0.049
39.4	43	35.6	0.3	0.053
39.4	43	35.6	0.3	0.069
39.4	43	35.6	0.3	0.091
41.4	45	35.6	0.3	0.078
41.4	45	35.6	0.3	0.089
41.4	45	35.6	0.3	0.156
41.4	45	37.6	0.3	0.056
43.4	50	37.6	0.3	0.125
44.4	48	40.6	0.3	0.074
44.4	48	40.6	0.3	0.152
46.2	53	40.6	0.3	0.145

Without inner ring

Type RNAO  
Type RNAO · ZW

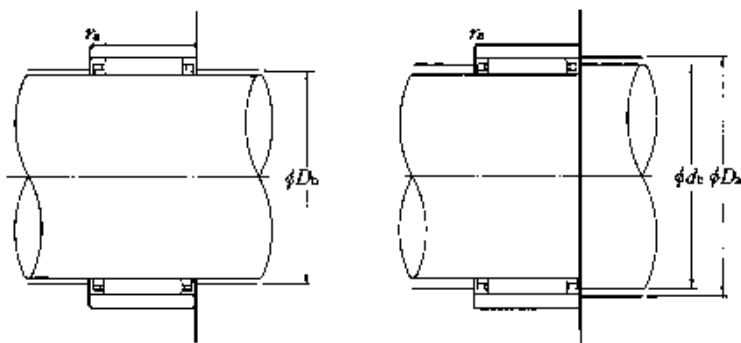


$F_w$  40~85mm

	Boundary dimensions					Basic load ratings				Limiting speeds		Bearing numbers
	mm					dynamic	static	dynamic	static	grease	oil	
	$F_w$	$D$	$C$	$r_a$ min <sup>1)</sup>	$E$	N	N	kgf	kgf			
<b>40</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	55	40	0.3	48	56 500	102 000	5 750	10 400	6 500	10 000	<b>RNAO-40</b> × <b>55</b> × <b>40ZW</b>
<b>45</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	55	17	0.3	50	22 300	44 500	2 280	4 550	6 000	9 000	<b>RNAO-45</b> × <b>55</b> × <b>17</b>
		55	34	0.3	50	38 500	89 500	3 900	9 100	6 000	9 000	<b>RNAO-45</b> × <b>55</b> × <b>34ZW</b>
		62	20	0.3	53	36 000	59 000	3 650	6 000	6 000	9 000	<b>RNAO-45</b> × <b>62</b> × <b>20</b>
		62	40	0.3	53	61 500	118 000	6 250	12 000	6 000	9 000	<b>RNAO-45</b> × <b>62</b> × <b>40ZW</b>
<b>50</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	62	20	0.3	55	27 900	62 000	2 850	6 300	5 500	8 000	<b>RNAO-50</b> × <b>62</b> × <b>20</b>
		62	40	0.3	55	48 000	124 000	4 900	12 600	5 500	8 000	<b>RNAO-50</b> × <b>62</b> × <b>40ZW</b>
		65	20	0.3	58	38 500	67 500	3 950	6 850	5 500	8 000	<b>RNAO-50</b> × <b>65</b> × <b>20</b>
		65	40	0.6	58	66 500	135 000	6 750	13 700	5 500	8 000	<b>RNAO-50</b> × <b>65</b> × <b>40ZW</b>
<b>55</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	68	20	0.6	60	28 800	66 500	2 940	6 750	4 800	7 500	<b>RNAO-55</b> × <b>68</b> × <b>20</b>
		68	25	0.6	63	50 500	97 500	5 150	9 950	4 800	7 500	<b>RNAO-55</b> × <b>68</b> × <b>25</b>
		68	40	0.6	60	49 500	133 000	5 050	13 500	4 800	7 500	<b>RNAO-55</b> × <b>68</b> × <b>40ZW</b>
		72	20	0.6	63	39 000	70 000	3 950	7 100	4 800	7 500	<b>RNAO-55</b> × <b>72</b> × <b>20</b>
<b>60</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	72	40	0.6	63	66 500	140 000	6 800	14 200	4 800	7 500	<b>RNAO-55</b> × <b>72</b> × <b>40ZW</b>
		75	46	1	68	76 000	170 000	7 750	17 400	4 400	6 500	<b>RNAO-60</b> × <b>75</b> × <b>46ZW</b>
		78	20	1	68	40 000	75 000	4 100	7 650	4 400	6 500	<b>RNAO-60</b> × <b>78</b> × <b>20</b>
		78	40	1	68	69 000	150 000	7 050	15 300	4 400	6 500	<b>RNAO-60</b> × <b>78</b> × <b>40ZW</b>
<b>65</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	85	30	1	73	61 000	132 000	6 200	13 400	4 100	6 000	<b>RNAO-65</b> × <b>85</b> × <b>30</b>
		85	60	1	73	104 000	263 000	10 600	26 800	4 100	6 000	<b>RNAO-65</b> × <b>85</b> × <b>60ZW</b>
<b>70</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	90	30	1	78	65 500	149 000	6 700	15 200	3 800	5 500	<b>RNAO-70</b> × <b>90</b> × <b>30</b>
		90	60	1	78	112 000	297 000	11 500	30 500	3 800	5 500	<b>RNAO-70</b> × <b>90</b> × <b>60ZW</b>
<b>75</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	95	30	1	83	67 500	157 000	6 850	16 100	3 600	5 500	<b>RNAO-75</b> × <b>95</b> × <b>30</b>
		95	60	1	83	115 000	315 000	11 800	32 000	3 600	5 500	<b>RNAO-75</b> × <b>95</b> × <b>60ZW</b>
<b>80</b>	$\begin{matrix} +0.049 \\ +0.030 \end{matrix}$	95	30	1	86	57 000	159 000	5 800	16 200	3 300	5 000	<b>RNAO-80</b> × <b>95</b> × <b>30</b>
		95	56	1	88	105 000	284 000	10 700	29 000	3 300	5 000	<b>RNAO-80</b> × <b>95</b> × <b>56ZW</b>
		100	30	1	88	69 000	166 000	7 050	17 000	3 300	5 000	<b>RNAO-80</b> × <b>100</b> × <b>30</b>
		100	60	1	88	119 000	335 000	12 100	34 000	3 300	5 000	<b>RNAO-80</b> × <b>100</b> × <b>60ZW</b>
<b>85</b>	$\begin{matrix} +0.058 \\ +0.036 \end{matrix}$	105	25	1	93	61 500	146 000	6 250	14 900	3 100	4 700	<b>RNAO-85</b> × <b>105</b> × <b>25</b>

Note 1) Allowable minimum chamfer dimension  $r$ .

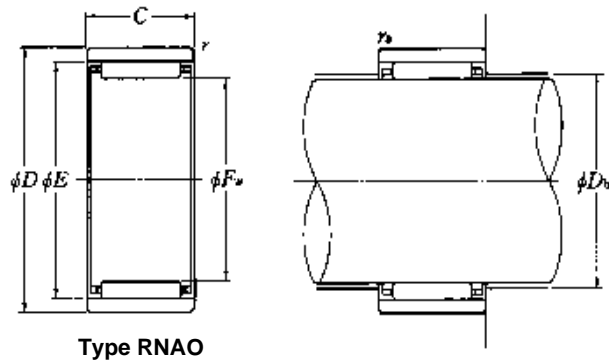
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



$d_b$	Abutment dimensions			Mass kg (approx.)
	$D_a$ max	$D_b$	$r_{as}^{(2)}$ max	
47.2	53	40.6	0.3	0.275
49.2	53	45.6	0.3	0.083
49.2	53	45.6	0.3	0.165
52.2	60	45.6	0.3	0.175
52.2	60	45.6	0.3	0.377
54.2	60	50.6	0.3	0.140
54.2	60	50.6	0.3	0.295
57.2	63	50.6	0.3	0.168
57.2	61	50.6	0.6	0.355
59.4	64	55.8	0.6	0.166
62.4	64	55.8	0.6	0.200
59.4	64	55.8	0.6	0.310
62.4	68	55.8	0.6	0.216
62.4	68	55.8	0.6	0.425
67.2	70	60.8	1	0.461
67.2	73	60.8	1	0.255
67.2	73	60.8	1	0.500
72.2	80	66	1	0.464
72.2	80	66	1	0.951
77.2	85	71	1	0.499
77.2	85	71	1	1.00
82.2	90	76	1	0.520
82.2	90	76	1	1.04
85.2	90	81	1	0.405
87.2	90	81	1	0.755
87.2	95	81	1	0.580
87.2	95	81	1	1.10
92.2	100	86	1	0.459

Without inner ring

Type RNAO

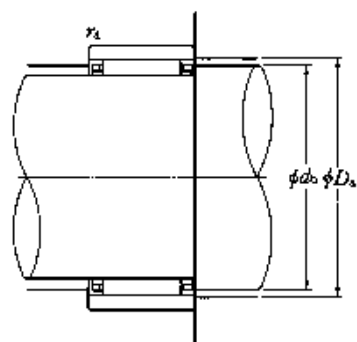


$F_w$  85~100mm

Boundary dimensions					Basic load ratings				Limiting speeds		Bearing numbers	
mm					dynamic	static	dynamic	static	grease	oil		
$F_w$	$D$	$C$	$r_3 \text{ min}^{1)}$	$E$	$C_r$	$C_{or}$	$C_r$	$C_{or}$			$\text{min}^{-1}$	
<b>85</b>	$\begin{matrix} +0.058 \\ +0.036 \end{matrix}$	105	30	1	93	71 000	175 000	7 200	17 900	3 100	4 700	<b>RNAO- 85×105×30</b>
<b>90</b>	$\begin{matrix} +0.058 \\ +0.036 \end{matrix}$	105	26	1	98	64 000	157 000	6 550	16 000	3 000	4 400	<b>RNAO- 90×105×26</b>
		110	30	1	98	72 500	184 000	7 400	18 800	3 000	4 400	<b>RNAO- 90×110×30</b>
<b>95</b>	$\begin{matrix} +0.058 \\ +0.036 \end{matrix}$	115	30	1	103	74 000	193 000	7 550	19 600	2 800	4 200	<b>RNAO- 95×115×30</b>
<b>100</b>	$\begin{matrix} +0.058 \\ +0.035 \end{matrix}$	120	30	1	108	76 000	201 000	7 700	20 500	2 700	4 000	<b>RNAO-100×120×30</b>

Note 1) Allowable minimum chamfer dimension  $r$ .

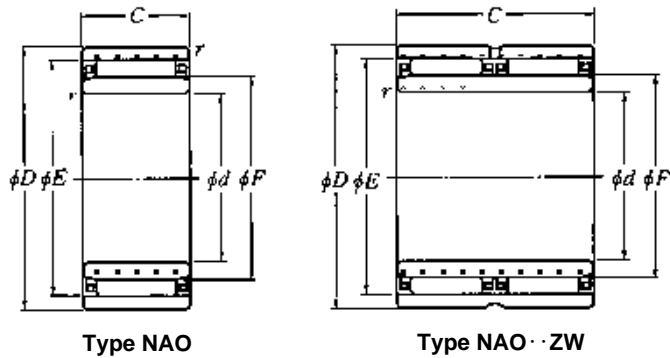
2) Max. allowable dimension of radius  $r_h$  for corner roundness on shaft/housing.



$d_b$	Abutment dimensions mm			Mass kg (approx.)
	$D_a$ max	$D_b$	$r_{as}^{2)}$ max	
92.2	100	86	1	0.585
97.2	100	91	1	0.373
97.2	105	91	1	0.610
102.2	110	96	1	0.640
107.2	115	101	1	0.694

With inner ring

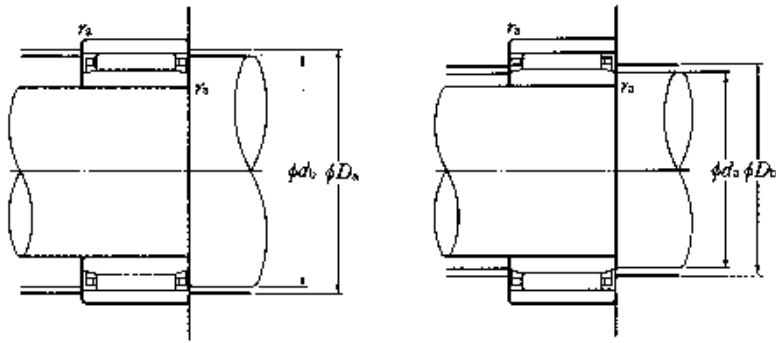
Type NAO  
Type NAO · · ZW



d 6~30mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	min <sup>-1</sup>		
d	D	C	r <sub>a</sub> min <sup>1)</sup>	F	E	N	N	kgf	kgf	grease	oil	
6	17	10	0.3	10	13	4 550	5 100	460	520	19 000	28 000	NAO- 6×17×10T2
7	20	12	0.3	10	16	7 100	5 950	720	610	19 000	28 000	NAO- 7×20×12
9	22	12	0.3	12	18	8 650	8 000	880	815	17 000	26 000	NAO- 9×22×12
10	22	13	0.3	14	18	8 300	10 100	845	1 030	16 000	24 000	NAO-10×22×13
	22	20	0.3	14	18	11 800	16 000	1 210	1 630	16 000	24 000	NAO-10×22×20ZW
	26	12	0.3	14	20	9 350	9 150	955	930	16 000	24 000	NAO-10×26×12
12	24	13	0.3	16	20	9 050	11 800	925	1 200	15 000	23 000	NAO-12×24×13
	24	20	0.3	16	20	12 900	18 500	1 310	1 890	15 000	23 000	NAO-12×24×20ZW
	28	12	0.3	16	22	11 700	12 500	1 190	1 280	15 000	23 000	NAO-12×28×12
15	28	13	0.3	20	24	10 000	14 300	1 020	1 460	13 000	20 000	NAO-15×28×13
	28	26	0.3	20	24	17 100	28 600	1 750	2 910	13 000	20 000	NAO-15×28×26ZW
	32	12	0.3	20	26	12 900	15 100	1 320	1 540	13 000	20 000	NAO-15×32×12
17	30	13	0.3	22	26	10 200	15 200	1 040	1 550	12 000	18 000	NAO-17×30×13
	30	26	0.3	22	26	17 500	30 500	1 790	3 100	12 000	18 000	NAO-17×30×26ZW
	35	16	0.3	22	29	18 700	22 700	1 910	2 310	12 000	18 000	NAO-17×35×16
	35	32	0.3	22	29	32 000	45 500	3 300	4 650	12 000	18 000	NAO-17×35×32ZW
20	35	17	0.3	25	29	14 200	24 000	1 450	2 450	11 000	16 000	NAO-20×35×17
	35	26	0.3	25	29	18 400	33 500	1 880	3 450	11 000	16 000	NAO-20×35×26ZW
	37	16	0.3	25	32	19 500	24 700	1 990	2 520	11 000	16 000	NAO-20×37×16
	37	32	0.3	25	32	33 500	49 500	3 400	5 050	11 000	16 000	NAO-20×37×32ZW
25	40	17	0.3	30	35	19 400	32 500	1 970	3 350	9 000	13 000	NAO-25×40×17
	40	26	0.3	30	35	25 200	46 000	2 570	4 650	9 000	13 000	NAO-25×40×26ZW
	42	16	0.3	30	37	21 900	30 500	2 230	3 100	9 000	13 000	NAO-25×42×16
	42	32	0.3	30	37	37 500	60 500	3 850	6 200	9 000	13 000	NAO-25×42×32ZW
29	42	13	0.3	32	37	14 500	23 000	1 480	2 350	8 500	13 000	NAO-29×42×13
30	45	13	0.3	35	40	15 200	25 100	1 550	2 560	7 500	11 000	NAO-30×45×13
	45	17	0.3	35	40	20 000	36 000	2 040	3 650	7 500	11 000	NAO-30×45×17
	45	26	0.3	35	40	26 100	50 000	2 660	5 100	7 500	11 000	NAO-30×45×26ZW

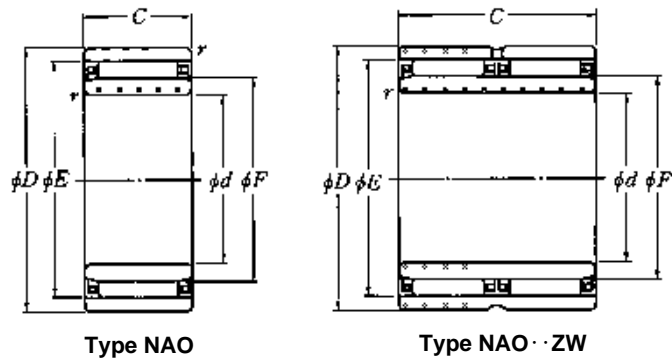
Note 1) Allowable minimum chamfer dimension *r*.  
2) Max. allowable dimension of radius *r<sub>a</sub>* for corner roundness on shaft/housing.



$d_a$ min	Abutment dimensions mm				$r_a^{(2)}$ max	Mass kg (approx.)
	$d_b$	$D_a$ max	$D_b$			
8	12.7	15	10.3	0.3	0.014	
9	15.7	18	10.3	0.3	0.022	
11	17.6	20	12.3	0.3	0.024	
12	17.6	20	14.4	0.3	0.026	
12	17.6	20	14.4	0.3	0.039	
12	19.6	24	14.4	0.3	0.036	
14	19.6	22	16.4	0.3	0.030	
14	19.6	22	16.4	0.3	0.044	
14	21.6	26	16.4	0.3	0.040	
17	23.6	26	20.4	0.3	0.029	
17	23.6	26	20.4	0.3	0.075	
17	25.6	30	20.4	0.3	0.050	
19	25.6	28	22.4	0.3	0.042	
19	25.6	28	22.4	0.3	0.081	
19	28.4	33	22.4	0.3	0.078	
19	28.4	33	22.4	0.3	0.148	
22	28.4	33	25.6	0.3	0.076	
22	28.4	33	25.6	0.3	0.112	
22	31.4	35	25.6	0.3	0.082	
22	31.4	35	25.6	0.3	0.155	
27	34.4	38	30.6	0.3	0.088	
27	34.4	38	30.6	0.3	0.130	
27	36.4	40	30.6	0.3	0.086	
27	36.4	40	30.6	0.3	0.190	
31	36.4	40	32.6	0.3	0.062	
32	39.4	43	35.6	0.3	0.077	
32	39.4	43	35.6	0.3	0.102	
32	39.4	43	35.6	0.3	0.157	

With inner ring

Type NAO  
Type NAO · · ZW

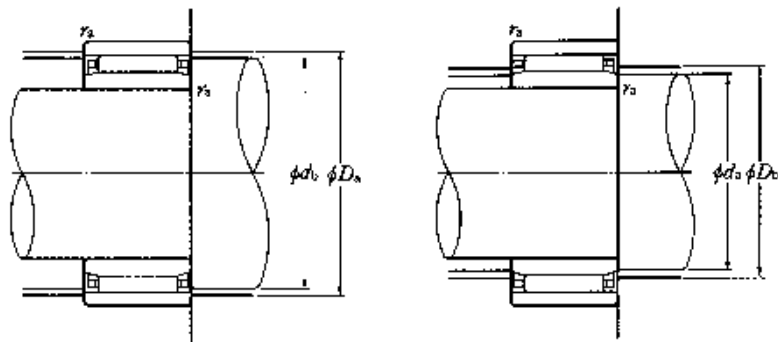


d 30~65mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
d	D	C	r <sub>s min</sub> <sup>1)</sup>	F	E	N	C <sub>0r</sub>	kgf	C <sub>0r</sub>			min <sup>-1</sup>
30	47	16	0.3	35	42	24 100	36 000	2 450	3 650	7 500	11 000	NAO-30×47×16
	47	18	0.3	35	42	24 700	37 000	2 510	3 750	7 500	11 000	NAO-30×47×18
	47	32	0.3	35	42	41 500	71 500	4 200	3 700	7 500	11 000	NAO-30×47×32ZW
	52	18	0.3	37	44	26 300	41 000	2 680	4 150	7 000	11 000	NAO-30×52×18
33	47	13	0.3	37	42	15 900	27 100	1 620	2 770	7 000	11 000	NAO-33×47×13
35	50	17	0.3	40	45	21 800	41 500	2 220	4 250	6 500	10 000	NAO-35×50×17
	50	34	0.3	40	45	37 500	83 000	3 800	8 500	6 500	10 000	NAO-35×50×34ZW
	55	20	0.3	40	47	31 000	51 500	3 150	5 250	6 500	10 000	NAO-35×55×20
	55	40	0.3	40	48	56 500	102 000	5 750	10 400	6 500	10 000	NAO-35×55×40ZW
40	55	17	0.3	45	50	22 300	44 500	2 280	4 550	6 000	9 000	NAO-40×55×17
	55	34	0.3	45	50	38 500	89 500	3 900	9 100	6 000	9 000	NAO-40×55×34ZW
	62	20	0.3	45	53	36 000	59 000	3 650	6 000	6 000	9 000	NAO-40×62×20
	62	40	0.3	45	53	61 500	118 000	6 250	12 000	6 000	9 000	NAO-40×62×40ZW
	65	20	0.3	50	58	38 500	67 500	3 950	6 850	5 500	8 000	NAO-40×65×20
45	62	20	0.3	50	55	27 900	62 000	2 850	6 300	5 500	8 000	NAO-45×62×20
	62	40	0.3	50	55	48 000	124 000	4 900	12 600	5 500	8 000	NAO-45×62×40ZW
	72	20	0.6	55	63	39 000	70 000	3 950	7 100	4 800	7 500	NAO-45×72×20
	72	40	0.6	55	63	66 500	140 000	6 800	14 200	4 800	7 500	NAO-45×72×40ZW
50	68	20	0.6	55	60	28 800	66 500	2 940	6 750	4 800	7 500	NAO-50×68×20
	68	40	0.6	55	60	49 500	133 000	5 050	13 500	4 800	7 500	NAO-50×68×40ZW
	78	20	1	60	68	40 000	75 000	4 100	7 650	4 400	6 500	NAO-50×78×20
	78	40	1	60	68	69 000	150 000	7 050	15 300	4 400	6 500	NAO-50×78×40ZW
55	85	30	1	65	73	61 000	132 000	6 200	13 400	4 100	6 000	NAO-55×85×30
	85	60	1	65	73	104 000	263 000	10 600	26 800	4 100	6 000	NAO-55×85×60ZW
60	90	30	1	70	78	65 500	149 000	6 700	15 200	3 800	5 500	NAO-60×90×30
	90	60	1	70	78	112 000	297 000	11 500	30 500	3 800	5 500	NAO-60×90×60ZW
65	95	30	1	75	83	67 500	157 000	6 850	16 100	3 600	5 500	NAO-65×95×30
	95	60	1	75	83	115 000	315 000	11 800	32 000	3 600	5 500	NAO-65×95×60ZW

Note 1) Allowable minimum chamfer dimension *r*.

2) Max. allowable dimension of radius *r*<sub>a</sub> for corner roundness on shaft/housing.

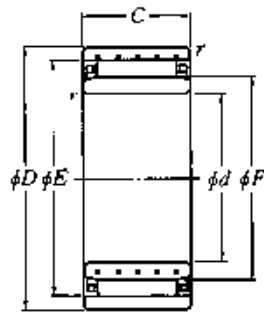


$d_a$ min	Abutment dimensions mm				$r_a^{(2)}$ max	Mass kg (approx.)
	$d_b$	$D_a$ max	$D_b$			
32	41.4	45	35.6	0.3	0.109	
32	41.4	45	35.6	0.3	0.119	
32	41.4	45	35.6	0.3	0.205	
32	43.4	50	37.6	0.3	0.177	
35	41.4	45	37.6	0.3	0.085	
37	44.4	48	40.6	0.3	0.113	
37	44.4	48	40.6	0.3	0.225	
37	46.2	53	40.6	0.3	0.190	
37	47.2	53	40.6	0.3	0.360	
42	49.2	53	45.6	0.3	0.127	
42	49.2	53	45.6	0.3	0.250	
42	52.2	60	45.6	0.3	0.230	
42	52.2	60	45.6	0.3	0.385	
42	57.2	63	50.6	0.3	0.279	
47	54.2	60	50.6	0.3	0.192	
47	54.2	60	50.6	0.3	0.385	
49	62.4	68	55.8	0.6	0.335	
49	62.4	68	55.8	0.6	0.660	
54	59.4	64	55.8	0.6	0.230	
54	59.4	64	55.8	0.6	0.440	
55	67.2	73	60.8	1	0.410	
55	67.2	73	60.8	1	0.755	
60	72.2	80	66	1	0.680	
60	72.2	80	66	1	1.35	
65	77.2	85	71	1	0.720	
65	77.2	85	71	1	1.45	
70	82.2	90	76	1	0.770	
70	82.2	90	76	1	1.54	

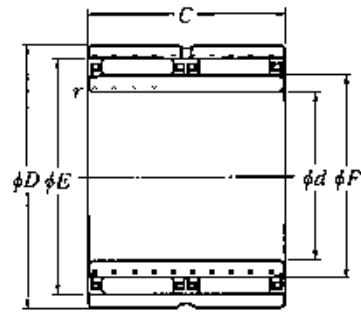
With inner ring

Type NAO

Type NAO··ZW



Type NAO



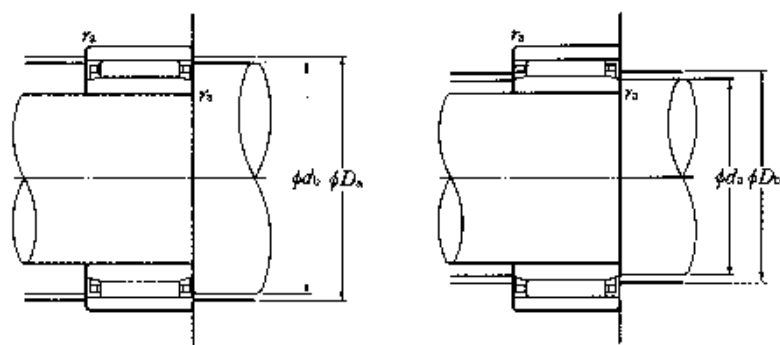
Type NAO··ZW

d 70~90mm

Boundary dimensions						Basic load ratings				Limiting speeds		Bearing numbers
mm						dynamic	static	dynamic	static	grease	oil	
d	D	C	r <sub>a</sub> min <sup>1)</sup>	F	E	N	N	kgf	kgf			
						C <sub>r</sub>	C <sub>0r</sub>	C <sub>r</sub>	C <sub>0r</sub>			
70	95	30	1	80	86	57 000	159 000	5 800	16 200	3 300	5 000	NAO-70× 95× 30
	95	56	1	80	88	105 000	284 000	10 700	29 000	3 300	5 000	NAO-70× 95× 56ZW
	100	30	1	80	88	69 000	166 000	7 050	17 000	3 300	5 000	NAO-70× 100× 30
	100	60	1	80	88	119 000	335 000	12 100	34 000	3 300	5 000	NAO-70× 100× 60ZW
75	105	25	1	85	93	61 500	146 000	6 250	14 900	3 100	4 700	NAO-75× 105× 25
	105	30	1	85	93	71 000	175 000	7 200	17 900	3 100	4 700	NAO-75× 105× 30
80	110	30	1	90	98	72 500	184 000	7 400	18 800	3 000	4 400	NAO-80× 110× 30
85	115	30	1	95	103	74 000	193 000	7 550	19 600	2 800	4 200	NAO-85× 115× 30
90	120	30	1	100	108	76 000	201 000	7 700	20 500	2 700	4 000	NAO-90× 120× 30

Note 1) Allowable minimum chamfer dimension r.

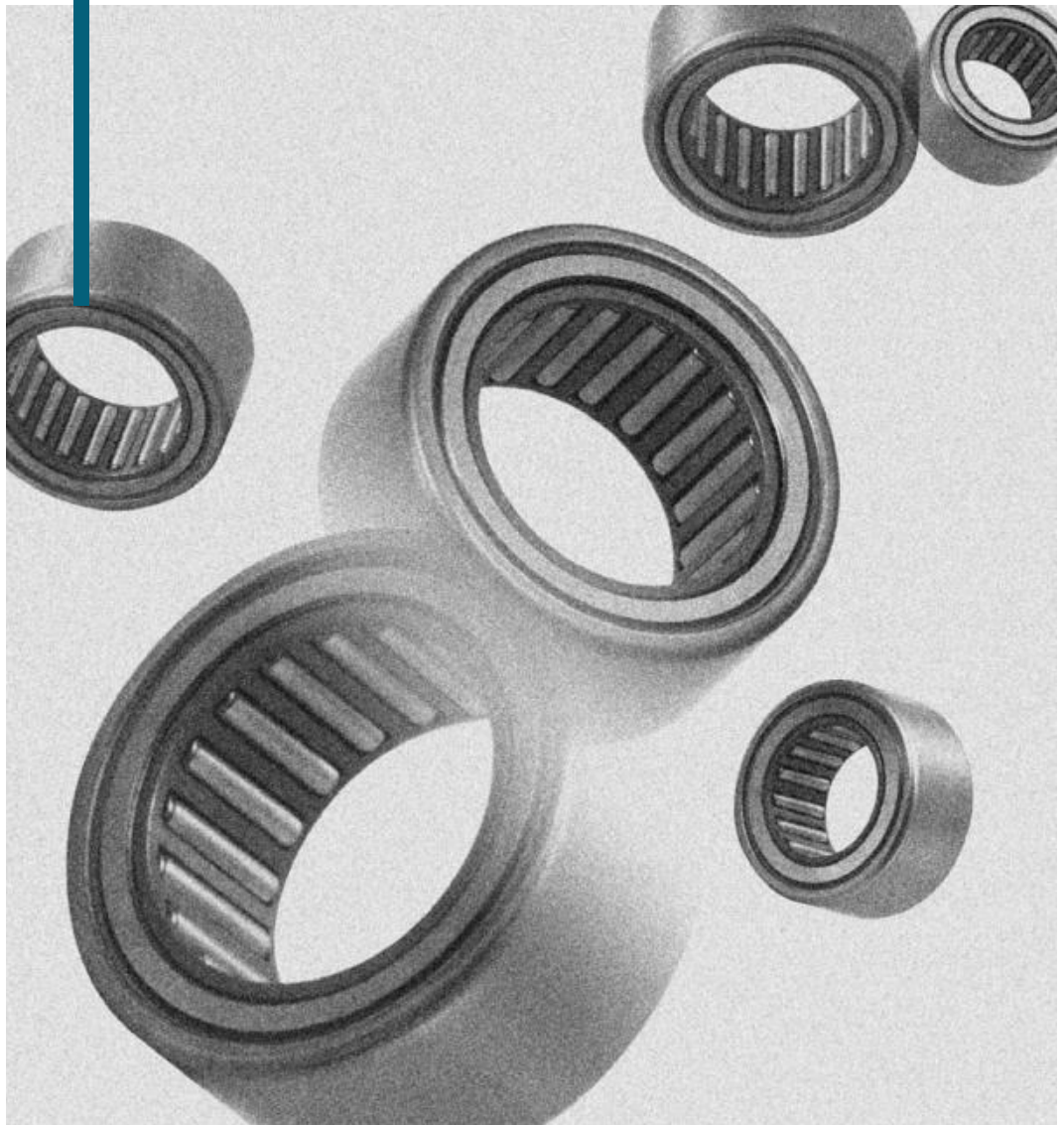
2) Max. allowable dimension of radius r<sub>a</sub> for corner roundness on shaft/housing.



$d_a$ min	Abutment dimensions mm				$r_{as}^{(2)}$ max	Mass kg (approx.)
	$d_b$	$D_a$ max	$D_b$			
75	85.2	90	81	1	0.675	
75	87.2	90	81	1	1.26	
75	87.2	95	81	1	0.850	
75	87.2	95	81	1	1.70	
80	92.2	100	86	1	0.700	
80	92.2	100	86	1	0.880	
85	97.2	105	91	1	0.920	
90	102.2	110	96	1	0.960	
95	107.2	115	101	1	1.04	



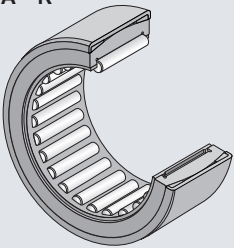
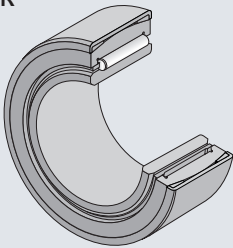
# Self-Aligning Needle Roller Bearings



## Self-Aligning Needle Roller Bearings

Self-aligning needle roller bearings each comprise an outer ring having spherical outside surface; a deep drawn steel collar around the outside surface of outer ring, and; a resin support ring situated between the outer ring and the collar so that the bearing can be automatically aligned; the inner ring alone can be separated from the bearing.

This bearing product has advantages that it can be used on a highly flexible shaft or in an area where alignment with the housing bore is difficult. Also, this bearing product is easy to handle: for example, it is axially positioned without using a snap ring by simply press-fitting into the housing bore in an appropriate fit mode.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
<p>Type RPNA · R</p> 	<p>φ 15– φ 45</p>	<p>RPNA 20 / 35 R</p> <p>RPNA: Type code 20: Roller set bore diameter 35: Outer diameter R: Suffix</p>	<p>Maximum permissible temperature is limited to 100°C because the bearing uses a resin-made support ring.</p>
<p>Type PNA · R</p> 	<p>φ 12– φ 40</p>	<p>[Suffix] R: Ribbed type</p>	

### Bearing accuracy

The dimensional accuracy and profile accuracy of any NTN self-aligning needle roller bearing shall be per JIS Class 0 specified in JIS B 1514 “Rolling bearings—Tolerances”. This does not apply to the outside diameter and width of precision drawn collar.

The dimensional tolerances of roller set bore diameter ( $F_w$ ) of the type RPNA · R (w/o inner ring) shall fall in the range of ISO Tolerance Class F6.

### Radial internal clearance and bearing fits

The NTN Type PNA · R self-aligning needle roller bearing (w/ inner ring) is manufactured to the tolerance range of radial internal clearance in **Table 5.1** in Sec. 5.1 “**Bearing radial internal clearance**” (page A-30). As a self-aligning needle roller bearing is used after being press-fitted into a housing, the fits to the housing and shaft specified in **Table 1** in this page need to be satisfied so that the bearing can function correctly. The bore of this housing needs to satisfy the accuracy specified in **Table 2** in this page. For accuracy of a shaft that uses an inner ring, refer to **Table 8.3** in Sec. 8.3 “**Accuracy of shaft and housing**” (page A-40); for accuracy of a shaft that is directly used as a raceway surface, refer to **Table 8.4** in Sec. 8.4 “**Accuracy of raceway surface**” (page A-40).

For material and hardness of the shaft that functions as raceway surface, refer to Sec. 8.5 “**Material and hardness of raceway**” (page A-40).

Table 1 Fits with housing and shaft (recommended)

Housing		Shaft	
Iron	Light alloy	w/o inner ring	w/ inner ring
N6(N7)	R6(R7)	h5(h6)	k5(j6)

Table 2 Accuracy of housing bore (recommended)

Characteristic	Tolerance
Roundness (max.)	IT5/2
Cylindricity (max.)	IT5/2
Surface roughness (max.)	0.8a

### Bearing mounting relation dimensions

Self-aligning needle roller bearing with an inner ring must be used within the permissible shift range ( $S$ ). (**state where the rollers remain in contact with the inner ring in an effective contact length range**). The permissible shift ( $S$ ) will be found in the relevant dimension table. When the axial shift of the intended bearing is large or a closing seal is used in close vicinity to this bearing, a wider inner ring needs to be adopted. Carefully use a closing seal as its sealing effect may be jeopardized when dimensional errors of fit and/or shaft deflection are large.

When installing a self-aligning needle roller bearing to a housing, place the jig on the marking side of the bearing, and then press-fit the bearing into the correct location in the housing bore.

**When installing, NEVER directly hit the bearing with a hard tool such as a steel hammer.** Instead, use the press-fit jig that is equipped with a mandrel fitted with an O-ring (see **Fig. 1** in this page). The bearing will be easily press-fitted as it will not be misaligned to the housing or fall.

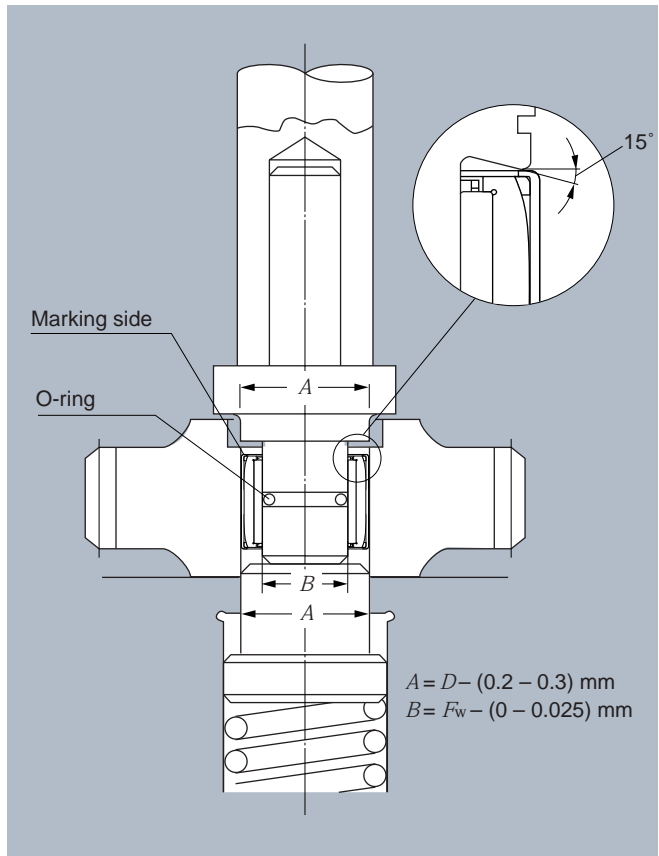
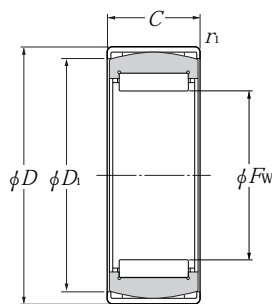


Fig. 1

## Without inner ring

### Type RPNA · · R



Type RPNA · · R

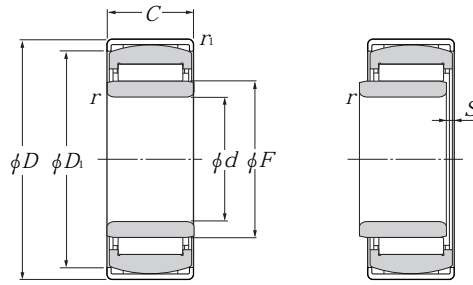
$F_w$  15~45mm

$F_w$	Boundary dimensions					Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
	mm					dynamic	static	dynamic	static	grease	oil		
	$D$	$D_i$	$C$ $\pm 0.5$	$r_1$ min	N	N	kgf	kgf					
<b>15</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	28	24.5	12	0.8	7 050	7 850	715	800	14 000	24 000	<b>RPNA 15/28R</b>	0.032
<b>18</b>	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	32	27	16	0.8	12 700	16 200	1 300	1 650	13 000	22 000	<b>RPNA 18/32R</b>	0.052
<b>20</b>	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	35	30.5	16	0.8	13 200	17 500	1 340	1 790	12 500	21 000	<b>RPNA 20/35R</b>	0.062
<b>25</b>	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	42	36.5	20	0.8	19 200	30 500	1 960	3 100	10 500	18 000	<b>RPNA 25/42R</b>	0.109
<b>28</b>	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	44	38.5	20	0.8	22 300	34 000	2 280	3 450	9 500	16 000	<b>RPNA 28/44R</b>	0.112
<b>30</b>	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	47	42	20	0.8	22 900	36 000	2 340	3 650	9 000	15 000	<b>RPNA 30/47R</b>	0.125
<b>35</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	52	47.5	20	0.8	24 800	41 500	2 520	4 250	7 800	13 000	<b>RPNA 35/52R</b>	0.131
<b>40</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	55	50.5	20	0.8	26 400	47 000	2 700	4 800	6 600	11 000	<b>RPNA 40/55R</b>	0.141
<b>45</b>	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	62	58	20	0.8	28 000	52 500	2 860	5 400	6 000	10 000	<b>RPNA 45/62R</b>	0.176

Remarks: Type RPNA products are imports from INA (German company in Schaeffler Group).

## With inner ring

### Type PNA · · R



Type PNA · · R

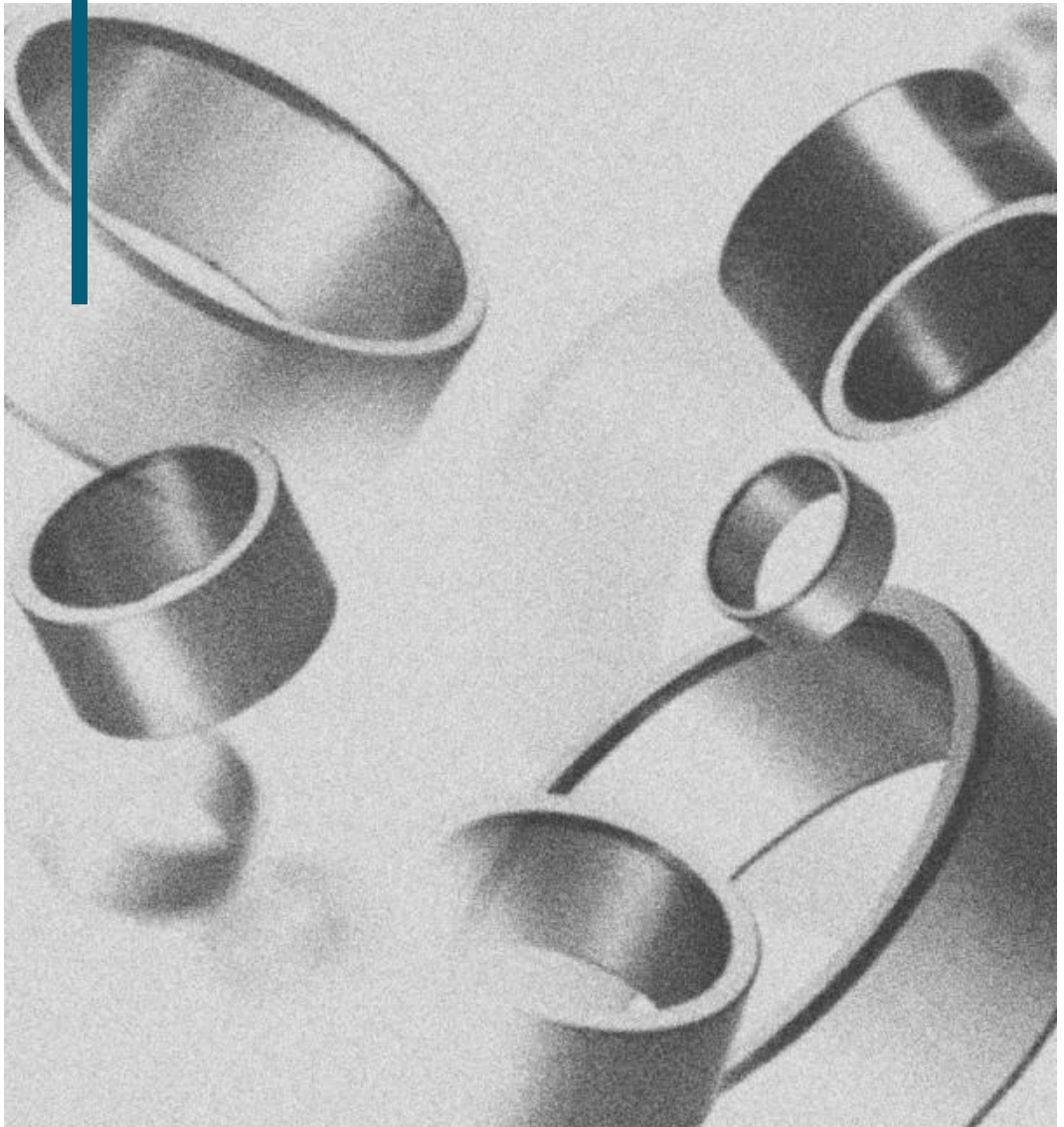
d 12~40mm

Boundary dimensions								Basic load ratings				Limiting speeds		Bearing numbers	Mass kg (approx.)
mm								dynamic	static	dynamic	static	grease	oil		
d	D	D <sub>1</sub>	C ±0.5	<i>t</i> (3 min <sup>-1</sup> )	F	r <sub>1</sub> min	s <sup>2</sup> )	C <sub>r</sub>	C <sub>or</sub>	C <sub>r</sub>	C <sub>or</sub>			min <sup>-1</sup>	
12	28	24.5	12	0.3	15	0.8	0.5	7 050	7 850	715	800	14 000	24 000	PNA 12/28R	0.037
15	32	27	16	0.3	18	0.8	0.5	12 700	16 200	1 300	1 650	13 000	22 000	PNA 15/32R	0.062
17	35	30.5	16	0.3	20	0.8	0.5	13 200	17 500	1 340	1 790	12 500	21 000	PNA 17/35R	0.073
20	42	36.5	20	0.3	25	0.8	0.5	19 200	30 500	1 960	3 100	10 500	18 000	PNA 20/42R	0.136
22	44	38.5	20	0.3	28	0.8	0.5	22 300	34 000	2 280	3 450	9 500	16 000	PNA 22/44R	0.145
25	47	42	20	0.3	30	0.8	0.5	22 900	36 000	2 340	3 650	9 000	15 000	PNA 25/47R	0.157
30	52	47.5	20	0.3	35	0.8	0.5	24 800	41 500	2 520	4 250	7 800	13 000	PNA 30/52R	0.181
35	55	50.5	20	0.3	40	0.8	0.5	26 400	47 000	2 700	4 800	6 600	11 000	PNA 35/55R	0.177
40	62	58	20	0.3	45	0.8	0.5	28 000	52 500	2 860	5 400	6 000	10 000	PNA 40/62R	0.227

Note 1) Allowable minimum chamfer dimension *r*. 2) Allowable axial stroking value of inner ring against outer ring.  
Remarks: Type RPNA products are imports from INA (German company in Schaeffler Group).



# Inner Rings



## Inner Rings

### Inner Rings

Many of the needle roller bearings use a shaft as the direct raceway surface without using inner ring. However, it is recommended to use any of the inner rings described hereunder, together with needle roller bearing, where applicable shaft can not be surface-hardened and surface-finished by grinding. Any inner rings are made of high carbon chrome bearing steel and finished by grinding after heat-treated.

It is desirable to use an inner ring of wide width, where the axial displacement of a shaft is great and also a seal is used at the outer side of bearing.

### Types and Designs

NTN inner rings are available in both of **IR type** with boundary dimensions of metric system and **MI type** with boundary dimensions of inch system. Both edges of inner ring raceway are chamfered to form gentle tapers in order to facilitate fitting of the inner ring. In contrast, inner rings whose inner ring number is headed by an asterisk (\*) are provided with slight-chamfering so that they will offer a greater axial travel. In addition to these inner rings, manufacture of special inner ring type (suffix D) with oil hole on its center is also available.

For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, NTN will supply a special inner ring whose raceway surface includes a grinding allowance. For details, contact NTN Engineering.

### Composition of inner ring number

Inner ring number consists of type code (**IR** or **MI**), dimension code [bore dia. ( $d$ )  $\times$  raceway dia. ( $F$ )  $\times$  width ( $B$ )] and a suffix. Note that the dimensions of Type **MI** (inch series) inner rings measure in 1/16 increments.

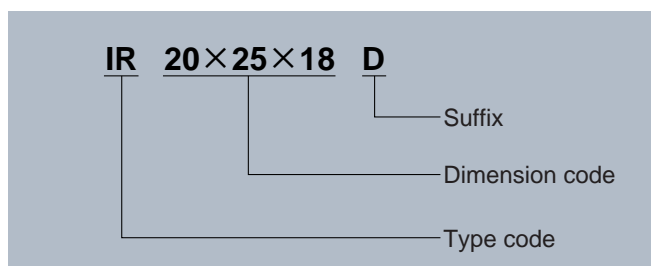


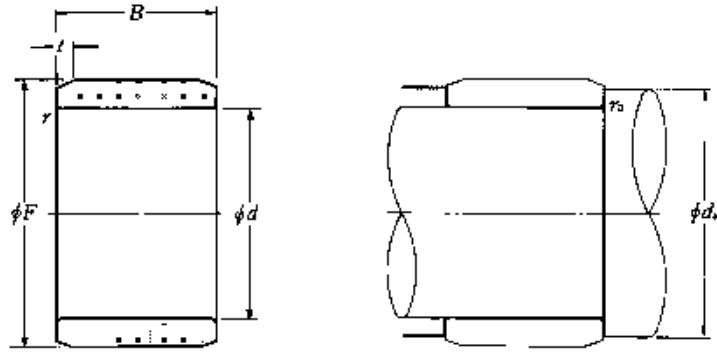
Fig. 1

### Dimensional accuracy for inner ring

The dimensional accuracy (bore diameter " $d$ ", width " $B$ " and chamfer dimension " $r_s$  min"), profile accuracy and running accuracy of the inner rings are as shown in **Tables 4.3** and **4.5** of Section 4 "**Bearing accuracy**" (page A-26). And the standard accuracy class of these items conforms to JIS Class-0, but other inner rings conforming to JIS Class-5 and -4 are also offerable on request.

Each inner ring has been finished to the dimensional tolerance of its raceway diameter ( $F$ ) in the relevant dimension table so that when the inner ring is combined with a needle roller bearing, the resultant radial internal clearance falls in a range of ordinary clearance (refer to **Table 5.1** in Sec. 5.2 "**Running clearance**".)

## Type IR



$d$  5~10mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_a \text{ min}^{2)}$	$t$		$d_a$ min	$r_a^{3)}$ max	
5	7	10	0.15	1	<b>IR 5×7×10</b>	6.2	0.15	0.0014
	$8 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	12	0.3	1	<b>IR 5×8×12</b>	7	0.3	0.0028
	8	16	0.3	—	<b>※IR 5×8×16</b>	7	0.3	0.0038
6	8	10	0.15	1	<b>IR 6×8×10</b>	7.2	0.15	0.0017
	9	12	0.3	1	<b>IR 6×9×12</b>	8	0.3	0.0032
	$9 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	16	0.3	1	<b>IR 6×9×16</b>	8	0.3	0.0043
	$10 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	10	0.3	1	<b>IR 6×10×10</b>	8	0.3	0.0037
	10	12	0.3	—	<b>※IR 6×10×12D</b>	8	0.3	0.0046
	10	13	0.3	1	<b>IR 6×10×13</b>	8	0.3	0.0050
7	9	10	0.15	1	<b>IR 7×9×10</b>	8.2	0.15	0.0019
	$10 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	10.5	0.3	1	<b>IR 7×10×10.5</b>	9	0.3	0.0031
	$10 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	12	0.3	1	<b>IR 7×10×12</b>	9	0.3	0.0036
	$10 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	16	0.3	1	<b>IR 7×10×16</b>	9	0.3	0.0049
	$12 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	16	0.3	1	<b>IR 7×12×16</b>	9	0.3	0.0093
8	$10 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	11	0.15	1	<b>IR 8×10×11</b>	9.2	0.15	0.0024
	$12 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	10	0.3	1	<b>IR 8×12×10</b>	10	0.3	0.0048
	$12 \begin{smallmatrix} 0 \\ -0.006 \end{smallmatrix}$	10.5	0.3	1	<b>IR 8×12×10.5</b>	10	0.3	0.0050
	$12 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	12	0.3	—	<b>※IR 8×12×12D</b>	10	0.3	0.0057
	$12 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	12.5	0.3	1	<b>IR 8×12×12.5</b>	10	0.3	0.0059
	14	16	0.3	1	<b>IR 8×14×16</b>	10	0.3	0.013
9	12	11	0.3	1	<b>IR 9×12×11</b>	11	0.3	0.0041
	$12 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	12	0.3	1	<b>IR 9×12×12</b>	11	0.3	0.0045
	$12 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	16	0.3	1	<b>IR 9×12×16</b>	11	0.3	0.0061
	15	16	0.3	1	<b>IR 9×15×16</b>	11	0.3	0.014
10	13	12.5	0.3	1	<b>IR10×13×12.5</b>	12	0.3	0.0052
	14	12	0.3	1	<b>IR10×14×12</b>	12	0.3	0.0073
	$14 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	13	0.3	1	<b>IR10×14×13</b>	12	0.3	0.0074
	$14 \begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	14	0.3	—	<b>※IR10×14×14D</b>	12	0.3	0.0080
	14	16	0.3	—	<b>※IR10×14×16</b>	12	0.3	0.0092
	14	20	0.3	1	<b>IR10×14×20</b>	12	0.3	0.012

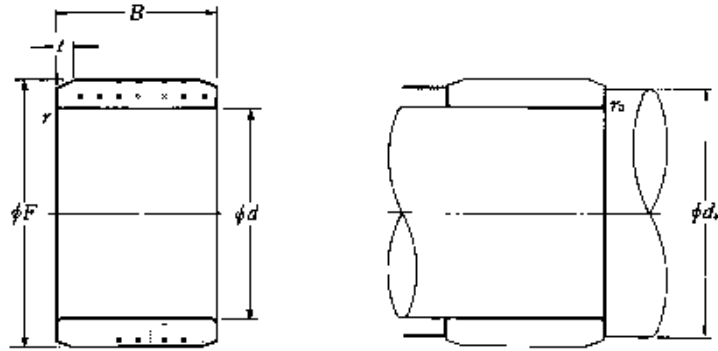
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

## Type IR



$d$  10~15mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{3 \text{ min}}^{2)}$	$t$		$d_a$ min	$r_{as}^{3)}$ max	
10	15	15.5	0.3	1	<b>IR10×15×15.5</b>	12	0.3	0.012
	15 <sub>-0.008</sub> <sup>0</sup>	20.5	0.3	1	<b>IR10×15×20.5</b>	12	0.3	0.015
	16	16	0.3	1	<b>IR10×16×16</b>	12	0.3	0.015
12	15	12	0.3	1	<b>IR12×15×12</b>	14	0.3	0.0058
	15	12.5	0.3	1	<b>IR12×15×12.5</b>	14	0.3	0.0061
	15	16	0.3	1	<b>IR12×15×16</b>	14	0.3	0.0078
	15	16.5	0.3	—	※ <b>IR12×15×16.5</b>	14	0.3	0.0080
	15	22.5	0.3	—	※ <b>IR12×15×22.5</b>	14	0.3	0.011
	16	12	0.3	1.5	<b>IR12×16×12</b>	14	0.3	0.0079
	16	13	0.3	1.5	<b>IR12×16×13</b>	14	0.3	0.0087
	16 <sub>-0.008</sub> <sup>0</sup>	14	0.3	—	※ <b>IR12×16×14D</b>	14	0.3	0.0095
	16	16	0.3	1.5	<b>IR12×16×16</b>	14	0.3	0.011
	16	20	0.3	1.5	<b>IR12×16×20</b>	14	0.3	0.014
	16	22	0.3	1.5	<b>IR12×16×22</b>	14	0.3	0.015
	17	20.5	0.3	1.5	<b>IR12×17×20.5</b>	14	0.3	0.019
	17	25.5	0.3	1.5	<b>IR12×17×25.5</b>	14	0.3	0.024
18	16	0.3	1.5	<b>IR12×18×16</b>	14	0.3	0.018	
14	17 <sub>-0.008</sub> <sup>0</sup>	17	0.3	1.5	<b>IR14×17×17</b>	16	0.3	0.0095
15	18	12.5	0.3	1.5	<b>IR15×18×12.5</b>	17	0.3	0.0072
	18	16	0.3	1.5	<b>IR15×18×16</b>	17	0.3	0.0093
	18	16.5	0.3	1.5	<b>IR15×18×16.5</b>	17	0.3	0.0096
	18 <sub>-0.008</sub> <sup>0</sup>	17.5	0.3	1.5	<b>IR15×18×17.5</b>	17	0.3	0.010
	18	20.5	0.3	1.5	<b>IR15×18×20.5</b>	17	0.3	0.012
	18	25.5	0.3	1.5	<b>IR15×18×25.5</b>	17	0.3	0.015
	19	16	0.3	1.5	<b>IR15×19×16</b>	17	0.3	0.013
	19	20	0.3	1.5	<b>IR15×19×20</b>	17	0.3	0.016
	20	12	0.3	1.5	<b>IR15×20×12</b>	17	0.3	0.012
	20 <sub>-0.009</sub> <sup>0</sup>	13	0.3	1.5	<b>IR15×20×13</b>	17	0.3	0.014
	20	14	0.3	—	※ <b>IR15×20×14D</b>	17	0.3	0.015
	20	18	0.3	1.5	<b>IR15×20×18</b>	17	0.3	0.019
	20	20.5	0.3	1.5	<b>IR15×20×20.5</b>	17	0.3	0.021

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

d 15~20mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
<i>d</i>	<i>F</i> <sup>1)</sup>	<i>B</i>	<i>r</i> <sub>s min</sub> <sup>2)</sup>	<i>t</i>	<i>d</i> <sub>a</sub> min	<i>r</i> <sub>as</sub> <sup>3)</sup> max		
15	20	23	0.3	—	※IR15×20×23	17	0.3	0.024
	20 <sub>0</sub>	26	0.3	1.5	IR15×20×26	17	0.3	0.027
	20 <sup>-0.009</sup>	30.5	0.3	1.5	IR15×20×30.5	17	0.3	0.032
	22	20	0.6	1.5	IR15×22×20	19	0.6	0.032
17	20	16	0.3	1.5	IR17×20×16	19	0.3	0.011
	20	16.5	0.3	1.5	IR17×20×16.5	19	0.3	0.011
	20	20	0.3	1.5	IR17×20×20	19	0.3	0.014
	20	20.5	0.3	—	※IR17×20×20.5	19	0.3	0.014
	20	30.5	0.3	—	※IR17×20×30.5	19	0.3	0.021
	21	16	0.3	1.5	IR17×21×16	19	0.3	0.014
	21	20	0.3	—	※IR17×21×20	19	0.3	0.018
	22 <sub>0</sub>	13	0.3	1.5	IR17×22×13	19	0.3	0.015
	22 <sup>-0.009</sup>	14	0.3	—	※IR17×22×14D	19	0.3	0.016
	22	16	0.3	—	※IR17×22×16	19	0.3	0.019
	22	18	0.3	1.5	IR17×22×18	19	0.3	0.021
	22	20.5	0.3	1.5	IR17×22×20.5	19	0.3	0.024
	22	23	0.3	—	※IR17×22×23	19	0.3	0.027
	22	26	0.3	1.5	IR17×22×26	19	0.3	0.030
	22	32	0.3	1.5	IR17×22×32	19	0.3	0.036
24	20	0.6	1.5	IR17×24×20	21	0.6	0.034	
20	24	16	0.3	1.8	IR20×24×16	22	0.3	0.017
	24	20	0.3	—	※IR20×24×20	22	0.3	0.021
	24	28.5	0.3	—	※IR20×24×28.5	22	0.3	0.030
	25	12.5	0.3	1.8	IR20×25×12.5	22	0.3	0.016
	25	16	0.3	—	※IR20×25×16	22	0.3	0.021
	25 <sub>0</sub>	16.5	0.3	1.8	IR20×25×16.5	22	0.3	0.022
	25 <sup>-0.009</sup>	17	0.3	1.8	IR20×25×17	22	0.3	0.022
	25	18	0.3	—	※IR20×25×18D	22	0.3	0.024
	25	20	0.3	—	※IR20×25×20	22	0.3	0.027
	25	20.5	0.3	1.8	IR20×25×20.5	22	0.3	0.028
	25	23	0.3	1.8	IR20×25×23	22	0.3	0.031

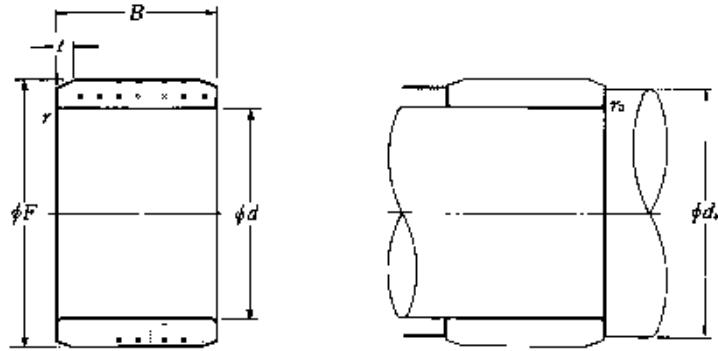
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius *r*<sub>a</sub> for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

## Type IR



$d$  20~28mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{3 \text{ min}}^{2)}$	$t$		$d_a$ min	$r_a^{3)}$ max	
20	25	26	0.3	1.8	IR20×25×26	22	0.3	0.034
	25	26.5	0.3	—	※IR20×25×26.5	22	0.3	0.036
	25 <sub>0</sub>	30	0.3	1.8	IR20×25×30	22	0.3	0.041
	25 <sub>-0.009</sub>	32	0.3	1.8	IR20×25×32	22	0.3	0.041
	25	38.5	0.3	—	※IR20×25×38.5	22	0.3	0.053
	28	20	0.6	1.8	IR20×28×20	24	0.6	0.045
22	26	16	0.3	1.8	IR22×26×16	24	0.3	0.017
	26	20	0.3	—	※IR22×26×20	24	0.3	0.022
	28	17	0.3	1.8	IR22×28×17	24	0.3	0.030
	28 <sub>0</sub>	20	0.3	1.8	IR22×28×20	24	0.3	0.035
	28 <sub>-0.009</sub>	20.5	0.3	1.8	IR22×28×20.5	24	0.3	0.036
	28	23	0.3	1.8	IR22×28×23	24	0.3	0.042
	28	30	0.3	—	※IR22×28×30	24	0.3	0.054
25	29	20	0.3	—	※IR25×29×20	27	0.3	0.026
	29	30	0.3	1.8	IR25×29×30	27	0.3	0.039
	30	12.5	0.3	1.8	IR25×30×12.5	27	0.3	0.020
	30	16	0.3	1	IR25×30×16	27	0.3	0.024
	30	16.5	0.3	1.8	IR25×30×16.5	27	0.3	0.026
	30	17	0.3	1.8	IR25×30×17	27	0.3	0.027
	30	18	0.3	—	※IR25×30×18	27	0.3	0.030
	30 <sub>0</sub>	20	0.3	1.8	IR25×30×20	27	0.3	0.033
	30 <sub>-0.009</sub>	20.5	0.3	1.8	IR25×30×20.5	27	0.3	0.034
	30	23	0.3	1.8	IR25×30×23	27	0.3	0.038
	30	26	0.3	1.8	IR25×30×26	27	0.3	0.041
	30	26.5	0.3	—	※IR25×30×26.5	27	0.3	0.043
	30	30	0.3	1.8	IR25×30×30	27	0.3	0.050
	30	32	0.3	1	IR25×30×32	27	0.3	0.054
	30	38.5	0.3	—	※IR25×30×38.5	27	0.3	0.064
32 <sub>+0.008</sub>	22	0.6	1.8	IR25×32×22	29	0.6	0.052	
32 <sub>-0.002</sub>	30.5	0.6	1.8	IR25×32×30.5	29	0.6	0.072	
28	32 <sub>-0.008</sub> <sub>-0.002</sub>	17	0.3	1.8	IR28×32×17	30	0.3	0.025

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

d 28~35mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
<i>d</i>	<i>F</i> <sup>1)</sup>	<i>B</i>	<i>r</i> <sub>s min</sub> <sup>2)</sup>	<i>t</i>	<i>d</i> <sub>a</sub> min	<i>r</i> <sub>as</sub> <sup>3)</sup> max		
28	32	20	0.3	1.8	IR28×32×20	30	0.3	0.028
	32 <sup>+0.008 -0.002</sup>	23	0.3	1.8	IR28×32×23	30	0.3	0.034
	32	30	0.3	—	※IR28×32×30	30	0.3	0.044
29	32 <sup>+0.008 -0.002</sup>	13	0.3	1.8	IR29×32×13	31	0.3	0.015
30	35	12.5	0.3	1.8	IR30×35×12.5	32	0.3	0.024
	35	13	0.3	1.3	IR30×35×13	32	0.3	0.025
	35	16	0.3	—	※IR30×35×16	32	0.3	0.031
	35	16.5	0.3	1.8	IR30×35×16.5	32	0.3	0.032
	35	17	0.3	1.8	IR30×35×17	32	0.3	0.032
	35	18	0.3	—	※IR30×35×18D	32	0.3	0.035
	35	20	0.3	—	※IR30×35×20	32	0.3	0.038
	35 <sup>+0.008 -0.002</sup>	20.5	0.3	1.8	IR30×35×20.5	32	0.3	0.039
	35	23	0.3	1.8	IR30×35×23	32	0.3	0.044
	35	26	0.3	1.8	IR30×35×26	32	0.3	0.050
	35	30	0.3	—	※IR30×35×30	32	0.3	0.059
	35	32	0.3	1.8	IR30×35×32	32	0.3	0.063
	37	18	0.3	1.8	IR30×37×18	32	0.3	0.050
	37	22	0.6	1.8	IR30×37×22	34	0.6	0.061
	38	20	0.6	—	※IR30×38×20	34	0.6	0.065
32	37	20	0.3	2	IR32×37×20	34	0.3	0.040
	37	30	0.3	—	※IR32×37×30	34	0.3	0.063
	38 <sub>0</sub>	32	0.3	2	IR32×38×32	34	0.3	0.082
	40 <sup>-0.011</sup>	20	0.6	2	IR32×40×20	36	0.6	0.068
	40	27	0.6	2	IR32×40×27	36	0.6	0.092
	40	36	0.6	2	IR32×40×36	36	0.6	0.124
33	37 <sub>0</sub> <sup>-0.011</sup>	13	0.3	2	IR33×37×13	35	0.3	0.022
35	40	12.5	0.3	2	IR35×40×12.5	37	0.3	0.027
	40 <sub>0</sub> <sup>-0.011</sup>	16.5	0.3	2	IR35×40×16.5	37	0.3	0.037
	40	17	0.3	2	IR35×40×17	37	0.3	0.038
	40	20	0.3	2	IR35×40×20	37	0.3	0.044

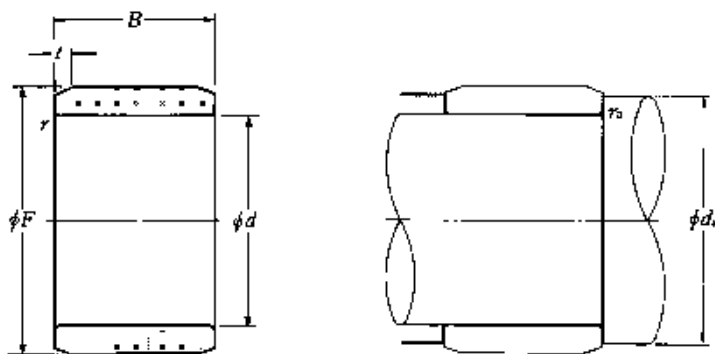
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius *r*<sub>a</sub> for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

## Type IR



d 35~45mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{3 \text{ min}}^{2)}$	$t$		$d_a$ min	$r_a^{3)}$ max	
35	40	20.5	0.3	2	<b>IR35×40×20.5</b>	37	0.3	0.046
	40	30	0.3	—	※IR35×40×30	37	0.3	0.068
	40	34	0.3	1.8	<b>IR35×40×34</b>	37	0.3	0.079
	40	40	0.3	2	<b>IR35×40×40</b>	37	0.3	0.091
	42 <sub>-0.011</sub> <sup>0</sup>	20	0.6	1.8	<b>IR35×42×20</b>	39	0.6	0.064
	42	21	0.6	—	※IR35×42×21	39	0.6	0.068
	42	23	0.6	—	※IR35×42×23D	39	0.6	0.074
	42	27	0.6	2	<b>IR35×42×27</b>	39	0.6	0.080
	42	36	0.6	2	<b>IR35×42×36</b>	39	0.6	0.117
43	22	0.6	2	<b>IR35×43×22</b>	39	0.6	0.081	
38	43 <sub>-0.011</sub> <sup>0</sup>	20	0.3	1.8	<b>IR38×43×20</b>	40	0.3	0.048
	43	30	0.3	—	※IR38×43×30	40	0.3	0.074
40	45	16.5	0.3	2	<b>IR40×45×16.5</b>	42	0.3	0.042
	45	17	0.3	2	<b>IR40×45×17</b>	42	0.3	0.043
	45	20	0.3	2	<b>IR40×45×20</b>	42	0.3	0.051
	45	20.5	0.3	2	<b>IR40×45×20.5</b>	42	0.3	0.053
	45	26.5	0.3	—	※IR40×45×26.5	42	0.3	0.068
	45	30	0.3	2	<b>IR40×45×30</b>	42	0.3	0.077
	45 <sub>-0.011</sub> <sup>0</sup>	34	0.3	2	<b>IR40×45×34</b>	42	0.3	0.088
	45	40	0.3	2	<b>IR40×45×40</b>	42	0.3	0.106
	48	22	0.6	2	<b>IR40×48×22</b>	44	0.6	0.092
	48	23	0.6	—	※IR40×48×23	44	0.6	0.097
	48	30	0.6	2	<b>IR40×48×30</b>	44	0.6	0.123
	48	40	0.6	2	<b>IR40×48×40</b>	44	0.6	0.170
	50	20	0.3	0.8	<b>IR40×50×20</b>	44	0.3	0.106
50	22	1	2	<b>IR40×50×22</b>	45	1	0.118	
42	47 <sub>-0.011</sub> <sup>0</sup>	20	0.3	2	<b>IR42×47×20</b>	44	0.3	0.053
	47	30	0.3	2	<b>IR42×47×30</b>	44	0.3	0.080
45	50 <sub>-0.011</sub> <sup>0</sup>	20	0.3	2	<b>IR45×50×20</b>	47	0.3	0.057
	50	25	0.6	2	<b>IR45×50×25</b>	49	0.6	0.071

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

$d$  45~55mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_s \text{ min}^{2)}$	$t$	$d_a$ min	$r_{as}^{3)}$ max		
45	50	25.5	0.3	—	※IR45×50×25.5	47	0.3	0.074
	50	32	0.6	—	※IR45×50×32	49	0.6	0.092
	50 <sup>0</sup> <sub>-0.011</sub>	35	0.6	2	IR45×50×35	49	0.6	0.101
	50	40	0.3	1.5	IR45×50×40	47	0.3	0.115
	52	22	0.6	2	IR45×52×22	49	0.6	0.088
	52	23	0.6	—	※IR45×52×23D	49	0.6	0.093
	52	30	0.6	2	IR45×52×30	49	0.6	0.123
	52 <sup>+0.008</sup> <sub>-0.004</sub>	40	0.6	2	IR45×52×40	49	0.6	0.164
	55	20	0.6	2	IR45×55×20	49	0.6	0.116
	55	22	1	2	IR45×55×22	50	1	0.130
	55	40	0.6	2	IR45×55×40	49	0.6	0.173
50	55	20	0.6	2	IR50×55×20	54	0.6	0.063
	55	25	0.6	2	IR50×55×25	54	0.6	0.078
	55	35	0.6	2	IR50×55×35	54	0.6	0.112
	55	40	0.6	2	IR50×55×40	54	0.6	0.128
	58	22	0.6	2	IR50×58×22	54	0.6	0.113
	58	23	0.6	—	※IR50×58×23D	54	0.6	0.119
	58 <sup>+0.008</sup> <sub>-0.004</sub>	30	0.6	2	IR50×58×30	54	0.6	0.159
	58	40	0.6	2	IR50×58×40	54	0.6	0.209
	60	20	1	2	IR50×60×20	55	1	0.129
	60	25	1	2	IR50×60×25	55	1	0.163
	60	28	1.1	2	IR50×60×28	56.5	1	0.183
60	40	1	2	IR50×60×40	55	1	0.262	
55	60	25	0.6	2.2	IR55×60×25	59	0.6	0.086
	60	35	0.6	2	IR55×60×35	59	0.6	0.121
	63	25	1	2	IR55×63×25	60	1	0.141
	63	34	1	2.2	IR55×63×34	60	1	0.192
	63 <sup>0</sup> <sub>-0.013</sub>	45	1	2.2	IR55×63×45	60	1	0.256
	65	28	1.1	2.2	IR55×65×28	61.5	1	0.206
	65	30	1	2.2	IR55×65×30	60	1	0.220
	65	60	1	1.5	IR55×65×60	60	1	0.440

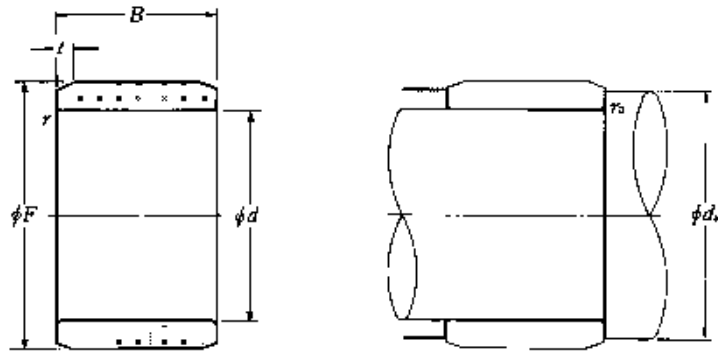
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus code "D" represents inner ring with oil hole.

2. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.

## Type IR



$d$  60~75mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{3 \text{ min}}^{2)}$	$t$	$d_a$ min	$r_{as}^{3)}$ max		
60	68	25	1	2.2	IR60×68×25	65	1	0.152
	68	34	1	2.2	IR60×68×34	65	1	0.206
	68	35	0.6	2.2	IR60×68×35	64	0.6	0.213
	68 <sub>0</sub> <sup>-0.013</sup>	45	1	2.2	IR60×68×45	65	1	0.270
	70	25	1	2.2	IR60×70×25	65	1	0.195
	70	28	1.1	2.2	IR60×70×28	66.5	1	0.216
	70	30	1	2.2	IR60×70×30	65	1	0.232
	70	60	1	2.2	IR60×70×60	65	1	0.463
65	72	25	1	2.2	IR65×72×25	70	1	0.142
	72	34	1	2.2	IR65×72×34	70	1	0.193
	72	45	1	2.2	IR65×72×45	70	1	0.259
	73 <sub>0</sub> <sup>-0.013</sup>	25	0.6	2.2	IR65×73×25	69	0.6	0.164
	73	35	0.6	2.2	IR65×73×35	69	0.6	0.232
	75	28	1.1	2.2	IR65×75×28	71.5	1	0.240
	75	30	1	2.2	IR65×75×30	70	1	0.256
	75	60	1	2.2	IR65×75×60	70	1	0.513
70	80	25	1	2.2	IR70×80×25	75	1	0.224
	80	28	1.1	2.2	IR70×80×28	76.5	1	0.250
	80	30	1	2.2	IR70×80×30	75	1	0.267
	80 <sub>0</sub> <sup>-0.013</sup>	35	1	2.2	IR70×80×35	75	1	0.313
	80	40	1	2.2	IR70×80×40	75	1	0.358
	80	54	1	2.2	IR70×80×54	75	1	0.483
	80	56	1	2.2	IR70×80×56	75	1	0.502
	80	60	1	2.2	IR70×80×60	75	1	0.540
75	85	25	1	2.2	IR75×85×25	80	1	0.238
	85	30	1	2.2	IR75×85×30	80	1	0.287
	85 <sub>0</sub> <sup>-0.015</sup>	35	1	2.2	IR75×85×35	80	1	0.336
	85	40	1	2.2	IR75×85×40	80	1	0.385
	85	54	1	2.2	IR75×85×54	80	1	0.515
	90	32	1.1	2.2	IR75×90×32	81.5	1	0.480

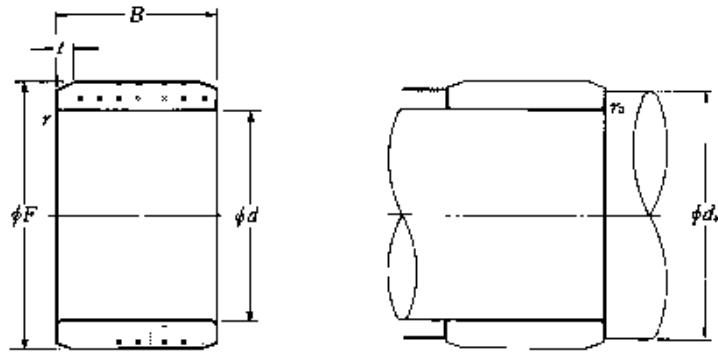
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

d 80~100mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
<i>d</i>	<i>F</i> <sup>1)</sup>	<i>B</i>	<i>r<sub>s</sub></i> min <sup>2)</sup>	<i>t</i>	<i>d<sub>a</sub></i> min	<i>r<sub>as</sub></i> <sup>3)</sup> max		
80	90	25	1	2.2	IR 80 × 90 × 25	85	1	0.254
	90	30	1	2.2	IR 80 × 90 × 30	85	1	0.304
	90 <sub>0</sub> <sup>-0.015</sup>	35	1	2.2	IR 80 × 90 × 35	85	1	0.355
	90 <sub>0</sub> <sup>-0.015</sup>	40	1	2.2	IR 80 × 90 × 40	85	1	0.408
	90	54	1	2.2	IR 80 × 90 × 54	85	1	0.543
	95	32	1.1	2.2	IR 80 × 95 × 32	86.5	1	0.510
85	95	26	1	2.5	IR 85 × 95 × 26	90	1	0.280
	95	30	1	2.5	IR 85 × 95 × 30	90	1	0.323
	95	36	1	2.5	IR 85 × 95 × 36	90	1	0.398
	100 <sub>0</sub> <sup>-0.015</sup>	32	1.1	2.5	IR 85 × 100 × 32	91.5	1	0.530
	100	35	1.1	2.5	IR 85 × 100 × 35	91.5	1	0.580
	100	46	1.1	2.5	IR 85 × 100 × 46	91.5	1	0.760
	100	63	1.1	2.5	IR 85 × 100 × 63	91.5	1	1.05
90	100	26	1	2.5	IR 90 × 100 × 26	95	1	0.294
	100	30	1	2.5	IR 90 × 100 × 30	95	1	0.340
	100	36	1	2.5	IR 90 × 100 × 36	95	1	0.406
	105 <sub>0</sub> <sup>-0.015</sup>	32	1.1	2.5	IR 90 × 105 × 32	96.5	1	0.560
	105	35	1.1	2.5	IR 90 × 105 × 35	96.5	1	0.610
	105	46	1.1	2.5	IR 90 × 105 × 46	96.5	1	0.800
	105	63	1.1	2.5	IR 90 × 105 × 63	96.5	1	1.11
95	105	26	1	2.5	IR 95 × 105 × 26	100	1	0.313
	105	36	1	2.5	IR 95 × 105 × 36	100	1	0.430
	110 <sub>0</sub> <sup>-0.015</sup>	32	1.1	2.5	IR 95 × 110 × 32	101.5	1	0.590
	110 <sub>0</sub> <sup>-0.015</sup>	35	1.1	2.5	IR 95 × 110 × 35	101.5	1	0.640
	110	46	1.1	2.5	IR 95 × 110 × 46	101.5	1	0.850
	110	63	1.1	2.5	IR 95 × 110 × 63	101.5	1	1.17
100	110	30	1.1	2.5	IR100 × 110 × 30	106.5	1	0.375
	110 <sub>0</sub> <sup>-0.015</sup>	40	1.1	2.5	IR100 × 110 × 40	106.5	1	0.505
	115 <sub>0</sub> <sup>-0.015</sup>	32	1.1	2.5	IR100 × 115 × 32	106.5	1	0.620
	115	40	1.1	2.5	IR100 × 115 × 40	106.5	1	0.775

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius *r<sub>a</sub>* for corner roundness on shaft/housing.

## Type IR



$d$  100~160mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{\text{a min}}^{2)}$	$t$	$d_a$ min	$r_{\text{a}}^{3)}$ max		
100	115 <sub>-0.015</sub> <sup>0</sup>	54	1.1	2.5	IR100×115×54	106.5	1	1.09
	120 <sub>-0.015</sub> <sup>0</sup>	30	1	2.5		IR110×120×30	115	1
110	120 <sub>-0.015</sub> <sup>0</sup>	40	1.1	2.5	IR110×120×40	116.5	1	0.580
	125 <sub>-0.018</sub> <sup>0</sup>	40	1.1	2.5	IR110×125×40	116.5	1	0.840
	125 <sub>-0.018</sub> <sup>0</sup>	54	1.1	2.5	IR110×125×54	116.5	1	1.16
120	130	30	1	2.2	IR120×130×30	125	1	0.440
	130	40	1.1	2.5	IR120×130×40	126.5	1	0.590
	135 <sub>-0.018</sub> <sup>0</sup>	40	2	2.5	IR120×135×40	129	2	0.870
	135	45	1.1	2.5	IR120×135×45	126.5	1	0.980
	135	60	1.1	2.5	IR120×135×60	126.5	1	1.25
130	145	32	1.5	3	IR130×145×32	138	1.5	0.780
	145	35	1.1	3	IR130×145×35	136.5	1	0.855
	145 <sub>-0.018</sub> <sup>0</sup>	42	1.5	3	IR130×145×42	138	1.5	1.05
	150 <sub>-0.018</sub> <sup>0</sup>	50	1.5	3	IR130×150×50	138	1.5	1.69
	150	52	2	3	IR130×150×52	139	2	1.75
	150	67	1.5	3	IR130×150×67	138	1.5	2.25
140	155	32	1.5	3	IR140×155×32	148	1.5	0.840
	155	35	1.1	3	IR140×155×35	146.5	1	0.917
	155 <sub>-0.018</sub> <sup>0</sup>	42	1.5	3	IR140×155×42	148	1.5	1.10
	160 <sub>-0.018</sub> <sup>0</sup>	50	1.5	3	IR140×160×50	148	1.5	1.70
	160	52	2	3	IR140×160×52	149	2	1.78
	160	67	1.5	3	IR140×160×67	148	1.5	2.30
150	165	32	1.5	3	IR150×165×32	158	1.5	0.900
	165	40	1.1	3	IR150×165×40	156.5	1	1.12
	165 <sub>-0.035</sub> <sup>-0.017</sup>	42	1.5	3	IR150×165×42	158	1.5	1.18
	170	52	2	3	IR150×170×52	159	2	2.00
	170	60	2	3	IR150×170×60	159	2	2.35
160	175 <sub>-0.035</sub> <sup>-0.017</sup>	40	1.1	3	IR160×175×40	166.5	1	1.20
	180 <sub>-0.035</sub> <sup>-0.017</sup>	60	2	3	IR160×180×60	169	2	2.50

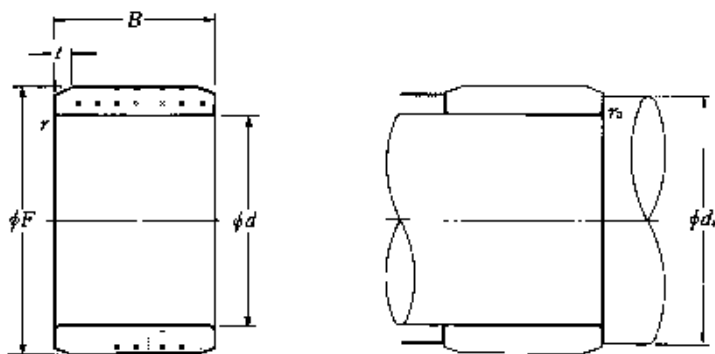
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

d 170~380mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
<i>d</i>	<i>F</i> <sup>1)</sup>	<i>B</i>	<i>r</i> <sub>s min</sub> <sup>2)</sup>	<i>t</i>	<i>d</i> <sub>a</sub> min	<i>r</i> <sub>as</sub> <sup>3)</sup> max		
<b>170</b>	185 <sup>-0.013</sup>	45	1.1	3	<b>IR170×185× 45</b>	176.5	1	1.45
	190 <sup>-0.043</sup>	60	2	3	<b>IR170×190× 60</b>	179	2	2.65
<b>180</b>	195 <sup>-0.013</sup>	45	1.1	3	<b>IR180×195× 45</b>	186.5	1	1.51
	205 <sup>-0.043</sup>	69	2	3	<b>IR180×205× 69</b>	189	2	4.10
<b>190</b>	210 <sup>-0.020</sup>	50	1.5	3.5	<b>IR190×210× 50</b>	198	1.5	2.41
	215 <sup>-0.050</sup>	69	2	3.5	<b>IR190×215× 69</b>	199	2	4.10
<b>200</b>	220 <sup>-0.020</sup>	50	1.5	3.5	<b>IR200×220× 50</b>	208	1.5	2.49
	225 <sup>-0.050</sup>	80	2.1	3.5	<b>IR200×225× 80</b>	211	2	5.10
<b>220</b>	240 <sup>-0.033</sup>	50	1.5	3.5	<b>IR220×240× 50</b>	228	1.5	2.75
	245 <sup>-0.063</sup>	80	2.1	3.5	<b>IR220×245× 80</b>	231	2	5.70
<b>240</b>	265 <sup>-0.037</sup>	60	2	3.5	<b>IR240×265× 60</b>	249	2	4.60
	265 <sup>-0.069</sup>	80	2.1	3.5	<b>IR240×265× 80</b>	251	2	6.30
<b>260</b>	285 <sup>-0.064</sup>	60	2	4	<b>IR260×285× 60</b>	269	2	4.98
	290 <sup>-0.092</sup>	100	2.1	4	<b>IR260×290×100</b>	271	2	10.0
<b>280</b>	305 <sup>-0.064</sup>	69	2	4	<b>IR280×305× 69</b>	289	2	6.20
	310 <sup>-0.092</sup>	100	2.1	4	<b>IR280×310×100</b>	291	2	10.8
<b>300</b>	330 <sup>-0.062</sup>	80	2.1	4	<b>IR300×330× 80</b>	311	2	9.30
	340 <sup>-0.098</sup>	118	3	4	<b>IR300×340×118</b>	313	2.5	18.5
<b>320</b>	350 <sup>-0.062</sup>	80	2.1	5	<b>IR320×350× 80</b>	331	2	9.80
	360 <sup>-0.098</sup>	118	3	5	<b>IR320×360×118</b>	333	2.5	20.0
<b>340</b>	370 <sup>-0.062</sup>	80	2.1	5	<b>IR340×370× 80</b>	351	2	10.1
	380 <sup>-0.098</sup>	118	3	5	<b>IR340×380×118</b>	353	2.5	22.0
<b>360</b>	390 <sup>-0.090</sup>	80	2.1	5	<b>IR360×390× 80</b>	371	2	10.9
	400 <sup>-0.126</sup>	118	3	5	<b>IR360×400×118</b>	373	2.5	22.0
<b>380</b>	415 <sup>-0.080</sup>	100	2.1	5	<b>IR380×415×100</b>	391	2	18.5
	430 <sup>-0.120</sup>	140	4	5	<b>IR380×430×140</b>	396	3	35.0

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius *r*<sub>a</sub> for corner roundness on shaft/housing.

## Type IR



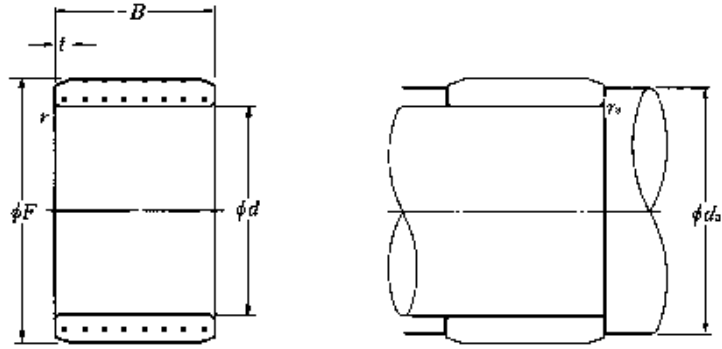
$d$  400~440mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm						mm		
$d$	$F^{1)}$	$B$	$r_{3 \text{ min}}^{2)}$	$t$	$d_a$ min	$r_{as}^{3)}$ max		
400	450 -0.080 -0.120	140	4	5	<b>IR400×450×140</b>	416	3	36.5
420	470 -0.105 -0.145	140	4	5	<b>IR420×470×140</b>	436	3	38.2
440	490 -0.105 -0.145	160	4	5	<b>IR440×490×160</b>	456	3	46.5

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension  $t$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## Inch series

### Type MI



d 9.525~34.925mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm ( $\frac{1}{25.4}$ mm)						mm		
d	F <sup>1)</sup>	B	r <sub>s min</sub> <sup>2)</sup>	t		d <sub>a</sub> min	r <sub>as</sub> <sup>3)</sup> max	
9.525( $\frac{3}{8}$ )	14.288( $\frac{9}{16}$ )	12.95	0.6	—	※MI-060908	13.5	0.6	0.013
	15.875( $\frac{5}{8}$ ) -0.008	19.30	0.6	1	MI-061012	13.5	0.6	0.019
	15.875( $\frac{5}{8}$ )	25.65	0.6	1	MI-061016	13.5	0.6	0.025
12.700( $\frac{1}{2}$ )	19.050( $\frac{3}{4}$ )	16.13	1	—	※MI-081210	17.5	1	0.020
	19.050( $\frac{3}{4}$ ) -0.009	19.30	1	—	※MI-081212	17.5	1	0.024
	19.050( $\frac{3}{4}$ )	25.65	1	—	※MI-081216	17.5	1	0.032
15.875( $\frac{5}{8}$ )	22.225( $\frac{7}{8}$ )	9.78	1	—	※MI-101406	21	1	0.014
	22.225( $\frac{7}{8}$ ) -0.009	12.95	1	—	※MI-101408	21	1	0.018
	22.225( $\frac{7}{8}$ )	19.30	1	—	※MI-101412	21	1	0.027
	22.225( $\frac{7}{8}$ )	25.65	1	—	※MI-101416	21	1	0.036
19.050( $\frac{3}{4}$ )	25.400(1) -0.009	19.30	1	—	※MI-121612	24	1	0.034
	25.400(1)	25.65	1	—	※MI-121616	24	1	0.045
22.225( $\frac{7}{8}$ )	28.575(1 $\frac{1}{8}$ )	12.95	1	—	※MI-141808	27	1	0.027
	28.575(1 $\frac{1}{8}$ ) -0.009	19.30	1	—	※MI-141812	27	1	0.040
	28.575(1 $\frac{1}{8}$ )	25.65	1	—	※MI-141816	27	1	0.052
	28.575(1 $\frac{1}{8}$ )	32.00	1	—	※MI-141820	27	1	0.066
25.400(1)	31.750(1 $\frac{1}{4}$ )	19.30	1	—	※MI-162012	30.5	1	0.039
	31.750(1 $\frac{1}{4}$ ) +0.008 -0.002	25.65	1	—	※MI-162016	30.5	1	0.052
	31.750(1 $\frac{1}{4}$ )	32.00	1	—	※MI-162020	30.5	1	0.065
28.575(1 $\frac{1}{8}$ )	34.925(1 $\frac{3}{8}$ )	12.95	1	—	※MI-182208	33.5	1	0.032
	34.925(1 $\frac{3}{8}$ ) +0.008 -0.002	25.65	1	—	※MI-182216	33.5	1	0.063
	34.925(1 $\frac{3}{8}$ )	32.00	1	—	※MI-182220	33.5	1	0.079
31.750(1 $\frac{1}{4}$ )	38.100(1 $\frac{1}{2}$ )	25.65	1.5	—	※MI-202416	37	1.5	0.075
	38.100(1 $\frac{1}{2}$ ) -0.011	32.00	1.5	—	※MI-202420	37	1.5	0.094
33.338(1 $\frac{5}{16}$ )	41.275(1 $\frac{5}{8}$ )	25.65	1.5	2	MI-212616	40	1.5	0.093
	41.275(1 $\frac{5}{8}$ ) -0.011	32.00	1.5	2	MI-212620	40	1.5	0.116
34.925(1 $\frac{3}{8}$ )	41.275(1 $\frac{5}{8}$ )	16.13	1.5	2	MI-222610	40	1.5	0.073
	44.450(1 $\frac{3}{4}$ ) -0.011	25.65	1.5	2	MI-222816	41.5	1.5	0.117

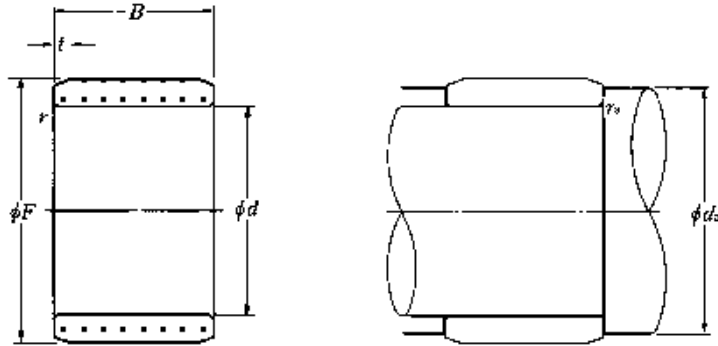
Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.

2) Allowable minimum chamfer dimension  $r$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

Remarks: 1. Nominal number plus ※-mark represents inner ring with fine-chamfered outer surface.  $r$

## Inch series

### Type MI



d 34.925~98.425mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm ( $\frac{1}{25.4}$ mm)						mm		
d	F <sup>1)</sup>	B	r <sub>s</sub> min <sup>2)</sup>	t		d <sub>a</sub> min	r <sub>as</sub> <sup>3)</sup> max	
<b>34.925(1 3/8)</b>	44.450(1 3/4) $_{-0.011}^0$	32.00	1.5	2	<b>MI-222820</b>	41.5	1.5	0.146
<b>38.100(1 1/2)</b>	44.450(1 3/4) $_{-0.011}^0$	19.30	1.5	2	<b>MI-242812</b>	43	1.5	0.062
	44.450(1 3/4) $_{-0.011}^0$	25.65	1.5	2	<b>MI-242816</b>	43	1.5	0.083
<b>39.688(1 9/16)</b>	47.625(1 7/8) $_{-0.011}^0$	32.00	1.5	2	<b>MI-253020</b>	46	1.5	0.136
<b>41.275(1 5/8)</b>	50.800(2) $_{-0.004}^{+0.008}$	25.65	1.5	2	<b>MI-263216</b>	48	1.5	0.140
	50.800(2) $_{-0.004}^{+0.008}$	32.00	1.5	2	<b>MI-263220</b>	48	1.5	0.175
<b>44.450(1 3/4)</b>	57.150(2 1/4) $_{-0.004}^{+0.008}$	38.35	1.5	2	<b>MI-283624</b>	51	1.5	0.310
	57.150(2 1/4) $_{-0.004}^{+0.008}$	44.70	1.5	2	<b>MI-283628</b>	51	1.5	0.360
<b>50.800(2)</b>	63.500(2 1/2) $_{-0.013}^0$	38.35	2	2	<b>MI-324024</b>	59	2	0.340
	63.500(2 1/2) $_{-0.013}^0$	44.70	2	2	<b>MI-324028</b>	59	2	0.420
<b>57.150(2 1/4)</b>	69.850(2 3/4) $_{-0.013}^0$	25.65	2	2.2	<b>MI-364416</b>	65	2	0.257
	69.850(2 3/4) $_{-0.013}^0$	38.35	2	2.2	<b>MI-364424</b>	65	2	0.384
	69.850(2 3/4) $_{-0.013}^0$	44.70	2	2.2	<b>MI-364428</b>	65	2	0.447
<b>63.500(2 1/2)</b>	76.200(3) $_{-0.013}^0$	38.35	2	2.2	<b>MI-404824</b>	71.5	2	0.417
	76.200(3) $_{-0.013}^0$	44.70	2	2.2	<b>MI-404828</b>	71.5	2	0.486
<b>66.675(2 5/8)</b>	82.550(3 1/4) $_{-0.015}^0$	44.70	2	2.2	<b>MI-425228</b>	74.5	2	0.648
	82.550(3 1/4) $_{-0.015}^0$	51.05	2	2.2	<b>MI-425232</b>	74.5	2	0.740
<b>69.850(2 3/4)</b>	82.550(3 1/4) $_{-0.015}^0$	44.70	2	2.2	<b>MI-445228</b>	78	2	0.530
<b>76.200(3)</b>	88.900(3 1/2) $_{-0.015}^0$	44.70	2	2.2	<b>MI-485628</b>	84	2	0.574
	88.900(3 1/2) $_{-0.015}^0$	51.05	2	2.2	<b>MI-485632</b>	84	2	0.655
<b>79.375(3 1/8)</b>	95.250(3 3/4) $_{-0.015}^0$	51.05	2.5	2.2	<b>MI-506032</b>	88.5	2.5	0.862
<b>85.725(3 3/8)</b>	101.600(4) $_{-0.015}^0$	51.05	2.5	2.5	<b>MI-546432</b>	94.5	2.5	0.930
<b>92.075(3 5/8)</b>	107.950(4 1/4) $_{-0.015}^0$	51.05	2.5	2.5	<b>MI-586832</b>	101	2.5	1.00
<b>95.250(3 3/4)</b>	114.300(4 1/2) $_{-0.015}^0$	57.40	2.5	2.5	<b>MI-607236</b>	104	2.5	1.40
<b>98.425(3 7/8)</b>	114.300(4 1/2) $_{-0.015}^0$	57.40	2.5	2.5	<b>MI-627236</b>	107.5	2.5	1.15
	114.300(4 1/2) $_{-0.015}^0$	63.88	2.5	2.5	<b>MI-627240</b>	107.5	2.5	1.28

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension  $r$ . 3) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

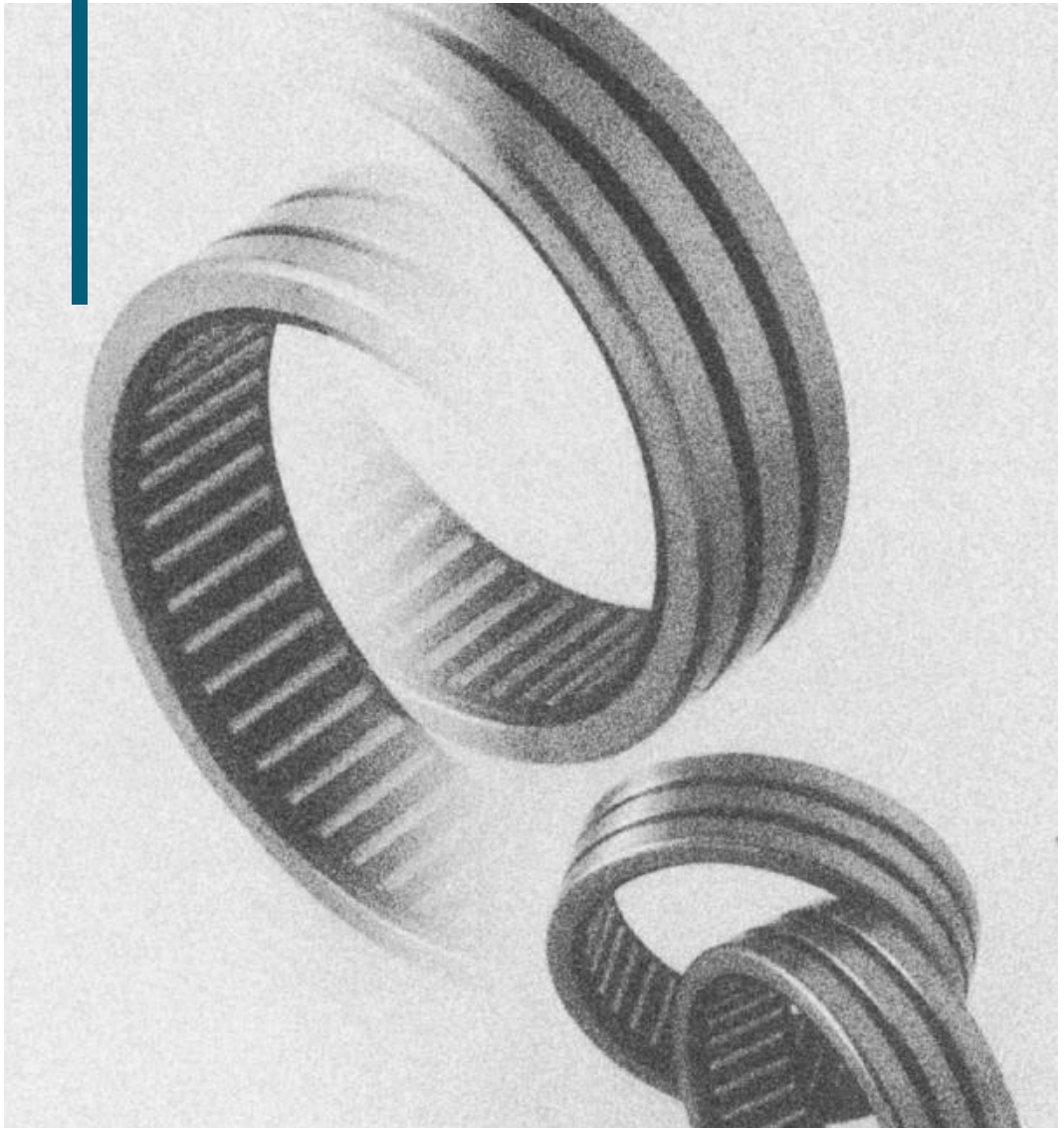
d 101.600~203.200mm

Boundary dimensions					Bearing numbers	Abutment dimensions		Mass kg (approx.)
mm ( $\frac{1}{25.4}$ mm)						mm		
<i>d</i>	<i>F</i> <sup>1)</sup>	<i>B</i>	<i>r</i> <sub>s min</sub> <sup>2)</sup>	<i>t</i>	<i>d</i> <sub>a</sub> min	<i>r</i> <sub>as</sub> <sup>3)</sup> max		
<b>101.600(4)</b>	127.000(5)	51.05	2.5	2.5	<b>MI-648032</b>	110.5	2.5	1.82
	127.000(5) $^0_{-0.018}$	57.40	2.5	2.5	<b>MI-648036</b>	110.5	2.5	2.05
	127.000(5)	63.88	2.5	2.5	<b>MI-648040</b>	110.5	2.5	2.28
<b>114.300(4 1/2)</b>	139.700(5 1/2) $^0_{-0.018}$	63.88	2.5	2.5	<b>MI-728840</b>	123.5	2.5	2.58
	139.700(5 1/2)	76.58	2.5	2.5	<b>MI-728848</b>	123.5	2.5	3.10
<b>120.650(4 3/4)</b>	146.050(5 3/4) $^0_{-0.018}$	76.58	3	3	<b>MI-769248</b>	132	3	3.18
<b>127.000(5)</b>	152.400(6) $^0_{-0.018}$	63.88	3	3	<b>MI-809640</b>	140	3	2.80
	152.400(6)	76.58	3	3	<b>MI-809648</b>	140	3	3.35
<b>139.700(5 1/2)</b>	165.100(6 1/2) $^0_{-0.010}$	63.88	3	3	<b>MI-8810440</b>	152.5	3	2.84
	165.100(6 1/2) $^0_{-0.028}$	76.58	3	3	<b>MI-8810448</b>	152.5	3	3.40
<b>152.400(6)</b>	184.150(7 1/4) $^0_{-0.013}$	76.58	3	3	<b>MI-9611648</b>	165.5	3	4.80
<b>165.100(6 1/2)</b>	196.850(7 3/4) $^0_{-0.013}$	76.58	3	3	<b>MI-10412448</b>	178	3	5.30
<b>177.800(7)</b>	209.550(8 1/4) $^0_{-0.013}$	76.58	3	3	<b>MI-11213248</b>	191	3	5.60
<b>190.500(7 1/2)</b>	222.250(8 3/4) $^0_{-0.020}$	76.58	4	3	<b>MI-12014048</b>	206.5	4	6.10
<b>203.200(8)</b>	234.950(9 1/4) $^0_{-0.033}$	76.58	4	3.5	<b>MI-12814848</b>	219	4	6.50

Note 1) Dimensional tolerance to secure ordinary clearance when any of these inner rings is combined with needle roller bearing with no inner ring.  
 2) Allowable minimum chamfer dimension *r*. 3) Max. allowable dimension of radius *r*<sub>a</sub> for corner roundness on shaft/housing.



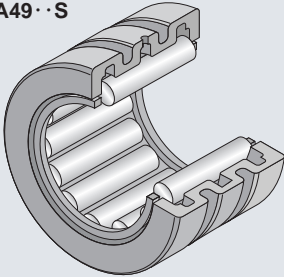
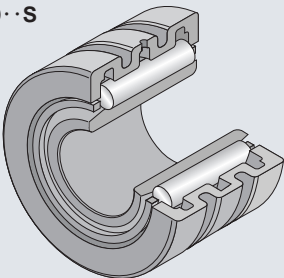
## Adjustable-Clearance Needle Roller Bearings



## Clearance-Adjustable Needle Roller Bearings

This bearing type comprises a solid outer ring with a unique cross-sections shape and needle rollers and cage built in the outer ring. The outer ring, needle rollers and cage are inseparable from each other. The outer ring raceway diameter is reduced by clamping the outer ring axially, which then reduces the roller inscribed circle diameter ( $F_w$ ).

Axial clamping force on the bearing can be adjusted to alter the reduction on outer ring raceway diameter so that the radial clearance can be finely adjusted. The bearing is used on machine tools main spindle and other similar which require high speed rotational accuracy of JIS Class-4.

Bearing type	Applicable shaft diameter (mm)	Composition of bearing number	Remarks
<b>Type RNA49·S</b> 	$\phi 30 \sim \phi 125$	<b>RNA 49 05 S</b> Type code Dimension series Roller set bore diameter code Suffix	The dimensional accuracy, profile accuracy and running accuracy conform to JIS Class-4 so as to be available for applications requiring high running accuracy.  Another inner ring type with grinding allowance for its raceway surface can also be supplied upon request.
<b>Type NA49·S</b> 	$\phi 25 \sim \phi 110$	<b>[Suffix]</b> S: Clearance-adjustable type	

### Bearing accuracy

Application of this bearing type is limited to the portions of a machine which require high running accuracy. Therefore, the dimensional accuracy, profile accuracy and running accuracy of this bearing type conform to JIS Class-4. For applications that need particularly high running accuracy, certain bearing users install the inner ring onto the shaft and then grind the raceway surface to targeted accuracy. To fulfill this type of request, NTN will supply a special inner ring whose raceway surface includes a grinding allowance.

### Radial internal clearance and bearing fits

The radial internal clearance of Type **RNA49·S** with inner ring is smaller than ordinary clearance. While the tolerance of roller set bore diameter ( $F_w$ ) of Type **NA49·S** without inner ring is listed in the relevant dimension table, the radial internal clearance of the bearing is determined once the applicable shaft diameter has been selected.

To be able to force the outer ring in the axial direction to shrink the raceway diameter, the fit of the outer ring to the housing bore needs to be "transition fit" or "interference fit" (interference of approximately  $5 \mu\text{m}$ ).

Bearing fit on a shaft and in a housing shall be per **Table 1**.

**Table 1 Bearing fit in shaft and housing (recommended)**

Bearing type	Shaft	Housing
RNA49·S	m5	K4
NA49·S	k5	

### Shaft and housing accuracy

This bearing type which is applied to the portions of a machine requiring high running accuracy is clamped with the outer ring inclination in installing restrained as less as possible. Therefore, the profile accuracy of the shaft and the housing must be made higher than that for general machined ring needle roller bearings. (**Table 2**)

**Table 2 Shaft and housing accuracy (recommended)**

Characteristics	Shaft	Housing
Roundness (max)	IT2	IT3
Cylindricity (max)	IT2	IT3
Tolerance of shoulder runout (max)	IT3	IT3

## Method for adjusting radial internal clearance

The ratio of outer ring axial shrinkage to shrinkage of roller inscribed circle diameter ( $F_w$ ) is nearly 3:1. In other words, to be able to decrease the radial internal clearance of the bearing by  $1\ \mu\text{m}$ , it is necessary to tighten the outer ring by  $3\ \mu\text{m}$  in the axial direction.

When adjusting the radial internal clearance of a bearing, be careful to uniformly tighten its outer ring along the centerline of the shaft.

In the case of adjustment by the method illustrated in **Fig. 1**, the spacer is put between the housing and the lid. Changing the thickness of the spacer by wrapping the spacer width or replacing the spacer, a certain amount of axial clamping can be obtained.

In **Fig. 2**, the fixed ring is fitted in the housing and, thereafter, the threaded lid is screwed in until it comes in contact with the outer ring for zero setting. Then, the threaded lid is further screwed in by the required value, after the fixed ring was loosened, and thereafter the fixed ring is retightened. Further, it is recommended to use a saw-toothed tightening screw as illustrated in **Fig. 3** because accuracy-down can be minimized by use of such a screw.

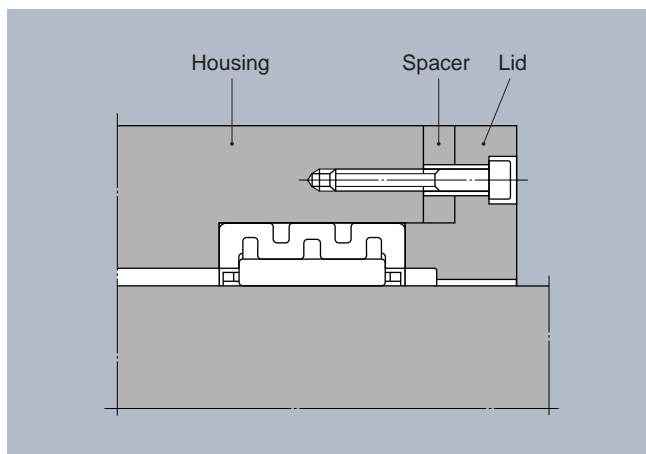


Fig. 1

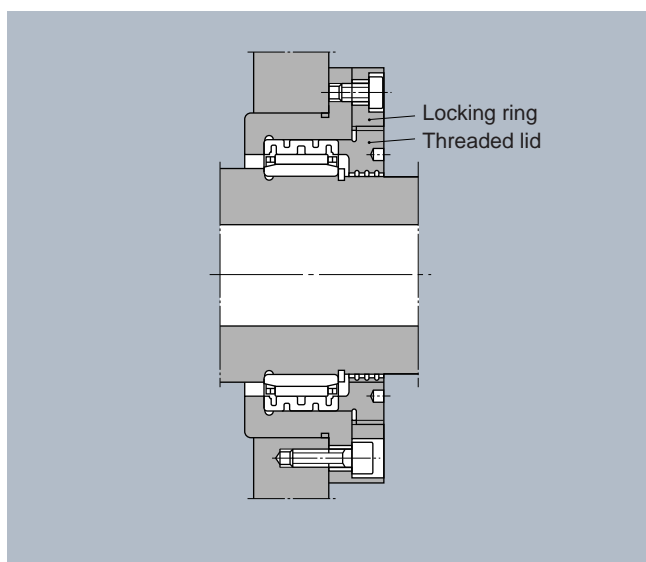


Fig. 2

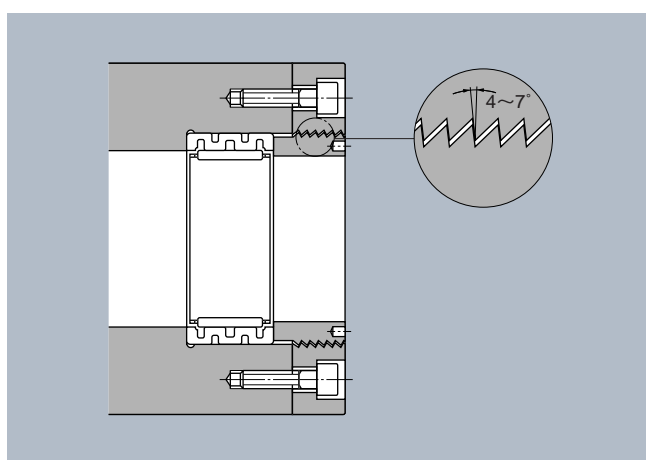
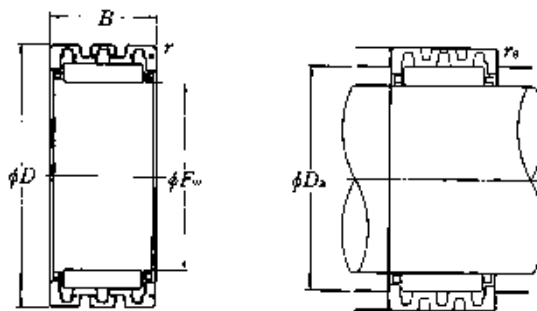


Fig. 3

## Without inner ring

### Type RNA49 · S



$F_w$  30~125mm

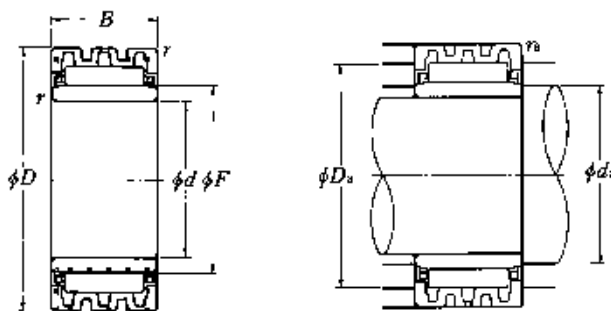
Boundary dimensions				Basic load ratings				Limiting speeds		Bearing numbers	Abutment dimensions		Mass kg (approx.)	
mm				dynamic	static	dynamic	static	min <sup>-1</sup>			$D_a$	$r_{as}^{(2)}$		
$F_w$	$D$	$B$	$r_{\min}^{(1)}$	$C_r$	$C_{or}$	$C_r$	$C_{or}$	grease	oil		max	max		
30	$\begin{matrix} +0.031 \\ +0.022 \end{matrix}$	42	17	0.3	12 300	16 000	1 260	1 630	8 700	13 000	RNA 4905S	36	0.3	0.070
35	$\begin{matrix} +0.038 \\ +0.028 \end{matrix}$	47	17	0.3	14 900	21 600	1 520	2 200	7 300	11 000	RNA 4906S	41	0.3	0.086
40	$\begin{matrix} +0.038 \\ +0.028 \end{matrix}$	52	20	0.6	17 600	27 800	1 790	2 830	6 700	10 000	RNA49/32S	46	0.6	0.088
42	$\begin{matrix} +0.038 \\ +0.028 \end{matrix}$	55	20	0.6	18 300	29 800	1 870	3 050	6 300	9 500	RNA 4907S	48	0.6	0.099
48	$\begin{matrix} +0.038 \\ +0.028 \end{matrix}$	62	22	0.6	22 500	40 500	2 300	4 150	5 700	8 500	RNA 4908S	54	0.6	0.134
52	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	68	22	0.6	23 100	43 500	2 360	4 400	5 000	7 500	RNA 4909S	58	0.6	0.168
58	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	72	22	0.6	24 700	49 000	2 520	5 000	4 700	7 000	RNA 4910S	64	0.6	0.189
63	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	80	25	1	33 000	65 500	3 350	6 650	4 300	6 500	RNA 4911S	70	1	0.212
68	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	85	25	1	34 000	69 000	3 450	7 050	4 000	6 000	RNA 4912S	75	1	0.257
72	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	90	25	1	34 000	70 500	3 450	7 200	3 700	5 500	RNA 4913S	79	1	0.286
80	$\begin{matrix} +0.045 \\ +0.035 \end{matrix}$	100	30	1	44 500	94 000	4 550	9 600	3 300	5 000	RNA 4914S	88	1	0.422
85	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	105	30	1	45 500	99 000	4 650	10 100	3 100	4 700	RNA 4915S	93	1	0.451
90	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	110	30	1	46 500	104 000	4 750	10 600	2 900	4 400	RNA 4916S	98	1	0.468
100	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	120	35	1.1	57 000	140 000	5 800	14 300	2 700	4 000	RNA 4917S	108	1	0.594
105	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	125	35	1.1	58 500	146 000	5 950	14 900	2 500	3 800	RNA 4918S	113	1	0.617
110	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	130	35	1.1	59 500	152 000	6 050	15 500	2 400	3 600	RNA 4919S	118	1	0.735
115	$\begin{matrix} +0.055 \\ +0.040 \end{matrix}$	140	40	1.1	72 000	168 000	7 350	17 100	2 300	3 500	RNA 4920S	125	1	0.980
125	$\begin{matrix} +0.065 \\ +0.050 \end{matrix}$	150	40	1.1	75 500	184 000	7 700	18 800	2 100	3 200	RNA 4922S	135	1	1.04

Note 1) Allowable minimum chamfer dimension  $r$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

## With inner ring

### Type NA49··S



$d$  25~110mm

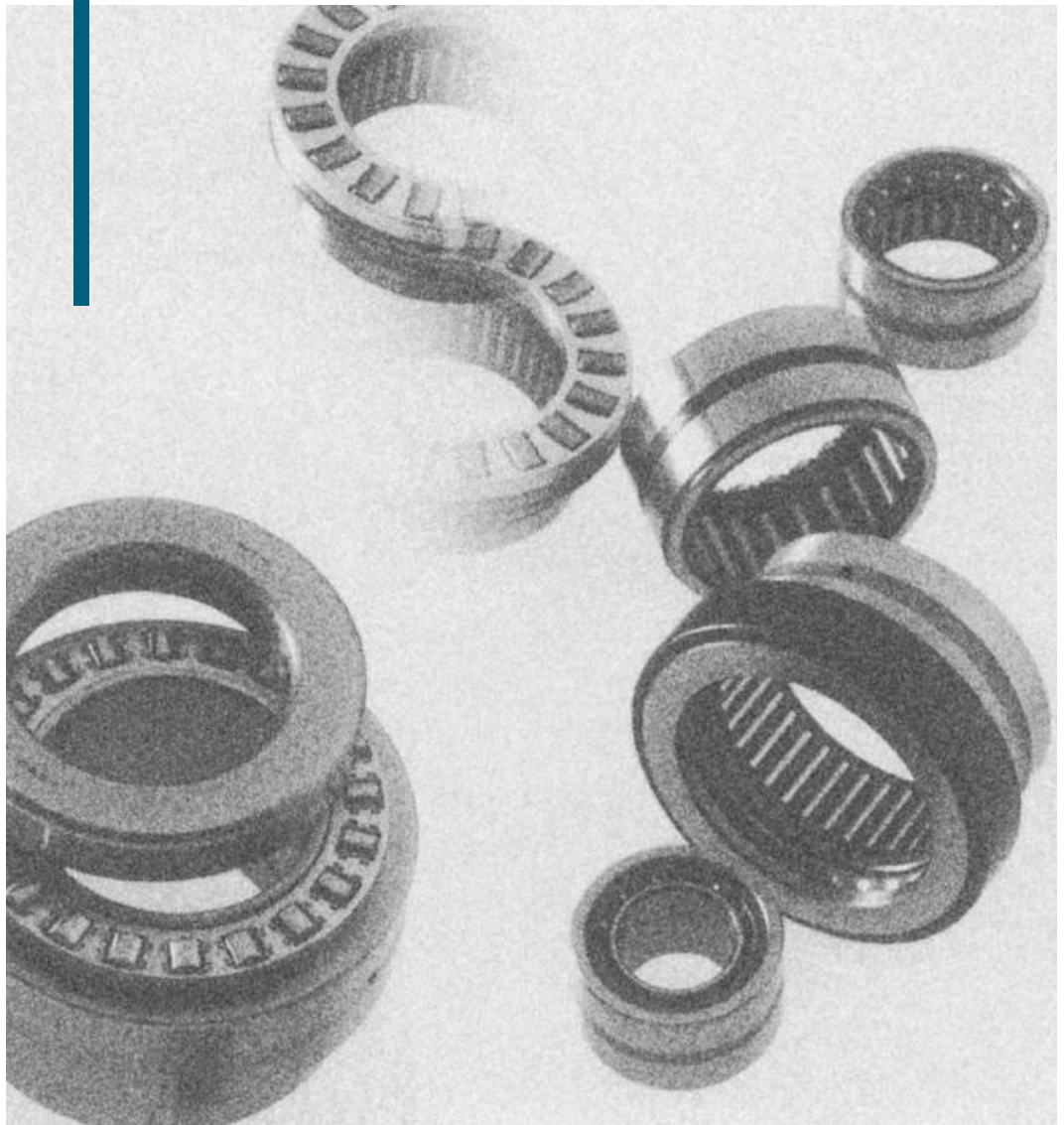
Boundary dimensions					Basic load ratings				Limiting speeds		Bearing numbers	Bearing clearanc before installation	Abutment dimensions			Mass
mm					dynamic	static	dynamic	static	grease	oil			$\mu\text{m}$	$d_a$	$D_a$	
$d$	$D$	$B$	$r_{s\text{min}}^{(1)}$	$F$	$C_r$	$C_{or}$	$C_r$	$C_{or}$					min	max	max	(approx.)
25	42	17	0.3	30	12 300	16 000	1 260	1 630	8 700	13 000	NA 4905S	10~25	27	36	0.3	0.084
30	47	17	0.3	35	14 900	21 600	1 520	2 200	7 300	11 000	NA 4906S	12~25	32	41	0.3	0.099
32	52	20	0.6	40	17 600	27 800	1 790	2 830	6 700	10 000	NA49/32S	12~25	36	46	0.6	0.157
35	55	20	0.6	42	18 300	29 800	1 870	3 050	6 300	9 500	NA 4907S	15~30	39	48	0.6	0.164
40	62	22	0.6	48	22 500	40 500	2 300	4 150	5 700	8 500	NA 4908S	15~30	44	54	0.6	0.227
45	68	22	0.6	52	23 100	43 500	2 360	4 400	5 000	7 500	NA 4909S	15~35	49	58	0.6	0.257
50	72	22	0.6	58	24 700	49 000	2 520	5 000	4 700	7 000	NA 4910S	15~35	54	64	0.6	0.271
55	80	25	1	63	33 000	65 500	3 350	6 650	4 300	6 500	NA 4911S	15~35	60	70	1	0.382
60	85	25	1	68	34 000	69 000	3 450	7 050	4 000	6 000	NA 4912S	20~40	65	75	1	0.410
65	90	25	1	72	34 000	70 500	3 450	7 200	3 700	5 500	NA 4913S	20~40	70	79	1	0.427
70	100	30	1	80	44 500	94 000	4 550	9 600	3 300	5 000	NA 4914S	20~40	75	88	1	0.689
75	105	30	1	85	45 500	99 000	4 650	10 100	3 100	4 700	NA 4915S	25~45	80	93	1	0.740
80	110	30	1	90	46 500	104 000	4 750	10 600	2 900	4 400	NA 4916S	25~45	85	98	1	0.774
85	120	35	1.1	100	57 000	140 000	5 800	14 300	2 700	4 000	NA 4917S	25~45	91.5	108	1	1.18
90	125	35	1.1	105	58 500	146 000	5 950	14 900	2 500	3 800	NA 4918S	25~50	96.5	113	1	1.23
95	130	35	1.1	110	59 500	152 000	6 050	15 500	2 400	3 600	NA 4919S	25~50	101.5	118	1	1.40
100	140	40	1.1	115	72 000	168 000	7 350	17 100	2 300	3 500	NA 4920S	25~50	106.5	125	1	1.91
110	150	40	1.1	125	75 500	184 000	7 700	18 800	2 100	3 200	NA 4922S	30~60	116.5	135	1	2.12

Note 1) Allowable minimum chamfer dimension  $F$ .

2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



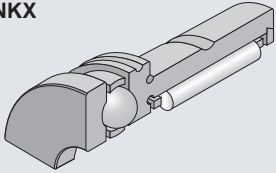
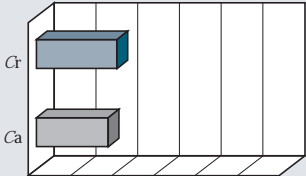
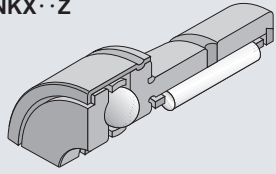
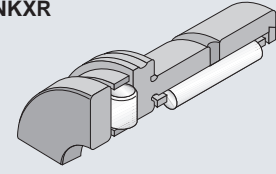
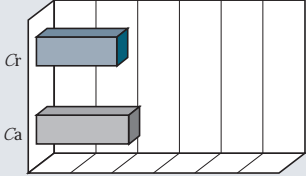
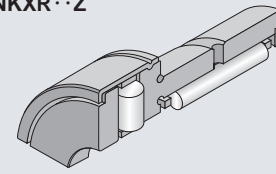
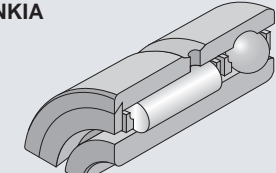
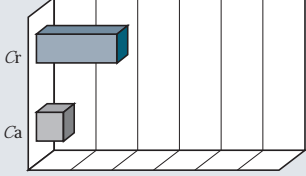
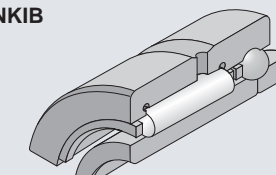
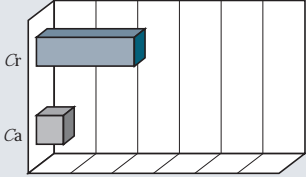
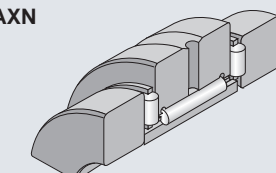
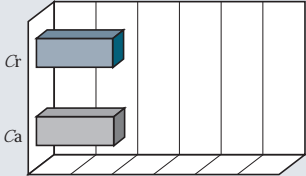
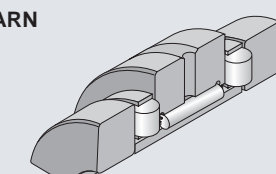
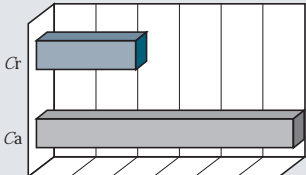
# Complex Bearings








## Complex Bearings

NTN complex bearing is comprised of a needle roller bearing of supporting radial load and a thrust bearing for supporting axial load which are assembled integrally. Comparing with individual use of a radial bearing and a

thrust bearing for the same purpose, this complex bearing saves the required installation space and thereby can contribute to making the overall construction of an equipment more compact.

Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
<b>Type NKX</b> 	$\phi 10 - \phi 70$		<b>NKX 20 T2</b> NKX: Type code 20: Dimension code (shaft diameter) T2: Suffix T2: Resin cage
<b>Type NKX·Z</b> 			<b>NKX 20 T2 Z</b> NKX: Type code 20: Dimension code (shaft diameter) T2: Suffix T2: Resin cage Z: with dust-proof cover
<b>Type NKXR</b> 	$\phi 15 - \phi 50$		<b>NKXR 20 T2</b> NKXR: Type code 20: Dimension code (shaft diameter) T2: Suffix T2: Resin cage
<b>Type NKXR·Z</b> 			<b>NKXR 20 T2Z</b> NKXR: Type code 20: Dimension code (shaft diameter) T2: Suffix T2: Resin cage Z: with dust-proof cover
<b>Type NKIA</b> 	$\phi 15 - \phi 70$		<b>NKIA 59 04</b> NKIA: Type code 59: Dimension series code 04: Bore diameter code
<b>Type NKIB</b> 	$\phi 15 - \phi 70$		<b>NKIB 59 04 R</b> NKIB: Type code 59: Dimension series code 04: Bore diameter code R: Suffix R: outer ring with rib
<b>Type AXN</b> 	$\phi 20 - \phi 50$		<b>AXN 20 52</b> AXN: Type code 20: Bore diameter code 52: Outer diameter code
<b>Type ARN</b> 	$\phi 20 - \phi 70$		<b>ARN 20 62</b> ARN: Type code 20: Bore diameter code 62: Outer diameter code

※Each listed load capacity is subject to reference bearing bore diameter of  $\phi 20$ .

Bearing components	Handling characteristic	Features
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Iron cage Thrust bearing : Ball type Resin cage Dust-proof cover : without Thrust plate : Separable	 Separable thrust plate Without dust-proof cover	Can be applied to high speed running under light axial load, due to use of ball type thrust bearing.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Iron cage Thrust bearing : Ball type Resin cage Dust-proof cover : with Thrust plate : Non-separable, integral type	 Integral thrust plate With dust-proof cover	This type is identical to Type NKX except in that the thrust bearing is protected with a dust cover. Furthermore, the handling characteristic is good because the dust cover makes the thrust plate non-separable integral.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Iron cage Thrust bearing : Cylindrical roller type Resin cage Dust-proof cover : without Thrust plate : Separable	 Separable thrust plate Without dust-proof cover	Due to the use of needle roller bearing as its thrust bearing, this type can support greater axial load than NKX.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Iron cage Thrust bearing : Cylindrical roller type Resin cage Dust-proof cover : with Thrust plate : Non-separable, integral type	 Integral thrust plate With dust-proof cover	This type is identical to NKXR, but its thrust bearing is provided with dust-proof cover to prevent grease scattering. Furthermore, the handling characteristic is good because the dust-proof cover makes the thrust plate non-separable and integral.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Thrust bearing : Angular type	 Integral angular bearing Inner ring separable	This type is composed of needle roller bearing and angular bearing which were integrated into one unit. The angular bearing supports axial load. Hence, this type can support one-way axial load only. Best-suited to high speed and light load application.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Radial bearing : Needle roller type Outer ring with rib Thrust bearing : Three-point contact angular type	 Double inner ring type Inner ring separable	This type is composed of needle roller bearing and three-point contact angular bearing which were integrated into one unit. Unlike KN1A, this type can support bi-directional axial load.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Outer ring outer diameter : 52 Radial bearing : Needle roller type Thrust bearing : Needle roller type	 Separable	This type is a special-purposed bearing to support a precision ball screw. This type uses the side face of the radial bearing as the raceway surface of thrust bearing. This can support axial load from both directions.
Inscribed circle diameter (shaft dia.) : $\phi 20$ Outer ring outer diameter : 62 Radial bearing : Needle roller type Thrust bearing : Cylindrical roller type	 Separable	This type is a special-purposed bearing to support a precision ball screw. This can support bi-directional axial load. This type is identical to AXN, but its axial load capacity is greater.

**Bearing Accuracy**

Regarding the dimensional tolerances for radial needle roller bearing, refer to **Table 4.3** of 4. "Bearing Tolerances" (page A-26) for others than the characteristics described in Dimensions Table and to **Table 4.4** (page A-26) for thrust bearing tolerances respectively. Manufacture of bearing **Type AXN** and **ARN** is limited to those of JIS accuracy class-5 and -4 only. (Allowable radial run-out values for Type AXN and ARN is as specified in **Table 1.**)

**Table 1 Allowable radial run-out values for Type AXN and ARN**  
Unit:  $\mu\text{m}$

Nominal bearing bore dia. $d$ or nominal bearing outer dia. $D$ (mm)		Radial runout of <sup>1</sup> radial inner ring		Allowable radial <sup>2</sup> run-out for outer ring	
Over	Incl.	$K_{ia}$		$K_{ea}$	
		Class 5	Class 4	Class 5	Class 4
18	30	4	3	—	—
30	50	5	4	—	—
50	80	5	4	8	5
80	120	—	—	10	6
120	150	—	—	11	7

<sup>1</sup> To be determined based on " $d$ ".  
<sup>2</sup> To be determined based on " $D$ ".

**Radial internal clearance**

The radial internal clearance of **Type NKX+IR**, **NKXR+IR** and **NKIA** is in accordance with the interchangeable clearance information in **Table 5.1(1)** in Sec. 5.1 "Bearing radial internal clearance" (page A-30). The standard bearings are manufactured subject to the regular clearances.

The radial internal clearance of **Types AXN** and **ARN** is unique to this type, and the clearance value specific to an intended bearing is found in the relevant dimension table.

**Bearing fits**

Radial needle roller bearings shall be fitted on shaft/in housing in compliance with **Table 2**. The thrust bearing washers of **Type NKX** and **NKXR** shall be fitted in a housing with hole diameter larger by 0.5mm or over than the washer outer diameter  $D_1$  or  $D_2$ . For **Type NKIA** and **NKIB** it is not allowed to make the interference greater than k5/M6.

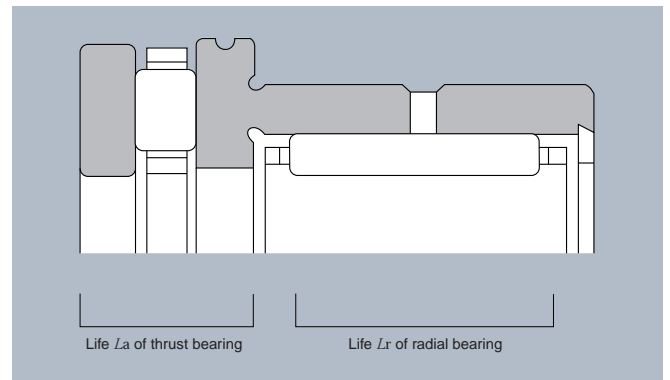
**Table 2 Bearing fit on shaft and in housing (recommended)**

Bearing type	Shaft	Housing
Series NKX, NKXR	k5	K6 (M6)
Series NKIA, NKIB	k5	M6
Series AXN, ARN	j5	J6

Remarks: The parenthesized housing code is applied, where high rigidity is required.

**Calculation of rating life**

The rating life ( $L$ ) of any complex bearing is determined as follows. Determine individually the rating life ( $L_r$ ) of radial needle roller bearing from radial load acting thereon and the rating life ( $L_a$ ) of thrust bearing from axial load acting thereon. And determine the rating life ( $L$ ) from these determined rating lives ( $L_r, L_a$ ) using the following formula.



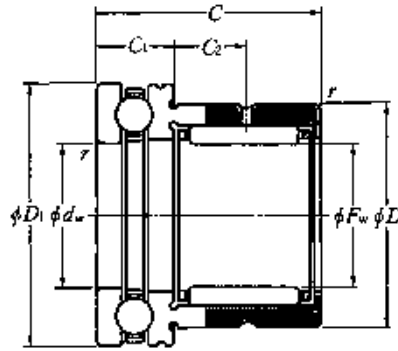
Rating life  $L$  of complex bearing

$$L = \frac{1}{\left(\frac{1}{L_r^{1.1}} + \frac{1}{L_a^{1.1}}\right)^{0.91}} \dots\dots\dots(1)$$

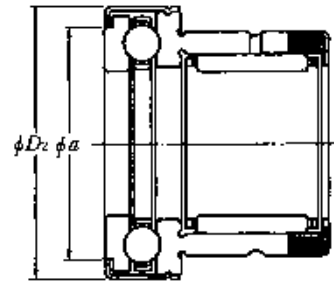


## Without inner ring

Type NKX  
Type NKX · Z



Type NKX  
(Open type)



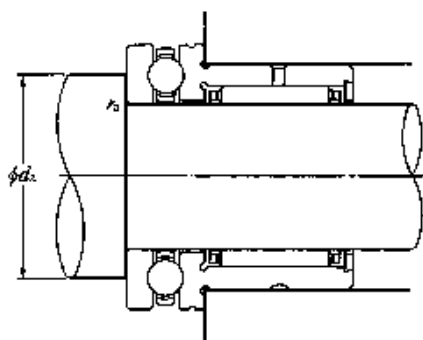
Type NKX · Z  
(With cover)

$F_w$  10~70mm

$F_w$	Boundary dimensions										Basic load ratings				
	$d_w$	$D$	$D_1$	mm			$a$	$r_s$ (min <sup>1)</sup> )	dynamic	static	dynamic	static			
				$D_2$	$C$	$C_1$	$C_2$		N	Radial	kgf				
					$0$ -0.25	$0$ -0.20					$C_r$	$C_{or}$	$C_r$	$C_{or}$	
10	+0.022 +0.013	10	+0.040 +0.025	19	24	25	23	9	6.5	19.7	0.3	5 450	6 450	555	660
12	+0.027 +0.016	12	+0.050 +0.032	21	26	27	23	9	6.5	21.7	0.3	6 000	7 700	615	785
15	+0.027 +0.016	15	+0.050 +0.032	24	28	29	23	9	6.5	23.7	0.3	8 250	10 200	840	1 040
17	+0.027 +0.016	17	+0.050 +0.032	26	30	31	25	9	8	25.7	0.3	10 400	14 400	1 060	1 460
20	+0.033 +0.020	20	+0.061 +0.040	30	35	36	30	10	10.5	30.7	0.3	16 400	27 100	1 670	2 760
25	+0.033 +0.020	25	+0.061 +0.040	37	42	43	30	11	9.5	37.7	0.6	14 200	24 000	1 450	2 450
30	+0.033 +0.020	30	+0.061 +0.040	42	47	48	30	11	9.5	42.7	0.6	22 300	39 500	2 280	4 000
35	+0.041 +0.025	35	+0.075 +0.050	47	52	53	30	12	9	47.7	0.6	20 000	36 000	2 040	3 650
40	+0.041 +0.025	40	+0.075 +0.050	52	60	61	32	13	10	55.7	0.6	25 900	52 500	2 650	5 350
45	+0.041 +0.025	45	+0.075 +0.050	58	65	66.5	32	14	9	60.5	0.6	27 600	59 000	2 810	6 000
50	+0.041 +0.025	50	+0.075 +0.050	62	70	71.5	35	14	10	65.5	0.6	27 900	62 000	2 850	6 300
60	+0.049 +0.030	60	+0.090 +0.060	72	85	86.5	40	17	12	80.5	1	29 800	71 500	3 050	7 300
70	+0.049 +0.030	70	+0.090 +0.060	85	95	96.5	40	18	11	90.5	1	36 500	86 000	3 700	8 750

Note 1) Allowable minimum chamfer dimension  $r_s$ .

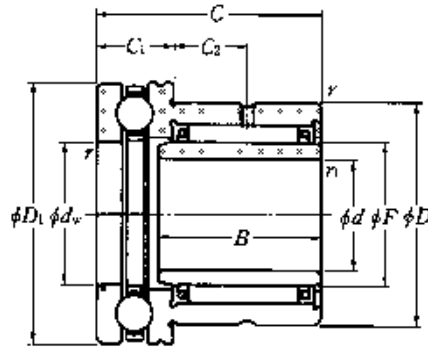
2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.



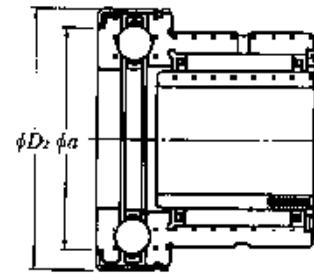
dynamic N	Basic load ratings				Limiting dimensions		Bearing numbers		Abutment dimensions		Mass (approx.)	
	Ca	C <sub>0a</sub>	kgf		grease	oil	Type NKX	Type NKX··Z	mm		Type NKX	Type NKX··Z
			dynamic	static					d <sub>a</sub>	r <sub>as</sub> (2)		
10 000	14 000	1 020	1 420	6 700	9 500	NKX10T2	NKX10T2Z	18	0.3	0.037	0.039	
10 300	15 400	1 050	1 570	6 400	9 200	NKX12T2	NKX12T2Z	20	0.3	0.042	0.044	
10 500	16 800	1 070	1 710	6 200	8 800	NKX15T2	NKX15T2Z	23	0.3	0.044	0.048	
10 800	18 200	1 100	1 850	6 000	8 500	NKX17T2	NKX17T2Z	25	0.3	0.051	0.056	
14 200	24 700	1 450	2 520	5 200	7 500	NKX20T2	NKX20T2Z	29	0.3	0.085	0.090	
19 600	37 000	1 990	3 800	4 600	6 500	NKX25T2	NKX25T2Z	35	0.6	0.125	0.132	
20 400	42 000	2 080	4 300	4 300	6 200	NKX30T2	NKX30T2Z	40	0.6	0.140	0.148	
20 400	44 500	2 080	4 550	3 900	5 600	NKX35T2	NKX35T2Z	45	0.6	0.167	0.175	
26 900	63 000	2 740	6 400	3 500	5 000	NKX40	NKX40Z	52	0.6	0.216	0.225	
27 900	69 000	2 840	7 050	3 200	4 600	NKX45	NKX45Z	57	0.6	0.252	0.265	
28 800	75 500	2 930	7 700	3 100	4 500	NKX50	NKX50Z	62	0.6	0.302	0.318	
41 500	113 000	4 200	11 500	2 600	3 700	NKX60	NKX60Z	75	1	0.465	0.484	
43 000	127 000	4 400	12 900	2 400	3 400	NKX70	NKX70Z	85	1	0.612	0.635	

## With inner ring

Type NKX+IR  
Type NKX·Z+IR



Type NKX+IR  
(Open type)

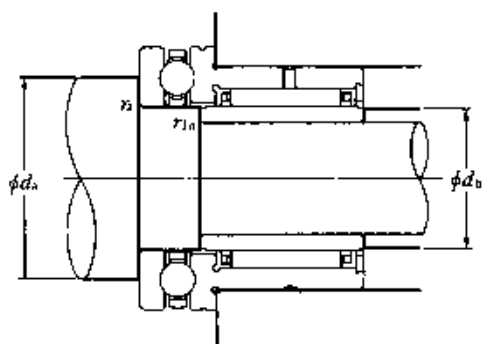


Type NKX·Z+IR  
(With cover)

d 7~60mm

Boundary dimensions													Basic load ratings								
d	dw	D	D1	D2	B	C	C1	C2	F	a	r (mm)	r1 (mm)	dynamic	static	dynamic	static	dynamic	static	dynamic	static	
													Radial				Axial				
													N	N	kgf	kgf	N	N	kgf	kgf	
													Cr	Cor	Cr	Cor	Ca	Coa	Ca	Coa	
7	10	<sup>+0.040</sup> / <sub>+0.025</sub>	19	24	25	16	23	9	6.5	10	19.7	0.3	0.3	5 450	6 450	555	660	10 000	14 000	1 020	1 420
9	12	<sup>+0.050</sup> / <sub>+0.032</sub>	21	26	27	16	23	9	6.5	12	21.7	0.3	0.3	6 000	7 700	615	785	10 300	15 400	1 050	1 570
12	15	<sup>+0.050</sup> / <sub>+0.032</sub>	24	28	29	16	23	9	6.5	15	23.7	0.3	0.3	8 250	10 200	840	1 040	10 500	16 800	1 070	1 710
14	17	<sup>+0.050</sup> / <sub>+0.032</sub>	26	30	31	17	25	9	8	17	25.7	0.3	0.3	10 400	14 400	1 060	1 460	10 800	18 200	1 100	1 850
17	20	<sup>+0.061</sup> / <sub>+0.040</sub>	30	35	36	20	30	10	10.5	20	30.7	0.3	0.3	16 400	27 100	1 670	2 760	14 200	24 700	1 450	2 520
20	25	<sup>+0.061</sup> / <sub>+0.040</sub>	37	42	43	20	30	11	9.5	25	37.7	0.6	0.3	14 200	24 000	1 450	2 450	19 600	37 000	1 990	3 800
25	30	<sup>+0.061</sup> / <sub>+0.040</sub>	42	47	48	20	30	11	9.5	30	42.7	0.6	0.3	22 300	39 500	2 280	4 000	20 400	42 000	2 080	4 300
30	35	<sup>+0.075</sup> / <sub>+0.050</sub>	47	52	53	20	30	12	9	35	47.7	0.6	0.3	20 000	36 000	2 040	3 650	20 400	44 500	2 080	4 550
35	40	<sup>+0.075</sup> / <sub>+0.050</sub>	52	60	61	20	32	13	10	40	55.7	0.6	0.3	25 900	52 500	2 650	5 350	26 900	63 000	2 740	6 400
40	45	<sup>+0.075</sup> / <sub>+0.050</sub>	58	65	66.5	20	32	14	9	45	60.5	0.6	0.3	27 600	59 000	2 810	6 000	27 900	69 000	2 840	7 050
45	50	<sup>+0.075</sup> / <sub>+0.050</sub>	62	70	71.5	25	35	14	10	50	65.5	0.6	0.6	27 900	62 000	2 850	6 300	28 800	75 500	2 930	7 700
50	60	<sup>+0.090</sup> / <sub>+0.060</sub>	72	85	86.5	25	40	17	12	60	80.5	1	1	29 800	71 500	3 050	7 300	41 500	113 000	4 200	11 500
60	70	<sup>+0.090</sup> / <sub>+0.060</sub>	85	95	96.5	25	40	18	11	70	90.5	1	1	36 500	86 000	3 700	8 750	43 000	127 000	4 400	12 900

Note 1) Allowable minimum chamfer dimension L. 2) Max. allowable dimension of radius Ra or Ra for corner roundness on shaft/housing.  
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.



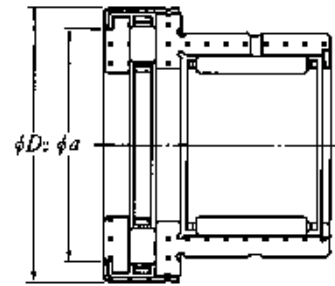
Limiting dimensions min <sup>-1</sup>		Bearing numbers		Abutment dimensions mm				Mass (approx.) kg	
grease	oil	Type NKX+IR	Type NKX·Z+IR	<i>d<sub>a</sub></i> min	<i>c<sub>b</sub></i> min	<i>r<sub>as</sub></i> <sup>2)</sup> max	<i>r<sub>ias</sub></i> <sup>2)</sup> max	Type NKX+IR	Type NKX·Z+IR
6 700	9 500	NKX10T2+IR 7×10×16	NKX10T2Z+IR 7×10×16	18	9	0.3	0.3	0.042	0.044
6 400	9 200	NKX12T2+IR 9×12×16	NKX12T2Z+IR 9×12×16	20	11	0.3	0.3	0.048	0.050
6 200	8 800	NKX15T2+IR12×15×16	NKX15T2Z+IR12×15×16	23	14	0.3	0.3	0.052	0.056
6 000	8 500	NKX17T2+IR14×17×17	NKX17T2Z+IR14×17×17	25	16	0.3	0.3	0.061	0.066
5 200	7 500	NKX20T2+IR17×20×20	NKX20T2Z+IR17×20×20	29	19	0.3	0.3	0.099	0.104
4 600	6 500	NKX25T2+IR20×25×20	NKX25T2Z+IR20×25×20	35	22	0.6	0.3	0.152	0.159
4 300	6 200	NKX30T2+IR25×30×20	NKX30T2Z+IR25×30×20	40	27	0.6	0.3	0.173	0.181
3 900	5 600	NKX35T2+IR30×35×20	NKX35T2Z+IR30×35×20	45	32	0.6	0.3	0.205	0.213
3 500	5 000	NKX40 +IR35×40×20	NKX40Z +IR35×40×20	52	37	0.6	0.3	0.260	0.269
3 200	4 600	NKX45 +IR40×45×20	NKX45Z +IR40×45×20	57	42	0.6	0.3	0.293	0.316
3 100	4 500	NKX50 +IR45×50×25	NKX50Z +IR45×50×25	62	48	0.6	0.6	0.373	0.389
2 600	3 700	NKX60 +IR50×60×25	NKX60Z +IR50×60×25	75	55	1	1	0.635	0.654
2 400	3 400	NKX70 +IR60×70×25	NKX70Z +IR60×70×25	85	65	1	1	0.814	0.837

## Without inner ring

Type NKXR  
Type NKXR··Z



Type NKXR  
(Open type)



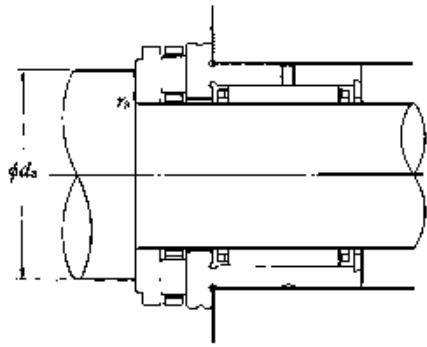
Type NKXR··Z  
(With cover)

$F_w$  15~50mm

$F_w$	$d_w$	Boundary dimensions								$r_s \text{ min}^{1)}$	Basic load ratings						
		$D$	$D_1$	mm			$a$	dynamic	static		dynamic	static					
				$D_2$	$C$	$C_1$							$C_2$	N	kgf		
$C_r$	$C_{or}$	Radial	$C_r$	$C_{or}$													
15	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	15	$\begin{matrix} +0.050 \\ +0.032 \end{matrix}$	24	28	29	$\begin{matrix} 0 \\ -0.25 \end{matrix}$	$\begin{matrix} 0 \\ -0.20 \end{matrix}$	23	9	6.5	23.7	0.3	8 250	10 200	840	1 040
17	$\begin{matrix} +0.027 \\ +0.016 \end{matrix}$	17	$\begin{matrix} +0.050 \\ +0.032 \end{matrix}$	26	30	31	25	9	8	25.7	0.3	10 400	14 400	1 060	1 460		
20	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	20	$\begin{matrix} +0.061 \\ +0.040 \end{matrix}$	30	35	36	30	10	10.5	30.7	0.3	16 400	27 100	1 670	2 760		
25	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	25	$\begin{matrix} +0.061 \\ +0.040 \end{matrix}$	37	42	43	30	11	9.5	37.7	0.6	14 200	24 000	1 450	2 450		
30	$\begin{matrix} +0.033 \\ +0.020 \end{matrix}$	30	$\begin{matrix} +0.061 \\ +0.040 \end{matrix}$	42	47	48	30	11	9.5	42.7	0.6	22 300	39 500	2 280	4 000		
35	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	35	$\begin{matrix} +0.075 \\ +0.050 \end{matrix}$	47	52	53	30	12	9	47.7	0.6	20 000	36 000	2 040	3 650		
40	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	40	$\begin{matrix} +0.075 \\ +0.050 \end{matrix}$	52	60	61	32	13	10	55.7	0.6	25 900	52 500	2 650	5 350		
45	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	45	$\begin{matrix} +0.075 \\ +0.050 \end{matrix}$	58	65	66.5	32	14	9	60.5	0.6	27 600	59 000	2 810	6 000		
50	$\begin{matrix} +0.041 \\ +0.025 \end{matrix}$	50	$\begin{matrix} +0.075 \\ +0.050 \end{matrix}$	62	70	71.5	35	14	10	65.5	0.6	27 900	62 000	2 850	6 300		

Note 1) Allowable minimum chamfer dimension  $r_s$ .

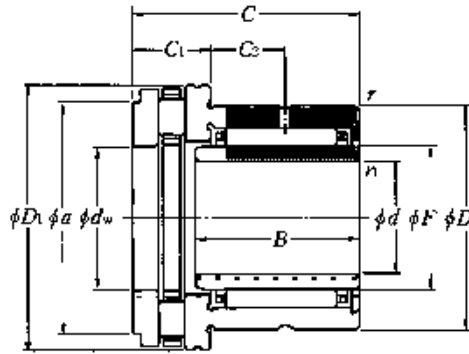
2) Max. allowable dimension of radius  $r_s$  for corner roundness on shaft/housing.



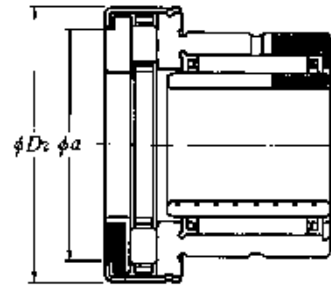
dynamic $C_a$	Basic load ratings				Limiting dimensions $\text{min}^{-1}$ grease oil		Bearing numbers		Abutment dimensions mm		Mass (approx.) kg	
	N	static $C_{oa}$	dynamic kgf				Type NKXR	Type NKXR · Z	$d_a$ min	$r_{as}^{(2)}$ max	Type NKXR	Type NKXR · Z
			Axial $C_a$	static $C_{oa}$								
12 200	26 800	1 250	2 730	2 800	11 000	NKXR15T2	NKXR15T2Z	25	0.3	0.048	0.052	
12 700	29 000	1 300	2 960	2 500	10 000	NKXR17T2	NKXR17T2Z	27	0.3	0.050	0.053	
20 200	46 500	2 060	4 700	2 100	8 500	NKXR20T2	NKXR20T2Z	32	0.3	0.090	0.095	
27 300	68 000	2 790	6 900	1 800	7 000	NKXR25T2	NKXR25T2Z	39	0.6	0.128	0.135	
27 800	72 500	2 840	7 400	1 500	6 000	NKXR30T2	NKXR30T2Z	44	0.6	0.162	0.169	
31 000	87 000	3 150	8 900	1 400	5 500	NKXR35T2	NKXR35T2Z	49	0.6	0.184	0.195	
43 000	121 000	4 350	12 400	1 200	4 800	NKXR40T2	NKXR40T2Z	56	0.6	0.226	0.237	
45 500	135 000	4 650	13 800	1 100	4 400	NKXR45T2	NKXR45T2Z	61	0.6	0.267	0.286	
48 500	150 000	4 900	15 300	1 000	4 000	NKXR50T2	NKXR50T2Z	66	0.6	0.309	0.329	

With inner ring

Type NKXR+IR  
Type NKXR··Z+IR



Type NKXR+IR  
(Open type)

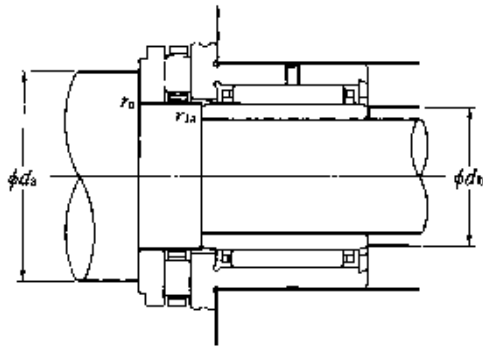


Type NKXR··Z+IR  
(With cover)

d 12~45mm

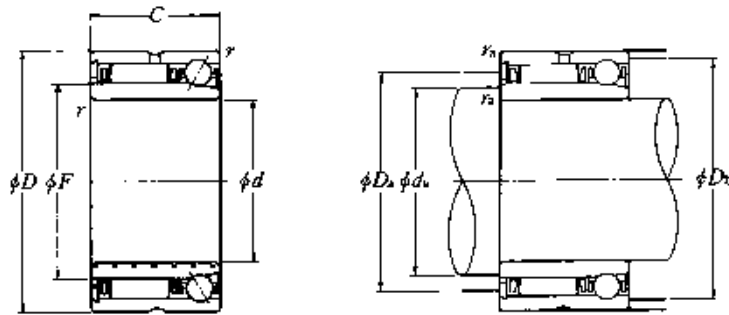
Boundary dimensions														Basic load ratings										
d	dw	D	D1	D2	mm								a	rs min <sup>1</sup> )	rs min <sup>1</sup> )	dynamic N	static N	dynamic kgf	static kgf	dynamic N	static N	dynamic kgf	static kgf	
					B	C	C1	C2	F	Radial		Axial												
					0	0	0	0	0	Cr	Cor	Ca												Coa
12	15 <sup>+0.050</sup> / <sub>+0.032</sub>	24	28	29	16	23	9	6.5	15	23.7	0.3	0.3	8 250	10 200	840	1 040	12 200	26 800	1 250	2 730				
14	17 <sup>+0.050</sup> / <sub>+0.032</sub>	26	30	31	17	25	9	8	17	25.7	0.3	0.3	10 400	14 400	1 060	1 460	12 700	29 000	1 300	2 960				
17	20 <sup>+0.061</sup> / <sub>+0.040</sub>	30	35	36	20	30	10	10.5	20	30.7	0.3	0.3	16 400	27 100	1 670	2 760	20 200	46 500	2 060	4 700				
20	25 <sup>+0.061</sup> / <sub>+0.040</sub>	37	42	43	20	30	11	9.5	25	37.7	0.6	0.3	14 200	24 000	1 450	2 450	27 300	68 000	2 790	6 900				
25	30 <sup>+0.061</sup> / <sub>+0.040</sub>	42	47	48	20	30	11	9.5	30	42.7	0.6	0.3	22 300	39 500	2 280	4 000	27 800	72 500	2 840	7 400				
30	35 <sup>+0.075</sup> / <sub>+0.050</sub>	47	52	53	20	30	12	9	35	47.7	0.6	0.3	20 000	36 000	2 040	3 650	31 000	87 000	3 150	8 900				
35	40 <sup>+0.075</sup> / <sub>+0.050</sub>	52	60	61	20	32	13	10	40	55.7	0.6	0.3	25 900	52 500	2 650	5 350	43 000	121 000	4 350	12 400				
40	45 <sup>+0.075</sup> / <sub>+0.050</sub>	58	65	66.5	20	32	14	9	45	60.5	0.6	0.3	27 600	59 000	2 810	6 000	45 500	135 000	4 650	13 800				
45	50 <sup>+0.075</sup> / <sub>+0.050</sub>	62	70	71.5	25	35	14	10	50	65.5	0.6	0.6	27 900	62 000	2 850	6 300	48 500	150 000	4 900	15 300				

Note 1) Allowable minimum chamfer dimension r. 2) Max. allowable dimension of radius ra or ra for corner roundness on shaft/housing.  
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.



Limiting dimensions min <sup>-1</sup>		Bearing numbers		Abutment dimensions mm				Mass (approx.) kg	
				<i>d<sub>a</sub></i> min	<i>c<sub>b</sub></i> min	<i>r<sub>as</sub></i> <sup>2)</sup> max	<i>r<sub>bs</sub></i> <sup>2)</sup> max	Type NKXR+IR	Type NKXR·Z+IR
grease	oil	Type NKXR+IR	Type NKXR·Z+IR						
2 800	11 000	NKXR15T2+IR12×15×16	NKXR15T2Z+IR12×15×16	25	14	0.3	0.3	0.056	0.060
2 500	10 000	NKXR17T2+IR14×17×17	NKXR17T2Z+IR14×17×17	27	16	0.3	0.3	0.060	0.063
2 100	8 500	NKXR20T2+IR17×20×20	NKXR20T2Z+IR17×20×20	32	19	0.3	0.3	0.105	0.110
1 800	7 000	NKXR25T2+IR20×25×20	NKXR25T2Z+IR20×25×20	39	22	0.6	0.3	0.155	0.162
1 500	6 000	NKXR30T2+IR25×30×20	NKXR30T2Z+IR25×30×20	44	27	0.6	0.3	0.197	0.202
1 400	5 500	NKXR35T2+IR30×35×20	NKXR35T2Z+IR30×35×20	49	32	0.6	0.3	0.224	0.235
1 200	4 800	NKXR40T2+IR35×40×20	NKXR40T2Z+IR35×40×20	56	37	0.6	0.3	0.270	0.281
1 100	4 400	NKXR45T2+IR40×45×20	NKXR45T2Z+IR40×45×20	61	42	0.6	0.3	0.318	0.337
1 000	4 000	NKXR50T2+IR45×50×25	NKXR50T2Z+IR45×50×25	66	48	0.6	0.6	0.379	0.400

## Type NKIA59



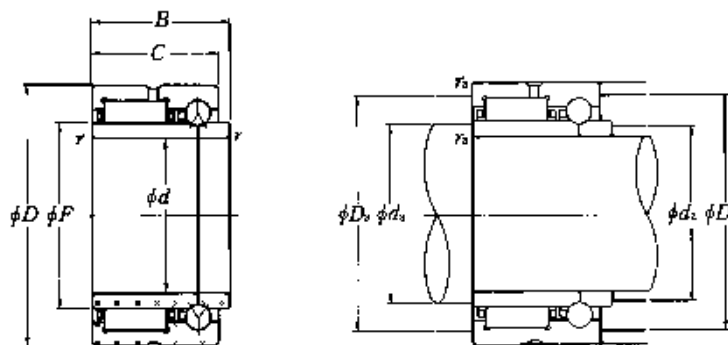
**d** 15~70mm

Boundary dimensions					Basic load ratings								Limiting dimensions	
mm					N				kgf				min <sup>-1</sup>	
d	D	C	F	r <sub>s min</sub> <sup>1)</sup>	Radial				Axial				grease	oil
					C <sub>r</sub>	C <sub>or</sub>	C <sub>r</sub>	C <sub>or</sub>	C <sub>a</sub>	C <sub>oa</sub>	C <sub>a</sub>	C <sub>oa</sub>		
15	28	18	20	0.3	9 500	13 400	970	1 370	2 340	3 050	239	310	13 000	20 000
17	30	18	22	0.3	10 100	14 900	1 030	1 520	2 530	3 550	258	360	12 000	18 000
20	37	23	25	0.3	16 500	22 100	1 680	2 250	4 700	6 150	480	625	11 000	16 000
22	39	23	28	0.3	17 500	24 800	1 790	2 530	4 900	6 750	500	690	9 500	14 000
25	42	23	30	0.3	18 600	27 400	1 900	2 790	5 100	7 350	520	750	8 500	13 000
30	47	23	35	0.3	19 400	30 500	1 980	3 100	5 400	8 550	550	870	7 500	11 000
35	55	27	42	0.6	25 700	46 000	2 630	4 700	7 400	12 300	755	1 260	6 500	9 500
40	62	30	48	0.6	31 000	61 000	3 150	6 250	7 750	14 000	790	1 430	5 500	8 500
45	68	30	55	0.6	33 000	69 500	3 350	7 100	8 500	17 100	870	1 740	5 000	7 500
50	72	30	60	0.6	33 500	73 500	3 450	7 500	8 800	18 700	900	1 910	4 300	6 500
55	80	34	63	1	44 500	95 500	4 500	9 700	14 300	33 000	1 460	3 350	4 300	6 500
60	85	34	68	1	45 500	101 000	4 600	10 300	14 800	36 000	1 510	3 650	4 000	6 000
65	90	34	75	1	46 000	106 000	4 700	10 800	15 200	39 000	1 550	4 000	3 700	5 500
70	100	40	80	1	62 500	146 000	6 350	14 900	18 600	47 500	1 890	4 850	3 300	5 000

Note 1) Allowable minimum chamfer dimension *F*. 2) Max. allowable dimension of radius *r<sub>s</sub>* for corner roundness on shaft/housing.  
Remarks: Nominal code number of inner ring comprises IR. Bore diameter×outer diameter×width.

Bearing numbers	Abutment dimensions mm				Mass kg (approx.)
	$d_a$ min	$D_a$ max	$D_b$ max	$r_{as}^{(2)}$ max	
NKIA 5902A	17.5	22	25.5	0.3	0.050
NKIA 5903A	19.5	24	27.5	0.3	0.056
NKIA 5904A	22.5	28	34.5	0.3	0.111
NKIA59/22A	24.5	31	36.5	0.3	0.120
NKIA 5905A	27.5	33	39.5	0.3	0.130
NKIA 5906A	32.5	38	44.5	0.3	0.147
NKIA 5907A	40	45	50	0.6	0.243
NKIA 5908A	45	51	57	0.6	0.347
NKIA 5909A	50	58	63	0.6	0.401
NKIA 5910A	55	63	67	0.6	0.410
NKIA 5911A	61	66.5	74	1	0.590
NKIA 5912A	66	71.5	79	1	0.632
NKIA 5913A	71	78.5	84	1	0.708
NKIA 5914A	76	84	94	1	1.05

## Type NKIB 59



**d** 15~70mm

Boundary dimensions						Basic load ratings								Limiting dimensions	
d	D	mm			I <sub>s</sub> min <sup>-1</sup> )	dynamic				static				grease	oil
		B	C	F		N	kgf	N	kgf	min <sup>-1</sup>					
		0 -0.3			Radial				Axial						
					C <sub>r</sub>	C <sub>or</sub>	C <sub>r</sub>	C <sub>or</sub>	C <sub>a</sub>	C <sub>oa</sub>	C <sub>a</sub>	C <sub>oa</sub>			
15	28	20	18	20	0.3	10 800	13 600	1 100	1 390	2 750	4 200	280	430	13 000	20 000
17	30	20	18	22	0.3	11 200	14 600	1 140	1 490	2 960	4 900	300	495	12 000	18 000
20	37	25	23	25	0.3	21 300	25 500	2 170	2 600	4 650	7 400	475	755	11 000	16 000
22	39	25	23	28	0.3	23 200	29 300	2 360	2 990	5 000	8 650	510	880	9 500	14 000
25	42	25	23	30	0.3	24 000	31 500	2 450	3 200	5 150	9 250	525	945	8 500	13 000
30	47	25	23	35	0.3	25 500	35 500	2 600	3 600	5 600	11 200	570	1 140	7 500	11 000
35	55	30	27	42	0.6	32 000	50 000	3 300	5 100	7 050	14 900	720	1 520	6 500	9 500
40	62	34	30	48	0.6	43 500	66 500	4 450	6 800	8 700	19 400	890	1 980	5 500	8 500
45	68	34	30	52	0.6	46 000	73 000	4 700	7 450	9 100	21 400	925	2 180	5 000	7 500
50	72	34	30	58	0.6	48 000	80 000	4 900	8 150	9 600	24 300	980	2 480	4 300	6 500
55	80	38	34	63	1	58 500	99 500	6 000	10 100	11 400	29 400	1 170	3 000	4 300	6 500
60	85	38	34	68	1	61 500	108 000	6 250	11 000	11 800	32 000	1 200	3 250	4 000	6 000
65	90	38	34	72	1	62 500	112 000	6 350	11 400	12 100	34 000	1 240	3 500	3 700	5 500
70	100	45	40	80	1	85 500	156 000	8 750	15 900	15 900	44 500	1 620	4 550	3 300	5 000

Note 1) Allowable minimum chamfer dimension *F*. 2) Max. allowable dimension of radius *r*<sub>2</sub> for corner roundness on shaft/housing.

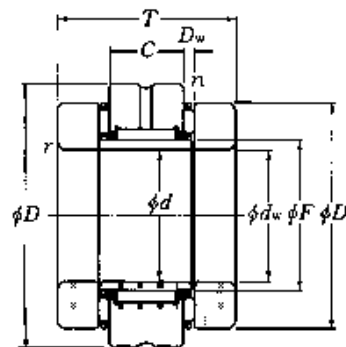
Remarks: 1. This complex can support bi-directional axial load.

2. The ball bearing of this complex bearing is complete with a synthetic resin cage, and the allowable operating temperature shall be 120°C and, under continuous running, 100°C or less.

3. This bearing type is the imported product from INA, Germany.

Bearing numbers	Abutment dimensions			Mass kg (approx.)
	$d_a$ min	$D_a$ max	$r_{as}^{(2)}$ max	
NKIB 5902R	17.5	25.5	0.3	0.052
NKIB 5903R	19.5	27.5	0.3	0.058
NKIB 5904R	22.5	34.5	0.3	0.107
NKIB59/22R	24.5	36.5	0.3	0.122
NKIB 5905R	27.5	39.5	0.3	0.134
NKIB 5906R	32.5	44.5	0.3	0.151
NKIB 5907R	40	50	0.6	0.247
NKIB 5908R	45	57	0.6	0.320
NKIB 5909R	50	63	0.6	0.380
NKIB 5910R	55	67	0.6	0.385
NKIB 5911R	61	74	1	0.555
NKIB 5912R	66	79	1	0.595
NKIB 5913R	71	84	1	0.640
NKIB 5914R	76	94	1	0.985

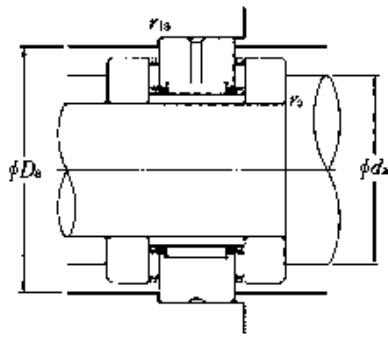
Type AXN



d 20~50mm

Boundary dimensions										Basic load ratings																	
d	dw	D	mm					IS min <sup>1)</sup>	IS min <sup>1)</sup>	dynamic	static	dynamic	static	dynamic	static	dynamic	static	dynamic	static								
			D1	T	C	F	Dw													N				N			
			-0.20 -0.50	0 -0.370	0 -0.130															Radial				Axial			
								Cr	Cor	Cr	Cor	Ca	Coa	Ca	Coa	Ca	Coa										
20	20 <sup>+0.061</sup> / <sub>+0.040</sub>	52	42	40	16	25	2	0.6	0.6	15 100	22 400	1 540	2 280	14 600	58 000	1 490	5 900										
25	25 <sup>+0.061</sup> / <sub>+0.040</sub>	57	47	44	20	30	2	0.6	0.6	22 100	34 000	2 260	3 500	16 300	69 500	1 660	7 100										
30	30 <sup>+0.061</sup> / <sub>+0.040</sub>	62	52	44	20	35	2	0.6	0.6	24 800	41 500	2 520	4 250	17 800	81 500	1 820	8 300										
35	35 <sup>+0.075</sup> / <sub>+0.050</sub>	70	60	48	20	40	3	1	0.6	26 400	47 000	2 700	4 800	27 400	110 000	2 790	11 300										
40	40 <sup>+0.075</sup> / <sub>+0.050</sub>	75	65	48	20	45	3	1	0.6	28 000	52 500	2 860	5 400	29 800	128 000	3 050	13 100										
45	45 <sup>+0.075</sup> / <sub>+0.050</sub>	80	70	54	25	50	3	1	0.6	38 500	74 500	3 950	7 550	31 500	143 000	3 250	14 500										
50	50 <sup>+0.075</sup> / <sub>+0.050</sub>	90	78	54	25	55	3	1	0.6	41 000	82 000	4 150	8 400	38 000	186 000	3 850	19 000										

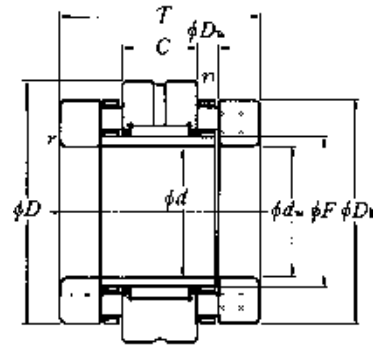
Note 1) Allowable minimum chamfer dimension *r* or *r1*.



Limiting dimensions min <sup>-1</sup>		Bearing numbers	Radial clearance μm		Abutment dimensions mm				Preload		Starting torque <sup>2)</sup>		Mass kg (approx.)
grease	oil		min	max	da min	Da max	ras <sup>2)</sup> max	ras <sup>2)</sup> max	N	kgf	N·mm	kgf·mm	
1 800	7 000	<b>AXN2052</b>	10	30	39	46	0.6	0.6	1 300	130	330	33	0.400
1 500	6 000	<b>AXN2557</b>	10	30	44	51	0.6	0.6	1 450	145	400	40	0.520
1 400	5 500	<b>AXN3062</b>	10	40	50	56	0.6	0.6	1 600	160	550	55	0.590
1 200	4 700	<b>AXN3570</b>	10	40	56	64	1	0.6	2 450	245	900	90	0.800
1 100	4 300	<b>AXN4075</b>	10	40	62	69	1	0.6	2 650	265	1 050	105	0.890
1 000	3 900	<b>AXN4580</b>	10	40	67	74	1	0.6	2 800	280	1 200	120	1.00
900	3 500	<b>AXN5090</b>	15	50	75	83	1	0.6	3 400	340	1 600	160	1.42

Note 2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.  
 3) Starting torque subject to standard preload.

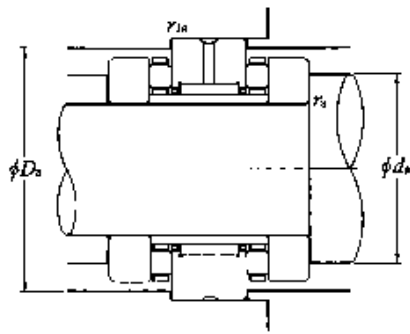
Type ARN



d 20~70mm

Boundary dimensions										Basic load ratings									
d	dw	D	mm					IS min <sup>1)</sup>	IS min <sup>1)</sup>	dynamic	static	dynamic	static	dynamic	static	dynamic	static	dynamic	static
			D1	T	C	F	Dw												
			-0.20 -0.50	0 -0.370	0 -0.130				Cr	Cor	Cr	Cor	Ca	Coa	Ca	Coa			
20	20 <sup>+0.061</sup> <sub>+0.040</sub>	52	42	46	16	25	5	0.6	0.6	15 100	22 400	1 540	2 280	27 300	68 000	2 790	6 900		
20	20 <sup>+0.061</sup> <sub>+0.040</sub>	62	52	60	20	30	7.5	1	0.6	22 100	34 000	2 260	3 500	53 500	129 000	5 450	13 100		
25	25 <sup>+0.061</sup> <sub>+0.040</sub>	57	47	50	20	30	5	0.6	0.6	22 100	34 000	2 260	3 500	27 800	72 500	2 840	7 400		
25	25 <sup>+0.061</sup> <sub>+0.040</sub>	72	62	60	20	35	7.5	1	0.6	24 800	41 500	2 520	4 250	54 500	139 000	5 550	14 200		
30	30 <sup>+0.061</sup> <sub>+0.040</sub>	62	52	50	20	35	5	0.6	0.6	24 800	41 500	2 520	4 250	31 000	87 000	3 150	8 900		
30	30 <sup>+0.061</sup> <sub>+0.040</sub>	80	68	66	20	40	9	1	0.6	26 400	47 000	2 700	4 800	74 500	190 000	7 600	19 400		
35	35 <sup>+0.075</sup> <sub>+0.050</sub>	70	60	54	20	40	6	1	0.6	26 400	47 000	2 700	4 800	43 000	121 000	4 350	12 400		
35	35 <sup>+0.075</sup> <sub>+0.050</sub>	85	73	66	20	45	9	1	0.6	28 000	52 500	2 860	5 400	82 000	222 000	8 350	22 600		
40	40 <sup>+0.075</sup> <sub>+0.050</sub>	75	65	54	20	45	6	1	0.6	28 000	52 500	2 860	5 400	45 500	135 000	4 650	13 800		
40	40 <sup>+0.075</sup> <sub>+0.050</sub>	90	78	75	25	50	9	1	0.6	38 500	74 500	3 950	7 550	85 000	238 000	8 650	24 200		
45	45 <sup>+0.075</sup> <sub>+0.050</sub>	80	70	60	25	50	6	1	0.6	38 500	74 500	3 950	7 550	48 500	150 000	4 900	15 300		
45	45 <sup>+0.075</sup> <sub>+0.050</sub>	105	90	82	25	55	11	1	0.6	41 000	82 000	4 150	8 400	121 000	340 000	12 300	34 500		
50	50 <sup>+0.075</sup> <sub>+0.050</sub>	90	78	60	25	55	6	1	0.6	41 000	82 000	4 150	8 400	62 500	215 000	6 350	21 900		
50	50 <sup>+0.075</sup> <sub>+0.050</sub>	110	95	82	25	60	11	1.1	0.6	41 000	85 000	4 200	8 700	125 000	365 000	12 800	37 000		
55	55 <sup>+0.090</sup> <sub>+0.060</sub>	115	100	82	25	65	11	1.1	0.6	45 000	98 000	4 550	10 000	130 000	385 000	13 200	39 500		
60	60 <sup>+0.090</sup> <sub>+0.060</sub>	120	105	82	25	70	11	1.1	0.6	45 000	91 500	4 600	9 350	134 000	410 000	13 700	42 000		
65	65 <sup>+0.090</sup> <sub>+0.060</sub>	125	110	82	25	75	11	1.1	0.6	55 000	104 000	5 600	10 600	138 000	435 000	14 100	44 500		
70	70 <sup>+0.090</sup> <sub>+0.060</sub>	130	115	82	25	80	11	1.1	0.6	57 000	119 000	5 800	12 200	142 000	460 000	14 500	47 000		

Note 1) Allowable minimum chamfer dimension r or r1.



Limiting dimensions $\text{min}^{-1}$		Bearing numbers	Radial clearance $\mu\text{m}$		Abutment dimensions $\text{mm}$				Preload		Starting torque <sup>2)</sup>		Mass
grease	oil		min	max	$d_a$ min	$D_a$ max	$r_{\text{ass}}^{2)}$ max	$r_{\text{ass}}^{2)}$ max	N	kgf	N·mm	kgf·mm	kg (approx.)
1 800	7 000	ARN2052T2	10	30	39	46	0.6	0.6	2 500	250	430	43	0.440
1 500	6 000	ARN2062	10	30	48	56	1	0.6	4 950	495	1 150	115	0.910
1 500	6 000	ARN2557T2	10	30	44	51	0.6	0.6	2 600	260	500	50	0.560
1 200	4 900	ARN2572	10	40	56	66	1	0.6	5 050	505	1 400	140	1.22
1 400	5 500	ARN3062T2	10	40	49	56	0.6	0.6	2 900	290	650	65	0.630
1 100	4 400	ARN3080	10	40	63	73	1	0.6	6 900	690	2 100	210	1.54
1 200	4 800	ARN3570T2	10	40	56	64	1	0.6	3 950	395	1 050	105	0.850
1 000	4 100	ARN3585	10	40	68	77	1	0.6	7 600	760	2 500	250	1.67
1 100	4 400	ARN4075T2	10	40	61	69	1	0.6	4 200	420	1 250	125	0.930
950	3 800	ARN4090	10	40	73	87	1	0.6	7 850	785	2 850	285	2.15
1 000	4 000	ARN4580T2	10	40	66	74	1	0.6	4 450	445	1 550	155	1.16
850	3 300	ARN45105	15	50	83	96	1	0.6	11 200	1 120	4 350	435	3.16
900	3 600	ARN5090	15	50	75	83	1	0.6	5 800	580	2 050	205	1.48
800	3 100	ARN50110	15	50	88	101	1	0.6	11 600	1 160	4 900	490	3.38
750	2 900	ARN55115	15	50	93	106	1	0.6	12 000	1 200	5 500	550	3.61
700	2 700	ARN60120	15	50	98	111	1	0.6	12 400	1 240	6 000	600	3.81
650	2 600	ARN65125	15	50	103	116	1	0.6	12 800	1 280	6 500	650	4.00
650	2 500	ARN70130	15	50	106	121	1	0.6	13 200	1 320	7 000	700	4.25

Note 2) Max. allowable dimension of radius  $r_a$  for corner roundness on shaft/housing.

3) Starting torque subject to standard preload.



# Cam Followers / Roller Followers

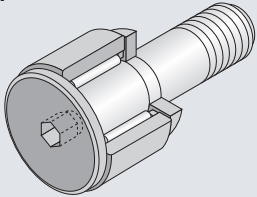
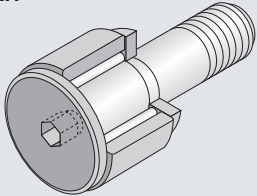
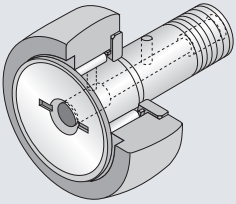
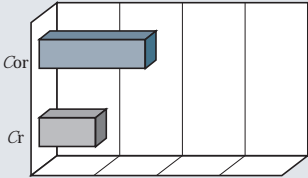
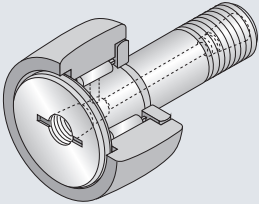
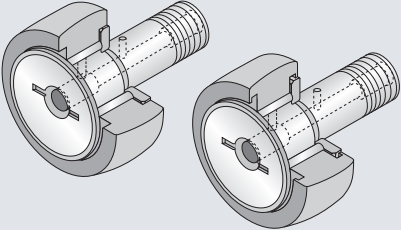
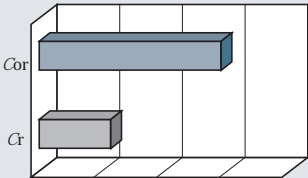
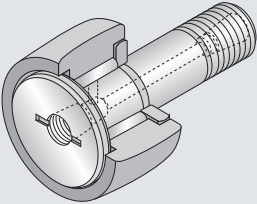


## Cam Followers (Stud Type Track Roller)

This is a track roller complete with stud instead of inner ring, which is designed to operate with its outer ring rolling on the track. These NTN stud type track rollers are applied to eccentric roller, guide roller, rocker arm roller, etc. similarly to the roller followers. One end of the stud is threaded and the hexagonal nut is used to be mounted

easily.

The cam follower types marked with a suffix including "F" are product per new standard specification. They are identically to the conventional products in terms of fitting method and lubrication method, but boast improved functionality through crowned rollers and special heat

Followers type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
<b>KRM··XH</b> 	$\phi 1.5 - \phi 6$		<b>KRM 4 XT2H / 3AS</b> Suffix X: Cylinder outer diameter T2: Resin cage H: Hexagonal socket 3AS: Grease Dimension code Type code
<b>KRMV··XH</b> 	$\phi 1.5 - \phi 6$		<b>KRMV 4 XH / 3AS</b> Suffix X: Cylinder outer diameter H: Hexagonal socket 3AS: Grease Dimension code Type code
<b>KR CR</b> 	<b>KR :</b> $\phi 3 - \phi 30$ <b>CR :</b> $\phi 4.826 - \phi 22.225$	 <b>KR90</b>	<b>KR 16 FD02H / L588</b> Suffix F: New standard specification D0: w/o oil hole T2: Resin cage H: Hexagonal socket L588: Grease Dimension code Type code
<b>KRT</b> 	$\phi 6 - \phi 30$		<b>KRT 32 X</b> Suffix X: Cylinder outer diameter Dimension code Type code
<b>KRV CRV</b> 	<b>KRV :</b> $\phi 3 - \phi 30$ <b>CRV :</b> $\phi 4.826 - \phi 63.5$	 <b>KRV90</b>	<b>KRV 22 FXLLH / 3AS</b> Suffix F: New standard specification X: Cylinder outer diameter LL: Seal H: Hexagonal socket 3AS: Grease Dimension code Type code
<b>KRVT</b> 	$\phi 6 - \phi 30$		<b>KRVT 52 XLL / 3AS</b> Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code

※Each listed load capacity is subject to the reference bearing diameter of  $\phi 30$ .

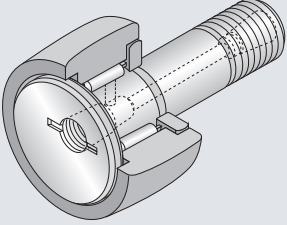
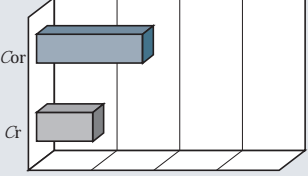
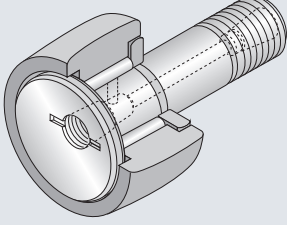
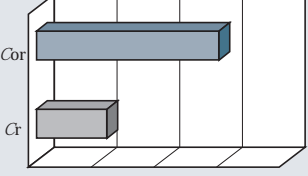
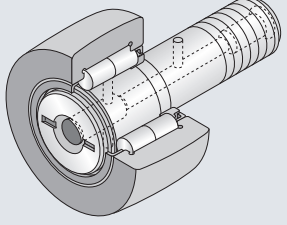
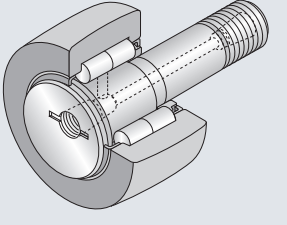
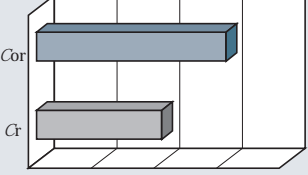
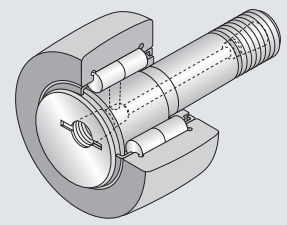
treatment. Note that the cam follower types having a suffix including “F” but lacking an oil hole are prefilled with urea-based high-functionality grease and are identified with a suffix including “DO”.

The outer ring is guided in the axial direction with a flange at the end of stud and the side plate press-fitted to

the stud.

The outer ring has a thick wall and both of spherical outer profile and cylindrical outer surface (tail code: **X**) are available for it similarly to the outer ring of the roller follower.

Follower components	Features
Outer ring outer diameter: $\phi 4$ With metric series cage Outer profile: Cylindrical Stud head: Hexagonal socket Cage: Resin cage Grease: Prefilled	<ul style="list-style-type: none"> <li>  Polyamide resin cage (T2 suffix) can operate at temperatures up to 120°C (100°C for continuous operation).</li> <li>  Prelubricated (no relubrication hole)</li> </ul>
Outer ring outer diameter: $\phi 4$ Metric series full complement roller type Outer profile: Cylindrical Stud head: Hexagonal socket Grease: Prefilled	<ul style="list-style-type: none"> <li>  Better for heavy loads than KRM··XH type.</li> <li>  Prelubricated (no relubrication hole)</li> </ul>
Outer ring outer diameter: $\phi 16$ With metric series cage New standard specification Without oil hole Without seal Outer profile: Spherical Stud head: Hexagonal socket Cage: resin cage Grease: Prefilled	<ul style="list-style-type: none"> <li>  Standard cage is pressed steel.</li> <li>  Polyamide resin cage (T2 suffix) is also available.                      Allowable temperature: 120°C max.                      Continuous operating temperature: 100°C max</li> <li>  Suited to high speed.</li> </ul>
Outer ring outer diameter: $\phi 32$ With metric series cage Stud head: with recessed slot for screw-driver use and tapped hole Outer surface profile: Cylindrical Seal: w/o seal Grease: Not prefilled	<ul style="list-style-type: none"> <li>  Due to a high initial grease fill, this type can be used for a long period of time without additional greasing.</li> <li>  The standard Type KRT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.</li> <li>  If there is no grease code, the follower is not prelubricated.</li> </ul>
Outer ring outer diameter: $\phi 22$ Metric series full complement roller type New standard specification Stud head: Hexagonal socket Outer surface profile: Cylindrical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>  Suited to high load.</li> <li>  Lower allowable running speed than caged types.</li> <li>  Grease replenishing interval must be shortened due to the small internal volume available for grease.</li> </ul>
Outer ring outer diameter: $\phi 52$ Metric series full complement roller type Stud head: with recessed slot for screw-driver use and tapped hole Outer surface profile: Cylindrical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>  The standard Type KRVT follower has no hexagonal hole (H suffix), but a hexagonal socket is standard with a threaded plug.</li> </ul>

Follower type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
<p><b>KRU</b></p> 	<p><math>\phi 6 - \phi 30</math></p>	 <p><b>KRU90</b></p>	<p><b>KRU 32 LL / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix</li> <li>LL: seal</li> <li>3AS: Grease</li> </ul> <p>Dimension code</p> <p>Type code</p>
<p><b>KRVU</b></p> 	<p><math>\phi 6 - \phi 30</math></p>	 <p><b>KRVU90</b></p>	<p><b>KRVU 62 X LL / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix</li> <li>LL: seal</li> <li>3AS: Grease</li> </ul> <p>Suffix</p> <p>X: Cylinder outer diameter</p> <p>Dimension code</p> <p>Type code</p>
<p><b>NUKR</b></p> 	<p><math>\phi 12 - \phi 64</math></p>		<p><b>NUKR 80 H / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix</li> <li>H: with hexagon socket</li> <li>3AS: Grease</li> </ul> <p>Dimension code</p> <p>Type code</p>
<p><b>NUKRT</b></p> 	<p><math>\phi 12 - \phi 64</math></p>	 <p><b>NUKR90</b></p>	<p><b>NUKRT 90 / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix</li> <li>3AS: Grease</li> </ul> <p>Dimension code</p> <p>Type code</p>
<p><b>NUKRU</b></p> 	<p><math>\phi 12 - \phi 64</math></p>		<p><b>NUKRU 140 X / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix</li> <li>X: Cylinder outer diameter</li> <li>3AS: Grease</li> </ul> <p>Dimension code</p> <p>Dimension code</p>

※Each listed load capacity is subject to the reference bearing diameter of  $\phi 30$ .

Follower components	Features
<p>Outer ring outer diameter: <math>\phi 32</math>                      Eccentric stud w/ metric series cage                      Stud head: with recessed slot for screw-driver use and tapped hole                      Outer profile: Spherical                      Seal: w/ seal                      Grease: Prefilled</p>	<ul style="list-style-type: none"> <li>⌋ Unlike Type KRT and KRVT, Type KRU and KRVU have the eccentric stud (eccentricity : 0.25 to 1.0mm) so as to enable to adjust positional variation of the stud mounting hole.</li> <li>⌋ Certain Type KRU cam followers, which lack a seal and whose suffix does not include grease code, are supplied without prefilled grease.</li> </ul>
<p>Outer ring outer diameter: <math>\phi 62</math>                      Eccentric stud, metric series full complement roller type                      Stud head: with recessed slot for screw-driver use and tapped hole                      Outer profile: Cylindrical                      Seal: w/ seal                      Grease: Prefilled</p>	
<p>Outer ring outer diameter: <math>\phi 80</math>                      Metric series double-row cylindrical roller type                      Shielded full-complement roller type                      Stud head: Hexagonal socket                      Outer profile: Spherical                      Grease: Prefilled</p>	<ul style="list-style-type: none"> <li>⌋ Highest rated load, best-suited to applications subjected to high load and shock load.</li> <li>⌋ The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical roller.</li> <li>⌋ Grease replenishing interval must be shortened due to the small spacing volume.</li> <li>⌋ Type NUKRU has the eccentric stud (eccentricity: 0.4 to 2.5mm) so as to enable to adjust positional variation of the stud mounting hole.</li> </ul>
<p>Outer ring outer diameter <math>\phi 90</math>                      Metric series double-row cylindrical roller type                      Shielded full-complement roller type                      Stud head: with recessed slot for screw-driver use and tapped hole                      Outer profile: Spherical                      Grease: Prefilled</p>	
<p>Outer ring outer diameter: <math>\phi 140</math>                      Metric series double-row cylindrical roller type                      Shielded full-complement roller type stud, eccentric type                      Stud head: with recessed slot for screw-driver use and tapped hole                      Outer profile: Cylindrical                      Grease: Prefilled</p>	

## Bearing accuracy

The dimensional accuracy and profile accuracy of cylindrical roller outer diameter ( $D$ ) and outer ring width ( $C$ ), and the running accuracy of bearing assy are as shown in **Tables 4.3** and 4.4 of Section 4 "Bearing Tolerances" (page A-26) and the accuracy class of each conforms to JIS Class-0. The dimensional accuracy of spherical outer diameter ( $D$ ) and stud diameter ( $d_1$ ) are as shown in applicable Dimensions Table.

## Bearing fit and radial internal clearance

**Table 1** shows the recommended fitting tolerance for the stud mounting hole.

And **Table 2** shows the radial internal clearance.

**Table 1 Recommended tolerance**

Classification	Tolerance range class for mounting hole
Metric series	H7
Inch series	F7

**Note) When shock load acts on, make the stud - hole clearance as less as possible in assembling.**

**Table 2 Radial internal clearance**

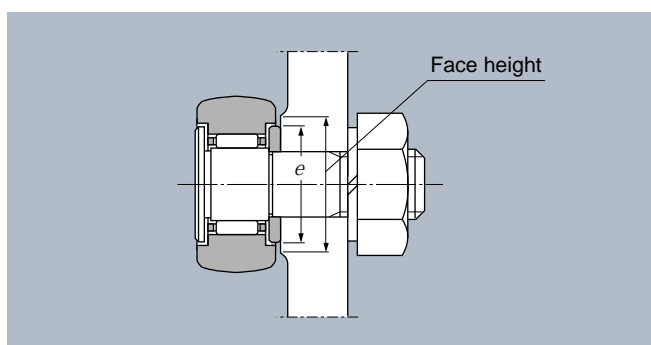
Unit :  $\mu\text{m}$

Nominal roller inscribed circle diameter $F_w$ (mm)		Clearance							
		C2		CN (ordinary)		C3		C4	
over	incl.	min	max	min	max	min	max	min	max
—	6	0	10	3	17	15	30	20	40
6	10	0	12	5	20	15	30	25	45
10	18	0	15	5	25	15	35	30	55
18	30	0	20	10	30	20	40	40	65
30	50	0	25	10	40	25	55	50	80
50	80	0	30	15	50	30	65	60	100
80	100	0	35	20	55	35	75	70	115

## Fitting relations

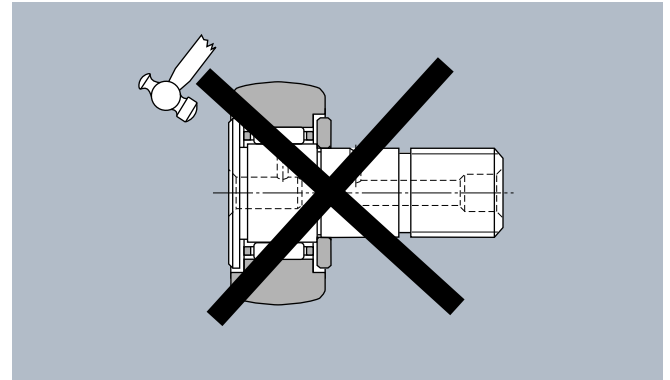
(1) Make the face height at the cam follower mount greater than "e" dimension given in applicable Dimension Table. (**Fig.1**)

Furthermore, chamfer the stud mounting hole at  $R$  as small as possible (around  $0.5 \times 45^\circ$ ) and bring the side faces of side face in precise contact.



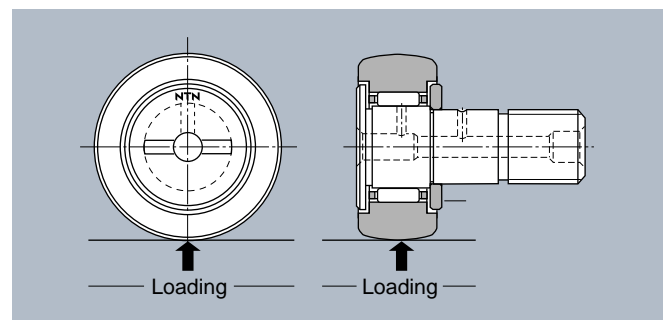
**Fig. 1**

(2) Don't hammer directly the cam follower rib. Doing so would cause breakdown and rotation failure of the rib.



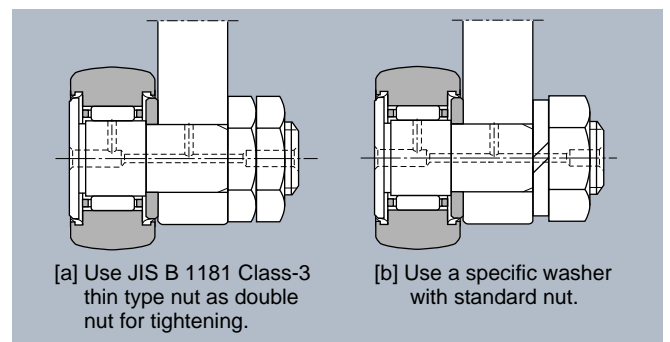
**Fig. 2**

(3) The oil hole position on the stud raceway surface is shown with NTN mark stamped on the stud rib surface. Mount the stud so the oil hole locates within the non-load area (non-load side). (**Fig. 3**) If the oil hole locates within the load area, it would cause shorter life of the follower. (4) Particularly where loose



**Fig. 3**

of the mounting screw is forecast due to wide amplitude vibration during running, the mounting methods as illustrated in **Fig. 4** are available.



**Fig. 4**

- (5) The stud is subjected to bending stress and tensile force arising from bearing load. Tighten the stud screws with tightening torque which does not exceed the torque value specified in applicable Dimension Table.  
**Too tight tightening torque could result in rupture of the threaded portion.**
- (6) A hole is provided on the stud center at right angle to the shaft axial center, as illustrated in **Fig. 5**. Use this hole for locking or grease replenishment.

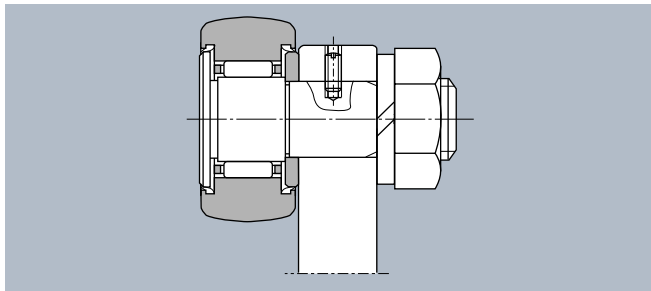


Fig. 5

- (7) For mounting and adjusting the eccentric stud type cam follower, follow the sequence given hereunder.
1. Insert the stud into the mounting hole such that the **NTN** mark (oil hole position) is located relative to the load acting direction as shown in **Fig. 3**. Then, lightly tighten the nut. Be sure that the stud remains capable of turning.
  2. Fit the tip of flat blade screwdriver into the slot on the stud head or insert an Allen key into the socket of the hexagonal socket head plug (included with the cam follower) fastened into the stud; then turn the stud to adjust the gap between the cam follower to the mating contact surface.
  3. After completion of gap adjustment, tighten the nut to the tightening torque listed in the relevant dimension table in order to jam the stud.

Usually, NTN cam followers are each mounted in cantilever configuration: consequently, when used for a prolonged period, fit of a cam follower to a corresponding bearing can get loose, and a non-uniform load (biased load) can eventually act on the bearing. To keep the machinery having NTN cam followers, it is necessary to prevent excessive loosening of the cam followers.

## Lubrication and how to feed and replenish grease into the follower

### Lubrication

The types having a synthetic rubber seal (suffix LL) and the full complement roller types are prefilled with lithium soap grease (grease code: 3AS), while the new standard specification bearing (w/o oil hole) is prefilled with urea-based high-functionality grease (grease code: L588),

thereby these bearing types may be used in a temperature range of -20 to +120°C or can be continuously used at a temperature of 100°C or lower. When a bearing is always used a temperature of 0°C or lower, use of a bearing prefilled with cold temperature grease. For more information, contact NTN Engineering.

Bearings having a cage, but lacking a seal, do not have prefilled grease. (This description does not apply to bearings whose stud lacks an oil hole.)

If a prefilled grease is needed, feel free to contact NTN.

Note that NTN offers its unique bearing products prefilled with solid grease: these bearings feature minimized outward leakage of lubricant.

For bearing applications that need to minimize possible release oil mist into the atmosphere, NTN will offer bearings prefilled with low dusting grease. For more information, contact NTN Engineering.

**The outer ring outer surface of bearing and the track surface must both be lubricated. Lack of lubrication for these surfaces can lead to premature bearing failure.**

### How to feed and replenish grease

Use a tool such as a grease gun to inject grease into a grease nipple installed to the end face of flange or end face of threaded side of the stud. In this case, plug the grease-feed hole or the tapped hole at non-greasing side (with a special-purposed plug or a threaded plug with hexagon socket.)

These grease nipple and plug are enclosed in each cam follower package. Screw-in them in specific position before mounting the cam follower.

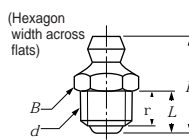
Special grease nipple and that specified in JIS Standard as applicable are available for use. The dimensions thereof and the applicable bearing types are as specified in **Tables 3** and **4** respectively.

Furthermore, special press-fit type plug and threaded plug with hexagon socket are available for use. The dimensions thereof and the applicable bearing types are as specified in **Tables 5-1, -2** and **Table 6** respectively.

When using the special-purposed press-fit plug, press-fit it in the grease feed hole using a mandrel of applicable dimension shown in **Table 7**.

Table 3 Grease nipple dimension

Nominal nipple number	Dimension mm			
	<i>d</i>	<i>D</i>	<i>L</i>	<i>L<sub>1</sub></i>
NIP-B3	3	7.5	9	5.5
NIP-B4	4	7.5	10	5.5
NIP-B6	6	8	13	6
NIP-B8	8	10	16	7

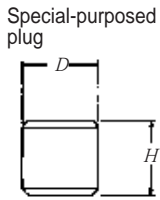


Nominal nipple number	Dimension mm				
	<i>d</i>	<i>H</i>	<i>R</i>	<i>L</i>	<i>B</i>
NIP-X30	M4×0.7	13.9	4	5	7
JIS A-M6F	M6×0.75	13.5	4	5.4	7
JIS A-PT1/8	PT1/8	20	8	9.5	10

**Table 4 Grease nipple applied bearing types and grease nipple dimension codes**

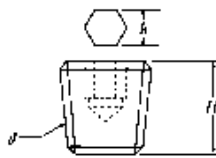
Nominal nipple number	Nipple applied bearing types										
	KR, KRV	KR·H, KRV·H	CR, CRV	CR·H, CRV·H	NUKR	NUKR·H	KRT, KRVT	NUKRT	KRU, KRUV	NUKRU	
NIP-B3	—	—	Refer to the accessories field in the relevant dimension table.		—	—	—	—	—	—	
NIP-B4	16~26	22~26			—	—	—	—	—	—	—
NIP-B6	30~40	30~40			30~40	30~40	—	—	—	—	—
NIP-B8	47~90	47~90			47~90	47~90	—	—	—	—	—
NIP-X30	—	—			—	—	16~26	—	—	16~26	—
JIS Type 1 (A-M6F)	—	—	—	—	30~32	30	30~35	30~35	30~35		
JIS Type 2 (A-PT1/8)	—	—	—	—	100~180 (Threaded side)	100~180 (Threaded side)	35~90	35~180	40~90	40~180	

**Table 5-1 Plug dimension**  
unit : mm



Nominal number	D	H
SEN 3	3	3
SEN 4	4	4
SEN 6	6	6
SEN 8	8	8

Threaded plug with hexagon socket

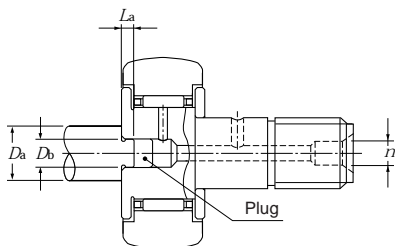


**Table 5-2 Plug dimension**  
unit : mm

Nominal number	d	H	Width across flats h
M4X0.7X4R	M4X0.7	4	2
M6X0.75X6R	M6X0.75	6	3
PT1/8X7R	PT1/8	7	5

**Table 6 Plug applied bearing types and plug dimension codes**

Plug	Plug applied bearing types									
	KR, KRV	KR·H, KRV·H	CR, CRV	CR·H, CRV·H	NUKR	NUKR·H	KRT, KRVT	NUKRT	KRU, KRUV	NUKRU
SEN3	30~40	30~40	Refer to the accessories field in the relevant dimension table.		30~40	30~40	—	—	—	—
SEN4	16~26 47~90	22~26 47~90			47~90	47~90	—	—	—	—
SEN6	30~40	30~40			30~40	30~40	—	—	—	—
SEN8	47~90	47~90			47~180	47~90	—	—	—	—
M4X0.7X4R	—	—			—	—	16~26	—	—	16~26
M6X0.75X6R	—	—	—	—	30~32	30	30~35	30~35	30~35	
PT1/8X7R	—	—	—	—	100~180	35~90	35~180	40~90	40~180	



**Table 7 Mandrels used for plug press-fitting**  
unit : mm

Grease feed hole dia. n	Mandrel dimension		
	Da	Db <sub>-0.1</sub>	La <sub>-0.1</sub>
3	8	2.8	1.5
4	10	3.8	1.5
6	12	5.8	1.5
8	15	7.8	2.5

### Track load capacity of cam follower and roller follower

The reference hardness (reference tensile stress) was set up from the relationship between the follower hardness and net tensile stress of the material and the track load capacity was determined

from the relationship of the setup reference stress to hertz stress.

How to set up the reference hardness (tensile stress) differs a little bit depending on each bearing manufacturer. Herein, the relevant Table appended to "JIS Handbook for Irons and Steels" was used as the hardness - tensile stress relationship.

(Approximate values per Hardness Conversion Table SAE J 417)

For HRC40,  $\sigma = 1.245\text{MPa}$  (127kgf/mm<sup>2</sup>) was adopted as the reference hardness (tensile stress).

### <Track load capacity adjustment factor>

The tensile stress of a material for cam follower is greater with increase in material hardness, and, at the same time, the load capacity of the track will be greater. The resultant track load capacity can be determined by multiplying a track load capacity found in the relevant dimension table by an appropriate track load adjustment factor found in **Table 8** "Track load adjustment factor". **If the calculated track load capacity exceeds the basic static load rating  $C_{or}$  of the cam follower in question, then take  $C_{or}$  as the track load capacity of that cam follower.**

Note) The track load capacity determined herein is based on net tensile stress as the reference, not allowable hertz stress. Generally stress (specific stress) resulting in creep of follower material is greater than the tensile stress. Particularly in the case of static load, this track load capacity comes to a safety side value.

[Ex.] Determination of load capacity  $T_c'$  of track with certain hardness by use of track load capacity adjustment factor.

Assuming track load capacity described in Dimensions Table as  $T_c$  and track load capacity adjustment factor at applicable hardness as  $G$  respectively, the track load capacity  $T_c'$  can be determined as follows.

$$T_c' = G \cdot T_c$$

For hardness HRC50 at KR35XH,

$$T_c = 11\,900\text{N} \text{ (1\,220kgf)}, \quad G = 1.987$$

$$\begin{aligned} \therefore T_c' &= 1.987 \times 11\,900\text{N} \text{ (1\,220kgf)} \\ &= 23\,645\text{N} \text{ (2\,424kgf)} \end{aligned}$$

Since the basic static load rating  $C_{or}$  of the KR35XH is 17,900 N (1,830 kgf), and, accordingly,  $T_c' > C_{or}$ , track load capacity is assumed to be the value of  $C_{or}$ , that is, 17,900 N (1,830 kgf).

### Reference (Track load capacity calculation process)

i For a cylindrical outer ring

$$\begin{aligned} \sigma_{\max} &= 190.7 \sqrt{\frac{T_c \Sigma \rho}{B_{\text{eff}}}} \quad \text{N} \\ &= 60.9 \sqrt{\frac{T_c \Sigma \rho}{B_{\text{eff}}}} \quad \text{kgf} \end{aligned}$$

j For spherical R outer

$$\begin{aligned} \sigma_{\max} &= \frac{856.8}{\mu \nu} \sqrt[3]{(\Sigma \rho)^2 T_c} \quad \text{N} \\ &= \frac{187}{\mu \nu} \sqrt[3]{(\Sigma \rho)^2 T_c} \quad \text{kgf} \end{aligned}$$

$\sigma_{\max} = 1\,245\text{MPa}$  (127kgf/mm<sup>2</sup>)

$T_c$  : Track load capacity N (kgf)

$\Sigma \rho$  : Sum of curvature

$B_{\text{eff}}$  : Effective contact length mm

Herein (Outer ring width - chamfer)

$\mu \nu$  : Factor being determined by curvature

**Table 8 Track load capacity adjustment factor**

Hardness HRC	Tensile strength MPa {kgf/mm <sup>2</sup> }	Adjustment factor $G$	
		for cylindrical outer ring	for spherical outer ring
20	755 {77}	0.368	0.223
21	774 {79}	0.387	0.241
22	784 {80}	0.397	0.250
23	804 {82}	0.417	0.269
24	823 {84}	0.437	0.289
25	843 {86}	0.459	0.311
26	862 {88}	0.480	0.333
27	882 {90}	0.502	0.356
28	911 {93}	0.536	0.393
29	931 {95}	0.560	0.419
30	951 {97}	0.583	0.446
31	980 {100}	0.620	0.488
32	1 000 {102}	0.645	0.518
33	1 029 {105}	0.684	0.565
34	1 058 {108}	0.723	0.615
35	1 078 {110}	0.750	0.650
36	1 117 {114}	0.806	0.723
37	1 156 {118}	0.863	0.802
38	1 176 {120}	0.893	0.844
39	1 215 {124}	0.953	0.931
40	1 245 {127}	1.0	1.0
41	1 294 {132}	1.080	1.123
42	1 333 {136}	1.147	1.228
43	1 382 {141}	1.233	1.369
44	1 431 {146}	1.322	1.519
45	1 480 {151}	1.414	1.681
46	1 529 {156}	1.509	1.853
47	1 578 {161}	1.607	2.037
48	1 637 {167}	1.729	2.274
49	1 686 {172}	1.834	2.484
50	1 754 {179}	1.987	2.800
51	1 823 {186}	2.145	3.141
52	1 882 {192}	2.286	3.455
53	1 950 {199}	2.455	3.847
54	2 009 {205}	2.606	4.206
55	2 078 {212}	2.787	4.652

## Outer ring strength

Generally any outer ring never breaks down as long as the load acting it is a usual operating load. This paragraph describes hereunder the strength calculation method to be used when the outer ring strength under shock load and heavy load is reviewed.

The outer ring strength can be determined using the formula given hereunder, assuming the respective outer ring profiles as illustrated in **Fig. 6**. In this case, the outer ring rupture strength means the bridged rupture strength of roller.

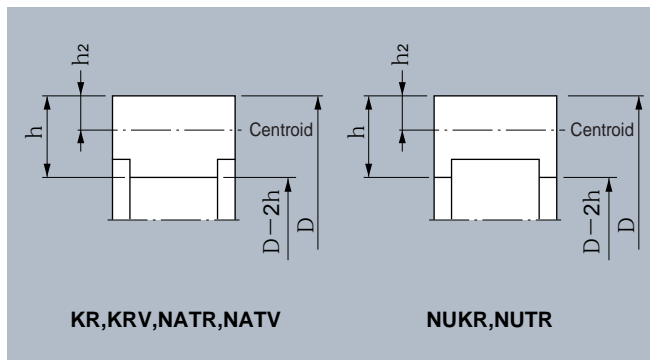


Fig. 6

Regarding how to set up breaking stress, in general 1760MPa [180kg/mm<sup>2</sup>] can be set up as the breaking stress for bearing steel, but it is desirable to set up the breaking strength with safety-side value (1170MPa [120kgf/mm<sup>2</sup>]), where stress concentration is taken into account. Generally any outer ring never break down as long as the load acting on it is usual operating load, but it necessary to check the rupture structure of outer ring, where shock load and heavy load act on it.

Incidentally, the stress acting on the outer ring in the bearing in ordinary use should be 196 MPa [20kgf/mm<sup>2</sup>] or smaller.

$$P = \frac{4\pi}{1+f(\alpha)} \times \frac{D-2h}{h(D-2h)^2} \times I \times \sigma$$

Where,

$$f(\alpha) = \frac{(\pi - \alpha) \sin \alpha - (1 + \cos \alpha)}{2 \cos \alpha}$$

$$\alpha = \frac{\pi}{Z} \text{ (rad.)}$$

- $P$  : Breaking load (N)
- $I$  : Secondary moment of outer ring section (mm<sup>4</sup>)
- $Z$  : Number of rollers
- $\sigma$  = Breaking stress (MPa)
- $D, h, h_2$  : per **Fig. 6** (mm)

## Stud strength

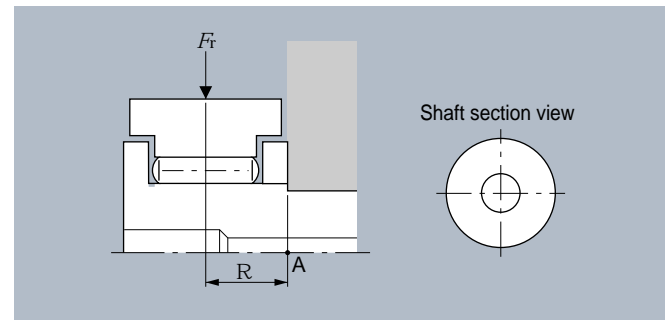


Fig. 7

When load  $F_r$  acts on the center point of outer ring as illustrated in **Fig.7**, bending moment  $F_r \cdot R$  generates and consequently bending stress  $\sigma_1$  (deemed as tensile stress) acts on the stud surface. In addition to this bending stress, tensile stress  $\sigma_2$  generates from screw tightening because the stud itself is clamped to machine body with nuts. The stud strength can be reviewed from comparison of the sum ( $\sigma_1 + \sigma_2$ ) of these two tensile stresses with allowable stress  $\sigma$  for the stud material.

$$\sigma_1 + \sigma_2 < \sigma$$

$$\sigma_1 = \frac{F_r \cdot R}{Z} \quad \begin{array}{l} F_r : \text{Maximum radial load} \\ Z : \text{Coefficient of shaft section through Point-A} \end{array}$$

$$\sigma_2 \doteq 98 \text{MPa (10kgf/mm}^2\text{)}$$

Tensile stress generating from maximum tightening torque described in "Dimensions Table"

$\sigma$  : Allowable stress for material

The following values are adopted from the repeated bending test result of the stud material.

Where the stud material is subjected to static bending stress;

$$\sigma = 1372 \text{MPa (140kgf/mm}^2\text{)}$$

Where the stud material is subjected to repeated bending stress (single direction)

$$\sigma = 784 \text{MPa (80kgf/mm}^2\text{)}$$

Where the stud material is subjected to repeated bending stress (double directions)

$$\sigma = 392 \text{MPa (40kgf/mm}^2\text{)}$$

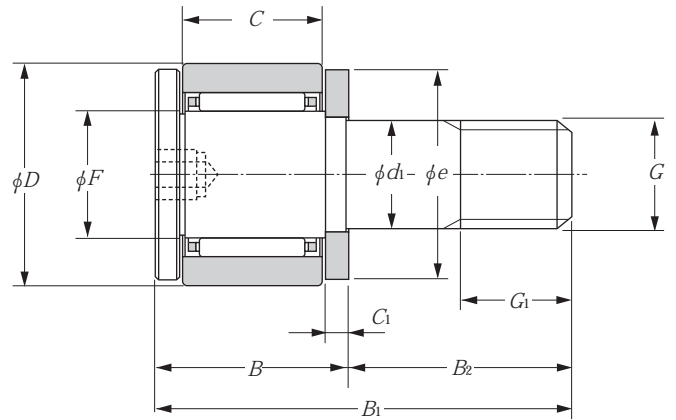
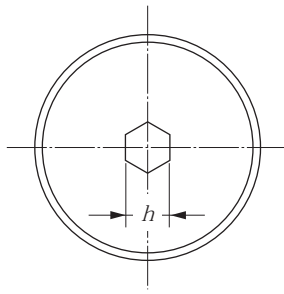
Accordingly,

$$F_r < \frac{Z}{R} (\sigma - \sigma_2)$$



Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

**KRM··XH type  
(with cage)**  
**KRMV··XH type  
(Full-complement roller type)**

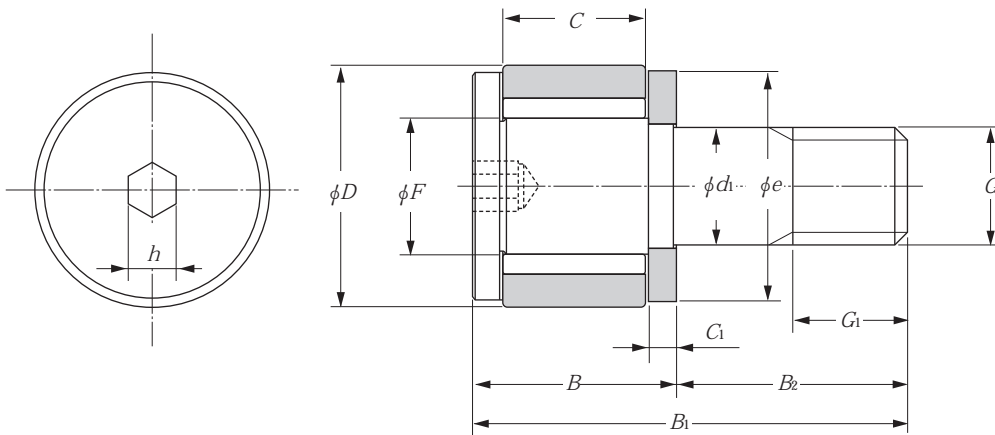


**KRM··XH type  
(with cage)**

$D$  4~12mm

OD <sup>1)</sup> mm	Boundary dimensions mm											Basic load ratings			
	$d_1$	$C$	$F$	$B$	$B_1$	$B_2$	$G$	$G_1$	$C_1$	$e$	$h$	dynamic N	static	dynamic kgf	static
$D$												$C_r$	$C_{or}$	$C_r$	$C_{or}$
4	1.5 <sub>0</sub>	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9	222	138	23	14
	1.5 <sup>-0.006</sup>	2	1.8	3.5	6.5	3	M1.4×0.3	1.5	0.7	3.8	0.9	505	480	51	49
4.5	2 <sub>0</sub>	2.5	2.25	4	8	4	M2 ×0.4	2	0.7	4.3	0.9	305	216	31	22
	2 <sup>-0.006</sup>	2.5	2.25	4	8	4	M2 ×0.4	2	0.7	4.3	0.9	695	765	71	78
5	2.5 <sub>0</sub>	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9	445	370	45	37
	2.5 <sup>-0.006</sup>	3	2.7	4.5	9.5	5	M2.5×0.45	2.5	0.7	4.8	0.9	905	1 110	92	114
6	3 <sub>0</sub>	4	3.4	5.5	11.5	6	M3 ×0.5	3	0.7	5.8	1.3	645	630	66	64
	3 <sup>-0.006</sup>	4	3.4	5.5	11.5	6	M3 ×0.5	3	0.7	5.8	1.3	1 280	1 840	130	187
8	4 <sub>0</sub>	5	4.5	7	15	8	M4 ×0.7	4	1	7.7	1.5	1 120	1 120	114	114
	4 <sup>-0.008</sup>	5	4.5	7	15	8	M4 ×0.7	4	1	7.7	1.5	2 120	3 050	216	310
10	5 <sub>0</sub>	6	5.9	8	18	10	M5 ×0.8	5	1	9.6	2	1 570	1 860	160	189
	5 <sup>-0.008</sup>	6	5.9	8	18	10	M5 ×0.8	5	1	9.6	2	2 820	4 800	288	490
12	6 <sub>0</sub>	7	6.7	9.5	21.5	12	M6 ×1	6	1.2	11.6	2.5	2 160	2 300	220	237
	6 <sup>-0.008</sup>	7	6.7	9.5	21.5	12	M6 ×1	6	1.2	11.6	2.5	4 150	6 450	425	655

Note: 1. JIS Class 0 is the dimensional tolerance.



**KRMV··XH type**  
(Full-complement roller type)

**Accessories**

Applicable bearing number	Applicable hexagonal nut
4	1M1.4×0.3
4.5	1M2×0.4
5	1M2.5×0.45
6	1M3×0.5
8	1M4×0.7
10	1M5×0.8
12	1M6×1

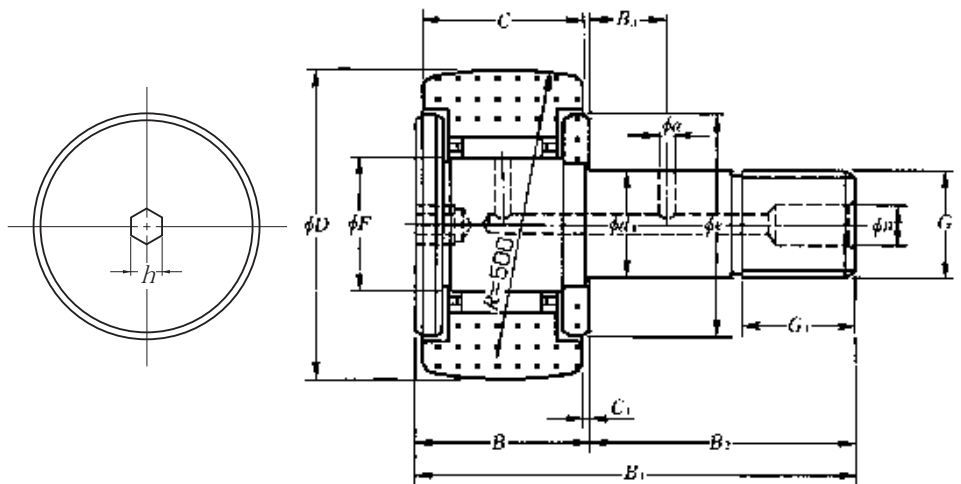


1M6×1

Track load capacity		Maximum tightening torque		Bearing numbers		Mass	Stud dia.
N	kgf	N·m	kgf·m	with cage	Full-complement roller type	kg (approx.)	mm
							$d_1$
147	15	0.1	0.01	KRM4XT2H/3AS —	— KRMV4XH/3AS	0.0003 0.0004	1.5
216	22	0.1	0.01	KRM4.5XT2H/3AS —	— KRMV4.5XH/3AS	0.0005 0.0006	2
294	30	0.3	0.03	KRM5XT2H/3AS —	— KRMV5XH/3AS	0.0007 0.0009	2.5
480	49	0.5	0.05	KRM6XT2H/3AS —	— KRMV6XH/3AS	0.0013 0.0014	3
785	80	1	0.1	KRM8XT2H/3AS —	— KRMV8XH/3AS	0.0029 0.0030	4
1 190	121	2	0.2	KRM10XT2H/3AS —	— KRMV10XH/3AS	0.0055 0.0059	5
1 640	167	3	0.3	KRM12XT2H/3AS —	— KRMV12XH/3AS	0.0093 0.0080	6

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

**KR··H type**  
**KR··XH type**  
**KR··LLH type**  
**KR··XLLH type**

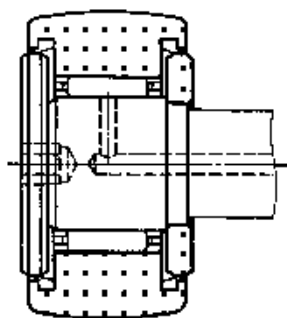


**KR··H type  
(with cage)**

**D** 10~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm														Basic load ratings	
	$d_1$	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	h	d <sub>r</sub>	N kgf
10	3 <sub>-0.010</sub> <sup>0</sup>	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	1 640 168	1 270 130
12	4 <sub>-0.012</sub> <sup>0</sup>	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	2 170 221	1 690 172
13	5 <sub>-0.012</sub> <sup>0</sup>	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	2 650 270	2 260 231
16	6 <sub>-0.012</sub> <sup>0</sup>	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	4 050 415	4 200 430
19	8 <sub>-0.015</sub> <sup>0</sup>	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	4 750 480	5 400 555
22	10 <sub>-0.015</sub> <sup>0</sup>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300 540	6 650 680
26	10 <sub>-0.015</sub> <sup>0</sup>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	5 300 540	6 650 680
30	12 <sub>-0.018</sub> <sup>0</sup>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850 800	9 650 985
32	12 <sub>-0.018</sub> <sup>0</sup>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	7 850 800	9 650 985
35	16 <sub>-0.018</sub> <sup>0</sup>	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	12 200 1 240	17 900 1 830
40	18 <sub>-0.018</sub> <sup>0</sup>	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	14 000 1 430	22 800 2 330
47	20 <sub>-0.021</sub> <sup>0</sup>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450
52	20 <sub>-0.021</sub> <sup>0</sup>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	20 700 2 110	33 500 3 450
62	24 <sub>-0.021</sub> <sup>0</sup>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600
72	24 <sub>-0.021</sub> <sup>0</sup>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	28 900 2 950	55 000 5 600
80	30 <sub>-0.021</sub> <sup>0</sup>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050
85	30 <sub>-0.021</sub> <sup>0</sup>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050
90	30 <sub>-0.021</sub> <sup>0</sup>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the KR··XH and KR··XLLH types whose outside surface form is cylindrical.



**KR·LLH type  
(with cage, sealed)**

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
10~19	—	—	1M3×0.5~1M8×1.25
22~26	NIP-B4	SEN4	1M10×1.25
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



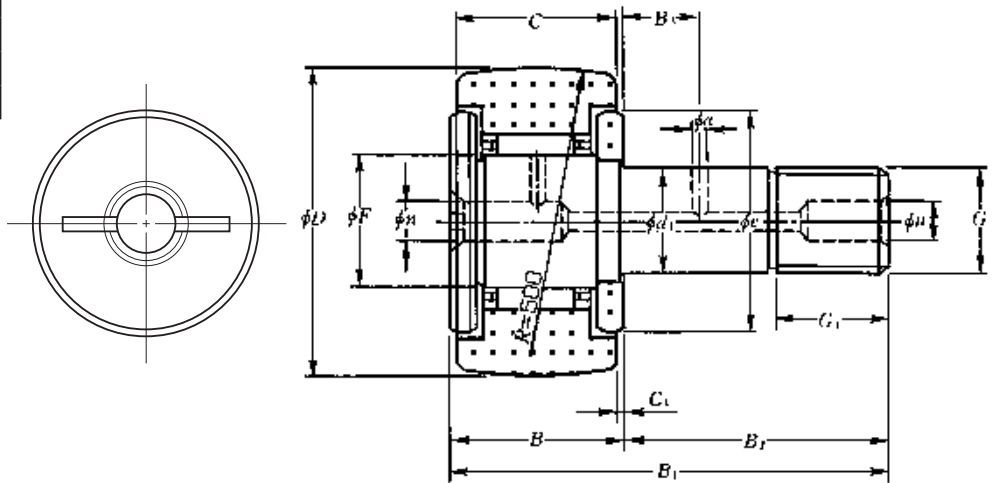
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf		min <sup>-1</sup>			Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
560 57	1 360 139	*27 000	*40 000	0.5 0.05	KR10T2H/3AS	KR10XT2H/3AS	KR10T2LLH/3AS	KR10XT2LLH/3AS	0.005	3
725 74	1 790 183	*25 000	*36 000	1 0.1	KR12T2H/3AS	KR12XT2H/3AS	KR12T2LLH/3AS	KR12XT2LLH/3AS	0.008	4
805 82	2 220 226	*23 000	*33 000	2 0.2	KR13T2H/3AS	KR13XT2H/3AS	KR13T2LLH/3AS	KR13XT2LLH/3AS	0.010	5
1 080 110	3 400 350	*19 000	*25 000	3 0.3	KR16FDOH/L588	KR16FXDOH/L588	KR16FLDOH/L588	KR16FXLLOH/L588	0.019	6
1 380 141	4 050 415	*15 000	*20 000	8 0.8	KR19FDOH/L588	KR19FXDOH/L588	KR19FLDOH/L588	KR19FXLLOH/L588	0.031	8
1 690 172	5 150 525	*12 000	*16 000	14 1.4	KR22FH	KR22FXH	KR22FLLH/3AS	KR22FXLLH/3AS	0.046	10
2 120 216	6 100 620	*12 000	*16 000	14 1.4	KR26FH	KR26FXH	KR26FLLH/3AS	KR26FXLLH/3AS	0.059	10
2 620 267	7 700 785	10 000	*13 000	20 2	KR30H	KR30XH	KR30LLH/3AS	KR30XLLH/3AS	0.087	12
2 860 291	8 200 835	10 000	*13 000	20 2	KR32H	KR32XH	KR32LLH/3AS	KR32XLLH/3AS	0.097	12
3 200 325	11 900 1 220	8 000	*11 000	52 5.3	KR35H	KR35XH	KR35LLH/3AS	KR35XLLH/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KR40H	KR40XH	KR40LLH/3AS	KR40XLLH/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KR47H	KR47XH	KR47LLH/3AS	KR47XLLH/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KR52H	KR52XH	KR52LLH/3AS	KR52XLLH/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KR62H	KR62XH	KR62LLH/3AS	KR62XLLH/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KR72H	KR72XH	KR72LLH/3AS	KR72XLLH/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KR80H	KR80XH	KR80LLH/3AS	KR80XLLH/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KR85H	KR85XH	KR85LLH/3AS	KR85XLLH/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KR90H	KR90XH	KR90LLH/3AS	KR90XLLH/3AS	1.95	30

Remarks: 1. The limiting speed of KR·LLH and KR·XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.  
2. A bearing number with a T2 suffix indicates a bearing with a resin cage. Its maximum allowable temperature is 120°C and continuous operation temperature is 100°C.

Metric series		Inch series
With cage		Full-complement roller
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal		With seal

**KR type**  
**KR··X type**  
**KR··LL type**  
**KR··XLL type**

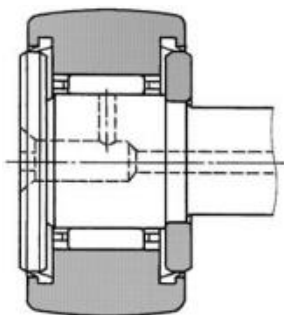


**KR type  
(with cage)**

**D** 16~90mm

OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Boundary dimensions mm													Basic load ratings	
	<i>d</i> <sub>1</sub>	<i>C</i>	<i>F</i>	<i>B</i>	<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>	<i>G</i>	<i>G</i> <sub>1</sub>	<i>B</i> <sub>3</sub>	<i>C</i> <sub>1</sub>	<i>n</i>	<i>a</i>	<i>e</i>	dynamic <i>C</i> <sub>r</sub>	static <i>C</i> <sub>or</sub>
<b>16</b>	6 <sup>0</sup> <sub>-0.012</sub>	11	8	12	28	16	M6×1	8	—	0.6	4 <sup>2)</sup>	—	12	4 050 415	4 200 430
<b>19</b>	8 <sup>0</sup> <sub>-0.015</sub>	11	10	12	32	20	M8×1.25	10	—	0.6	4 <sup>2)</sup>	—	14	4 750 480	5 400 555
<b>22</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300 540	6 650 680
<b>26</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	5 300 540	6 650 680
<b>30</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850 800	9 650 985
<b>32</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	7 850 800	9 650 985
<b>35</b>	16 <sup>0</sup> <sub>-0.018</sub>	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	12 200 1 240	17 900 1 830
<b>40</b>	18 <sup>0</sup> <sub>-0.018</sub>	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	14 000 1 430	22 800 2 330
<b>47</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700 2 110	33 500 3 450
<b>52</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	20 700 2 110	33 500 3 450
<b>62</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900 2 950	55 000 5 600
<b>72</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	28 900 2 950	55 000 5 600
<b>80</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 4 600	88 500 9 050
<b>85</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 4 600	88 500 9 050
<b>90</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KR··X and KR··XLL types whose outside surface form is cylindrical.  
 2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



**KR·LL type  
(with cage, sealed)**

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
16~26	NIP-B4	SEN4	1M 6×1 ~1M10×1.25
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



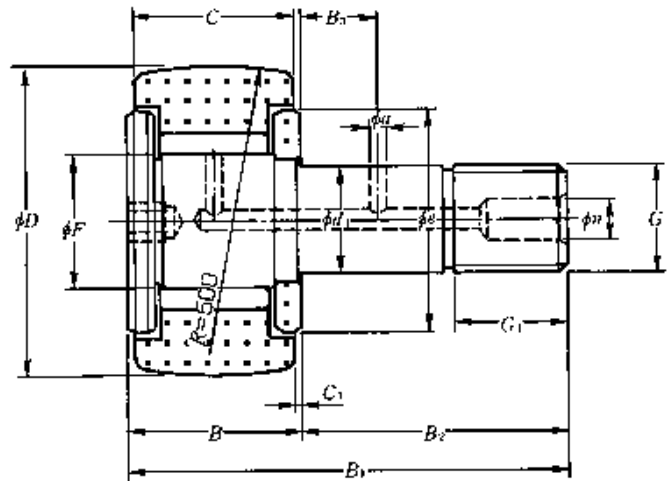
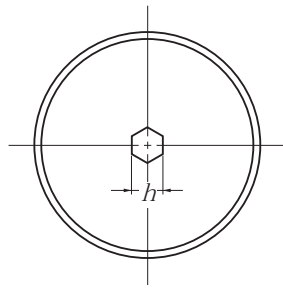
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf	Spherical outer ring Cylindrical outer ring	Grease lubrication	Oil lubrication		Without seal		With seal			
					Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	*19 000	*25 000	3 0.3	KR16F	KR16FX	KR16FLL/3AS	KR16FXLL/3AS	0.019	6
1 380 141	4 050 415	*15 000	*20 000	8 0.8	KR19F	KR19FX	KR19FLL/3AS	KR19FXLL/3AS	0.031	8
1 690 172	5 150 525	*12 000	*16 000	14 1.4	KR22F	KR22FX	KR22FLL/3AS	KR22FXLL/3AS	0.046	10
2 120 216	6 100 620	*12 000	*16 000	14 1.4	KR26F	KR26FX	KR26FLL/3AS	KR26FXLL/3AS	0.059	10
2 620 267	7 700 785	10 000	*13 000	20 2	KR30	KR30X	KR30LL/3AS	KR30FXLL/3AS	0.087	12
2 860 291	8 200 835	10 000	*13 000	20 2	KR32	KR32X	KR32LL/3AS	KR32XLL/3AS	0.097	12
3 200 325	11 900 1 220	8 000	*11 000	52 5.3	KR35	KR35X	KR35LL/3AS	KR35XLL/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KR40	KR40X	KR40LL/3AS	KR40XLL/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KR47	KR47X	KR47LL/3AS	KR47XLL/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KR52	KR52X	KR52LL/3AS	KR52XLL/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KR62	KR62X	KR62LL/3AS	KR62XLL/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KR72	KR72X	KR72LL/3AS	KR72XLL/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KR80	KR80X	KR80LL/3AS	KR80XLL/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KR85	KR85X	KR85LL/3AS	KR85XLL/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KR90	KR90X	KR90LL/3AS	KR90XLL/3AS	1.95	30

Remarks: 1. The limiting speed of KR·LL and KR·XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

**KRV··H type**  
**KRV··XH type**  
**KRV··LLH type**  
**KRV··XLLH type**

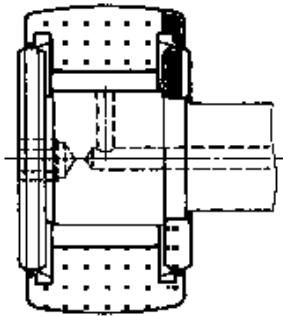


**KRV··H type**  
**(Full-complement roller type)**

**D** 10~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm														Basic load ratings	
	d <sub>1</sub>	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	h	d <sub>r</sub>	C <sub>or</sub>
10	3 <sub>-0.010</sub> <sup>0</sup>	7	4	8	17	9	M3×0.5	5	—	0.5	—	—	7	2.5	2 500 255	2 610 267
12	4 <sub>-0.012</sub> <sup>0</sup>	8	4.8	9	20	11	M4×0.7	6	—	0.5	—	—	8.5	2.5	3 500 360	3 800 385
13	5 <sub>-0.012</sub> <sup>0</sup>	9	5.75	10	23	13	M5×0.8	7.5	—	0.5	—	—	9.5	3	4 650 475	5 550 570
16	6 <sub>-0.012</sub> <sup>0</sup>	11	8	12	28	16	M6×1	8	—	0.6	—	—	12	3	6 500 665	9 350 955
19	8 <sub>-0.015</sub> <sup>0</sup>	11	10	12	32	20	M8×1.25	10	—	0.6	—	—	14	4	7 450 760	11 700 1 190
22	10 <sub>-0.015</sub> <sup>0</sup>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200 840	14 000 1 420
26	10 <sub>-0.015</sub> <sup>0</sup>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	4	8 200 840	14 000 1 420
30	12 <sub>-0.018</sub> <sup>0</sup>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070
32	12 <sub>-0.018</sub> <sup>0</sup>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	6	12 000 1 230	20 300 2 070
35	16 <sub>-0.018</sub> <sup>0</sup>	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	6	17 600 1 790	34 000 3 500
40	18 <sub>-0.018</sub> <sup>0</sup>	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	6	19 400 1 980	42 000 4 250
47	20 <sub>-0.021</sub> <sup>0</sup>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250
52	20 <sub>-0.021</sub> <sup>0</sup>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	8	28 800 2 940	61 000 6 250
62	24 <sub>-0.021</sub> <sup>0</sup>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000
72	24 <sub>-0.021</sub> <sup>0</sup>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	8	39 500 4 000	98 500 10 000
80	30 <sub>-0.021</sub> <sup>0</sup>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000 5 900	147 000 15 000
90	30 <sub>-0.021</sub> <sup>0</sup>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	8	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KRV··XH and KRV··XLLH types whose outside surface form is cylindrical.



**KRV·LLH type**  
(Full-complement roller type, with seal)

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
10~19	—	—	1M3×0.5~1M8×1.25
22~26	NIP-B4	SEN4	1M10×1.25
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



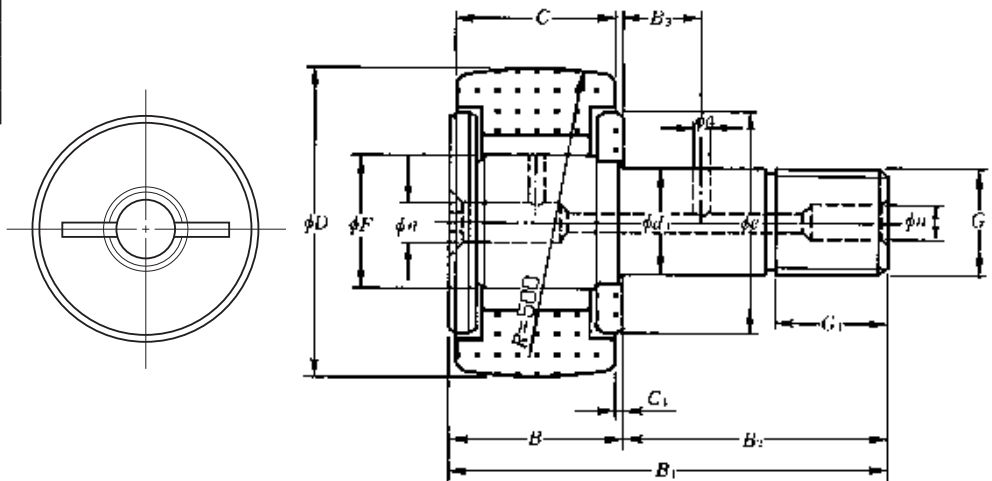
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N	kgf	min <sup>-1</sup>	min <sup>-1</sup>		Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication	N·m	Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings	(approx.)	
				kgf·m						
560 57	1 360 139	*25 000	*32 000	0.5 0.05	KRV10H/3AS	KRV10XH/3AS	KRV10LLH/3AS	KRV10XLLH/3AS	0.005	3
725 74	1 790 183	*20 000	*27 000	1 0.1	KRV12H/3AS	KRV12XH/3AS	KRV12LLH/3AS	KRV12XLLH/3AS	0.008	4
805 82	2 220 226	*17 000	*22 000	2 0.2	KRV13H/3AS	KRV13XH/3AS	KRV13LLH/3AS	KRV13XLLH/3AS	0.011	5
1 080 110	3 400 350	*13 000	*16 000	3 0.3	KRV16FDOH/L588	KRV16FXDOH/L588	KRV16FLDOH/L588	KRV16FXLLDOH/L588	0.020	6
1 380 141	4 050 415	10 000	*13 000	8 0.8	KRV19FDOH/L588	KRV19FXDOH/L588	KRV19FLDOH/L588	KRV19FXLLDOH/L588	0.032	8
1 690 172	5 150 525	8 500	*11 000	14 1.4	KRV22FH/3AS	KRV22FXH/3AS	KRV22FLLH/3AS	KRV22FXLLH/3AS	0.047	10
2 120 216	6 100 620	8 500	*11 000	14 1.4	KRV26FH/3AS	KRV26FXH/3AS	KRV26FLLH/3AS	KRV26FXLLH/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRV30H/3AS	KRV30XH/3AS	KRV30LLH/3AS	KRV30XLLH/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRV32H/3AS	KRV32XH/3AS	KRV32LLH/3AS	KRV32XLLH/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRV35H/3AS	KRV35XH/3AS	KRV35LLH/3AS	KRV35XLLH/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRV40H/3AS	KRV40XH/3AS	KRV40LLH/3AS	KRV40XLLH/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRV47H/3AS	KRV47XH/3AS	KRV47LLH/3AS	KRV47XLLH/3AS	0.392	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRV52H/3AS	KRV52XH/3AS	KRV52LLH/3AS	KRV52XLLH/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRV62H/3AS	KRV62XH/3AS	KRV62LLH/3AS	KRV62XLLH/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRV72H/3AS	KRV72XH/3AS	KRV72LLH/3AS	KRV72XLLH/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRV80H/3AS	KRV80XH/3AS	KRV80LLH/3AS	KRV80XLLH/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRV90H/3AS	KRV90XH/3AS	KRV90LLH/3AS	KRV90XLLH/3AS	1.97	30

Remarks: 1. The limiting speed of KRV·LLH and KRV·XLLH types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

**KRV type**  
**KRV··X type**  
**KRV··LL type**  
**KRV··XLL type**

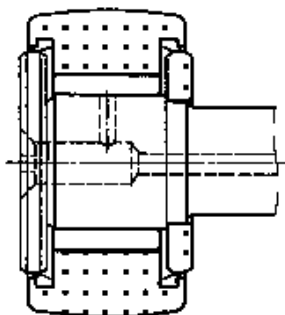


**KRV type**  
**(Full-complement roller type)**

**D** 16~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm													Basic load ratings	
	$d_1$	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	d <sub>g</sub>	N kgf
16	6 <sup>0</sup> <sub>-0.012</sub>	11	8	12	28	16	M6×1	8	—	0.6	4 <sup>2)</sup>	—	12	6 500 665	9 350 955
19	8 <sup>0</sup> <sub>-0.015</sub>	11	10	12	32	20	M8×1.25	10	—	0.6	4 <sup>2)</sup>	—	14	7 450 760	11 700 1 190
22	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200 840	14 000 1 420
26	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	—	0.6	4	—	17	8 200 840	14 000 1 420
30	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000 1 230	20 300 2 070
32	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	6	0.6	6	3	23	12 000 1 230	20 300 2 070
35	16 <sup>0</sup> <sub>-0.018</sub>	18	18	19.5	52	32.5	M16×1.5	17	8	0.8	6	3	27	17 600 1 790	34 000 3 500
40	18 <sup>0</sup> <sub>-0.018</sub>	20	22	21.5	58	36.5	M18×1.5	19	8	0.8	6	3	32	19 400 1 980	42 000 4 250
47	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800 2 940	61 000 6 250
52	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	9	0.8	8	4	37	28 800 2 940	61 000 6 250
62	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500 4 000	98 500 10 000
72	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	11	0.8	8	4	44	39 500 4 000	98 500 10 000
80	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000 5 900	147 000 15 000
90	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	15	1	8	4	53	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the KRV··X and KRV··XLL types whose outside surface form is cylindrical.  
2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



**KRV·LL type**  
(Full-complement roller type, with seal)

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
16~26	NIP-B4	SEN4	1M 6×1 ~1M10×1.25
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



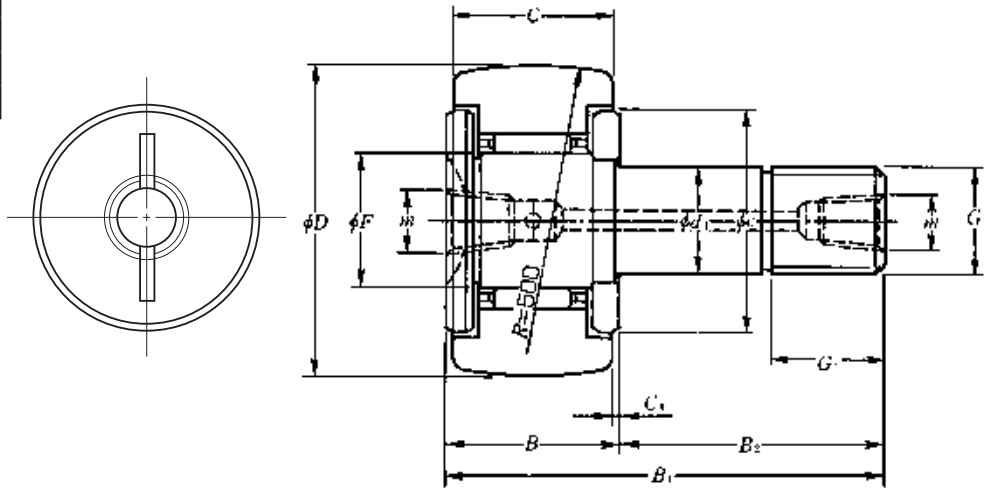
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf		min <sup>-1</sup>			Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	*13 000	*16 000	3 0.3	KRV16F/3AS	KRV16FX/3AS	KRV16FLL/3AS	KRV16FXLL/3AS	0.020	6
1 380 141	4 050 415	10 000	*13 000	8 0.8	KRV19F/3AS	KRV19FX/3AS	KRV19FLL/3AS	KRV19FXLL/3AS	0.032	8
1 690 172	5 150 525	8 500	*11 000	14 1.4	KRV22F/3AS	KRV22FX/3AS	KRV22FLL/3AS	KRV22FXLL/3AS	0.047	10
2 120 216	6 100 620	8 500	*11 000	14 1.4	KRV26F/3AS	KRV26FX/3AS	KRV26FLL/3AS	KRV26FXLL/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRV30/3AS	KRV30X/3AS	KRV30LL/3AS	KRV30XLL/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRV32/3AS	KRV32X/3AS	KRV32LL/3AS	KRV32XLL/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRV35/3AS	KRV35X/3AS	KRV35LL/3AS	KRV35XLL/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRV40/3AS	KRV40X/3AS	KRV40LL/3AS	KRV40XLL/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRV47/3AS	KRV47X/3AS	KRV47LL/3AS	KRV47XLL/3AS	0.390	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRV52/3AS	KRV52X/3AS	KRV52LL/3AS	KRV52XLL/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRV62/3AS	KRV62X/3AS	KRV62LL/3AS	KRV62XLL/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRV72/3AS	KRV72X/3AS	KRV72LL/3AS	KRV72XLL/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRV80/3AS	KRV80X/3AS	KRV80LL/3AS	KRV80XLL/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRV90/3AS	KRV90X/3AS	KRV90LL/3AS	KRV90XLL/3AS	1.97	30

Remarks: 1. The limiting speed of KRV·LL and KRV·XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

**KRT type**  
**KRT··X type**  
**KRT··LL type**  
**KRT··XLL type**

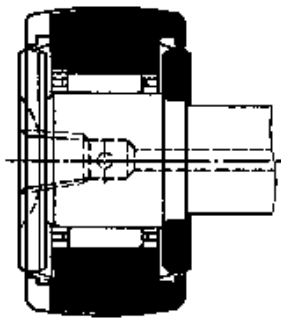


**KRT type  
(with cage)**

**D** 16~90mm

OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Boundary dimensions mm											Basic load ratings	
	<i>d</i> <sub>1</sub>	<i>C</i>	<i>F</i>	<i>B</i>	<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>	<i>G</i>	<i>G</i> <sub>1</sub>	<i>C</i> <sub>1</sub>	<i>m</i>	<i>e</i>	dynamic <i>C</i> <sub>r</sub>	static <i>C</i> <sub>0r</sub>
<b>16</b>	6 <sup>0</sup> <sub>-0.012</sub>	11	8	12	28	16	M6×1	8	0.6	M4×0.7 <sup>2)</sup>	12	4 050 415	4 200 430
<b>19</b>	8 <sup>0</sup> <sub>-0.015</sub>	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7 <sup>2)</sup>	14	4 750 480	5 400 555
<b>22</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300 540	6 650 680
<b>26</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	5 300 540	6 650 680
<b>30</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850 800	9 650 985
<b>32</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	7 850 800	9 650 985
<b>35</b>	16 <sup>0</sup> <sub>-0.018</sub>	18	18	19.5	52	32.5	M16×1.5	17	0.8	PT <sup>1</sup> / <sub>8</sub>	27	12 200 1 240	17 900 1 830
<b>40</b>	18 <sup>0</sup> <sub>-0.018</sub>	20	22	21.5	58	36.5	M18×1.5	19	0.8	PT <sup>1</sup> / <sub>8</sub>	32	14 000 1 430	22 800 2 330
<b>47</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	37	20 700 2 110	33 500 3 450
<b>52</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	37	20 700 2 110	33 500 3 450
<b>62</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	28 900 2 950	55 000 5 600
<b>72</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	28 900 2 950	55 000 5 600
<b>80</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050
<b>85</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050
<b>90</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRT··X and KRT··XLL types whose outside surface form is cylindrical.  
 2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



**KRT··LL type  
(with cage, sealed)**

### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16~26	NIP-X30	M4×0.7 ×4R	1M 6×1 ~1M10×1.25
30~32	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5
35~90	JIS 2 (A-PT!ø)	PT!ø×7R	1M16×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø



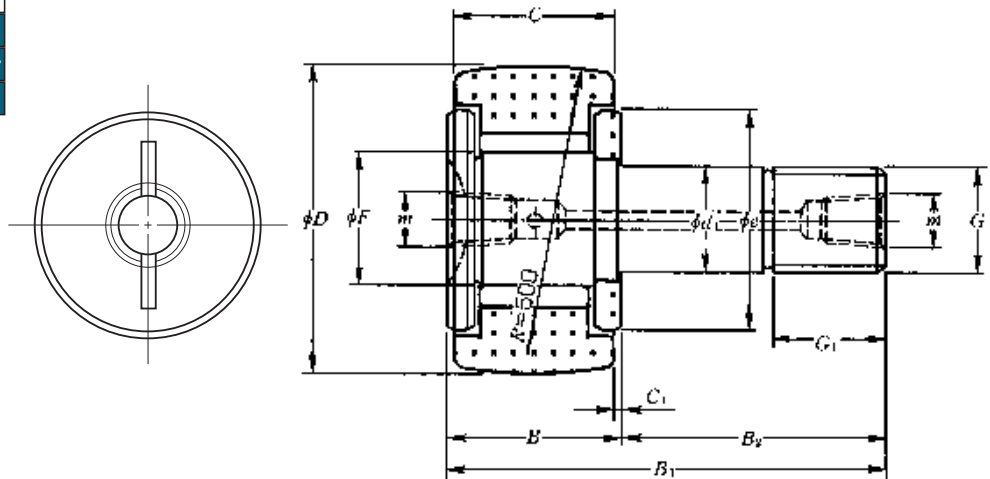
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf		min <sup>-1</sup>			Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	*19 000	*25 000	3 0.3	KRT16	KRT16X	KRT16LL/3AS	KRT16XLL/3AS	0.019	6
1 380 141	4 050 415	*15 000	*20 000	8 0.8	KRT19	KRT19X	KRT19LL/3AS	KRT19XLL/3AS	0.031	8
1 690 172	5 150 525	*12 000	*16 000	14 1.4	KRT22	KRT22X	KRT22LL/3AS	KRT22XLL/3AS	0.046	10
2 120 216	6 100 620	*12 000	*16 000	14 1.4	KRT26	KRT26X	KRT26LL/3AS	KRT26XLL/3AS	0.059	10
2 620 267	7 700 785	10 000	*13 000	20 2	KRT30	KRT30X	KRT30LL/3AS	KRT30XLL/3AS	0.087	12
2 860 291	8 200 835	10 000	*13 000	20 2	KRT32	KRT32X	KRT32LL/3AS	KRT32XLL/3AS	0.097	12
3 200 325	11 900 1 220	8 000	*11 000	52 5.3	KRT35	KRT35X	KRT35LL/3AS	KRT35XLL/3AS	0.169	16
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KRT40	KRT40X	KRT40LL/3AS	KRT40XLL/3AS	0.248	18
4 700 480	21 000 2 150	6 000	8 000	98 10	KRT47	KRT47X	KRT47LL/3AS	KRT47XLL/3AS	0.386	20
5 550 565	23 300 2 370	6 000	8 000	98 10	KRT52	KRT52X	KRT52LL/3AS	KRT52XLL/3AS	0.461	20
6 950 710	34 500 3 500	5 000	6 500	178 18	KRT62	KRT62X	KRT62LL/3AS	KRT62XLL/3AS	0.790	24
8 050 820	38 500 3 900	5 000	6 500	178 18	KRT72	KRT72X	KRT72LL/3AS	KRT72XLL/3AS	1.04	24
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KRT80	KRT80X	KRT80LL/3AS	KRT80XLL/3AS	1.55	30
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KRT85	KRT85X	KRT85LL/3AS	KRT85XLL/3AS	1.74	30
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KRT90	KRT90X	KRT90LL/3AS	KRT90XLL/3AS	1.95	30

Remarks: 1. The limiting speed of KRT··LL and KRT··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series
With cage		Full-complement roller
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal		With seal

KRVT type  
 KRVT··X type  
 KRVT··LL type  
 KRVT··XLL type

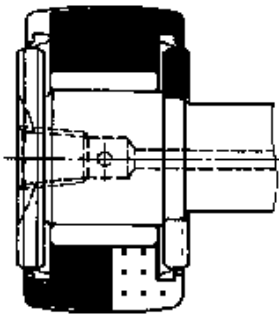


**KRVT type**  
 (Full-complement roller type)

**D** 16~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm											Basic load ratings	
	d <sub>1</sub>	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	C <sub>1</sub>	m	e	d <sub>r</sub> N kgf	C <sub>or</sub> N kgf
16	6 <sup>0</sup> -0.012	11	8	12	28	16	M6×1	8	0.6	M4×0.7 <sup>2)</sup>	12	6 500 665	9 350 955
19	8 <sup>0</sup> -0.015	11	10	12	32	20	M8×1.25	10	0.6	M4×0.7 <sup>2)</sup>	14	7 450 760	11 700 1 190
22	10 <sup>0</sup> -0.015	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200 840	14 000 1 420
26	10 <sup>0</sup> -0.015	12	12	13	36	23	M10×1.25	12	0.6	M4×0.7	17	8 200 840	14 000 1 420
30	12 <sup>0</sup> -0.018	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
32	12 <sup>0</sup> -0.018	14	15	15	40	25	M12×1.5	13	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
35	16 <sup>0</sup> -0.018	18	18	19.5	52	32.5	M16×1.5	17	0.8	PT <sup>1</sup> / <sub>8</sub>	27	17 600 1 790	34 000 3 500
40	18 <sup>0</sup> -0.018	20	22	21.5	58	36.5	M18×1.5	19	0.8	PT <sup>1</sup> / <sub>8</sub>	32	19 400 1 980	42 000 4 250
47	20 <sup>0</sup> -0.021	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	37	28 800 2 940	61 000 6 250
52	20 <sup>0</sup> -0.021	24	25	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	37	28 800 2 940	61 000 6 250
62	24 <sup>0</sup> -0.021	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	39 500 4 000	98 500 10 000
72	24 <sup>0</sup> -0.021	29	30	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	39 500 4 000	98 500 10 000
80	30 <sup>0</sup> -0.021	35	38	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	53	58 000 5 900	147 000 15 000
90	30 <sup>0</sup> -0.021	35	38	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	53	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRVT··X and KRVT··XLL types whose outside surface form is cylindrical.  
 2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16~26	NIP-X30	M4×0.7 ×4R	1M 6×1 ~1M10×1.25
30~32	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5
35~90	JIS 2 (A-PT!ø)	PT!ø×7R	1M16×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø



1M12

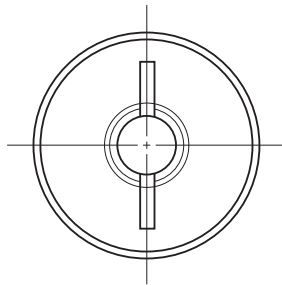
### KRVT·LL type (Full-complement roller type, with seal)

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf		min <sup>-1</sup>			Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
1 080 110	3 400 350	*13 000	*16 000	3 0.3	KRVT16/3AS	KRVT16X/3AS	KRVT16LL/3AS	KRVT16XLL/3AS	0.020	6
1 380 141	4 050 415	10 000	*13 000	8 0.8	KRVT19/3AS	KRVT19X/3AS	KRVT19LL/3AS	KRVT19XLL/3AS	0.032	8
1 690 172	5 150 525	8 500	*11 000	14 1.4	KRVT22/3AS	KRVT22X/3AS	KRVT22LL/3AS	KRVT22XLL/3AS	0.047	10
2 120 216	6 100 620	8 500	*11 000	14 1.4	KRVT26/3AS	KRVT26X/3AS	KRVT26LL/3AS	KRVT26XLL/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRVT30/3AS	KRVT30X/3AS	KRVT30LL/3AS	KRVT30XLL/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRVT32/3AS	KRVT32X/3AS	KRVT32LL/3AS	KRVT32XLL/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRVT35/3AS	KRVT35X/3AS	KRVT35LL/3AS	KRVT35XLL/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRVT40/3AS	KRVT40X/3AS	KRVT40LL/3AS	KRVT40XLL/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRVT47/3AS	KRVT47X/3AS	KRVT47LL/3AS	KRVT47XLL/3AS	0.390	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRVT52/3AS	KRVT52X/3AS	KRVT52LL/3AS	KRVT52XLL/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRVT62/3AS	KRVT62X/3AS	KRVT62LL/3AS	KRVT62XLL/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRVT72/3AS	KRVT72X/3AS	KRVT72LL/3AS	KRVT72XLL/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRVT80/3AS	KRVT80X/3AS	KRVT80LL/3AS	KRVT80XLL/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRVT90/3AS	KRVT90X/3AS	KRVT90LL/3AS	KRVT90XLL/3AS	1.97	30

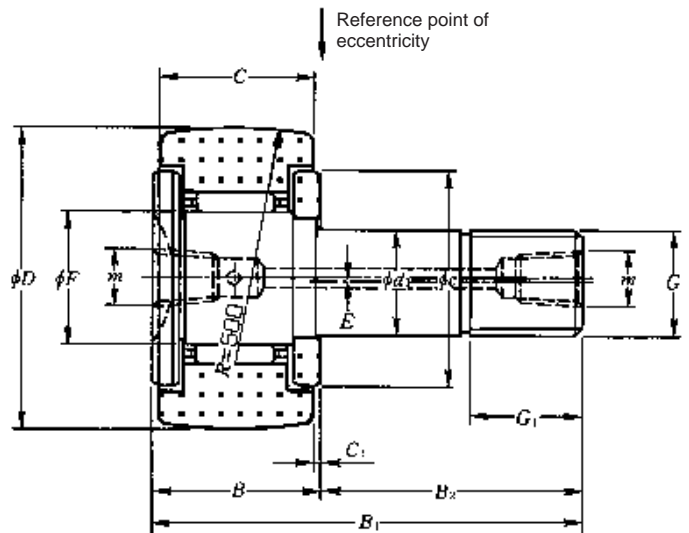
Remarks: 1. The limiting speed of KRVT·LL and KRVT·XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series
With cage		Full-complement roller
Hexagonal socket	Tapped hole	Slot for screwdriver
Without seal		With seal
Eccentric stud		

**KRU type**  
**KRU··X type**  
**KRU··LL type**  
**KRU··XLL type**



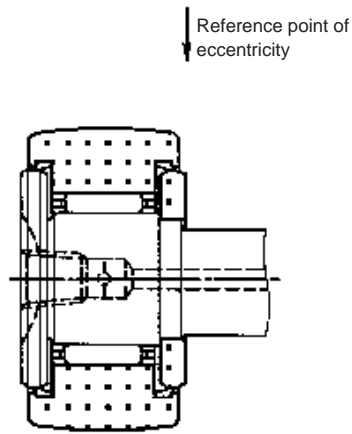
**KRU type  
(with cage)**



**D** 16~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm													Basic load ratings	
	<i>d</i> <sub>1</sub>	<i>C</i>	<i>F</i>	<i>B</i>	<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>	<i>G</i>	<i>G</i> <sub>1</sub>	Eccentricity <i>E</i>	<i>C</i> <sub>1</sub>	<i>m</i>	<i>e</i>	dynamic <i>C</i> <sub>r</sub>	static <i>C</i> <sub>0r</sub>	
<b>16</b>	6 <sup>0</sup> <sub>-0.012</sub>	11	8	12	28	16	M6×1	8	0.25	0.6	M4×0.7 <sup>2)</sup>	12	4 050 415	4 200 430	
<b>19</b>	8 <sup>0</sup> <sub>-0.015</sub>	11	10	12	32	20	M8×1.25	10	0.25	0.6	M4×0.7 <sup>2)</sup>	14	4 750 480	5 400 555	
<b>22</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	5 300 540	6 650 680	
<b>26</b>	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	5 300 540	6 650 680	
<b>30</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	7 850 800	9 650 985	
<b>32</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	7 850 800	9 650 985	
<b>35</b>	16 <sup>0</sup> <sub>-0.018</sub>	18	19	19.5	52	32.5	M16×1.5	17	0.5	0.8	M6×0.75	27	12 500 1 280	18 900 1 930	
<b>40</b>	18 <sup>0</sup> <sub>-0.018</sub>	20	22	21.5	58	36.5	M18×1.5	19	0.6	0.8	PT <sup>1</sup> / <sub>8</sub>	32	14 000 1 430	22 800 2 330	
<b>47</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT <sup>1</sup> / <sub>8</sub>	37	20 700 2 110	33 500 3 450	
<b>52</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT <sup>1</sup> / <sub>8</sub>	37	20 700 2 110	33 500 3 450	
<b>62</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT <sup>1</sup> / <sub>8</sub>	44	28 900 2 950	55 000 5 600	
<b>72</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT <sup>1</sup> / <sub>8</sub>	44	28 900 2 950	55 000 5 600	
<b>80</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1.0	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050	
<b>85</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1.0	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050	
<b>90</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1.0	1	PT <sup>1</sup> / <sub>8</sub>	53	45 000 4 600	88 500 9 050	

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRU··X and KRU··XLL types whose outside surface form is cylindrical.  
 2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



**KRU·LL type  
(with cage)**

### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16~26	NIP-X30	M4×0.7 ×4R	1M 6×1 ~1M10×1.25
30~35	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5~1M16×1.5
40~90	JIS 2 (A-PT!ø)	PT!ø×7R	1M18×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø



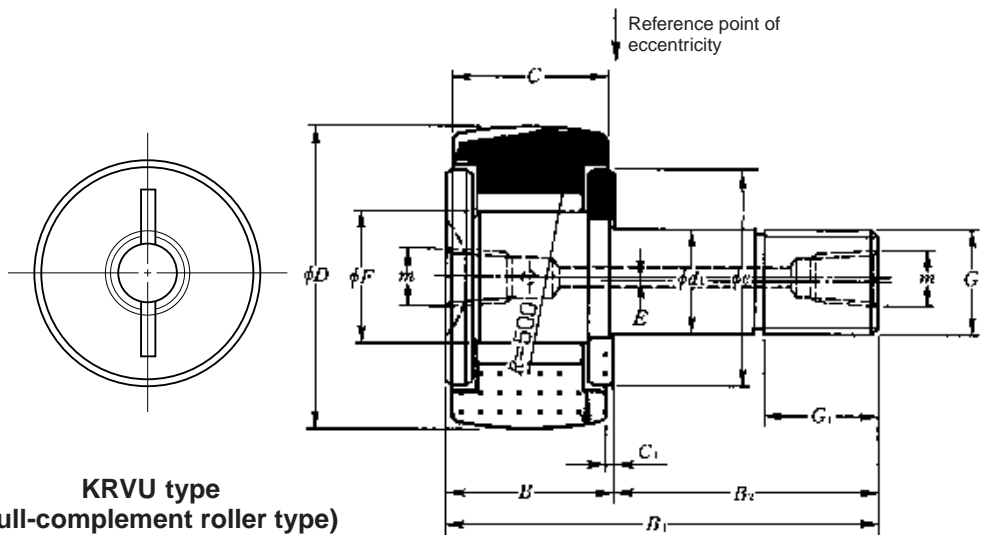
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.	
N kgf		min <sup>-1</sup>			Without seal		With seal				kg (approx.)
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication		Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings			
1 080 110	3 400 350	*19 000	*25 000	3 0.3	KRU16	KRU16X	KRU16LL/3AS	KRU16XLL/3AS	0.019	6	
1 380 141	4 050 415	*15 000	*20 000	8 0.8	KRU19	KRU19X	KRU19LL/3AS	KRU19XLL/3AS	0.031	8	
1 690 172	5 150 525	*12 000	*16 000	14 1.4	KRU22	KRU22X	KRU22LL/3AS	KRU22XLL/3AS	0.046	10	
2 120 216	6 100 620	*12 000	*16 000	14 1.4	KRU26	KRU26X	KRU26LL/3AS	KRU26XLL/3AS	0.059	10	
2 620 267	7 700 785	10 000	*13 000	20 2	KRU30	KRU30X	KRU30LL/3AS	KRU30XLL/3AS	0.087	12	
2 860 291	8 200 835	10 000	*13 000	20 2	KRU32	KRU32X	KRU32LL/3AS	KRU32XLL/3AS	0.097	12	
3 200 325	11 900 1 220	8 000	*11 000	52 5.3	KRU35	KRU35X	KRU35LL/3AS	KRU35XLL/3AS	0.169	16	
3 850 390	14 500 1 480	7 000	9 000	76 7.8	KRU40	KRU40X	KRU40LL/3AS	KRU40XLL/3AS	0.248	18	
4 700 480	21 000 2 150	6 000	8 000	98 10	KRU47	KRU47X	KRU47LL/3AS	KRU47XLL/3AS	0.386	20	
5 550 565	23 300 2 370	6 000	8 000	98 10	KRU52	KRU52X	KRU52LL/3AS	KRU52XLL/3AS	0.461	20	
6 950 710	34 500 3 500	5 000	6 500	178 18	KRU62	KRU62X	KRU62LL/3AS	KRU62XLL/3AS	0.790	24	
8 050 820	38 500 3 900	5 000	6 500	178 18	KRU72	KRU72X	KRU72LL/3AS	KRU72XLL/3AS	1.04	24	
9 800 1 000	53 000 5 400	4 000	5 500	360 37	KRU80	KRU80X	KRU80LL/3AS	KRU80XLL/3AS	1.55	30	
10 400 1 060	56 000 5 750	4 000	5 500	360 37	KRU85	KRU85X	KRU85LL/3AS	KRU85XLL/3AS	1.74	30	
11 400 1 160	59 000 6 100	4 000	5 500	360 37	KRU90	KRU90X	KRU90LL/3AS	KRU90XLL/3AS	1.95	30	

Remarks: 1. The limiting speed of KRU·LL and KRU·XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	
Eccentric stud			

KRVU type  
 KRVU··X type  
 KRVU··LL type  
 KRVU··XLL type

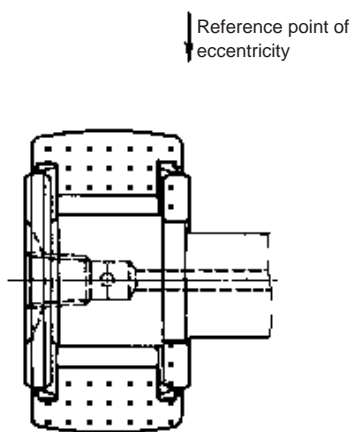


**KRVU type**  
 (Full-complement roller type)

**D** 16~90mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm												Basic load ratings	
	d <sub>1</sub>	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	Eccentricity E	C <sub>1</sub>	m	e	d <sub>r</sub>	N kgf
16	6 <sup>0</sup> <sub>-0.012</sub>	11	8	12	28	16	M6×1	8	0.25	0.6	M4×0.7 <sup>2)</sup>	12	6 500 665	9 350 955
19	8 <sup>0</sup> <sub>-0.015</sub>	11	10	12	32	20	M8×1.25	10	0.25	0.6	M4×0.7 <sup>2)</sup>	14	7 450 760	11 700 1 190
22	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	8 200 840	14 000 1 420
26	10 <sup>0</sup> <sub>-0.015</sub>	12	12	13	36	23	M10×1.25	12	0.3	0.6	M4×0.7	17	8 200 840	14 000 1 420
30	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
32	12 <sup>0</sup> <sub>-0.018</sub>	14	15	15	40	25	M12×1.5	13	0.4	0.6	M6×0.75	23	12 000 1 230	20 300 2 070
35	16 <sup>0</sup> <sub>-0.018</sub>	18	19	19.5	52	32.5	M16×1.5	17	0.5	0.8	M6×0.75	27	18 000 1 840	36 500 3 700
40	18 <sup>0</sup> <sub>-0.018</sub>	20	22	21.5	58	36.5	M18×1.5	19	0.6	0.8	PT <sup>1</sup> / <sub>8</sub>	32	19 400 1 980	42 000 4 250
47	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT <sup>1</sup> / <sub>8</sub>	37	28 800 2 940	61 000 6 250
52	20 <sup>0</sup> <sub>-0.021</sub>	24	25	25.5	66	40.5	M20×1.5	21	0.7	0.8	PT <sup>1</sup> / <sub>8</sub>	37	28 800 2 940	61 000 6 250
62	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT <sup>1</sup> / <sub>8</sub>	44	39 500 4 000	98 500 10 000
72	24 <sup>0</sup> <sub>-0.021</sub>	29	30	30.5	80	49.5	M24×1.5	25	0.8	0.8	PT <sup>1</sup> / <sub>8</sub>	44	39 500 4 000	98 500 10 000
80	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1.0	1	PT <sup>1</sup> / <sub>8</sub>	53	58 000 5 900	147 000 15 000
90	30 <sup>0</sup> <sub>-0.021</sub>	35	38	37	100	63	M30×1.5	32	1.0	1	PT <sup>1</sup> / <sub>8</sub>	53	58 000 5 900	147 000 15 000

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KRVU··X and KRVU··XLL types whose outside surface form is cylindrical.  
 2) The grease replenishment port is situated only in the front (in the left side face in the diagram above).



**KRVU··LL type**  
(Full-complement roller type, with seal)

### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
16~26	NIP-X30	M4×0.7 ×4R	1M 6×1 ~1M10×1.25
30~35	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5~1M16×1.5
40~90	JIS 2 (A-PT!ø)	PT!ø×7R	1M18×1.5~1M30×1.5

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø



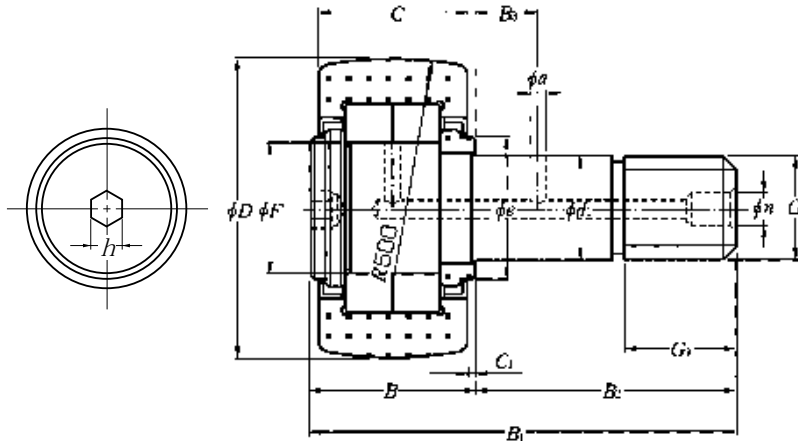
1M12

Track load capacity		Limiting speed		Maximum tightening torque	Cam Follower number				Mass	Stud dia.
N kgf	Spherical outer ring Cylindrical outer ring	min <sup>-1</sup>	Grease lubrication Oil lubrication		Without seal		With seal			
				Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings			
1 080 110	3 400 350	*13 000	*16 000	3 0.3	KRVU16/3AS	KRVU16X/3AS	KRVU16LL/3AS	KRVU16XLL/3AS	0.020	6
1 380 141	4 050 415	10 000	*13 000	8 0.8	KRVU19/3AS	KRVU19X/3AS	KRVU19LL/3AS	KRVU19XLL/3AS	0.032	8
1 690 172	5 150 525	8 500	*11 000	14 1.4	KRVU22/3AS	KRVU22X/3AS	KRVU22LL/3AS	KRVU22XLL/3AS	0.047	10
2 120 216	6 100 620	8 500	*11 000	14 1.4	KRVU26/3AS	KRVU26X/3AS	KRVU26LL/3AS	KRVU26XLL/3AS	0.061	10
2 620 267	7 700 785	6 500	8 500	20 2	KRVU30/3AS	KRVU30X/3AS	KRVU30LL/3AS	KRVU30XLL/3AS	0.089	12
2 860 291	8 200 835	6 500	8 500	20 2	KRVU32/3AS	KRVU32X/3AS	KRVU32LL/3AS	KRVU32XLL/3AS	0.100	12
3 200 325	11 900 1 220	5 500	7 000	52 5.3	KRVU35/3AS	KRVU35X/3AS	KRVU35LL/3AS	KRVU35XLL/3AS	0.172	16
3 850 390	14 500 1 480	4 500	6 000	76 7.8	KRVU40/3AS	KRVU40X/3AS	KRVU40LL/3AS	KRVU40XLL/3AS	0.252	18
4 700 480	21 000 2 150	4 000	5 000	98 10	KRVU47/3AS	KRVU47X/3AS	KRVU47LL/3AS	KRVU47XLL/3AS	0.390	20
5 550 565	23 300 2 370	4 000	5 000	98 10	KRVU52/3AS	KRVU52X/3AS	KRVU52LL/3AS	KRVU52XLL/3AS	0.465	20
6 950 710	34 500 3 500	3 300	4 500	178 18	KRVU62/3AS	KRVU62X/3AS	KRVU62LL/3AS	KRVU62XLL/3AS	0.800	24
8 050 820	38 500 3 900	3 300	4 500	178 18	KRVU72/3AS	KRVU72X/3AS	KRVU72LL/3AS	KRVU72XLL/3AS	1.05	24
9 800 1 000	53 000 5 400	2 600	3 500	360 37	KRVU80/3AS	KRVU80X/3AS	KRVU80LL/3AS	KRVU80XLL/3AS	1.56	30
11 400 1 160	59 000 6 100	2 600	3 500	360 37	KRVU90/3AS	KRVU90X/3AS	KRVU90LL/3AS	KRVU90XLL/3AS	1.97	30

Remarks: 1. The limiting speed of KRVU··LL and KRVU··XLL types incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket	Tapped hole
Without shield	Slot for screwdriver
	With shield

**NUKR··H type**  
**NUKR··XH type**

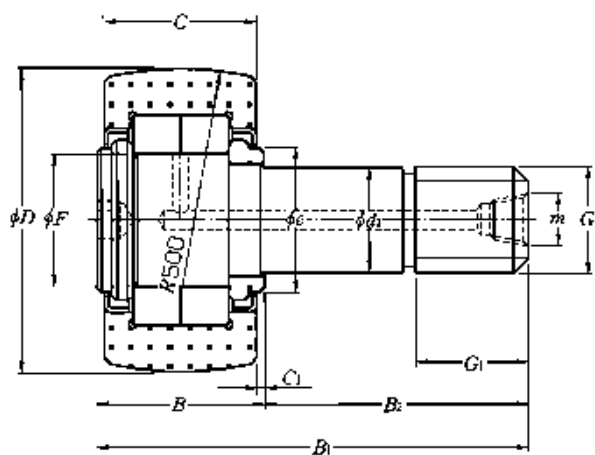


**NUKR··H type ( $D < 100\text{mm}$ )**  
**(Shielded full-complement double-row cylindrical roller type)**

**D** 30~180mm

OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Boundary dimensions mm														
	<i>d<sub>1</sub></i>	<i>C</i>	<i>F</i>	<i>B</i>	<i>B<sub>1</sub></i>	<i>B<sub>2</sub></i>	<i>G</i>	<i>G<sub>1</sub></i>	<i>B<sub>3</sub></i>	<i>C<sub>1</sub></i>	<i>n</i>	<i>m</i>	<i>a</i>	<i>e</i>	<i>h</i>
<b>30</b>	12 <sup>0</sup> <sub>-0.018</sub>	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15	6
<b>35</b>	16 <sup>0</sup> <sub>-0.018</sub>	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21	6
<b>40</b>	18 <sup>0</sup> <sub>-0.018</sub>	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23	6
<b>47</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27	8
<b>52</b>	20 <sup>0</sup> <sub>-0.021</sub>	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31	8
<b>62</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38	8
<b>72</b>	24 <sup>0</sup> <sub>-0.021</sub>	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44	8
<b>80</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8
<b>90</b>	30 <sup>0</sup> <sub>-0.021</sub>	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51	8
<b>100</b>	36 <sup>0</sup> <sub>-0.025</sub>	43	48.5	46	120	74	M36×1.5	38	—	1.5	—	PT <sup>1</sup> / <sub>8</sub>	—	53	14
<b>120</b>	42 <sup>0</sup> <sub>-0.025</sub>	50	60.5	53	140	87	M42×1.5	44	—	1.5	—	PT <sup>1</sup> / <sub>8</sub>	—	66	14
<b>140</b>	48 <sup>0</sup> <sub>-0.025</sub>	57	65	60	160	100	M48×1.5	52	—	1.5	—	PT <sup>1</sup> / <sub>8</sub>	—	72.5	14
<b>150</b>	52 <sup>0</sup> <sub>-0.030</sub>	60	75.5	63	170	107	M52×1.5	52	—	1.5	—	PT <sup>1</sup> / <sub>8</sub>	—	85.5	17
<b>160</b>	56 <sup>0</sup> <sub>-0.030</sub>	63	80.5	67	180	113	M56×3	58	—	2	—	PT <sup>1</sup> / <sub>8</sub>	—	89.5	17
<b>170</b>	60 <sup>0</sup> <sub>-0.030</sub>	66	86	70	190	120	M60×3	58	—	2	—	PT <sup>1</sup> / <sub>8</sub>	—	96.5	17
<b>180</b>	64 <sup>0</sup> <sub>-0.030</sub>	72	91.5	76	200	124	M64×3	65	—	2	—	PT <sup>1</sup> / <sub>8</sub>	—	103.5	17

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KUKR··XH types whose outside surface form is cylindrical.



NUKR·H type ( $D \geq 100\text{mm}$ )

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5
100~180	JIS 2 (A-PT!#)	—	M36×1.5~ M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



JIS 2 (A-PT!#)



SEN6

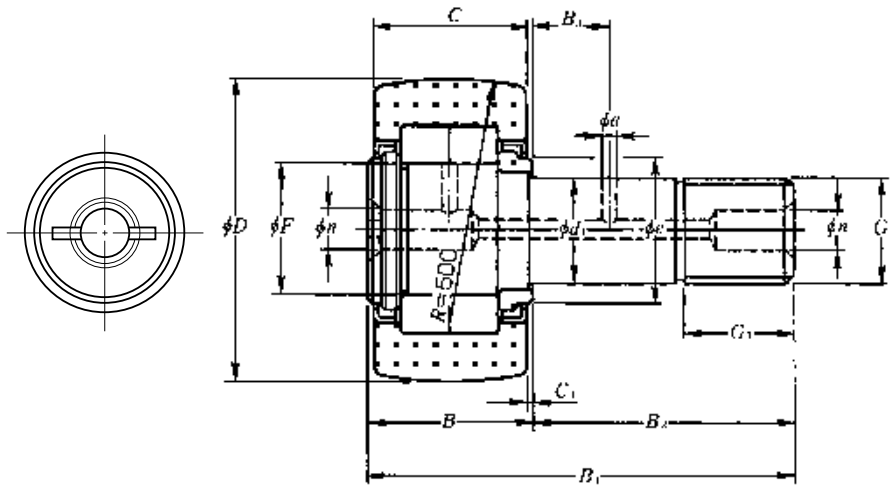


1M12

Basic load ratings		Track load capacity		Limiting speed min <sup>-1</sup>	Maximum tightening torque	Cam Follower number		Mass kg (approx.)	Stud dia. mm
dynamic N kgf	static N kgf	Spherical outer rings N kgf	Cylindrical outer rings N kgf			Spherical outer rings	Cylindrical outer rings		
$C_r$	$C_{or}$			Grease lubrication	N · m kgf · m				
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	NUKR30H/3AS	NUKR30XH/3AS	0.088	12
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	NUKR35H/3AS	NUKR35XH/3AS	0.165	16
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	NUKR40H/3AS	NUKR40XH/3AS	0.242	18
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	NUKR47H/3AS	NUKR47XH/3AS	0.380	20
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	NUKR52H/3AS	NUKR52XH/3AS	0.450	20
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	NUKR62H/3AS	NUKR62XH/3AS	0.795	24
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	NUKR72H/3AS	NUKR72XH/3AS	1.01	24
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	NUKR80H/3AS	NUKR80XH/3AS	1.54	30
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	NUKR90H/3AS	NUKR90XH/3AS	1.96	30
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	NUKR100H/3AS	NUKR100XH/3AS	3.08	36
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	NUKR120H/3AS	NUKR120XH/3AS	5.17	42
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	NUKR140H/3AS	NUKR140XH/3AS	7.98	48
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	NUKR150H/3AS	NUKR150XH/3AS	9.70	52
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	NUKR160H/3AS	NUKR160XH/3AS	11.7	56
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	NUKR170H/3AS	NUKR170XH/3AS	13.9	60
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	NUKR180H/3AS	NUKR180XH/3AS	17.0	64

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without shield		With shield	

**NUKR type**  
**NUKR··X type**

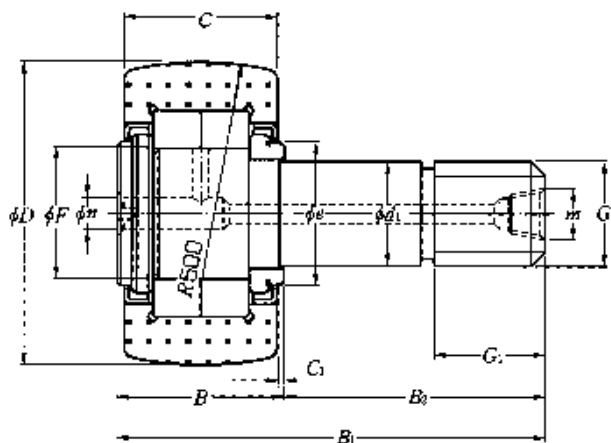


**NUKR type ( $D < 100\text{mm}$ )**  
**(Shielded full-complement double-row cylindrical roller type)**

**D** 30~180mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm													
	$d_1$	C	F	B	$B_1$	$B_2$	G	$G_1$	$B_3$	$C_1$	n	m	a	e
<b>30</b>	12 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	14	14.5	15	40	25	M12×1.5	13	6	0.6	6	—	3	15
<b>35</b>	16 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	18	19	19.5	52	32.5	M16×1.5	17	8	0.8	6	—	3	21
<b>40</b>	18 $\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	20	21.5	21.5	58	36.5	M18×1.5	19	8	0.8	6	—	3	23
<b>47</b>	20 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	24	25.5	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	27
<b>52</b>	20 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	24	30	25.5	66	40.5	M20×1.5	21	9	0.8	8	—	4	31
<b>62</b>	24 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	29	35	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	38
<b>72</b>	24 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	29	41.5	30.5	80	49.5	M24×1.5	25	11	0.8	8	—	4	44
<b>80</b>	30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51
<b>90</b>	30 $\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	35	47.5	37	100	63	M30×1.5	32	15	1	8	—	4	51
<b>100</b>	36 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$	43	48.5	46	120	74	M36×1.5	38	—	1.5	8	PT $\frac{1}{8}$	—	53
<b>120</b>	42 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$	50	60.5	53	140	87	M42×1.5	44	—	1.5	8	PT $\frac{1}{8}$	—	66
<b>140</b>	48 $\begin{smallmatrix} 0 \\ -0.025 \end{smallmatrix}$	57	65	60	160	100	M48×1.5	52	—	1.5	8	PT $\frac{1}{8}$	—	72.5
<b>150</b>	52 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$	60	75.5	63	170	107	M52×1.5	52	—	1.5	8	PT $\frac{1}{8}$	—	85.5
<b>160</b>	56 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$	63	80.5	67	180	113	M56×3	58	—	2	8	PT $\frac{1}{8}$	—	89.5
<b>170</b>	60 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$	66	86	70	190	120	M60×3	58	—	2	8	PT $\frac{1}{8}$	—	96.5
<b>180</b>	64 $\begin{smallmatrix} 0 \\ -0.030 \end{smallmatrix}$	72	91.5	76	200	124	M64×3	65	—	2	8	PT $\frac{1}{8}$	—	103.5

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter D of the outer rings of the KUKR··X types whose outside surface form is cylindrical.



NUKR type ( $D \geq 100\text{mm}$ )

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
30~40	NIP-B6	SEN3, SEN6	1M12×1.5~1M18×1.5
47~90	NIP-B8	SEN4, SEN8	1M20×1.5~1M30×1.5
100~180	JIS 2 (A-PT!#)	SEN8	M36×1.5~ M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



JIS 2 (A-PT!#)



SEN6

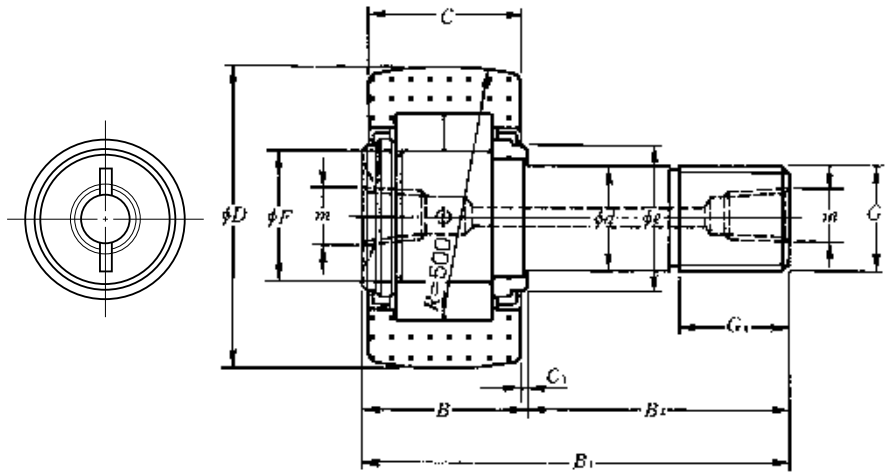


1M12

Basic load ratings		Track load capacity		Limiting speed min <sup>-1</sup>	Maximum tightening torque N·m kgf·m	Cam Follower number		Mass kg (approx.)	Stud dia. mm
dynamic C <sub>r</sub>	static C <sub>or</sub>	Spherical outer rings N kgf	Cylindrical outer rings N kgf			Spherical outer rings	Cylindrical outer rings		
13 300 1 360	13 500 1 380	2 620 267	7 700 785	6 900	20 2	NUKR 30/3AS	NUKR 30X/3AS	0.088	12
22 300 2 280	25 700 2 620	3 200 325	11 900 1 220	5 500	52 5.3	NUKR 35/3AS	NUKR 35X/3AS	0.165	16
24 100 2 450	29 100 2 970	3 850 390	14 500 1 480	4 700	76 7.8	NUKR 40/3AS	NUKR 40X/3AS	0.242	18
38 500 3 950	48 000 4 900	4 700 480	21 000 2 150	4 000	98 10	NUKR 47/3AS	NUKR 47X/3AS	0.380	20
42 500 4 350	57 500 5 850	5 550 565	23 300 2 370	3 300	98 10	NUKR 52/3AS	NUKR 52X/3AS	0.450	20
56 500 5 750	72 500 7 400	6 950 710	34 500 3 500	2 900	178 18	NUKR 62/3AS	NUKR 62X/3AS	0.795	24
62 000 6 350	85 500 8 700	8 050 820	38 500 3 900	2 400	178 18	NUKR 72/3AS	NUKR 72X/3AS	1.01	24
101 000 10 300	151 000 15 400	9 800 1 000	53 000 5 400	2 100	360 37	NUKR 80/3AS	NUKR 80X/3AS	1.54	30
101 000 10 300	151 000 15 400	11 400 1 160	59 000 6 100	2 100	360 37	NUKR 90/3AS	NUKR 90X/3AS	1.96	30
119 000 12 100	167 000 17 000	13 000 1 300	79 000 8 050	2 000	630 65	NUKR 100/3AS	NUKR 100X/3AS	3.08	36
172 000 17 600	266 000 27 100	16 400 1 670	113 000 11 500	1 700	1 020 105	NUKR 120/3AS	NUKR 120X/3AS	5.17	42
201 000 20 500	294 000 30 000	20 000 2 040	152 000 15 500	1 500	1 540 160	NUKR 140/3AS	NUKR 140X/3AS	7.98	48
258 000 26 300	380 000 39 000	22 000 2 250	173 000 17 600	1 300	1 950 200	NUKR 150/3AS	NUKR 150X/3AS	9.70	52
274 000 27 900	400 000 41 000	24 000 2 450	194 000 19 800	1 200	2 480 250	NUKR 160/3AS	NUKR 160X/3AS	11.7	56
320 000 32 500	475 000 48 500	26 000 2 650	218 000 22 200	1 100	3 030 310	NUKR 170/3AS	NUKR 170X/3AS	13.9	60
365 000 37 500	555 000 56 500	27 900 2 840	253 000 25 800	1 000	3 670 375	NUKR 180/3AS	NUKR 180X/3AS	17.0	64

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without shield		With shield	

NUKRT type  
NUKRT··X type



NUKRT type  
(Shielded full-complement double-row cylindrical roller type)

D 30~180mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm											Basic load ratings	
	<i>d</i> <sub>1</sub>	<i>C</i>	<i>F</i>	<i>B</i>	<i>B</i> <sub>1</sub>	<i>B</i> <sub>2</sub>	<i>G</i>	<i>G</i> <sub>1</sub>	<i>C</i> <sub>1</sub>	<i>m</i>	<i>e</i>	dynamic <i>C</i> <sub>r</sub>	static <i>C</i> <sub>0r</sub>
30	12 <sup>0</sup> <sub>-0.018</sub>	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	13 300 1 360	13 500 1 380
35	16 <sup>0</sup> <sub>-0.018</sub>	18	19	19.5	52	32.5	M16×1.5	17	0.8	PT <sup>1</sup> / <sub>8</sub>	21	22 300 2 280	25 700 2 620
40	18 <sup>0</sup> <sub>-0.018</sub>	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT <sup>1</sup> / <sub>8</sub>	23	24 100 2 450	29 100 2 970
47	20 <sup>0</sup> <sub>-0.021</sub>	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	27	38 500 3 950	48 000 4 900
52	20 <sup>0</sup> <sub>-0.021</sub>	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	31	42 500 4 350	57 500 5 850
62	24 <sup>0</sup> <sub>-0.021</sub>	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	38	56 500 5 750	72 500 7 400
72	24 <sup>0</sup> <sub>-0.021</sub>	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	62 000 6 350	85 500 8 700
80	30 <sup>0</sup> <sub>-0.021</sub>	35	47.5	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	51	101 000 10 300	151 000 15 400
90	30 <sup>0</sup> <sub>-0.021</sub>	35	47.5	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	51	101 000 10 300	151 000 15 400
100	36 <sup>0</sup> <sub>-0.025</sub>	43	48.5	46	120	74	M36×1.5	38	1.5	PT <sup>1</sup> / <sub>8</sub>	53	119 000 12 100	167 000 17 000
120	42 <sup>0</sup> <sub>-0.025</sub>	50	60.5	53	140	87	M42×1.5	44	1.5	PT <sup>1</sup> / <sub>8</sub>	66	172 000 17 600	266 000 27 100
140	48 <sup>0</sup> <sub>-0.025</sub>	57	65	60	160	100	M48×1.5	52	1.5	PT <sup>1</sup> / <sub>8</sub>	72.5	201 000 20 500	294 000 30 000
150	52 <sup>0</sup> <sub>-0.030</sub>	60	75.5	63	170	107	M52×1.5	52	1.5	PT <sup>1</sup> / <sub>8</sub>	85.5	258 000 26 300	380 000 39 000
160	56 <sup>0</sup> <sub>-0.030</sub>	63	80.5	67	180	113	M56×3	58	2	PT <sup>1</sup> / <sub>8</sub>	89.5	274 000 27 900	400 000 41 000
170	60 <sup>0</sup> <sub>-0.030</sub>	66	86	70	190	120	M60×3	58	2	PT <sup>1</sup> / <sub>8</sub>	96.5	320 000 32 500	475 000 48 500
180	64 <sup>0</sup> <sub>-0.030</sub>	72	91.5	76	200	124	M64×3	65	2	PT <sup>1</sup> / <sub>8</sub>	103.5	365 000 37 500	555 000 56 500

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KUKRT··X types whose outside surface form is cylindrical.

### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
30	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5
35~180	JIS 2 (A-PT!ø)	PT!ø×7R	1M16×1.5~1M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø

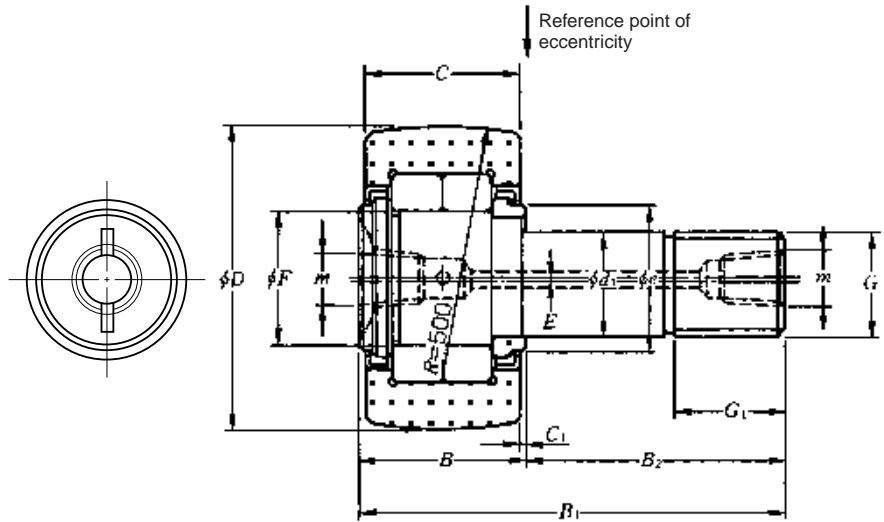


1M12

Track load capacity		Limiting speed min <sup>-1</sup>	Maximum tightening torque N·m kgf·m	Cam Follower number		Mass kg (approx.)	Stud dia. mm
Spherical outer rings	N kgf Cylindrical outer rings			Spherical outer rings	Cylindrical outer rings		
2 620 267	7 700 785	6 900	20 2	NUKRT 30/3AS	NUKRT 30X/3AS	0.088	12
3 200 325	11 900 1 220	5 500	52 5.3	NUKRT 35/3AS	NUKRT 35X/3AS	0.165	16
3 850 390	14 500 1 480	4 700	76 7.8	NUKRT 40/3AS	NUKRT 40X/3AS	0.242	18
4 700 480	21 000 2 150	4 000	98 10	NUKRT 47/3AS	NUKRT 47X/3AS	0.380	20
5 550 565	23 300 2 370	3 300	98 10	NUKRT 52/3AS	NUKRT 52X/3AS	0.450	20
6 950 710	34 500 3 500	2 900	178 18	NUKRT 62/3AS	NUKRT 62X/3AS	0.795	24
8 050 820	38 500 3 900	2 400	178 18	NUKRT 72/3AS	NUKRT 72X/3AS	1.01	24
9 800 1 000	53 000 5 400	2 100	360 37	NUKRT 80/3AS	NUKRT 80X/3AS	1.54	30
11 400 1 160	59 000 6 100	2 100	360 37	NUKRT 90/3AS	NUKRT 90X/3AS	1.96	30
13 000 1 300	79 000 8 050	2 000	630 65	NUKRT 100/3AS	NUKRT 100X/3AS	3.08	36
16 400 1 670	113 000 11 500	1 700	1 020 105	NUKRT 120/3AS	NUKRT 120X/3AS	5.17	42
20 000 2 040	152 000 15 500	1 500	1 540 160	NUKRT 140/3AS	NUKRT 140X/3AS	7.98	48
22 000 2 250	173 000 17 600	1 300	1 950 200	NUKRT 150/3AS	NUKRT 150X/3AS	9.70	52
24 000 2 450	194 000 19 800	1 200	2 480 250	NUKRT 160/3AS	NUKRT 160X/3AS	11.7	56
26 000 2 650	218 000 22 200	1 100	3 030 310	NUKRT 170/3AS	NUKRT 170X/3AS	13.9	60
27 900 2 840	253 000 25 800	1 000	3 670 375	NUKRT 180/3AS	NUKRT 180X/3AS	17.0	64

Metric series	Inch series
With cage	Full-complement roller
Hexagonal socket	Tapped hole
Slot for screwdriver	
Without shield	With shield
Eccentric stud	

**NUKRU type**  
**NUKRU··X type**



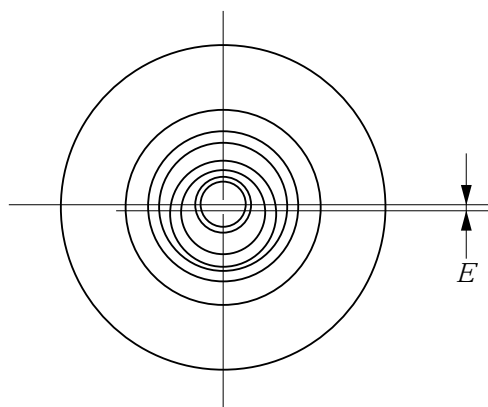
**NUKRU type**

**(Shielded full-complement double-row cylindrical roller type)**

**D** 30~180mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm													Basic load ratings	
	$d_i$	C	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	C <sub>1</sub>	m	e	Eccentricity E	dynamic C <sub>r</sub>	static C <sub>0r</sub>	
<b>30</b>	12 <sub>-0.018</sub> <sup>0</sup>	14	14.5	15	40	25	M12×1.5	13	0.6	M6×0.75	15	0.4	13 300 1 360	13 500 1 380	
<b>35</b>	16 <sub>-0.018</sub> <sup>0</sup>	18	19	19.5	52	32.5	M16×1.5	17	0.8	M6×0.75	21	0.5	22 300 2 280	25 700 2 620	
<b>40</b>	18 <sub>-0.018</sub> <sup>0</sup>	20	21.5	21.5	58	36.5	M18×1.5	19	0.8	PT <sup>1</sup> / <sub>8</sub>	23	0.6	24 100 2 450	29 100 2 970	
<b>47</b>	20 <sub>-0.021</sub> <sup>0</sup>	24	25.5	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	27	0.7	38 500 3 950	48 000 4 900	
<b>52</b>	20 <sub>-0.021</sub> <sup>0</sup>	24	30	25.5	66	40.5	M20×1.5	21	0.8	PT <sup>1</sup> / <sub>8</sub>	31	0.7	42 500 4 350	57 500 5 850	
<b>62</b>	24 <sub>-0.021</sub> <sup>0</sup>	29	35	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	38	0.8	56 500 5 750	72 500 7 400	
<b>72</b>	24 <sub>-0.021</sub> <sup>0</sup>	29	41.5	30.5	80	49.5	M24×1.5	25	0.8	PT <sup>1</sup> / <sub>8</sub>	44	1.0	62 000 6 350	85 500 8 700	
<b>80</b>	30 <sub>-0.021</sub> <sup>0</sup>	35	47.5	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	51	1.0	101 000 10 300	151 000 15 400	
<b>90</b>	30 <sub>-0.021</sub> <sup>0</sup>	35	47.5	37	100	63	M30×1.5	32	1	PT <sup>1</sup> / <sub>8</sub>	51	1.0	101 000 10 300	151 000 15 400	
<b>100</b>	36 <sub>-0.025</sub> <sup>0</sup>	43	48.5	46	120	74	M36×1.5	38	1.5	PT <sup>1</sup> / <sub>8</sub>	53	1.5	119 000 12 100	167 000 17 000	
<b>120</b>	42 <sub>-0.025</sub> <sup>0</sup>	50	60.5	53	140	87	M42×1.5	44	1.5	PT <sup>1</sup> / <sub>8</sub>	66	1.5	172 000 17 600	266 000 27 100	
<b>140</b>	48 <sub>-0.025</sub> <sup>0</sup>	57	65	60	160	100	M48×1.5	52	1.5	PT <sup>1</sup> / <sub>8</sub>	72.5	2	201 000 20 500	294 000 30 000	
<b>150</b>	52 <sub>-0.030</sub> <sup>0</sup>	60	75.5	63	170	107	M52×1.5	52	1.5	PT <sup>1</sup> / <sub>8</sub>	85.5	2	258 000 26 300	380 000 39 000	
<b>160</b>	56 <sub>-0.030</sub> <sup>0</sup>	63	80.5	67	180	113	M56×3	58	2	PT <sup>1</sup> / <sub>8</sub>	89.5	2	274 000 27 900	400 000 41 000	
<b>170</b>	60 <sub>-0.030</sub> <sup>0</sup>	66	86	70	190	120	M60×3	58	2	PT <sup>1</sup> / <sub>8</sub>	96.5	2.5	320 000 32 500	475 000 48 500	
<b>180</b>	64 <sub>-0.030</sub> <sup>0</sup>	72	91.5	76	200	124	M64×3	65	2	PT <sup>1</sup> / <sub>8</sub>	103.5	2.5	365 000 37 500	555 000 56 500	

Note 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the KUKRU··X types whose outside surface form is cylindrical.



### Accessories

Applicable bearing number	Grease nipple number	Plug with hexagonal socket number	Applicable hexagonal nut
30~35	JIS 1 (A-M6F)	M6×0.75×6R	1M12×1.5~1M16×1.5
40~180	JIS 2 (A-PT!ø)	PT!ø×7R	1M18×1.5~1M64×3

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



JIS 2 (A-PT!ø)



PT!ø

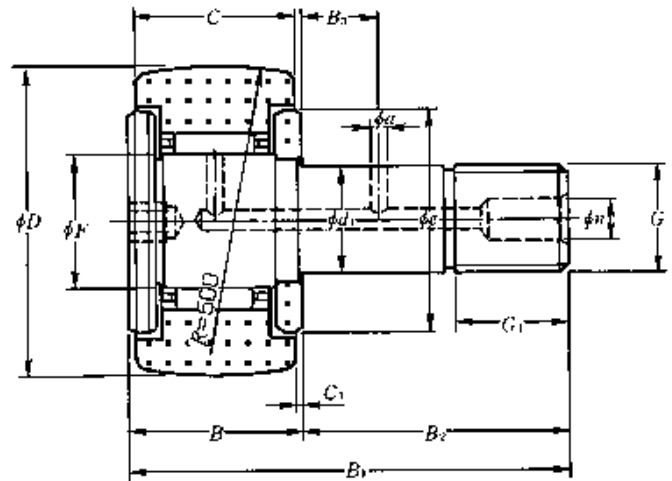
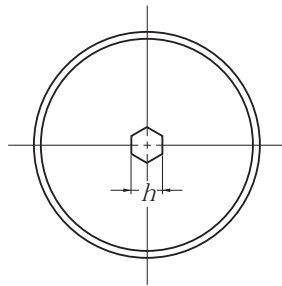


1M12

Track load capacity		Limiting speed min <sup>-1</sup>	Maximum tightening torque N·m kgf·m	Cam Follower number		Mass kg (approx.)	Stud dia. mm
Spherical outer rings	N kgf Cylindrical outer rings			Spherical outer rings	Cylindrical outer rings		
2 620 267	7 700 785	6 900	20 2	NUKRU 30/3AS	NUKRU 30X/3AS	0.088	12
3 200 325	11 900 1 220	5 500	52 5.3	NUKRU 35/3AS	NUKRU 35X/3AS	0.165	16
3 850 390	14 500 1 480	4 700	76 7.8	NUKRU 40/3AS	NUKRU 40X/3AS	0.242	18
4 700 480	21 000 2 150	4 000	98 10	NUKRU 47/3AS	NUKRU 47X/3AS	0.380	20
5 550 565	23 300 2 370	3 300	98 10	NUKRU 52/3AS	NUKRU 52X/3AS	0.450	20
6 950 710	34 500 3 500	2 900	178 18	NUKRU 62/3AS	NUKRU 62X/3AS	0.795	24
8 050 820	38 500 3 900	2 400	178 18	NUKRU 72/3AS	NUKRU 72X/3AS	1.01	24
9 800 1 000	53 000 5 400	2 100	360 37	NUKRU 80/3AS	NUKRU 80X/3AS	1.54	30
11 400 1 160	59 000 6 100	2 100	360 37	NUKRU 90/3AS	NUKRU 90X/3AS	1.96	30
13 000 1 300	79 000 8 050	2 000	630 65	NUKRU 100/3AS	NUKRU 100X/3AS	3.08	36
16 400 1 670	113 000 11 500	1 700	1 020 105	NUKRU 120/3AS	NUKRU 120X/3AS	5.17	42
20 000 2 040	152 000 15 500	1 500	1 540 160	NUKRU 140/3AS	NUKRU 140X/3AS	7.98	48
22 000 2 250	173 000 17 600	1 300	1 950 200	NUKRU 150/3AS	NUKRU 150X/3AS	9.70	52
24 000 2 450	194 000 19 800	1 200	2 480 250	NUKRU 160/3AS	NUKRU 160X/3AS	11.7	56
26 000 2 650	218 000 22 200	1 100	3 030 310	NUKRU 170/3AS	NUKRU 170X/3AS	13.9	60
27 900 2 840	253 000 25 800	1 000	3 670 375	NUKRU 180/3AS	NUKRU 180X/3AS	17.0	64

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

CR··H type  
 CR··XH type  
 CR··LLH type  
 CR··XLLH type

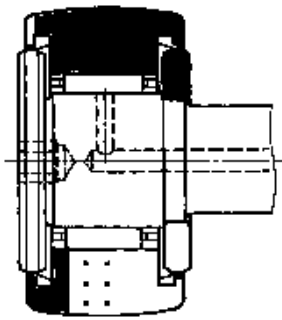


CR··H type (with cage)

D 12.700~57.150mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm														Basic load ratings	
	$d_1^{+0.025}_0$	$C_{-0.130}^0$	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	h	C <sub>r</sub>	C <sub>or</sub>
12.700 (1/2)	4.762 (3/8)	8.731 (1 1/32)	6	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	2 820 287	2 450 250
12.700 (1/2)	4.762 (3/8)	9.525 (3/8)	6	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	2 820 287	2 450 250
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	4 050 415	4 200 430
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	4 050 415	4 200 430
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	3/16	5 300 540	6 650 680
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	3/16	5 300 540	6 650 680
25.400 (1)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	1/4	7 250 740	8 350 850
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	1/4	7 250 740	8 350 850
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	11 400 1 160	15 900 1 620
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	11 400 1 160	15 900 1 620
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	5/16	13 300 1 360	20 800 2 120
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	5/16	13 300 1 360	20 800 2 120
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	20 700 2 110	33 500 3 450
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	20 700 2 110	33 500 3 450
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	42	7/16	28 900 2 950	55 000 5 600
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	42	7/16	28 900 2 950	55 000 5 600

Note 1)  $^{0}_{-0.025}$  is the dimensional tolerance of the outside diameter D of the outer rings of the CR··XH and CR··XLLH types whose outside surface form is cylindrical.



CR·LLH type (with cage, sealed)

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8,8-1	NIP-B3	SEN3	No. 10-32UNF
10,10-1	NIP-B4	SEN4	1/4-28UNF
12~18	NIP-B4	SEN3, SEN4	#8-24UNF~#1/8-20UNF
20~22	NIP-B6	SEN3, SEN6	1/2-20UNF
24~30	NIP-B6	SEN4, SEN6	#8-18UNF~#1/4-16UNF
32~36	NIP-B6	SEN5, SEN8	#8-14UNF

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



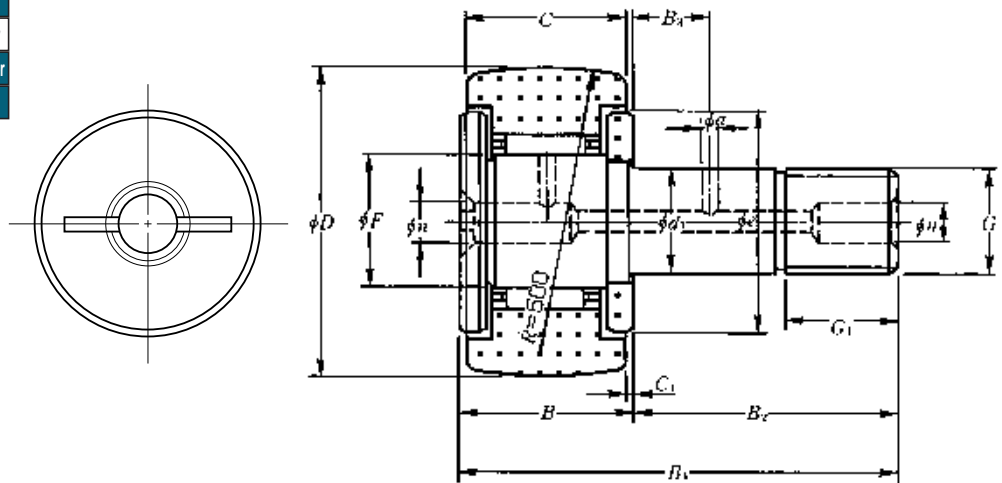
1/2-20UNF

Track load capacity N kgf		Limiting speed min <sup>-1</sup>		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer rings	Cylindrical outer rings	Grease lubrication	Oil lubrication		Without seal		With seal			
					Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
790 81	2 090 213	20 000	28 000	2 0.2	CR8T2H/3AS	CR8XT2H/3AS	—	—	0.009	4.762 (3/16)
790 81	2 310 235	20 000	28 000	2 0.2	CR8-1T2H/3AS	CR8-1XT2H/3AS	—	—	0.010	4.762 (3/16)
1 080 110	3 000 310	18 000	25 000	4 0.4	CR10H/3AS	CR10XH/3AS	—	—	0.020	6.350 (1/4)
1 080 110	3 300 335	*18 000	*25 000	4 0.4	CR10-1H/3AS	CR10-1XH/3AS	CR10-1LLH/3AS	CR10-1XLLH/3AS	0.022	6.350 (1/4)
1 380 140	4 600 470	13 000	*16 000	13 1.3	CR12H	CR12XH	CR12LLH/3AS	CR12XLLH/3AS	0.037	9.525 (3/8)
1 710 174	5 350 545	13 000	*16 000	13 1.3	CR14H	CR14XH	CR14LLH/3AS	CR14XLLH/3AS	0.048	9.525 (3/8)
2 060 210	7 400 755	12 000	15 000	18 1.9	CR16H	CR16XH	CRV16LLH/3AS	CR16XLLH/3AS	0.087	11.112 (7/16)
2 430 248	8 350 850	12 000	15 000	18 1.9	CR18H	CR18XH	CR18LLH/3AS	CR18XLLH/3AS	0.100	11.112 (7/16)
2 840 290	11 400 1 160	9 000	13 000	24 2.4	CR20H	CR20XH	CR20LLH/3AS	CR20XLLH/3AS	0.150	12.700 (1/2)
3 250 330	12 500 1 280	9 000	13 000	24 2.4	CR22H	CR22XH	CR22LLH/3AS	CR22XLLH/3AS	0.166	12.700 (1/2)
3 600 365	16 300 1 660	7 500	10 000	51 5.2	CR24H	CR24XH	CR24LLH/3AS	CR24XLLH/3AS	0.225	15.875 (5/8)
4 050 410	17 600 1 800	7 500	10 000	51 5.2	CR26H	CR26XH	CR26LLH/3AS	CR26XLLH/3AS	0.265	15.875 (5/8)
4 400 450	21 600 2 200	6 000	8 000	92 9.3	CR28H	CR28XH	CR28LLH/3AS	CR28XLLH/3AS	0.375	19.050 (3/4)
4 850 495	23 200 2 360	6 000	8 000	92 9.3	CR30H	CR30XH	CR30LLH/3AS	CR30XLLH/3AS	0.420	19.050 (3/4)
5 300 540	31 000 3 150	5 000	6 600	150 15	CR32H	CR32XH	CR32LLH/3AS	CR32XLLH/3AS	0.505	22.225 (7/8)
6 200 635	35 000 3 550	5 000	6 600	150 15	CR36H	CR36XH	CR36LLH/3AS	CR36XLLH/3AS	0.750	22.225 (7/8)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

CR type  
 CR··X type  
 CR··LL type  
 CR··XLL type

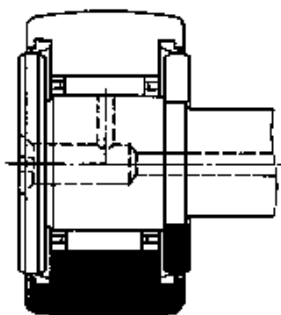


CR type (with cage)

D 12.700~57.150mm

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm													Basic load ratings	
															dynamic N kgf
12.700 (1/2)	4.762 (3/8)	8.731 (1 1/32)	6	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	3 <sup>2)</sup>	—	10	2 820 287	2 450 250
12.700 (1/2)	4.762 (3/8)	9.525 (3/8)	6	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	3 <sup>2)</sup>	—	10	2 820 287	2 450 250
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	4 <sup>2)</sup>	—	12.5	4 050 415	4 200 430
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	4 <sup>2)</sup>	—	12.5	4 050 415	4 200 430
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	12	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	16.5	5 300 540	6 650 680
25.400 (1)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	7 250 740	8 350 850
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	13	17.4	42.8	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	21	7 250 740	8 350 850
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	16	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	11 400 1 160	15 900 1 620
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	13 300 1 360	20 800 2 120
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	20	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	30	13 300 1 360	20 800 2 120
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	25	27	71.4	44.4	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	20 700 2 110	33 500 3 450
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	30	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	8	5	42	28 900 2 950	55 000 5 600

Notes 1)  $0_{-0.025}$  is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the CR··X and CR··XLL types whose outside surface form is cylindrical.  
 2) The grease port is situated only in the front (in the left side face in the diagram above).



CR·LL type (with cage, sealed)

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8,8-1	NIP-B3	SEN3	No. 10-32UNF
10,10-1	NIP-B4	SEN4	!#-28UNF
12~18	NIP-B4	SEN3. SEN4	#%-24UNF~&#%-20UNF
20~22	NIP-B6	SEN3. SEN6	!Z-20UNF
24~30	NIP-B6	SEN4. SEN6	%%-18UNF~#%-16UNF
32~36	NIP-B6	SEN5. SEN8	&#%-14UNF

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



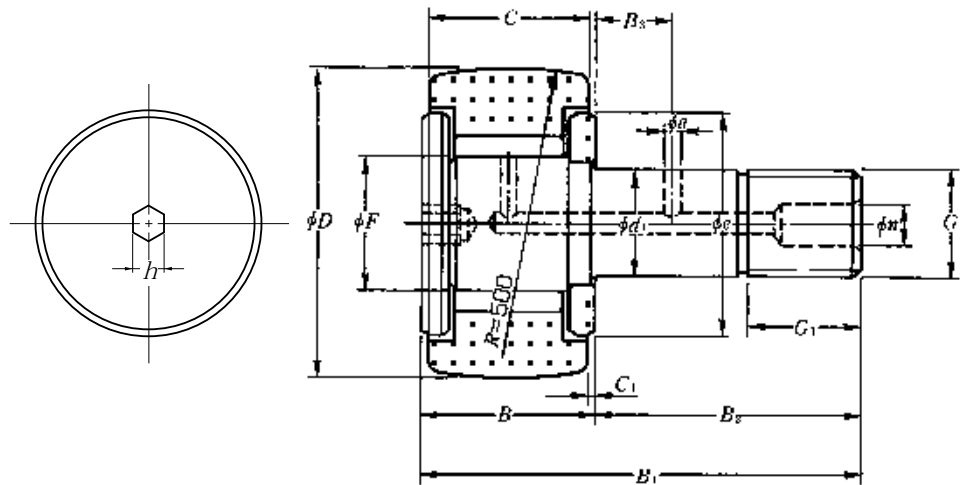
IZ-20UNF

Track load capacity N kgf		Limiting speed min <sup>-1</sup>		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer rings	Cylindrical outer rings	Grease lubrication	Oil lubrication		Without seal		With seal			
					Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
790 81	2 090 213	20 000	28 000	2 0.2	CR8T2	CR8XT2	—	—	0.009	4.762 (3/8)
790 81	2 310 235	20 000	28 000	2 0.2	CR8-1T2	CR8-1XT2	—	—	0.010	4.762 (3/8)
1 080 110	3 000 310	18 000	25 000	4 0.4	CR10	CR10X	—	—	0.020	6.350 (1/4)
1 080 110	3 300 335	*18 000	*25 000	4 0.4	CR10-1	CR10-1X	CR10-1LL/3AS	CR10-1XLL/3AS	0.022	6.350 (1/4)
1 380 140	4 600 470	13 000	*16 000	13 1.3	CR12	CR12X	CR12LL/3AS	CR12XLL/3AS	0.037	9.525 (3/8)
1 710 174	5 350 545	13 000	*16 000	13 1.3	CR14	CR14X	CR14LL/3AS	CR14XLL/3AS	0.048	9.525 (3/8)
2 060 210	7 400 755	12 000	15 000	18 1.9	CR16	CR16X	CRV16LL/3AS	CR16XLL/3AS	0.087	11.112 (7/16)
2 430 248	8 350 850	12 000	15 000	18 1.9	CR18	CR18X	CR18LL/3AS	CR18XLL/3AS	0.100	11.112 (7/16)
2 840 290	11 400 1 160	9 000	13 000	24 2.4	CR20	CR20X	CR20LL/3AS	CR20XLL/3AS	0.150	12.700 (1/2)
3 250 330	12 500 1 280	9 000	13 000	24 2.4	CR22	CR22X	CR22LL/3AS	CR22XLL/3AS	0.166	12.700 (1/2)
3 600 365	16 300 1 660	7 500	10 000	51 5.2	CR24	CR24X	CR24LL/3AS	CR24XLL/3AS	0.225	15.875 (5/8)
4 050 410	17 600 1 800	7 500	10 000	51 5.2	CR26	CR26X	CR26LL/3AS	CR26XLL/3AS	0.265	15.875 (5/8)
4 400 450	21 600 2 200	6 000	8 000	92 9.3	CR28	CR28X	CR28LL/3AS	CR28XLL/3AS	0.375	19.050 (3/4)
4 850 495	23 200 2 360	6 000	8 000	92 9.3	CR30	CR30X	CR30LL/3AS	CR30XLL/3AS	0.420	19.050 (3/4)
5 300 540	31 000 3 150	5 000	6 600	150 15	CR32	CR32X	CR32LL/3AS	CR32XLL/3AS	0.505	22.225 (7/8)
6 200 635	35 000 3 550	5 000	6 600	150 15	CR36	CR36X	CR36LL/3AS	CR36XLL/3AS	0.750	22.225 (7/8)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

CRV··H type  
 CRV··XH type  
 CRV··LLH type  
 CRV··XLLH type

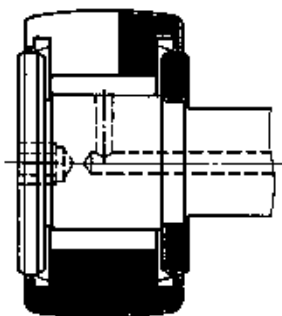


D 12.700~152.400mm

CRV··H type (Full-complement roller type)

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm														Basic load ratings	
	$d_1^{+0.025}_0$	$C_{-0.130}^0$	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	h	C <sub>r</sub>	C <sub>or</sub>
12.700 (1/2)	4.826 (-)	8.731 (1 1/32)	5.75	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	3 400 350	3 750 385
12.700 (1/2)	4.826 (-)	9.525 (3/8)	5.75	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	—	—	10	1/8	3 950 405	4 550 465
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	5 550 565	7 600 770
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	—	—	12.5	1/8	6 200 630	8 700 885
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	3/16	8 050 825	13 300 1 360
25.400 (1)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	1/4	11 700 1 190	18 900 1 920
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	1/4	17 700 1 810	35 000 3 600
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	5/16	21 100 2 150	45 500 4 650
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	5/16	28 400 2 900	60 500 6 150
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	5/16	41 000 4 200	87 500 8 950
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	5/16	41 000 4 200	87 500 8 950
63.500 (2 1/2)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200
69.850 (2 3/4)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	1/2	54 500 5 600	119 000 12 200
76.200 (3)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000
82.550 (3 1/4)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	5/8	76 500 7 800	177 000 18 000
88.900 (3 1/2)	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF	34.9	17.46	0.8	8	5	60	5/8	84 500 8 650	214 000 21 800
101.600 (4)	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF	38.1	19.05	0.8	8	5	63	3/4	106 000 10 800	244 000 24 900
127.000 (5)	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF	65.1	22.23	0.8	8	5	89	7/8	189 000 19 300	520 000 53 000
152.400 (6)	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF	76.2	25.4	0.8	8	5	110	1	260 000 26 500	675 000 68 500

Notes 1)  $0_{-0.025}$  is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the CR··X and CR··XLL types whose outside surface form is cylindrical.



**CRV·LLH type**  
**(Full-complement roller type, with seal)**

### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8~10-1	—	—	No. 10-32UNF~1/4-28UNF
12~18	NIP-B4	SEN3. SEN4	#8-24UNF~3/16-20UNF
20~22	NIP-B6	SEN3. SEN6	1/2-20UNF
24~30	NIP-B6	SEN4. SEN6	3/8-18UNF~#4-16UNF
32~44	NIP-B6	SEN5. SEN6	3/8-14UNF~1-14UNF
48~96	NIP-B8	SEN5. SEN8	1 1/4-12UNF~2 1/2-12UNF

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



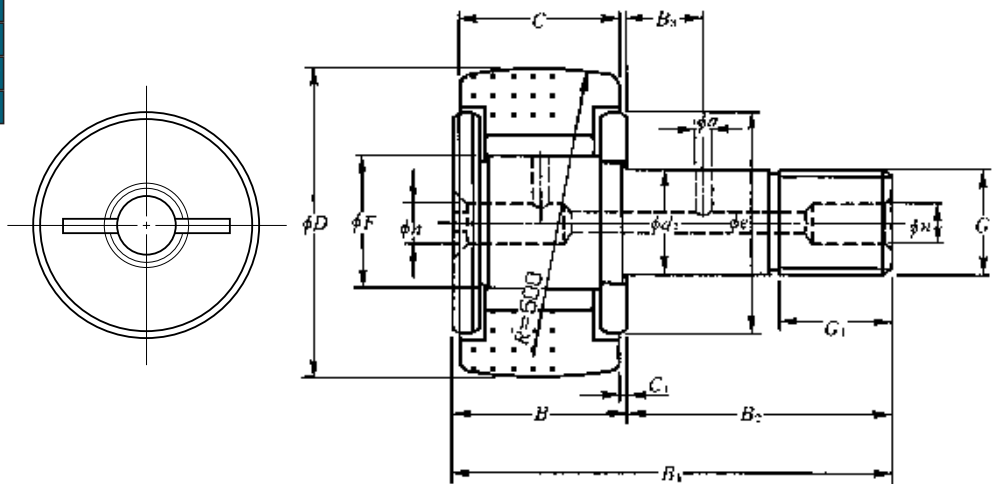
1/2-20UNF

Track load capacity N kgf		Limiting speed min <sup>-1</sup>		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer rings	Cylindrical outer rings	Grease lubrication	Oil lubrication		Without seal		With seal			
					Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
790 81	2 090 213	*17 000	*22 000	2 0.2	CRV8H/3AS	CRV8XH/3AS	CRV8LLH/3AS	CRV8XLLH/3AS	0.010	4.826 (—)
790 81	2 310 235	*17 000	*22 000	2 0.2	CRV8-1H/3AS	CRV8-1XH/3AS	CRV8-1LLH/3AS	CRV8-1XLLH/3AS	0.011	4.826 (—)
1 080 110	3 000 310	*12 000	*15 000	4 0.4	CRV10H/3AS	CRV10XH/3AS	CRV10LLH/3AS	CRV10XLLH/3AS	0.020	6.350 (1/4)
1 080 110	3 300 335	*12 000	*15 000	4 0.4	CRV10-1H/3AS	CRV10-1XH/3AS	CRV10-1LLH/3AS	CRV10-1XLLH/3AS	0.022	6.350 (1/4)
1 380 140	4 600 470	9 000	*11 000	13 1.3	CRV12H/3AS	CRV12XH/3AS	CRV12LLH/3AS	CRV12XLLH/3AS	0.038	9.525 (3/8)
1 710 174	5 350 545	9 000	*11 000	13 1.3	CRV14H/3AS	CRV14XH/3AS	CRV14LLH/3AS	CRV14XLLH/3AS	0.048	9.525 (3/8)
2 060 210	7 400 755	7 100	9 200	18 1.9	CRV16H/3AS	CRV16XH/3AS	CRV16LLH/3AS	CRV16XLLH/3AS	0.080	11.112 (7/16)
2 430 248	8 350 850	7 100	9 200	18 1.9	CRV18H/3AS	CRV18XH/3AS	CRV18LLH/3AS	CRV18XLLH/3AS	0.096	11.112 (7/16)
2 840 290	11 400 1 160	5 400	7 000	24 2.4	CRV20H/3AS	CRV20XH/3AS	CRV20LLH/3AS	CRV20XLLH/3AS	0.140	12.700 (1/2)
3 250 330	12 500 1 280	5 400	7 000	24 2.4	CRV22H/3AS	CRV22XH/3AS	CRV22LLH/3AS	CRV22XLLH/3AS	0.165	12.700 (1/2)
3 600 365	16 300 1 660	4 800	6 200	51 5.2	CRV24H/3AS	CRV24XH/3AS	CRV24LLH/3AS	CRV24XLLH/3AS	0.240	15.875 (5/8)
4 050 410	17 600 1 800	4 800	6 200	51 5.2	CRV26H/3AS	CRV26XH/3AS	CRV26LLH/3AS	CRV26XLLH/3AS	0.280	15.875 (5/8)
4 400 450	21 600 2 200	4 100	5 300	92 9.3	CRV28H/3AS	CRV28XH/3AS	CRV28LLH/3AS	CRV28XLLH/3AS	0.400	19.050 (3/4)
4 850 495	23 200 2 360	4 100	5 300	92 9.3	CRV30H/3AS	CRV30XH/3AS	CRV30LLH/3AS	CRV30XLLH/3AS	0.440	19.050 (3/4)
5 300 540	31 000 3 150	3 700	4 800	150 15	CRV32H/3AS	CRV32XH/3AS	CRV32LLH/3AS	CRV32XLLH/3AS	0.650	22.225 (7/8)
6 200 635	35 000 3 550	3 700	4 800	150 15	CRV36H/3AS	CRV36XH/3AS	CRV36LLH/3AS	CRV36XLLH/3AS	0.780	22.225 (7/8)
7 200 735	44 500 4 550	3 200	4 100	230 23	CRV40H/3AS	CRV40XH/3AS	CRV40LLH/3AS	CRV40XLLH/3AS	1.20	25.400 (1)
8 250 840	49 000 5 000	3 200	4 100	230 23	CRV44H/3AS	CRV44XH/3AS	CRV44LLH/3AS	CRV44XLLH/3AS	1.34	25.400 (1)
9 150 935	64 000 6 500	2 700	3 500	435 45	CRV48H/3AS	CRV48XH/3AS	CRV48LLH/3AS	CRV48XLLH/3AS	1.92	31.750 (1 1/4)
10 000 1 020	69 000 7 050	2 700	3 500	435 45	CRV52H/3AS	CRV52XH/3AS	CRV52LLH/3AS	CRV52XLLH/3AS	2.20	31.750 (1 1/4)
11 100 1 130	86 500 8 800	2 200	2 800	580 60	CRV56H/3AS	CRV56XH/3AS	CRV56LLH/3AS	CRV56XLLH/3AS	2.92	34.925 (1 3/8)
13 200 1 350	113 000 11 500	2 200	2 800	760 78	CRV64H/3AS	CRV64XH/3AS	CRV64LLH/3AS	CRV64XLLH/3AS	4.32	38.100 (1 1/2)
17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	CRV80H/3AS	CRV80XH/3AS	CRV80LLH/3AS	CRV80XLLH/3AS	8.80	50.800 (2)
22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	CRV96H/3AS	CRV96XH/3AS	CRV96LLH/3AS	CRV96XLLH/3AS	15.3	63.500 (2 1/2)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series		Inch series	
With cage		Full-complement roller	
Hexagonal socket	Tapped hole	Slot for screwdriver	
Without seal		With seal	

CRV type  
 CRV··X type  
 CRV··LL type  
 CRV··XLL type

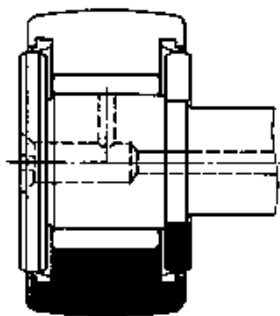


D 12.700~152.400mm

### CRV type (Full-complement roller type)

OD <sup>1)</sup> mm D 0 -0.05	Boundary dimensions mm														Basic load ratings	
	$d_1^{+0.025}_0$	$C_{-0.130}^0$	F	B	B <sub>1</sub>	B <sub>2</sub>	G	G <sub>1</sub>	B <sub>3</sub>	C <sub>1</sub>	n	a	e	C <sub>r</sub>	C <sub>or</sub>	
12.700 (1/2)	4.826 (-)	8.731 (1 1/32)	5.75	10.3	23	12.7	No.10-32UNF	6.4	—	0.8	3 <sup>2)</sup>	—	10	3 400 350	3 750 385	
12.700 (1/2)	4.826 (-)	9.525 (3/8)	5.75	11.1	27	15.9	No.10-32UNF	6.4	—	0.8	3 <sup>2)</sup>	—	10	3 950 405	4 550 465	
15.875 (5/8)	6.350 (1/4)	10.319 (13/32)	8.11	11.9	27.8	15.9	1/4-28UNF	7.9	—	0.8	4 <sup>2)</sup>	—	12.5	5 550 565	7 600 770	
15.875 (5/8)	6.350 (1/4)	11.112 (7/16)	8.11	12.7	31.8	19.1	1/4-28UNF	7.9	—	0.8	4 <sup>2)</sup>	—	12.5	6 200 630	8 700 885	
19.050 (3/4)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360	
22.225 (7/8)	9.525 (3/8)	12.700 (1/2)	11	14.3	36.5	22.2	3/8-24UNF	9.5	6.35	0.8	4	3	15.5	8 050 825	13 300 1 360	
25.400 (1)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920	
28.575 (1 1/8)	11.112 (7/16)	15.875 (5/8)	14	17.6	43	25.4	7/16-20UNF	12.7	6.35	0.8	4	3	19.5	11 700 1 190	18 900 1 920	
31.750 (1 1/4)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600	
34.925 (1 3/8)	12.700 (1/2)	19.050 (3/4)	18.47	20.6	52.4	31.8	1/2-20UNF	15.9	7.94	0.8	6	3	25	17 700 1 810	35 000 3 600	
38.100 (1 1/2)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650	
41.275 (1 5/8)	15.875 (5/8)	22.225 (7/8)	21	23.8	61.9	38.1	5/8-18UNF	19.1	9.53	0.8	6	4	27	21 100 2 150	45 500 4 650	
44.450 (1 3/4)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150	
47.625 (1 7/8)	19.050 (3/4)	25.400 (1)	24.65	26.9	71.4	44.5	3/4-16UNF	22.2	11.11	0.8	6	4	36.5	28 400 2 900	60 500 6 150	
50.800 (2)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950	
57.150 (2 1/4)	22.225 (7/8)	31.750 (1 1/4)	26.71	33.3	84.1	50.8	7/8-14UNF	25.4	12.7	0.8	6	5	36.5	41 000 4 200	87 500 8 950	
63.500 (2 1/2)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200	
69.850 (2 3/4)	25.400 (1)	38.100 (1 1/2)	31.15	39.6	96.8	57.2	1-14UNF	28.6	14.29	0.8	6	5	44	54 500 5 600	119 000 12 200	
76.200 (3)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000	
82.550 (3 1/4)	31.750 (1 1/4)	44.450 (1 3/4)	36.85	46	109.5	63.5	1 1/4-12UNF	31.8	15.88	0.8	8	5	53	76 500 7 800	177 000 18 000	
88.900 (3 1/2)	34.925 (1 3/8)	50.800 (2)	44.5	52.3	122.2	69.9	1 3/8-12UNF	34.9	17.46	0.8	8	5	60	84 500 8 650	214 000 21 800	
101.600 (4)	38.100 (1 1/2)	57.150 (2 1/4)	44.5	58.7	147.6	88.9	1 1/2-12UNF	38.1	19.05	0.8	8	5	63	106 000 10 800	244 000 24 900	
127.000 (5)	50.800 (2)	69.850 (2 3/4)	68.7	71.4	200	128.6	2-12UNF	65.1	22.23	0.8	8	5	89	189 000 19 300	520 000 53 000	
152.400 (6)	63.500 (2 1/2)	82.550 (3 1/4)	81.35	84.2	236.6	152.4	2 1/2-12UNF	76.2	25.4	0.8	8	5	110	260 000 26 500	675 000 68 500	

Notes 1)  $0_{-0.025}$  is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the CRV··X and CRV··XLL types whose outside surface form is cylindrical.  
 2) The grease port is situated only in the front (in the left side face in the diagram above).



**CRV·LL type**  
(Full-complement roller type, with seal)

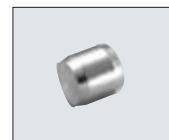
### Accessories

Applicable bearing number	Grease nipple number	Plug number	Applicable hexagonal nut
8, 8-1	NIP-B3	SEN3	No. 10-32UNF
10, 10-1	NIP-B4	SEN4	1#-28UNF
12~18	NIP-B4	SEN3, SEN4	#8-24UNF~#1/8-20UNF
20~22	NIP-B6	SEN3, SEN6	1/2-20UNF
24~30	NIP-B6	SEN4, SEN6	#8-18UNF~#1/8-16UNF
32~44	NIP-B6	SEN5, SEN6	#8-14UNF~1-14UNF
48~96	NIP-B8	SEN5, SEN8	1!#-12UNF~2!2-12UNF

Note: The boundary dimensions of grease nipples and plugs are listed in **Table 3** on page 179 and **Table 5** on page 180.



NIP-B6



SEN6



1/2-20UNF

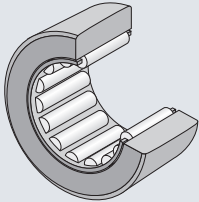
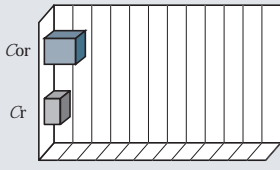
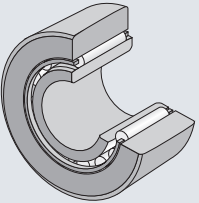
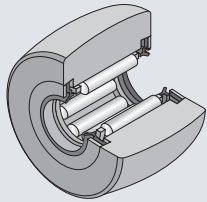
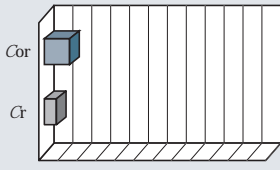
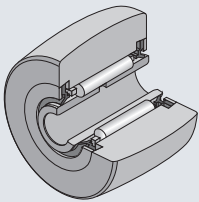
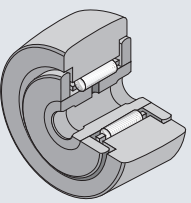
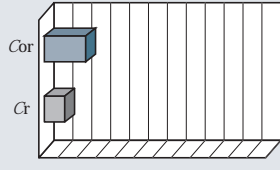
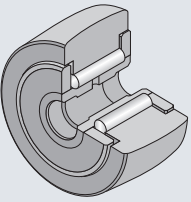
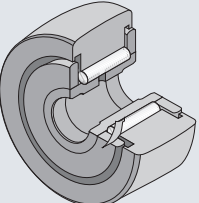
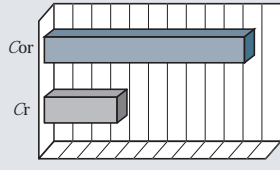
Track load capacity N kgf		Limiting speed min <sup>-1</sup>		Maximum tightening torque N·m kgf·m	Cam Follower number				Mass kg (approx.)	Stud dia. mm
Spherical outer rings	Cylindrical outer rings	Grease lubrication	Oil lubrication		Without seal		With seal			
					Spherical outer rings	Cylindrical outer rings	Spherical outer rings	Cylindrical outer rings		
790 81	2 090 213	*17 000	*22 000	2 0.2	CRV8/3AS	CRV8X/3AS	CRV8LL/3AS	CRV8XLL/3AS	0.010	4.826 (—)
790 81	2 310 235	*17 000	*22 000	2 0.2	CRV8-1/3AS	CRV8-1X/3AS	CRV8-1LL/3AS	CRV8-1XLL/3AS	0.011	4.826 (—)
1 080 110	3 000 310	*12 000	*15 000	4 0.4	CRV10/3AS	CRV10X/3AS	CRV10LL/3AS	CRV10XLL/3AS	0.020	6.350 (1/4)
1 080 110	3 300 335	*12 000	*15 000	4 0.4	CRV10-1/3AS	CRV10-1X/3AS	CRV10-1LL/3AS	CRV10-1XLL/3AS	0.022	6.350 (1/4)
1 380 140	4 600 470	9 000	*11 000	13 1.3	CRV12/3AS	CRV12X/3AS	CRV12LL/3AS	CRV12XLL/3AS	0.038	9.525 (3/8)
1 710 174	5 350 545	9 000	*11 000	13 1.3	CRV14/3AS	CRV14X/3AS	CRV14LL/3AS	CRV14XLL/3AS	0.048	9.525 (3/8)
2 060 210	7 400 755	7 100	9 200	18 1.9	CRV16/3AS	CRV16X/3AS	CRV16LL/3AS	CRV16XLL/3AS	0.080	11.112 (1/2)
2 430 248	8 350 850	7 100	9 200	18 1.9	CRV18/3AS	CRV18X/3AS	CRV18LL/3AS	CRV18XLL/3AS	0.096	11.112 (1/2)
2 840 290	11 400 1 160	5 400	7 000	24 2.4	CRV20/3AS	CRV20X/3AS	CRV20LL/3AS	CRV20XLL/3AS	0.140	12.700 (1/2)
3 250 330	12 500 1 280	5 400	7 000	24 2.4	CRV22/3AS	CRV22X/3AS	CRV22LL/3AS	CRV22XLL/3AS	0.165	12.700 (1/2)
3 600 365	16 300 1 660	4 800	6 200	51 5.2	CRV24/3AS	CRV24X/3AS	CRV24LL/3AS	CRV24XLL/3AS	0.240	15.875 (5/8)
4 050 410	17 600 1 800	4 800	6 200	51 5.2	CRV26/3AS	CRV26X/3AS	CRV26LL/3AS	CRV26XLL/3AS	0.280	15.875 (5/8)
4 400 450	21 600 2 200	4 100	5 300	92 9.3	CRV28/3AS	CRV28X/3AS	CRV28LL/3AS	CRV28XLL/3AS	0.400	19.050 (3/4)
4 850 495	23 200 2 360	4 100	5 300	92 9.3	CRV30/3AS	CRV30X/3AS	CRV30LL/3AS	CRV30XLL/3AS	0.440	19.050 (3/4)
5 300 540	31 000 3 150	3 700	4 800	150 15	CRV32/3AS	CRV32X/3AS	CRV32LL/3AS	CRV32XLL/3AS	0.650	22.225 (7/8)
6 200 635	35 000 3 550	3 700	4 800	150 15	CRV36/3AS	CRV36X/3AS	CRV36LL/3AS	CRV36XLL/3AS	0.780	22.225 (7/8)
7 200 735	44 500 4 550	3 200	4 100	230 23	CRV40/3AS	CRV40X/3AS	CRV40LL/3AS	CRV40XLL/3AS	1.20	25.400 (1)
8 250 840	49 000 5 000	3 200	4 100	230 23	CRV44/3AS	CRV44X/3AS	CRV44LL/3AS	CRV44XLL/3AS	1.34	25.400 (1)
9 150 935	64 000 6 500	2 700	3 500	435 45	CRV48/3AS	CRV48X/3AS	CRV48LL/3AS	CRV48XLL/3AS	1.92	31.750 (1 1/4)
10 000 1 020	69 000 7 050	2 700	3 500	435 45	CRV52/3AS	CRV52X/3AS	CRV52LL/3AS	CRV52XLL/3AS	2.20	31.750 (1 1/4)
11 100 1 130	86 500 8 800	2 200	2 800	580 60	CRV56/3AS	CRV56X/3AS	CRV56LL/3AS	CRV56XLL/3AS	2.92	34.925 (1 3/8)
13 200 1 350	113 000 11 500	2 200	2 800	760 78	CRV64/3AS	CRV64X/3AS	CRV64LL/3AS	CRV64XLL/3AS	4.32	38.100 (1 1/2)
17 900 1 830	165 000 16 900	1 500	1 900	1 820 190	CRV80/3AS	CRV80X/3AS	CRV80LL/3AS	CRV80XLL/3AS	8.80	50.800 (2)
22 100 2 250	240 000 24 400	1 200	1 500	3 550 360	CRV96/3AS	CRV96X/3AS	CRV96LL/3AS	CRV96XLL/3AS	15.3	63.500 (2 1/2)

Note: The limiting speed of cam followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

## Roller Followers (Yoke Type Track Rollers)

NTN Yoke Type Track Rollers are the rolling mechanisms whose outer ring rolls on a track. For example, these track rollers are applied to eccentric roller, guide roller, rocker arm roller, cam roller and pressure roller. For that, the outer ring is designed to a wall thickness so as to be resistible to high load and shock

load. Both spherical outer surface (rolling surface) and cylindrical outer surface are available for the outer ring. The spherical outer ring can withstand edge-load acting on the contact surface between the track and the track roller, while the cylindrical outer ring (Tail code: **X**) has track load capacity greater than the spherical outer ring.

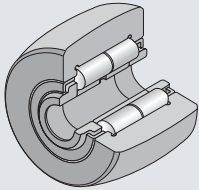
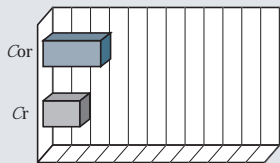
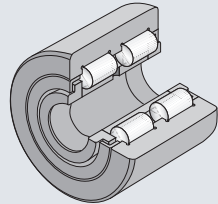
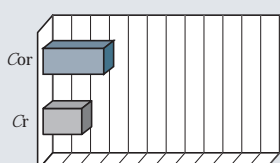
Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
<b>RNAB2</b> 	$\phi 7 - \phi 60$	 <b>NAB210</b>	<b>RNAB 2 02</b> Dimension code Dimension series code Type code
<b>NAB2</b> 	$\phi 6 - \phi 50$		<b>NAB 2 06 X</b> Suffix Dimension code Dimension series code Type code
<b>RNA22</b> 	$\phi 10 - \phi 58$	 <b>NA2210LL</b>	<b>RNA 22 / 6 LL / 3AS</b> Suffix LL: Seal 3AS: Grease Dimension code Dimension series code Type code
<b>NA22</b> 	$\phi 6 - \phi 50$		<b>NA 22 06 X LL / 3AS</b> Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Dimension series code Type code
<b>NATR</b> 	$\phi 5 - \phi 50$	 <b>NATV50</b>	<b>NATR 30 X LL / 3AS</b> Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code
<b>NATV</b> 	$\phi 5 - \phi 50$		<b>NATV 25 LL / 3AS</b> Suffix LL: Seal 3AS: Grease Dimension code Type code
<b>NACV</b> 	$\phi 6.35 - \phi 57.15$	 <b>NACV80</b>	<b>NACV 32 X LL / 3AS</b> Suffix X: Cylinder outer diameter LL: Seal 3AS: Grease Dimension code Type code

Listed load capacity values are based on basic bearing bore diameter of  $\phi 50$  ( $\phi 44.45$  for Type NACV).

Continued onto next page→

Track roller components	Features
Inscribed circle diameter: $\phi 20$ Type with cage Inner ring: w/o inner ring Outer profile: Spherical	<ul style="list-style-type: none"> <li>┆ Inner ring (NAB2 type only) is separable from outer ring, needle rollers, and cage.</li> <li>┆ The cage guides needle rollers.</li> <li>┆ Use a shaft (pin) with a flange or a thrust washer to guide the outer ring.</li> </ul>
Inscribed circle diameter: $\phi 30$ Type with cage Inner ring: w/ inner ring Outer profile: Cylindrical	<ul style="list-style-type: none"> <li>┆ The accuracy and hardness of the shaft (pin) impact the performance of the RNAB2 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (Page A-40).</li> </ul>
Inscribed circle diameter: $\phi 6$ Type with cage Inner ring: w/o inner ring Outer profile: Spherical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>┆ The needle rollers and the cage are retained in the outer ring by a steel-plate-reinforced synthetic rubber seal.</li> <li>┆ The cage guides needle rollers.</li> <li>┆ Use a shaft (pin) with a flange or a thrust washer to guide the outer ring.</li> </ul>
Inscribed circle diameter: $\phi 30$ Type with cage Inner ring: w/ inner ring Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>┆ The accuracy and hardness of the shaft (pin) impact the performance of the RNA22 type without inner ring. Please refer to the sections "Raceway surface accuracy" and "Material and hardness of raceway surface" (Page A-40).</li> </ul>
Inscribed circle diameter: $\phi 30$ Type with cage Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>┆ Needle rollers guided by cage.</li> <li>┆ Outer ring is guided in axial direction by thrust washer press-fit into inner ring.</li> <li>┆ Labyrinth is formed between the outer ring and the thrust washer.</li> </ul>
Inscribed circle diameter: $\phi 25$ Full complement roller type Outer profile: Spherical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>┆ Outer ring is guided in axial direction by thrust washer press-fit into inner ring.</li> <li>┆ High load rating due to the full complement of needle rollers.</li> </ul>
Inscribed circle diameter: $\phi 15.875$ Full complement roller type Outer profile: Cylindrical Seal: w/ seal Grease: Prefilled	<ul style="list-style-type: none"> <li>┆ Lower allowable running speed than bearing with cage.</li> <li>┆ Labyrinth is formed between the outer ring and the thrust washer.</li> </ul>

Continued from previous page

Bearing type	Applicable shaft diameter (mm)	Load capacity	Composition of bearing number
 <p><b>NUTR</b></p>	$\phi 15 - \phi 50$	 <p><b>NUTR310</b></p>	<p><b>NUTR 3 10 / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix: 3AS: Grease</li> <li>Dimension code: 10</li> <li>Dimension series code: 3</li> <li>Type code: NUTR</li> </ul>
 <p><b>NUTW</b></p>	$\phi 15 - \phi 50$	 <p><b>NUTW210</b></p>	<p><b>NUTW 2 05 X / 3AS</b></p> <ul style="list-style-type: none"> <li>Suffix: X: Cylinder outer diameter, 3AS: Grease</li> <li>Dimension code: 05</li> <li>Dimension series code: 2</li> <li>Type code: NUTW</li> </ul>

### Bearing Tolerances

The dimensional accuracy, and profile accuracy and running accuracy about the bearing bore diameter ( $d$ ), cylindrical roller outside diameter ( $D$ ), outer ring width ( $C$ ), and inner ring width ( $B$ ) of the **Types NAB2 and NA22** are as listed in **Table 4.3** in Sec. 4 “**Bearing accuracy**” (page A-26) (JIS Accuracy Class 0). The accuracies, and tolerances of assembled inner ring width ( $B$ ), and spherical outside surface diameter ( $D$ ) of the Type NACV, as well as the dimensional tolerances of roller set bore diameter ( $F_w$ ) of the **Types RNAB2 and RNA22** are listed in the relevant dimension table.

### Radial internal clearance and bearing fits

The tolerance class of a shaft to which a bearing having inner ring is installed shall be g6 (h6): when the shaft is directly used as a raceway surface (Types **RNAB2** and **RNA22**), the tolerance class of the shaft shall be k5 (k6). In general, the outer ring is not fitted in a housing. Mounting relations

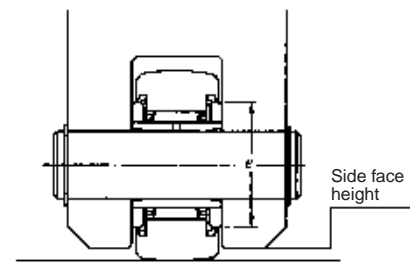
**Table 1 Radial internal clearance** Unit:  $\mu\text{m}$

Nominal roller inscribed circle dia. $F_w$ (mm)	Clearance							
	C2		Ordinary		C3		C4	
over Incl.	min	max	min	max	min	max	min	max
3 6	0	10	3	17	15	30	20	40
6 10	0	12	5	20	15	30	25	45
10 18	0	15	5	25	15	35	30	55
18 30	0	20	10	30	20	40	40	65
30 50	0	25	10	40	25	55	50	80
50 80	0	30	15	50	30	65	60	100
80 100	0	35	20	55	35	75	70	115

### Installation

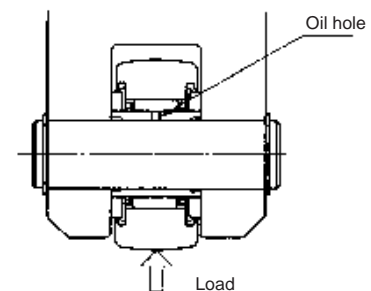
(1) The side face height in the roller follower mount must be made larger than “ $e$ ” dimension described in applicable Dimensions Table. (**Fig.1**) In mounting, chamfer the mounting surface at R as small as possible (around  $0.5 \times 45^\circ$ ) and bring the inner ring

and the end face of side plate in precise contact with one another.



**Fig.1**

(2) Where the roller follower is mounted, locate the inner ring oil hole within the non-load area (load free side). (**Fig. 2**) If the oil hole locates within the load area, it would cause shorter life.



**Fig.2**

(3) The **Types RNAB2, NAB2, RNA22** and **NA22** feature separable configuration. Their outer ring is guided by a flange or thrust washer mounted onto the shaft (pin). Therefore, the guide surface needs to be finished at quality better than that obtained from turning; also, burrs must be thoroughly removed to achieve much smoother surface. Therefore, the guide surface must be finished more precisely than by lathe-turning and deburred completely for surface

Track roller components	Features
Inscribed circle diameter : $\phi 50$ Double-row cylindrical Full-complement roller type Labyrinth seal Outer profile spherical Grease: Prefilled	<ul style="list-style-type: none"> <li>⌋ High load rating, best-suited to applications subjected to high load and shock load.</li> <li>⌋ A steel plate is press-fit into the outer ring to form a labyrinth with the side plates on both sides of the inner ring, and the side plates are held so as not to separate from one another and make a good seal.</li> <li>⌋ The inner ring and the side plates are tightened together in axial direction to prevent axial movement.</li> <li>⌋ The outer ring is guided in axial direction by the outer ring ribs and the end faces of cylindrical rollers. Type NUTW provides the following additional features.</li> </ul>
Inscribed circle diameter : $\phi 25$ Double-row cylindrical Full-complement roller type with center rib Labyrinth seal Outer profile : spherical Grease: Prefilled	<ul style="list-style-type: none"> <li>⌋ The highest load rating of all roller follower types.</li> <li>⌋ Due to the outer ring with inner rib, this type is good for axial and moment loads and runs smoothly depending on actual operating conditions.</li> <li>⌋ Good lubrication and longer life can be expected due to increase grease fill volume.</li> </ul>

smoothing. In addition, when the guide surface is not hardened the outer ring must be guided at *A*-dimension shown in Fig.3. When it is hardened, even a little smaller guide surface can be used.

During assembly of the **Types RNA22 and NA22**, be very carefully not to curl the lip of seal or damage the seal.

$$A \geq \frac{1}{2} (D + e)$$

For *D* and *e* dimensions refer to applicable Dimensions Table.

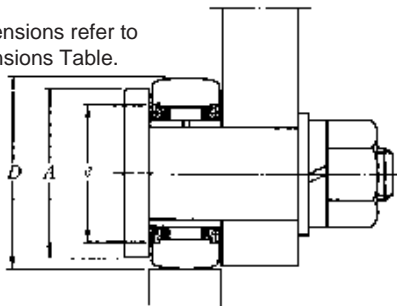


Fig.3

Lubricant feeding and replenishing into the bearing are done through an oil hole provided on the inner ring. In this case, the inner ring must be fitted so the oil hole locates within non-load area. For the full complement roller type roller followers **NATV, NACV, NUTR** and **NUTW** with no cage, it is necessary to shorten the grease replenishing interval.

Further, a roller follower with cage and without seal is not filled up with lubrication grease. When needing a follower with grease-filled cage, feel free to contact **NTN**.

Note that **NTN** offers its unique bearing products prefilled with solid grease: these bearings feature minimized of lubricant leakage.

If low dust-emission characteristics in the atmosphere is necessary, **NTN** will offer bearings prefilled with low dust-emission grease. For more information, contact **NTN**Engineering.

**The outer ring outer surface of bearing and the track surface must both be lubricated. Lack of lubrication for these surfaces can lead to premature bearing failure.**

### Track load capacity

Refer to the track load capacity data in page B-181.

### Outer ring strength

Refer to the outer ring strength data in page B-182.

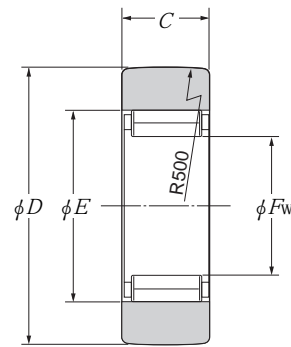
**Where any of NTN roller followers was stub-mounted, non-uniform load (bias load) could act on the bearing, inversely affected by fitting loose arising from further continued running. Good care must be exercised of such fitting loose, for stable running of the equipment.**

### Lubrication

The types having a synthetic rubber seal (suffix LL) and the full complement roller type are prefilled with lithium soap grease, thereby these bearing types can be used in a temperature range of -20 to +120°C or can be continuously used at a temperature of 100°C or lower. When a bearing is always used a temperature of 0°C or lower, use of a bearing prefilled with cold temperature grease. For more information, contact **NTN** Engineering.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

## RNAB2 type RNAB2··X type



RNAB2 type

$D$  16~90mm

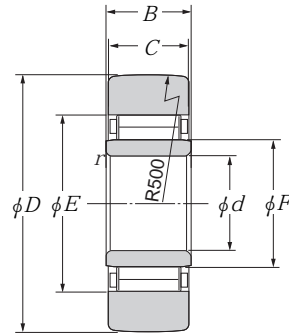
OD <sup>1)</sup> mm $D$ 0 -0.05	Dimensions mm			Basic load ratings		Track load capacity	
	$F_w$	$C$	$E$	dynamic $C_r$	static $C_{or}$	Spherical outer ring N kgf	Cylindrical outer ring N kgf
16	7 +0.022 +0.013	7.8	10	2 820 287	2 520 257	1 080 110	2 320 237
19	10 +0.022 +0.013	9.8	13	4 700 480	5 350 550	1 370 140	3 570 364
24	12 +0.027 +0.016	9.8	15	5 200 530	6 400 655	1 890 193	4 500 459
30	14 +0.027 +0.016	11.8	20	9 700 990	9 550 975	2 600 265	6 910 705
32	16 +0.027 +0.016	11.8	22	12 100 1 230	13 100 1 330	2 850 291	7 360 751
35	20 +0.033 +0.020	11.8	26	13 300 1 360	15 700 1 610	3 210 327	8 060 822
40	22 +0.033 +0.020	15.8	29	19 500 1 980	23 800 2 430	3 820 390	12 700 1 290
47	25 +0.033 +0.020	15.8	32	20 300 2 070	25 900 2 640	4 760 485	14 800 1 510
52	30 +0.033 +0.020	15.8	37	22 700 2 320	32 000 3 250	5 470 558	16 400 1 670
62	38 +0.041 +0.025	19.8	46	35 000 3 550	54 000 5 500	6 920 706	23 500 2 400
72	42 +0.041 +0.025	19.8	50	35 000 3 550	56 000 5 700	8 400 857	27 400 2 790
80	50 +0.041 +0.025	19.8	58	39 500 4 050	69 500 7 100	9 660 985	28 600 2 920
85	55 +0.049 +0.030	19.8	63	40 000 4 100	72 500 7 400	10 600 1 080	30 500 3 110
90	60 +0.049 +0.030	19.8	68	41 500 4 250	78 000 8 000	11 400 1 160	32 300 3 290

Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the RNAB2··X type whose outside surface form is cylindrical.

Limiting speed min <sup>-1</sup>		Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring		
21 000	27 000	<b>RNAB 2/5T2</b>	<b>RNAB 2/5XT2</b>	0.0085	16
15 000	20 000	<b>RNAB 2/6T2</b>	<b>RNAB 2/6XT2</b>	0.013	19
12 000	16 000	<b>RNAB 2/8</b>	<b>RNAB 2/8X</b>	0.021	24
11 000	14 000	<b>RNAB 200</b>	<b>RNAB 200X</b>	0.042	30
9 500	12 500	<b>RNAB 201</b>	<b>RNAB 201X</b>	0.049	32
7 500	10 000	<b>RNAB 202</b>	<b>RNAB 202X</b>	0.05	35
6 800	9 000	<b>RNAB 203</b>	<b>RNAB 203X</b>	0.088	40
6 000	8 000	<b>RNAB 204</b>	<b>RNAB 204X</b>	0.13	47
5 000	6 500	<b>RNAB 205</b>	<b>RNAB 205X</b>	0.15	52
4 000	5 500	<b>RNAB 206</b>	<b>RNAB 206X</b>	0.255	62
3 500	4 600	<b>RNAB 207</b>	<b>RNAB 207X</b>	0.375	72
3 000	4 000	<b>RNAB 208</b>	<b>RNAB 208X</b>	0.42	80
2 700	3 600	<b>RNAB 209</b>	<b>RNAB 209X</b>	0.435	85
2 500	3 300	<b>RNAB 210</b>	<b>RNAB 210X</b>	0.481	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

## NAB2 type NAB2··X type



NAB2 type

**D** 19~90mm

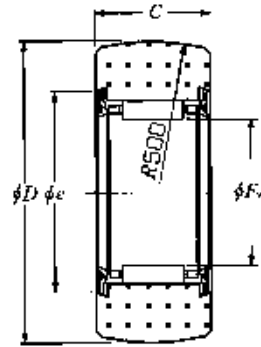
OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Dimensions mm						Basic load ratings			Track load capacity	
	<i>d</i>	<i>B</i>	<i>C</i>	<i>E</i>	<i>F</i>	<i>r</i> s min <sup>2)</sup>	dynamic <i>C<sub>r</sub></i>	N kgf	static <i>C<sub>0r</sub></i>	Spherical outer ring N kgf	Cylindrical outer ring
19	6	10	9.8	13	10	0.5	4 700 480		5 350 550	1 370 140	3 570 364
24	8	10	9.8	15	12	0.5	5 200 530		6 400 655	1 890 193	4 500 459
30	10	12	11.8	20	14	0.5	9 700 990		9 550 975	2 600 265	6 910 705
32	12	12	11.8	22	16	0.5	12 100 1 230		13 100 1 330	2 850 291	7 360 751
35	15	12	11.8	26	20	0.5	13 300 1 360		15 700 1 610	3 210 327	8 060 822
40	17	16	15.8	29	22	0.5	19 500 1 980		23 800 2 430	3 820 390	12 700 1 290
47	20	16	15.8	32	25	0.5	20 300 2 070		25 900 2 640	4 760 485	14 800 1 510
52	25	16	15.8	37	30	0.5	22 700 2 320		32 000 3 250	5 470 558	16 400 1 670
62	30	20	19.8	46	38	1	35 000 3 550		54 000 5 500	6 920 706	23 500 2 400
72	35	20	19.8	50	42	1	35 000 3 550		56 000 5 700	8 400 857	27 400 2 790
80	40	20	19.8	58	50	1.5	39 500 4 050		69 500 7 100	9 660 985	28 600 2 920
85	45	20	19.8	63	55	1.5	40 000 4 100		72 500 7 400	10 600 1080	30 500 3 110
90	50	20	19.8	68	60	1.5	41 500 4 250		78 000 8 000	11 400 1160	32 300 3 290

Notes: 1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NAB2··X type whose outside surface form is cylindrical.  
2) The minimum value of chamfer dimension *r*.

Limiting speed min <sup>-1</sup>		Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring		
15 000	20 000	<b>NAB 2/6T2</b>	<b>NAB 2/6XT2</b>	0.017	19
12 000	16 000	<b>NAB 2/8</b>	<b>NAB 2/8X</b>	0.026	24
11 000	14 000	<b>NAB 200</b>	<b>NAB 200X</b>	0.049	30
9 500	12 500	<b>NAB 201</b>	<b>NAB 201X</b>	0.057	32
7 500	10 000	<b>NAB 202</b>	<b>NAB 202X</b>	0.062	35
6 800	9 000	<b>NAB 203</b>	<b>NAB 203X</b>	0.107	40
6 000	8 000	<b>NAB 204</b>	<b>NAB 204X</b>	0.151	47
5 000	6 500	<b>NAB 205</b>	<b>NAB 205X</b>	0.174	52
4 000	5 500	<b>NAB 206</b>	<b>NAB 206X</b>	0.32	62
3 500	4 600	<b>NAB 207</b>	<b>NAB 207X</b>	0.439	72
3 000	4 000	<b>NAB 208</b>	<b>NAB 208X</b>	0.526	80
2 700	3 600	<b>NAB 209</b>	<b>NAB 209X</b>	0.551	85
2 500	3 300	<b>NAB 210</b>	<b>NAB 210X</b>	0.61	90

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

RNA22··LL type  
RNA22··XLL type



RNA22··LL type

$D$  19~90mm

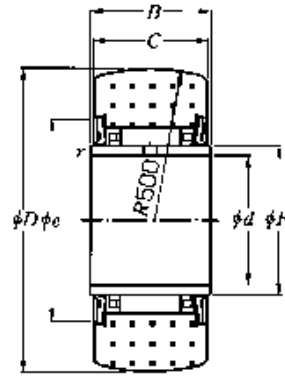
OD <sup>1)</sup> mm $D$ 0 -0.05	Dimensions mm			Basic load ratings		Track load capacity	
	$F_w$	$C$	$E$	dynamic $C_r$	static $C_{or}$	Spherical outer ring N kgf	Cylindrical outer ring N kgf
19	10 +0.022 +0.013	11.8	16	4 550 460	4 250 435	1 380 141	4 400 445
24	12 +0.027 +0.016	11.8	18	5 150 525	5 250 535	1 900 193	5 500 565
30	14 +0.027 +0.016	13.8	20	7 550 770	9 000 915	2 620 267	7 550 770
32	16 +0.027 +0.016	13.8	22	8 100 830	10 300 1 050	2 860 291	8 050 820
35	20 +0.033 +0.020	13.8	26	9 850 1 010	14 100 1 440	3 200 325	8 800 900
40	22 +0.033 +0.020	15.8	28	10 400 1 060	15 600 1 590	3 850 390	10 900 1 110
47	25 +0.033 +0.020	17.8	33	16 900 1 730	22 900 2 340	4 700 480	14 800 1 510
52	30 +0.033 +0.020	17.8	38	17 900 1 820	25 900 2 640	5 550 565	16 400 1 670
62	35 +0.041 +0.025	19.8	43	21 400 2 190	34 500 3 500	6 950 710	22 200 2 260
72	42 +0.041 +0.025	22.7	50	26 300 2 690	47 500 4 850	8 050 820	28 700 2 930
80	48 +0.041 +0.025	22.7	57	28 400 2 900	55 000 5 600	9 800 1 000	32 000 3 250
85	52 +0.049 +0.030	22.7	62	29 300 2 990	58 500 5 950	10 400 1 060	34 000 3 450
90	58 +0.049 +0.030	22.7	68	31 000 3 200	66 000 6 700	11 400 1 160	36 000 3 650

Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the RNA22··XLL type whose outside surface form is cylindrical.

Limiting speed min <sup>-1</sup>	Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
	Spherical outer ring	Cylindrical outer ring		
10 000	<b>RNA22/6LL/3AS</b>	<b>RNA22/6XLL/3AS</b>	0.018	<b>19</b>
10 000	<b>RNA22/8LL/3AS</b>	<b>RNA22/8XLL/3AS</b>	0.027	<b>24</b>
10 000	<b>RNA2200LL/3AS</b>	<b>RNA2200XLL/3AS</b>	0.052	<b>30</b>
9 500	<b>RNA2201LL/3AS</b>	<b>RNA2201XLL/3AS</b>	0.057	<b>32</b>
7 500	<b>RNA2202LL/3AS</b>	<b>RNA2202XLL/3AS</b>	0.060	<b>35</b>
7 000	<b>RNA2203LL/3AS</b>	<b>RNA2203XLL/3AS</b>	0.094	<b>40</b>
6 000	<b>RNA2204LL/3AS</b>	<b>RNA2204XLL/3AS</b>	0.152	<b>47</b>
5 000	<b>RNA2205LL/3AS</b>	<b>RNA2205XLL/3AS</b>	0.179	<b>52</b>
4 300	<b>RNA2206LL/3AS</b>	<b>RNA2206XLL/3AS</b>	0.284	<b>62</b>
3 600	<b>RNA2207LL/3AS</b>	<b>RNA2207XLL/3AS</b>	0.432	<b>72</b>
3 100	<b>RNA2208LL/3AS</b>	<b>RNA2208XLL/3AS</b>	0.530	<b>80</b>
2 900	<b>RNA2209LL/3AS</b>	<b>RNA2209XLL/3AS</b>	0.545	<b>85</b>
2 600	<b>RNA2210LL/3AS</b>	<b>RNA2210XLL/3AS</b>	0.563	<b>90</b>

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

NA22··LL type  
NA22··XLL type



NA22··LL type

$D$  19~90mm

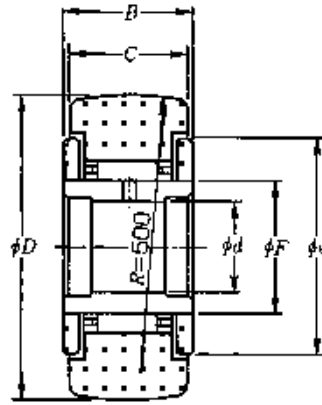
OD <sup>1)</sup> mm $D$ 0 -0.05	Dimensions mm						Basic load ratings		Track load capacity	
	$d$	$B$	$C$	$e$	$F$	$r$ (min <sup>2)</sup> )	dynamic $C_r$	static $C_{or}$	Spherical outer ring N kgf	Cylindrical outer ring N kgf
19	6	12	11.8	16	10	0.3	4 550 460	4 250 435	1 380 141	4 400 445
24	8	12	11.8	18	12	0.3	5 150 525	5 250 535	1 900 193	5 500 565
30	10	14	13.8	20	14	0.3	7 550 770	9 000 915	2 620 267	7 550 770
32	12	14	13.8	22	16	0.3	8 100 830	10 300 1 050	2 860 291	8 050 820
35	15	14	13.8	26	20	0.3	9 850 1 010	14 100 1 440	3 200 325	8 800 900
40	17	16	15.8	28	22	0.3	10 400 1 060	15 600 1 590	3 850 390	10 900 1 110
47	20	18	17.8	33	25	0.3	16 900 1 730	22 900 2 340	4 700 480	14 800 1 510
52	25	18	17.8	38	30	0.3	17 900 1 820	25 900 2 640	5 550 565	16 400 1 670
62	30	20	19.8	43	35	0.3	21 400 2 190	34 500 3 500	6 950 710	22 200 2 260
72	35	23	22.7	50	42	0.6	26 300 2 690	47 500 4 850	8 050 820	28 700 2 930
80	40	23	22.7	57	48	0.6	28 400 2 900	55 000 5 600	9 800 1 000	32 000 3 250
85	45	23	22.7	62	52	0.6	29 300 2 990	58 500 5 950	10 400 1 060	34 000 3 450
90	50	23	22.7	68	58	0.6	31 000 3 200	66 000 6 700	11 400 1 160	36 000 3 650

Notes:1) JIS Class 0 is the dimensional tolerance of the outside diameter  $D$  of the outer rings of the NA22··XLL type whose outside surface form is cylindrical.  
2) The minimum value of chamfering dimension  $r$ .

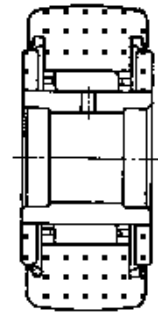
Limiting speed min <sup>-1</sup>	Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
	Spherical outer ring	Cylindrical outer ring		
10 000	<b>NA22/6LL/3AS</b>	<b>NA22/6XLL/3AS</b>	0.023	<b>19</b>
10 000	<b>NA22/8LL/3AS</b>	<b>NA22/8XLL/3AS</b>	0.035	<b>24</b>
10 000	<b>NA2200LL/3AS</b>	<b>NA2200XLL/3AS</b>	0.060	<b>30</b>
9 500	<b>NA2201LL/3AS</b>	<b>NA2201XLL/3AS</b>	0.067	<b>32</b>
7 500	<b>NA2202LL/3AS</b>	<b>NA2202XLL/3AS</b>	0.075	<b>35</b>
7 000	<b>NA2203LL/3AS</b>	<b>NA2203XLL/3AS</b>	0.113	<b>40</b>
6 000	<b>NA2204LL/3AS</b>	<b>NA2204XLL/3AS</b>	0.176	<b>47</b>
5 000	<b>NA2205LL/3AS</b>	<b>NA2205XLL/3AS</b>	0.209	<b>52</b>
4 300	<b>NA2206LL/3AS</b>	<b>NA2206XLL/3AS</b>	0.322	<b>62</b>
3 600	<b>NA2207LL/3AS</b>	<b>NA2207XLL/3AS</b>	0.506	<b>72</b>
3 100	<b>NA2208LL/3AS</b>	<b>NA2208XLL/3AS</b>	0.623	<b>80</b>
2 900	<b>NA2209LL/3AS</b>	<b>NA2209XLL/3AS</b>	0.638	<b>85</b>
2 600	<b>NA2210LL/3AS</b>	<b>NA2210XLL/3AS</b>	0.682	<b>90</b>

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

**NATR type**  
**NATR··X type**  
**NATR··LL type**  
**NATR··XLL type**



**NATR type**  
(with cage)



**NATR··LL type**  
(sealed, with cage)

**D** 16~90mm

OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Dimensions mm						Basic load ratings		Track load capacity	
	<i>d</i>	<i>B</i>	<i>C</i>	<i>e</i>	<i>F</i>	dynamic <i>C<sub>r</sub></i>	static N kgf <i>C<sub>0r</sub></i>	Spherical outer ring N kgf	Cylindrical outer ring	
<b>16</b>	5	12 <sup>0</sup> -0.180	11	12	8	4 050 415	4 200 430	1 080 110	3 400 350	
<b>19</b>	6	12 <sup>0</sup> -0.180	11	14	10	4 750 480	5 400 555	1 380 141	4 050 415	
<b>24</b>	8	15 <sup>0</sup> -0.180	14	19	12	6 900 705	7 700 785	1 900 193	6 650 680	
<b>30</b>	10	15 <sup>0</sup> -0.180	14	23	15	7 850 800	9 650 985	2 620 267	7 700 785	
<b>32</b>	12	15 <sup>0</sup> -0.180	14	25	17	8 050 820	10 300 1 050	2 860 291	8 200 835	
<b>35</b>	15	19 <sup>0</sup> -0.210	18	27	20	13 300 1 360	2 0800 2 120	3 200 325	11 900 1 220	
<b>40</b>	17	21 <sup>0</sup> -0.210	20	32	22	14 000 1 430	22 800 2 330	3 850 390	14 500 1 480	
<b>47</b>	20	25 <sup>0</sup> -0.210	24	37	25	20 700 2 110	33 500 3 450	4 700 480	21 000 2 150	
<b>52</b>	25	25 <sup>0</sup> -0.210	24	42	30	22 800 2 320	40 500 4 100	5 500 565	23 300 2 370	
<b>62</b>	30	29 <sup>0</sup> -0.210	28	51	38	36 000 3 650	66 000 6 750	6 950 710	33 000 3 350	
<b>72</b>	35	29 <sup>0</sup> -0.210	28	58	44.5	39 000 3 950	77 000 7 850	8 050 820	37 000 3 750	
<b>80</b>	40	32 <sup>0</sup> -0.250	30	66	50	49 500 5 050	92 500 9 400	9 800 1 000	44 500 4 500	
<b>85</b>	45	32 <sup>0</sup> -0.250	30	71	55	51 500 5 250	100 000 10 200	10 400 1 060	47 000 4 800	
<b>90</b>	50	32 <sup>0</sup> -0.250	30	76	60	53 000 5 450	108 000 11 000	11 400 1 160	50 000 5 100	

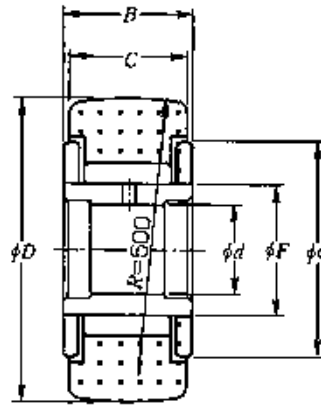
Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NATR··X and NATR··XLL types whose outside surface form is cylindrical.

Limiting speed min <sup>-1</sup>		Roller Follower number				Mass kg (approx.)	OD <sup>1)</sup> mm D 0 -0.05
Grease lubrication	Oil lubrication	Without seal		With seal			
		Spherical outer ring	Cylindrical outer ring	Spherical outer ring	Cylindrical outer ring		
*19 000	*25 000	<b>NATR5</b>	<b>NATR5X</b>	<b>NATR5LL/3AS</b>	<b>NATR5XLL/3AS</b>	0.018	<b>16</b>
*15 000	*20 000	<b>NATR6</b>	<b>NATR6X</b>	<b>NATR6LL/3AS</b>	<b>NATR6XLL/3AS</b>	0.025	<b>19</b>
*12 000	*16 000	<b>NATR8</b>	<b>NATR8X</b>	<b>NATR8LL/3AS</b>	<b>NATR8XLL/3AS</b>	0.042	<b>24</b>
10 000	*13 000	<b>NATR10</b>	<b>NATR10X</b>	<b>NATR10LL/3AS</b>	<b>NATR10XLL/3AS</b>	0.061	<b>30</b>
9 000	*12 000	<b>NATR12CT</b>	<b>NATR12XCT</b>	<b>NATR12CLLT/3AS</b>	<b>NATR12XCLLT/3AS</b>	0.069	<b>32</b>
7 500	10 000	<b>NATR15</b>	<b>NATR15X</b>	<b>NATR15LL/3AS</b>	<b>NATR15XLL/3AS</b>	0.098	<b>35</b>
7 000	9 000	<b>NATR17</b>	<b>NATR17X</b>	<b>NATR17LL/3AS</b>	<b>NATR17XLL/3AS</b>	0.140	<b>40</b>
6 000	8 000	<b>NATR20</b>	<b>NATR20X</b>	<b>NATR20LL/3AS</b>	<b>NATR20XLL/3AS</b>	0.246	<b>47</b>
5 000	6 500	<b>NATR25</b>	<b>NATR25X</b>	<b>NATR25LL/3AS</b>	<b>NATR25XLL/3AS</b>	0.275	<b>52</b>
4 000	5 500	<b>NATR30</b>	<b>NATR30X</b>	<b>NATR30LL/3AS</b>	<b>NATR30XLL/3AS</b>	0.470	<b>62</b>
3 300	4 500	<b>NATR35</b>	<b>NATR35X</b>	<b>NATR35LL/3AS</b>	<b>NATR35XLL/3AS</b>	0.635	<b>72</b>
3 000	4 000	<b>NATR40</b>	<b>NATR40X</b>	<b>NATR40LL/3AS</b>	<b>NATR40XLL/3AS</b>	0.875	<b>80</b>
2 700	3 600	<b>NATR45</b>	<b>NATR45X</b>	<b>NATR45LL/3AS</b>	<b>NATR45XLL/3AS</b>	0.910	<b>85</b>
2 500	3 300	<b>NATR50</b>	<b>NATR50X</b>	<b>NATR50LL/3AS</b>	<b>NATR50XLL/3AS</b>	0.960	<b>90</b>

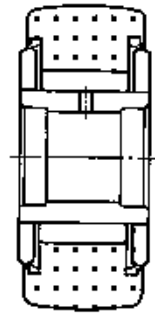
Remark: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

**NATV type**  
**NATV··X type**  
**NATV··LL type**  
**NATV··XLL type**



**NATV type**  
(Full-complement roller type)



**NATV··LL type**  
(Full-complement roller type, sealed)

**D** 16~90mm

OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Dimensions mm						Basic load ratings		Track load capacity	
	<i>d</i>	<i>B</i>	<i>C</i>	<i>e</i>	<i>F</i>	dynamic <i>C<sub>r</sub></i>	static <i>C<sub>0r</sub></i>	Spherical outer ring	Cylindrical outer ring	
16	5	12 <sup>0</sup> -0.180	11	12	8	6 500 665	9 350 955	1 080 110	3 400 350	
19	6	12 <sup>0</sup> -0.180	11	14	10	7 450 760	11 700 1 190	1 380 141	4 050 415	
24	8	15 <sup>0</sup> -0.180	14	19	12	10 700 1 090	16 200 1 650	1 900 193	6 650 680	
30	10	15 <sup>0</sup> -0.180	14	23	15	12 000 1 230	20 300 2 070	2 620 267	7 700 785	
32	12	15 <sup>0</sup> -0.180	14	25	17	13 000 1 330	23 000 2 350	2 860 291	8 200 835	
35	15	19 <sup>0</sup> -0.210	18	27	20	18 400 1 870	38 000 3 900	3 200 325	11 900 1 220	
40	17	21 <sup>0</sup> -0.210	20	32	22	19 400 1 980	42 000 4 250	3 850 390	14 500 1 480	
47	20	25 <sup>0</sup> -0.210	24	37	25	28 800 2 940	61 000 6 250	4 700 480	21 000 2 150	
52	25	25 <sup>0</sup> -0.210	24	42	30	31 500 3 200	73 500 7 500	5 500 565	23 300 2 370	
62	30	29 <sup>0</sup> -0.210	28	51	38	47 500 4 850	115 000 11 700	6 950 710	33 000 3 350	
72	35	29 <sup>0</sup> -0.210	28	58	44.5	52 000 5 300	134 000 13 600	8 050 820	37 000 3 750	
80	40	32 <sup>0</sup> -0.250	30	66	50	68 500 7 000	171 000 17 500	9 800 1 000	44 500 4 500	
90	50	32 <sup>0</sup> -0.250	30	76	60	76 000 7 750	205 000 20 900	11 400 1 160	50 000 5 100	

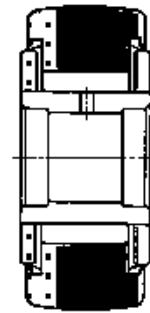
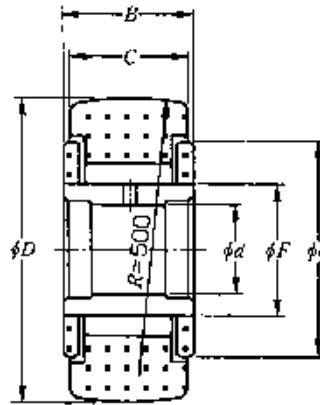
Note:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NATV··X and NATV··XLL types whose outside surface form is cylindrical.

Limiting speed min <sup>-1</sup>		Roller Follower number				Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
Grease lubrication	Oil lubrication	Without seal		With seal			
		Spherical outer ring	Cylindrical outer ring	Spherical outer ring	Cylindrical outer ring		
*13 000	*16 000	NATV5/3AS	NATV5X/3AS	NATV5LL/3AS	NATV5XLL/3AS	0.020	16
10 000	*13 000	NATV6/3AS	NATV6X/3AS	NATV6LL/3AS	NATV6XLL/3AS	0.027	19
8 500	*11 000	NATV8/3AS	NATV8X/3AS	NATV8LL/3AS	NATV8XLL/3AS	0.044	24
6 500	8 500	NATV10/3AS	NATV10X/3AS	NATV10LL/3AS	NATV10XLL/3AS	0.065	30
6 000	7 500	NATV12/3AS	NATV12X/3AS	NATV12LL/3AS	NATV12XLL/3AS	0.074	32
5 000	6 500	NATV15/3AS	NATV15X/3AS	NATV15LL/3AS	NATV15XLL/3AS	0.102	35
4 500	6 000	NATV17/3AS	NATV17X/3AS	NATV17LL/3AS	NATV17XLL/3AS	0.145	40
4 000	5 000	NATV20/3AS	NATV20X/3AS	NATV20LL/3AS	NATV20XLL/3AS	0.254	47
3 300	4 500	NATV25/3AS	NATV25X/3AS	NATV25LL/3AS	NATV25XLL/3AS	0.285	52
2 600	3 500	NATV30/3AS	NATV30X/3AS	NATV30LL/3AS	NATV30XLL/3AS	0.481	62
2 200	2 900	NATV35/3AS	NATV35X/3AS	NATV35LL/3AS	NATV35XLL/3AS	0.647	72
2 000	2 600	NATV40/3AS	NATV40X/3AS	NATV40LL/3AS	NATV40XLL/3AS	0.890	80
1 600	2 100	NATV50/3AS	NATV50X/3AS	NATV50LL/3AS	NATV50XLL/3AS	0.990	90

Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without seal	with seal

**NACV type**  
**NACV··X type**  
**NACV··LL type**  
**NACV··XLL type**



**NACV type**  
(Full-complement roller type)

**NACV··LL type**  
(Full-complement roller type, sealed)

**D** 19.050~152.400mm

OD <sup>1)</sup> mm(1/25.4mm) <i>D</i> 0 -0.05	Dimensions mm (1/25.4mm)					Basic load ratings	
	<i>d</i>	<i>B</i> <sub>0</sub> <sup>0</sup> <sub>-0.250</sub>	<i>C</i> <sub>0</sub> <sup>0</sup> <sub>-0.130</sub>	<i>e</i>	<i>F</i>	dynamic <i>C<sub>r</sub></i>	static <i>C<sub>0r</sub></i>
<b>19.050</b> (3/4)	6.350 (1/4) <sup>+0.005</sup> <sub>-0.010</sub>	14.288 (9/16)	12.700 (1/2)	15.5	11	8 050 825	13 300 1 360
<b>22.225</b> (7/8)	6.350 (1/4) <sup>+0.005</sup> <sub>-0.010</sub>	14.288 (9/16)	12.700 (1/2)	15.5	11	8 050 825	13 300 1 360
<b>25.400</b> (1)	7.938 (5/16) <sup>+0.005</sup> <sub>-0.010</sub>	17.462 (1 1/16)	15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920
<b>28.575</b> (1 1/8)	7.938 (5/16) <sup>+0.005</sup> <sub>-0.010</sub>	17.462 (1 1/16)	15.875 (5/8)	19.5	14	11 700 1 190	18 900 1 920
<b>31.750</b> (1 1/4)	9.525 (3/8) <sup>+0.005</sup> <sub>-0.010</sub>	20.638 (1 3/16)	19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600
<b>34.925</b> (1 3/8)	9.525 (3/8) <sup>+0.005</sup> <sub>-0.010</sub>	20.638 (1 3/16)	19.050 (3/4)	25	18.47	17 700 1 810	35 000 3 600
<b>38.100</b> (1 1/2)	11.112 (7/16) <sup>+0.005</sup> <sub>-0.010</sub>	23.812 (1 5/16)	22.225 (7/8)	27	21	21 100 2 150	45 500 4 650
<b>41.275</b> (1 5/8)	11.112 (7/16) <sup>+0.005</sup> <sub>-0.010</sub>	23.812 (1 5/16)	22.225 (7/8)	27	21	21 100 2 150	45 500 4 650
<b>44.450</b> (1 3/4)	12.700 (1/2) <sup>+0.005</sup> <sub>-0.010</sub>	26.988 (1 1/16)	25.400 (1)	27	24.65	28 400 2 900	60 500 6 150
<b>47.625</b> (1 7/8)	12.700 (1/2) <sup>+0.005</sup> <sub>-0.010</sub>	26.988 (1 1/16)	25.400 (1)	27	24.65	28 400 2 900	60 500 6 150
<b>50.800</b> (2)	15.875 (5/8) <sup>+0.005</sup> <sub>-0.010</sub>	33.338 (1 5/16)	31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950
<b>57.150</b> (2 1/4)	15.875 (5/8) <sup>+0.005</sup> <sub>-0.010</sub>	33.338 (1 5/16)	31.750 (1 1/4)	36.5	26.71	41 000 4 200	87 500 8 950
<b>63.500</b> (2 1/2)	19.050 (3/4) <sup>+0.005</sup> <sub>-0.010</sub>	39.688 (1 9/16)	38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200
<b>69.850</b> (2 3/4)	19.050 (3/4) <sup>+0.005</sup> <sub>-0.010</sub>	39.688 (1 9/16)	38.100 (1 1/2)	44	31.15	54 500 5 600	119 000 12 200
<b>76.200</b> (3)	25.400 (1) <sup>+0.002</sup> <sub>-0.013</sub>	46.038 (1 13/16)	44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000
<b>82.550</b> (3 1/4)	25.400 (1) <sup>+0.002</sup> <sub>-0.013</sub>	46.038 (1 13/16)	44.450 (1 3/4)	53	36.85	76 500 7 800	177 000 18 000
<b>88.900</b> (3 1/2)	28.575 (1 1/8) <sup>+0.002</sup> <sub>-0.013</sub>	52.388 (2 1/16)	50.800 (2)	60	44.5	84 500 8 650	214 000 21 800
<b>101.600</b> (4)	31.750 (1 1/4) <sup>+0.002</sup> <sub>-0.013</sub>	58.738 (2 5/16)	57.150 (2 1/4)	63	44.5	106 000 10 800	244 000 24 900
<b>127.000</b> (5)	44.450 (1 3/4) <sup>+0.002</sup> <sub>-0.013</sub>	73.025 (2 7/8)	69.850 (2 3/4)	89	68.7	189 000 19 300	520 000 53 000
<b>152.400</b> (6)	57.150 (2 1/4) <sup>+0.002</sup> <sub>-0.013</sub>	85.725 (3 3/8)	82.550 (3 1/4)	110	81.35	260 000 26 500	675 000 68 500

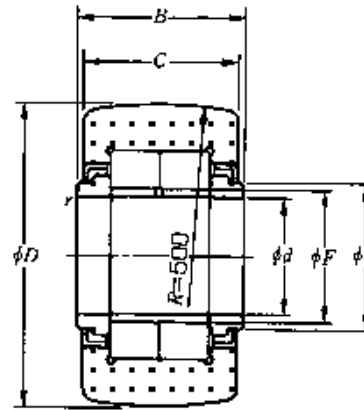
Note: 1.  $0_{-0.025}$  is the dimensional tolerance of the outside diameter *D* of the outer rings of the NACV··X and NACV··XLL types whose outside surface form is cylindrical

Track load capacity		Limiting speed		Roller Follower number				Mass kg (approx.)	OD <sup>1)</sup> mm( <sup>1</sup> / <sub>25.4</sub> mm) D 0 -0.05
N kgf		min <sup>-1</sup>		Without seal		With seal			
Spherical outer ring	Cylindrical outer ring	Grease lubrication	Oil lubrication	Spherical outer ring	Cylindrical outer ring	Spherical outer ring	Cylindrical outer ring		
1 380 140	4 600 470	9 000	*11 000	NACV12/3AS	NACV12X/3AS	NACV12LL/3AS	NACV12XLL/3AS	0.027	19.050 ( <sup>3</sup> / <sub>4</sub> )
1 710 174	5 350 545	9 000	*11 000	NACV14/3AS	NACV14X/3AS	NACV14LL/3AS	NACV14XLL/3AS	0.036	22.225 ( <sup>7</sup> / <sub>8</sub> )
2 060 210	7 400 755	7 100	9 200	NACV16/3AS	NACV16X/3AS	NACV16LL/3AS	NACV16XLL/3AS	0.059	25.400 (1)
2 430 248	8 350 850	7 100	9 200	NACV18/3AS	NACV18X/3AS	NACV18LL/3AS	NACV18XLL/3AS	0.073	28.575 (1 <sup>1</sup> / <sub>8</sub> )
2 840 290	11 400 1 160	5 400	7 000	NACV20/3AS	NACV20X/3AS	NACV20LL/3AS	NACV20XLL/3AS	0.109	31.750 (1 <sup>1</sup> / <sub>4</sub> )
3 250 330	12 500 1 280	5 400	7 000	NACV22/3AS	NACV22X/3AS	NACV22LL/3AS	NACV22XLL/3AS	0.132	34.925 (1 <sup>3</sup> / <sub>8</sub> )
3 600 365	16 300 1 660	4 800	6 200	NACV24/3AS	NACV24X/3AS	NACV24LL/3AS	NACV24XLL/3AS	0.177	38.100 (1 <sup>1</sup> / <sub>2</sub> )
4 050 410	17 600 1 800	4 800	6 200	NACV26/3AS	NACV26X/3AS	NACV26LL/3AS	NACV26XLL/3AS	0.218	41.275 (1 <sup>5</sup> / <sub>8</sub> )
4 400 450	21 600 2 200	4 100	5 300	NACV28/3AS	NACV28X/3AS	NACV28LL/3AS	NACV28XLL/3AS	0.281	44.450 (1 <sup>3</sup> / <sub>4</sub> )
4 850 495	23 200 2 360	4 100	5 300	NACV30/3AS	NACV30X/3AS	NACV30LL/3AS	NACV30XLL/3AS	0.327	47.625 (1 <sup>7</sup> / <sub>8</sub> )
5 300 540	31 000 3 150	3 700	4 800	NACV32/3AS	NACV32X/3AS	NACV32LL/3AS	NACV32XLL/3AS	0.454	50.800 (2)
6 200 635	35 000 3 550	3 700	4 800	NACV36/3AS	NACV36X/3AS	NACV36LL/3AS	NACV36XLL/3AS	0.585	57.150 (2 <sup>1</sup> / <sub>4</sub> )
7 200 735	44 500 4 550	3 200	4 100	NACV40/3AS	NACV40X/3AS	NACV40LL/3AS	NACV40XLL/3AS	0.902	63.500 (2 <sup>1</sup> / <sub>2</sub> )
8 250 840	49 000 5 000	3 200	4 100	NACV44/3AS	NACV44X/3AS	NACV44LL/3AS	NACV44XLL/3AS	1.05	69.850 (2 <sup>3</sup> / <sub>4</sub> )
9 150 935	64 000 6 500	2 700	3 500	NACV48/3AS	NACV48X/3AS	NACV48LL/3AS	NACV48XLL/3AS	1.39	76.200 (3)
10 000 1 020	69 000 7 050	2 700	3 500	NACV52/3AS	NACV52X/3AS	NACV52LL/3AS	NACV52XLL/3AS	1.66	82.550 (3 <sup>1</sup> / <sub>4</sub> )
11 100 1 130	86 000 8 800	2 200	2 800	NACV56/3AS	NACV56X/3AS	NACV56LL/3AS	NACV56XLL/3AS	2.19	88.900 (3 <sup>1</sup> / <sub>2</sub> )
13 200 1 350	112 500 11 500	2 200	2 800	NACV64/3AS	NACV64X/3AS	NACV64LL/3AS	NACV64XLL/3AS	3.22	101.600 (4)
17 900 1 830	165 500 16 900	1 500	1 900	NACV80/3AS	NACV80X/3AS	NACV80LL/3AS	NACV80XLL/3AS	6.08	127.000 (5)
22 100 2 250	239 500 24 400	1 200	1 500	NACV96/3AS	NACV96X/3AS	NACV96LL/3AS	NACV96XLL/3AS	10.0	152.400 (6)

Note: The limiting speed of roller followers incorporating a seal (those marked with an asterisk) is approximately 10,000 min<sup>-1</sup>.

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without shield	with shield

**NUTR2 type**  
**NUTR2··X type**  
**NUTR3 type**  
**NUTR3··X type**



**NUTR2 type**  
**NUTR3 type**

**D** 35~110mm

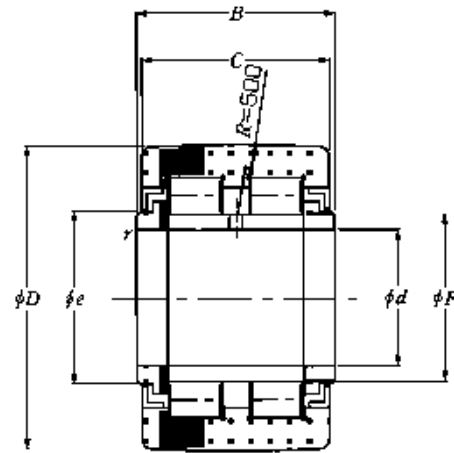
OD <sup>1)</sup> mm <i>D</i> 0 -0.05	Dimensions mm						Basic load ratings		Track load capacity		
	<i>d</i>	<i>B</i>	<i>C</i>	<i>e</i>	<i>F</i>	<i>r</i> (min <sup>2)</sup> )	dynamic <i>C<sub>r</sub></i>	static <i>C<sub>0r</sub></i>	Spherical outer ring	Cylindrical outer ring	
<b>35</b>	15	19	$0_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620	3 200 325	11 900 1 220
	<b>40</b>	17	21	$0_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970	3 850 390
<b>42</b>	15	19	$0_{-0.210}$	18	20	19	0.3	22 300 2 280	25 700 2 620	4 100 415	14 300 1 460
	<b>47</b>	17	21	$0_{-0.210}$	20	22	21.5	0.3	24 100 2 450	29 100 2 970	4 700 480
<b>52</b>		20	25	$0_{-0.210}$	24	27	25.5	0.3	38 500 3 950	48 000 4 900	4 700 480
	<b>52</b>	25	25	$0_{-0.210}$	24	31	30	0.3	38 500 3 950	48 000 4 900	5 550 565
<b>62</b>		25	25	$0_{-0.210}$	24	31	30	0.3	42 500 4 350	57 500 5 850	6 950 710
	<b>62</b>	30	29	$0_{-0.210}$	28	38	35	0.3	56 500 5 750	72 500 7 400	6 950 710
<b>72</b>		30	29	$0_{-0.210}$	28	38	35	0.3	56 500 5 750	72 500 7 400	8 050 820
	<b>72</b>	35	29	$0_{-0.210}$	28	44	41.5	0.6	62 000 6 350	85 500 8 700	8 050 820
<b>80</b>		35	29	$0_{-0.210}$	28	44	41.5	0.6	62 000 6 350	85 500 8 700	9 800 1 000
	<b>80</b>	40	32	$0_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700	9 800 1 000
<b>85</b>		45	32	$0_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000	10 400 1 060
	<b>90</b>	40	32	$0_{-0.250}$	30	51	47.5	0.6	87 000 8 850	125 000 12 700	11 400 1 160
<b>90</b>		50	32	$0_{-0.250}$	30	60	57	0.6	96 500 9 800	150 000 15 300	11 400 1 160
	<b>100</b>	45	32	$0_{-0.250}$	30	55	52.5	0.6	92 000 9 350	137 000 14 000	13 000 1 330
<b>110</b>		50	32	$0_{-0.250}$	30	60	57	0.6	96 500 9 800	150 000 15 300	14 700 1 500

Notes:1) JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the NUTR2··X and NUTR3··X types whose outside surface form is cylindrical.  
 2) The minimum value of chamfer dimension *r*.

Limiting speed min <sup>-1</sup>	Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
	Spherical outer ring	Cylindrical outer ring		
5 500	<b>NUTR202/3AS</b>	<b>NUTR202X/3AS</b>	0.100	<b>35</b>
4 700	<b>NUTR203/3AS</b>	<b>NUTR203X/3AS</b>	0.147	<b>40</b>
5 500	<b>NUTR302/3AS</b>	<b>NUTR302X/3AS</b>	0.160	<b>42</b>
4 700	<b>NUTR303/3AS</b>	<b>NUTR303X/3AS</b>	0.222	<b>47</b>
4 000	<b>NUTR204/3AS</b>	<b>NUTR204X/3AS</b>	0.245	
4 000	<b>NUTR304/3AS</b>	<b>NUTR304X/3AS</b>	0.321	<b>52</b>
3 300	<b>NUTR205/3AS</b>	<b>NUTR205X/3AS</b>	0.281	
3 300	<b>NUTR305/3AS</b>	<b>NUTR305X/3AS</b>	0.450	<b>62</b>
2 900	<b>NUTR206/3AS</b>	<b>NUTR206X/3AS</b>	0.466	
2 900	<b>NUTR306/3AS</b>	<b>NUTR306X/3AS</b>	0.697	<b>72</b>
2 400	<b>NUTR207/3AS</b>	<b>NUTR207X/3AS</b>	0.630	
2 400	<b>NUTR307/3AS</b>	<b>NUTR307X/3AS</b>	0.840	<b>80</b>
2 100	<b>NUTR208/3AS</b>	<b>NUTR208X/3AS</b>	0.817	
1 900	<b>NUTR209/3AS</b>	<b>NUTR209X/3AS</b>	0.883	<b>85</b>
2 100	<b>NUTR308/3AS</b>	<b>NUTR308X/3AS</b>	1.13	<b>90</b>
1 800	<b>NUTR210/3AS</b>	<b>NUTR210X/3AS</b>	0.950	
1 900	<b>NUTR309/3AS</b>	<b>NUTR309X/3AS</b>	1.40	<b>100</b>
1 800	<b>NUTR310/3AS</b>	<b>NUTR310X/3AS</b>	1.69	<b>110</b>

Metric series	Inch series
with cage	Full-complement roller
without inner ring	with inner ring
without shield	with shield

NUTW type  
NUTW··X type



NUTW2 type

D 35~90mm

OD <sup>1)</sup> mm D 0 -0.05	Dimensions mm						Basic load ratings		Track load capacity	
	d	B	C	e	F	r's min <sup>2)</sup>	dynamic C <sub>r</sub>	static C <sub>0r</sub>	Spherical outer ring N kgf	Cylindrical outer ring N kgf
35	15	22 <sub>-0.210</sub> <sup>0</sup>	21	20	19	0.3	24 100 2 460	28 300 2 880	3 200 325	14 200 1 450
40	17	24 <sub>-0.210</sub> <sup>0</sup>	23	22	21.5	0.3	26 000 2 650	32 000 3 250	3 850 390	17 100 1 740
47	20	29 <sub>-0.210</sub> <sup>0</sup>	28	27	25.5	0.3	40 500 4 150	51 500 5 250	4 700 480	25 100 2 560
52	25	29 <sub>-0.210</sub> <sup>0</sup>	28	31	30	0.3	45 000 4 600	61 500 6 250	5 550 565	27 700 2 830
62	30	35 <sub>-0.210</sub> <sup>0</sup>	34	38	35	0.3	59 500 6 050	77 000 7 900	6 950 710	41 000 4 200
72	35	35 <sub>-0.210</sub> <sup>0</sup>	34	44	41.5	0.6	65 000 6 650	91 000 9 250	8 050 820	46 000 4 700
80	40	38 <sub>-0.250</sub> <sup>0</sup>	36	51	47.5	0.6	90 500 9 250	131 000 13 400	9 800 1 000	54 500 5 550
85	45	38 <sub>-0.250</sub> <sup>0</sup>	36	55	52.5	0.6	95 500 9 750	144 000 14 700	10 400 1 060	58 000 5 900
90	50	38 <sub>-0.250</sub> <sup>0</sup>	36	60	57	0.6	100 000 10 200	158 000 16 100	11 400 1 160	61 500 6 250

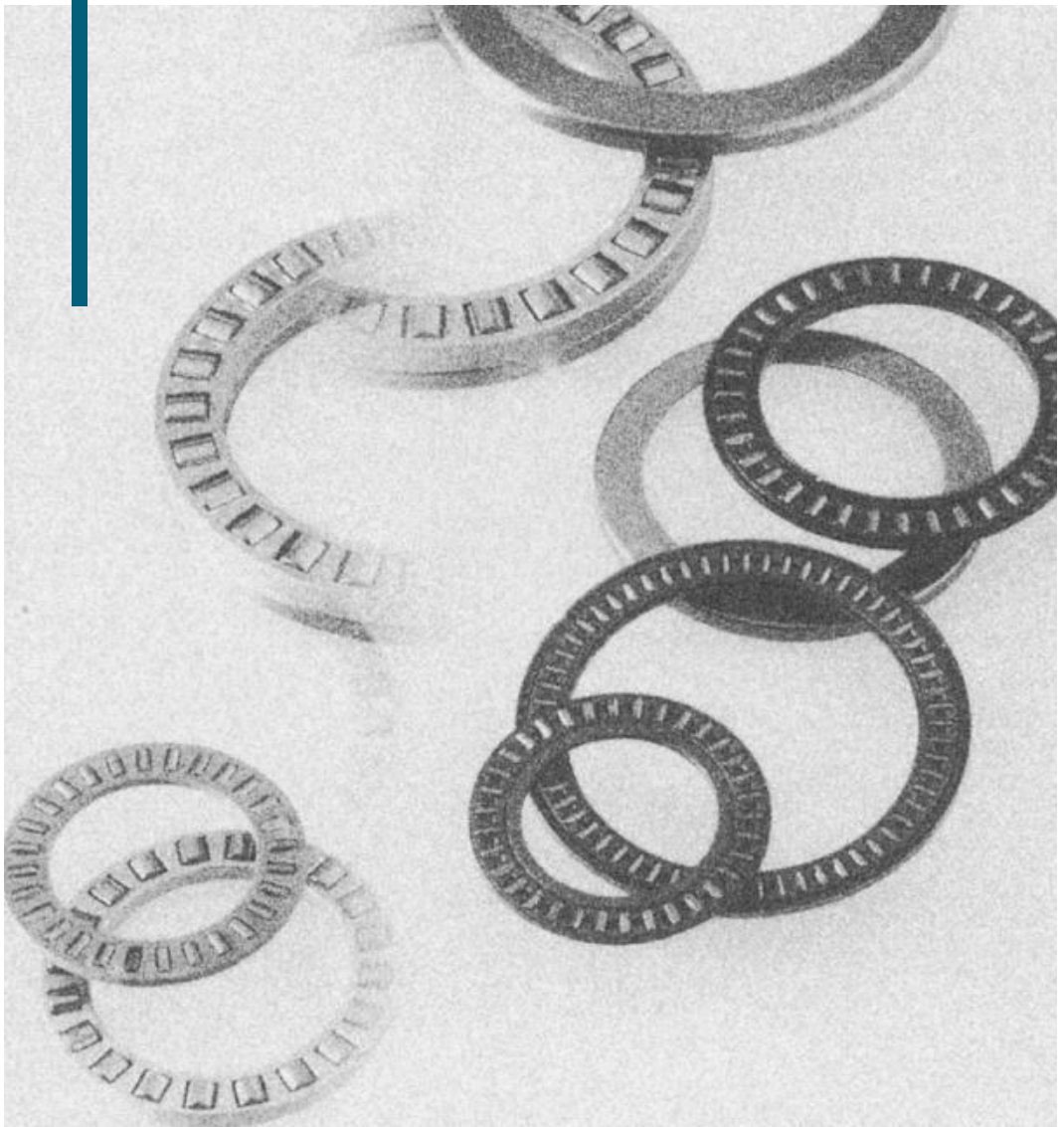
Notes:1) The bearing numbers of bearings whose outer ring surface is cylindrical have the suffix "X" JIS Class 0 is the dimensional tolerance of the outside diameter *D* of the outer rings of the bearings whose outside surface form is cylindrical. Example: NUTW203X

2) The minimum value of chamfer dimension *r*.

Limiting speed min <sup>-1</sup>	Roller Follower number		Mass kg (approx.)	OD <sup>1)</sup> mm <i>D</i> 0 -0.05
	Spherical outer ring	Cylindrical outer ring		
5500	<b>NUTW202/3AS</b>	<b>NUTW202X/3AS</b>	0.115	<b>35</b>
4700	<b>NUTW203/3AS</b>	<b>NUTW203X/3AS</b>	0.167	<b>40</b>
4000	<b>NUTW204/3AS</b>	<b>NUTW204X/3AS</b>	0.280	<b>47</b>
3300	<b>NUTW205/3AS</b>	<b>NUTW205X/3AS</b>	0.322	<b>52</b>
2900	<b>NUTW206/3AS</b>	<b>NUTW206X/3AS</b>	0.549	<b>62</b>
2400	<b>NUTW207/3AS</b>	<b>NUTW207X/3AS</b>	0.747	<b>72</b>
2100	<b>NUTW208/3AS</b>	<b>NUTW208X/3AS</b>	0.953	<b>80</b>
1900	<b>NUTW209/3AS</b>	<b>NUTW209X/3AS</b>	1.03	<b>85</b>
1800	<b>NUTW210/3AS</b>	<b>NUTW210X/3AS</b>	1.11	<b>90</b>



# Thrust Roller Bearings



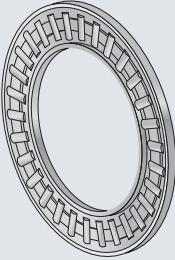
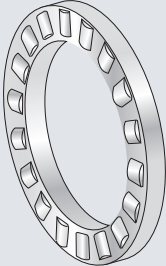
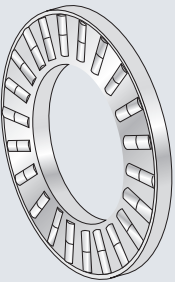
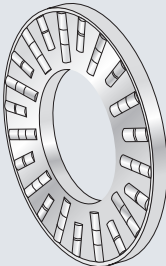
## Thrust Roller Bearings

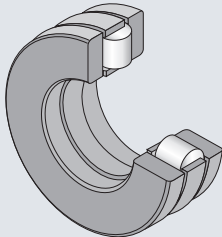
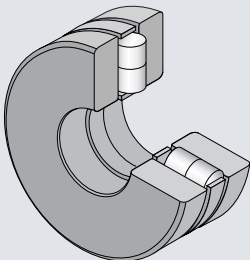
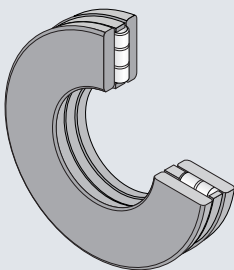
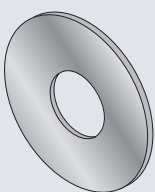
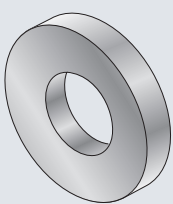
This thrust roller bearing composed of a thrust roller and cage assembly, wherein needle rollers or cylindrical rollers are configured radially in the cage, and a bearing ring of disc form is intended to support one-directional axial load.

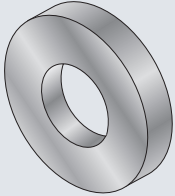
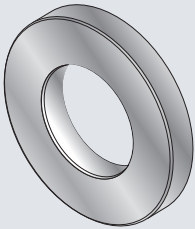
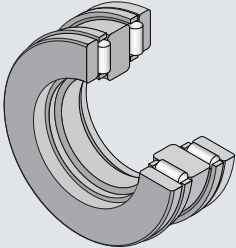
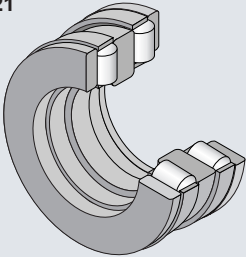
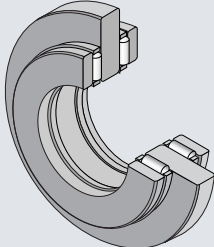
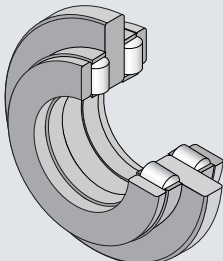
In mounting, it is possible to use a shaft or a housing as the direct raceway surface without using the bearing

ring, whereby design of a low height and lightweight compact construction is enabled.

This type of thrust roller bearing results in slipping on raceway surface because theoretically it can't roll perfectly, but in most cases it is practically trouble-free and can rotate at comparatively high speed.

Bearing type	Cage type	Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
<b>AXK</b> 	Pressed steel cage	$\phi 10 - \phi 120$	<b>AXK 11 04</b> ——— Bore diameter code ——— Dimension series code ——— Type code	<b>AXK1104</b>	The type can be used together with the Type AS bearing ring with the lower limit of safety factor $S_0$ is 3
	High strength brass cage	$\phi 130 - \phi 160$			
<b>K811 K812</b> 	Standard type Polyamide resin cage	<b>Type K811</b> $\phi 10 - \phi 120$ <b>Type K812</b> $\phi 30 - \phi 80$	<b>K8 11 10 T2</b> ——— Suffix ——— Bore diameter code ——— Dimension series code ——— Type code	<b>K81110T2</b>	The suffix T2 means that this bearing uses a polyamide resin cage. Therefore, use this bearing at a temperature 120°C or lower; or at 100°C or lower for continuous operation.  Feel free to contact NTN for the detail of the pressed steel cage.  Possible to use in combination with GS and WS bearing rings.  K811 conforms to the Dimension Series 11 specified in JIS B 1512.  K812 conforms to the Dimension Series 12 specified in JIS B 1512.
	Aluminum alloy cage	<b>Type K811</b> $\phi 130 - \phi 160$ <b>Type K812</b> $\phi 85 - \phi 140$			
	Pressed steel cage	$\phi 10 - \phi 90$			
<b>K893</b> 	Aluminum alloy cage	$\phi 30 - \phi 110$	<b>K8 93 10</b> ——— Bore diameter code ——— Dimension series code ——— Type code	<b>K89310</b>	K893 conforms to the Dimension Series 93 specified in JIS B 1512.
<b>K874</b> 	Aluminum alloy cage	$\phi 40 - \phi 90$	<b>K8 74 10</b> ——— Bore diameter code ——— Dimension series code ——— Type code	<b>K87410</b>	K874 conforms to the Dimension Series 74 specified in JIS B 1512.

Bearing type		Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
<p>811 812</p> 		$\phi 10 - \phi 160$	<p><b>8 11 10 T2</b></p> <ul style="list-style-type: none"> <li>8: Type code</li> <li>11: Dimension series code</li> <li>10: Bore diameter code</li> <li>T2: Suffix</li> </ul> <p>[Suffix] T2: resin cage J: Punched steel plate cage</p>	<b>81110T2</b>	<p>The suffix T2 means that this bearing uses a polyamide resin cage. Therefore, use this bearing at a temperature 120°C or lower; or at 100°C or lower for continuous operation.</p> <p>WS and GS bearing rings are used in set.</p> <p>811 conforms to the Dimension Series 11 specified in JIS B 1512.</p> <p>812 conforms to the Dimension Series 12 specified in JIS B 1512.</p>
<p>893</p> 		$\phi 30 - \phi 110$	<p><b>8 93 10</b></p> <ul style="list-style-type: none"> <li>8: Type code</li> <li>93: Dimension series code</li> <li>10: Bore diameter code</li> </ul>	<b>89310</b>	<p>WS and GS bearing rings are used in set.</p> <p>893 conforms to the Dimension Series 93 specified in JIS B 1512.</p>
<p>874</p> 		$\phi 40 - \phi 90$	<p><b>8 74 10</b></p> <ul style="list-style-type: none"> <li>8: Type code</li> <li>74: Dimension series code</li> <li>10: Bore diameter code</li> </ul>	<b>87410</b>	<p>WS and GS bearing rings are used in set.</p> <p>874 conforms to the Dimension Series 74 specified in JIS B 1512.</p>
<p>AS</p>  <p>Pressed steel ring</p>		$\phi 10 - \phi 160$	<p><b>AS 11 04</b></p> <ul style="list-style-type: none"> <li>AS: Type code</li> <li>11: Dimension series code</li> <li>04: Bore diameter code</li> </ul>	<b>AS1104</b>	<p>Because of its 1mm thick steel plate ring, this thrust bearing needs adequate rigidity and profile accuracy of machine parts adjacent to the bearing.</p> <p>As an individual, on occasion this thrust bearing results in slight camber, but it is flattened when specific thrust load acts thereon, having no problem in practical use.</p> <p>The lower limit of safety factor <math>S_0</math> is 3.</p>
<p>WS811 WS893 WS812 WS874</p>  <p>Machined type, for inner ring land riding</p>		$\phi 10 - \phi 160$	<p><b>WS8 11 04</b></p> <ul style="list-style-type: none"> <li>WS8: Type code</li> <li>11: Dimension series code</li> <li>04: Bore diameter code</li> </ul>	<b>WS81104</b>	<p>Higher rigidity and higher running accuracy than AS bearing ring .</p>

Bearing type		Applicable shaft diameter (mm)	Composition of bearing number	Bearing number	Remarks
GS811 GS893 GS812 GS874 	Machined type, for outer ring land riding	$\phi 10 - \phi 160$	GS8 11 04 ————  ————  Bore diameter ————  code ————  Dimension ————  series code ————  Type code	<b>GS81104</b>	Higher rigidity and higher running accuracy than AS bearing ring .
<b>ZS (Central washer)</b> 		$\phi 10 - \phi 160$	ZS 15 34 ————  ————  Outside ————  diameter ————  Dimension ————  series code ————  Type code	<b>ZS1534</b>	The central washer is used as an outer ring or inner ring in a double-direction thrust roller bearing. This washer can be used in combination with needle roller and cage thrust assembly AXK, or cylindrical roller and cage thrust assembly K811, or locking ring (outer ring) GS811 for locking the bearing to a housing or locking ring (inner ring) WS811 for locking the bearing to a shaft.
<b>AXA21</b> 		$\phi 10 - \phi 140$ (Central washer)	AXA21 04 ————  ————  Bore diameter ————  code ————  Type code	<b>AXA2104</b>	This is a double-direction thrust roller bearing that comprises two needle roller and cage thrust assemblies AXK, two housing-side locking rings (outer rings) GS811 and one central ring ZS.
<b>ARA821</b> 		$\phi 10 - \phi 140$ (Central washer)	ARA821 04 T2 ————  ————  Bore diameter ————  code ————  Type code [Suffix] T2: resin cage	<b>ARA82104T2</b>	The suffix T2 means that this bearing uses a polyamide molded cage. Therefore, use this bearing at a temperature 120°C or lower; or at 100°C or lower for continuous operation. This is a double-direction thrust cylindrical roller bearing that comprises two cylindrical roller and cage thrust assemblies K811, two housing-side locking rings (outer rings) GS811 and one central ring ZS.
<b>AXB21</b> 		$\phi 15 - \phi 160$ (Central washer)	AXB21 04 ————  ————  Bore diameter ————  code ————  Type code	<b>AXB2104</b>	This is a double-direction thrust needle roller bearing that comprises two needle roller and cage thrust assemblies AXK, two shaft-side locking rings (inner rings) WS811 and one central ring ZS.
<b>ARB821</b> 		$\phi 15 - \phi 160$ (Central washer)	ARB821 04 T2 ————  ————  Bore diameter ————  code ————  Type code [Suffix] T2: resin cage	<b>ARB82104T2</b>	The suffix T2 means that this bearing uses a polyamide molded cage. Therefore, use this bearing at a temperature 120°C or lower; or at 100°C or lower for continuous operation. This is a double-direction thrust cylindrical roller bearing that comprises two cylindrical roller and cage thrust assemblies K811, two shaft-side locking rings (inner rings) WS811 and one central ring ZS.

## Bearing accuracy

The dimensional accuracy, profile accuracy and running accuracy of **Types 811, 812, 893 and 874** thrust cylindrical roller bearings shall be as specified in **Table 4.4** in Sec. 4. “**Bearing accuracy**” (page A-28).

The thrust roller and cage assembly **Types AXK, K881, K812, K893 and K874** are machined to the following dimensional tolerances: E11 (or E12 for bearing marked with T2) for bore diameter ( $D_{c1}$ ); and c12 for outside diameter ( $D_c$ ) on **Type AXK**, and a13 for **Types K811, K81, K893 and K874**.

## Raceway surface requirements:

Where the plane portion of a shaft/a housing is used as the direct raceway surface of thrust roller and cage assembly, the raceway surface must meet the requirements specified as a guideline in **Table 1**.

**Table 1 Raceway surface requirements (recommended)**

Characteristics	Specified requirements
Perpendicularity (Max)	IT5 (IT4)
Surface roughness	0.2a
Surface hardness	HRC58~64
Effective case depth	Refer to Formula (8.1) on page A-40.

Reference : The parenthesized value shall be applied for high running accuracy.

## Cage guiding

To be able to center a running thrust roller and cage assembly (Type **AXK, K811, K812, K893** or **K874**), it is necessary to guide it on its bore (shaft side) or outside surface (housing side).

In general, the bore-side guide of low relative speed against the cage is mostly used. It should be used particularly for high speed running. The dimensional tolerances for shaft and housing, when the cage is guided thereby, shall be h8 for shaft diameter (bore guide) and H9 for housing bore diameter (outer surface guide) respectively, which of the guide surface shall be fine-finished by grinding.

## Bearing fit in bearing ring

**Table 2** shows the tolerances for fitting of the thrust bearing rings (**AS, WS** and **GS**) on shaft or in housing.

**Table 2 Bearing ring fit in shaft and housing (recommended)**

Bearing ring		Shaft	Housing
Type AS	Locking to shaft	h10	Clearance to housing
	Locking to housing	Clearance to shaft	H11
Type WS (inner ring)		h6	—
Type GS (outer ring)		—	H7
Type ZS (central ring)	Locking to shaft	h6	—
	Locking to housing	—	H7

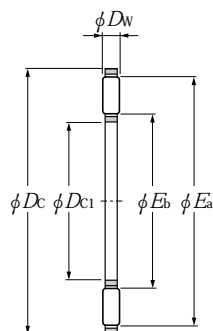
## Mounting related dimensions

The mounting dimensions for bearing ring **Types WS, GS** and **ZS** relative to a shaft or housing are listed in the relevant dimension table.

The fitting surface of **AS** bearing ring must be flat and have the rigidity sufficient to support thrust load throughout its entire surface.

The bearing ring has to be installed in correct orientation so that its raceway surface is seated onto the rolling elements. (As shown in the diagram in the relevant dimension table, the narrower chamfering on the bearing ring marks the raceway surface.)

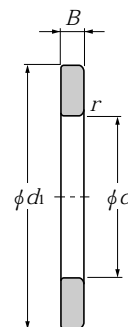
Type AXK11  
 Type AS11  
 Type WS811  
 Type GS811



**Type AXK**  
 (Thrust needle roller  
 and cage assy)



**AS bearing ring**  
 (washer)

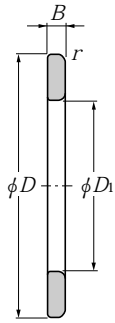


**WS bearing ring**  
 (inner ring)

$D_{c1}$  10~140mm

Boundary dimensions											Basic load ratings				
$D_{c1}$ E11	$D_c$ c12	$D_w$ $0_{-0.01}$	$D_p$ e13	$D_{p1}$ E12	$S^{2)}$ $0.05$	mm					$r$ min <sup>1)</sup>	dynamic N	static N	dynamic kgf	static kgf
						$d$	$d_1$ $-0.2$ $-0.5$	$D$	$D_1$ $+0.5$ $+0.2$	$B$					
10	24	2	24	10	1	10	24	24	10	$2.75_{-0.060}^0$	0.3	9 150	25 300	935	2 580
12	26	2	26	12	1	12	26	26	12	$2.75_{-0.060}^0$	0.3	9 850	28 900	1 010	2 940
15	28	2	28	15	1	15	28	28	16	$2.75_{-0.060}^0$	0.3	11 300	36 000	1 150	3 700
17	30	2	30	17	1	17	30	30	18	$2.75_{-0.060}^0$	0.3	11 900	39 500	1 220	4 050
20	35	2	35	20	1	20	35	35	21	$2.75_{-0.060}^0$	0.3	13 200	46 500	1 340	4 750
25	42	2	42	25	1	25	42	42	26	$3_{-0.060}^0$	0.6	14 600	58 000	1 490	5 900
30	47	2	47	30	1	30	47	47	32	$3_{-0.060}^0$	0.6	16 300	69 500	1 660	7 100
35	52	2	52	35	1	35	52	52	37	$3.5_{-0.075}^0$	0.6	17 800	81 500	1 820	8 300
40	60	3	60	40	1	40	60	60	42	$3.5_{-0.075}^0$	0.6	27 400	110 000	2 790	11 300
45	65	3	65	45	1	45	65	65	47	$4_{-0.075}^0$	0.6	29 800	128 000	3 050	13 100
50	70	3	70	50	1	50	70	70	52	$4_{-0.075}^0$	0.6	31 500	143 000	3 250	14 500
55	78	3	78	55	1	55	78	78	57	$5_{-0.075}^0$	0.6	38 000	186 000	3 850	19 000
60	85	3	85	60	1	60	85	85	62	$4.75_{-0.075}^0$	1	44 500	234 000	4 550	23 900
65	90	3	90	65	1	65	90	90	67	$5.25_{-0.075}^0$	1	46 500	254 000	4 750	25 900
70	95	4	95	70	1	70	95	95	72	$5.25_{-0.075}^0$	1	53 500	253 000	5 500	25 800
75	100	4	100	75	1	75	100	100	77	$5.75_{-0.075}^0$	1	55 000	266 000	5 650	27 100
80	105	4	105	80	1	80	105	105	82	$5.75_{-0.075}^0$	1	56 500	279 000	5 750	28 400
85	110	4	110	85	1	85	110	110	87	$5.75_{-0.075}^0$	1	57 500	291 000	5 850	29 700
90	120	4	120	90	1	90	120	120	92	$6.5_{-0.090}^0$	1	70 500	390 000	7 200	39 500
100	135	4	135	100	1	100	135	135	102	$7_{-0.090}^0$	1	90 000	550 000	9 200	56 500
110	145	4	145	110	1	110	145	145	112	$7_{-0.090}^0$	1	93 500	590 000	9 550	60 500
120	155	4	155	120	1	120	155	155	122	$7_{-0.090}^0$	1	99 000	650 000	10 100	66 500
130	170	5	170	130	1	130	170	170	132	$9_{-0.090}^0$	1	140 000	900 000	14 300	92 000
140	180	5	180	140	1	140	178	180	142	$9.5_{-0.090}^0$	1	145 000	960 000	14 800	97 500

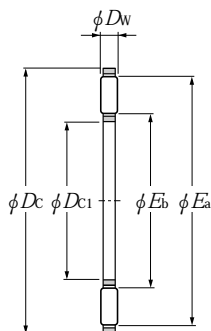
Note 1) Allowable minimum chamfer dimension  $r$ .  
 2) Subject to measured thrust load of 20kg or more.



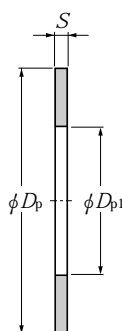
**GS bearing ring  
(Outer ring)**

Limiting speeds		Bearing numbers				Reference dimensions		Mass		
grease	oil	thrust needle roller and cage assembly	washer	inner ring	outer ring	mm		AXK11	AS11	WS811 GS811
						$E_b$	$E_a$			
3 500	14 000	<b>AXK1100</b>	<b>AS1100</b>	<b>WS81100</b>	<b>GS81100</b>	12.3	21.7	0.0028	0.003	0.008
3 300	13 000	<b>AXK1101</b>	<b>AS1101</b>	<b>WS81101</b>	<b>GS81101</b>	14.3	23.7	0.003	0.0033	0.009
2 800	11 000	<b>AXK1102</b>	<b>AS1102</b>	<b>WS81102</b>	<b>GS81102</b>	17.2	26.5	0.0035	0.0035	0.01
2 500	10 000	<b>AXK1103</b>	<b>AS1103</b>	<b>WS81103</b>	<b>GS81103</b>	19.2	28.5	0.004	0.0038	0.011
2 100	8 500	<b>AXK1104</b>	<b>AS1104</b>	<b>WS81104</b>	<b>GS81104</b>	21.3	31.3	0.005	0.0051	0.014
1 800	7 000	<b>AXK1105</b>	<b>AS1105</b>	<b>WS81105</b>	<b>GS81105</b>	29.5	39.4	0.007	0.007	0.021
1 500	6 000	<b>AXK1106</b>	<b>AS1106</b>	<b>WS81106</b>	<b>GS81106</b>	34.5	44.4	0.008	0.008	0.025
1 400	5 500	<b>AXK1107</b>	<b>AS1107</b>	<b>WS81107</b>	<b>GS81107</b>	39.5	49.4	0.01	0.0091	0.033
1 200	4 700	<b>AXK1108</b>	<b>AS1108</b>	<b>WS81108</b>	<b>GS81108</b>	44.2	56.2	0.0185	0.0123	0.044
1 100	4 300	<b>AXK1109</b>	<b>AS1109</b>	<b>WS81109</b>	<b>GS81109</b>	50.5	62.4	0.0205	0.0136	0.055
1 000	3 900	<b>AXK1110</b>	<b>AS1110</b>	<b>WS81110</b>	<b>GS81110</b>	55.5	67.4	0.0235	0.0148	0.06
900	3 500	<b>AXK1111</b>	<b>AS1111</b>	<b>WS81111</b>	<b>GS81111</b>	61.0	74.9	0.0308	0.0189	0.095
800	3 200	<b>AXK1112</b>	<b>AS1112</b>	<b>WS81112</b>	<b>GS81112</b>	66.0	81.9	0.0390	0.0223	0.101
750	3 000	<b>AXK1113</b>	<b>AS1113</b>	<b>WS81113</b>	<b>GS81113</b>	71.0	86.9	0.04	0.0239	0.125
750	2 900	<b>AXK1114</b>	<b>AS1114</b>	<b>WS81114</b>	<b>GS81114</b>	75.5	91.4	0.06	0.0254	0.134
700	2 700	<b>AXK1115</b>	<b>AS1115</b>	<b>WS81115</b>	<b>GS81115</b>	80.5	96.4	0.061	0.027	0.155
650	2 600	<b>AXK1116</b>	<b>AS1116</b>	<b>WS81116</b>	<b>GS81116</b>	84.4	100.3	0.063	0.0284	0.163
600	2 400	<b>AXK1117</b>	<b>AS1117</b>	<b>WS81117</b>	<b>GS81117</b>	90.5	106.4	0.0668	0.0301	0.175
600	2 300	<b>AXK1118</b>	<b>AS1118</b>	<b>WS81118</b>	<b>GS81118</b>	96.5	116.4	0.086	0.0388	0.25
500	2 000	<b>AXK1120</b>	<b>AS1120</b>	<b>WS81120</b>	<b>GS81120</b>	107.5	131.4	0.112	0.0505	0.35
480	1 900	<b>AXK1122</b>	<b>AS1122</b>	<b>WS81122</b>	<b>GS81122</b>	115.5	139.4	0.122	0.0549	0.385
430	1 700	<b>AXK1124</b>	<b>AS1124</b>	<b>WS81124</b>	<b>GS81124</b>	125.5	149.4	0.131	0.0592	0.415
400	1 600	<b>AXK1126</b>	<b>AS1126</b>	<b>WS81126</b>	<b>GS81126</b>	136.0	164.0	0.205	0.074	0.663
380	1 500	<b>AXK1128</b>	<b>AS1128</b>	<b>WS81128</b>	<b>GS81128</b>	146.0	174.0	0.219	0.079	0.749

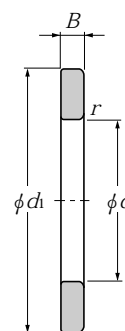
**Type AXK11**  
**Type AS11**  
**Type WS811**  
**Type GS811**



**Type AXK**  
**(Thrust needle roller and cage assy)**



**AS bearing ring**  
**(washer)**

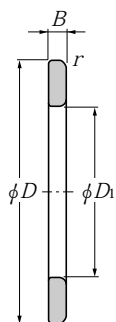


**WS bearing ring**  
**(Inner ring)**

$D_{c1}$  150~160mm

Boundary dimensions											Basic load ratings				
mm											dynamic	static	dynamic	static	
$D_{c1}$	$D_c$	$D_w$	$D_p$	$D_{p1}$	$S^{2)}$	$d$	$d_1$	$D$	$D_1$	$B$	$r \geq \min^1)$	N	N	kgf	kgf
E11	c12	$\begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$	e13	E12	0.05		$\begin{smallmatrix} -0.2 \\ -0.5 \end{smallmatrix}$		$\begin{smallmatrix} +0.5 \\ +0.2 \end{smallmatrix}$			$C_a$	$C_{oa}$	$C_a$	$C_{oa}$
150	190	5	190	150	1	150	188	190	152	$9.5 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$	1	149 000	1 020 000	15 200	104 000
160	200	5	200	160	1	160	198	200	162	$9.5 \begin{smallmatrix} 0 \\ -0.090 \end{smallmatrix}$	1	154 000	1 070 000	15 700	110 000

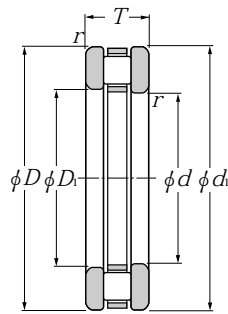
Note 1) Allowable minimum chamfer dimension  $r$ .  
 2) Subject to measured thrust load of 20kg or more.



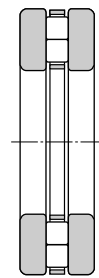
**GS bearing ring  
(Outer ring)**

Limiting speeds		Bearing numbers				Reference dimensions		Mass		
grease	min <sup>-1</sup>	thrust needle roller and cage assembly	washer	inner ring	outer ring	mm		kg (approx.)		
	oil					$E_b$	$E_a$	AXK11	AS11	WS811 GS811
350	1 400	<b>AXK1130</b>	<b>AS1130</b>	<b>WS81130</b>	<b>GS81130</b>	156.0	184.2	0.232	0.084	0.796
330	1 300	<b>AXK1132</b>	<b>AS1132</b>	<b>WS81132</b>	<b>GS81132</b>	166.0	194.2	0.246	0.089	0.842

Type 811  
Type 812  
Type 893  
Type 874



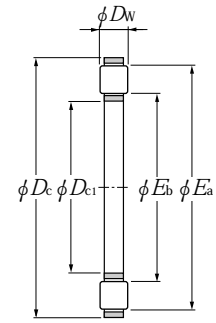
Type 811  
Type 812  
(Bearing)



Type 893  
(Bearing)



Type 874



Type K811, type K812  
(Thrust needle roller  
and cage assy)

$d$  10~55mm

Boundary dimensions										Basic load ratings				Limiting speeds		
$d$	$D$	$d_1$ -0.2 -0.5	$D_1$ +0.5 +0.2	mm						$r_3$ (min <sup>1</sup> )	dynamic $C_a$	static N $C_{oa}$	dynamic kgf $C_a$	static $C_{oa}$	grease	oil
				$T$	$D_{c1}$ E11	$D_c$ a13	$D_w$ -0.010	$B$ h11	min <sup>-1</sup>							
10	24	24	10	9	10	24	3.5	2.75	0.3	10 800	21 500	1 110	2 190	3 400	13 000	
12	26	26	12	9	12	26	3.5	2.75	0.3	11 500	23 900	1 170	2 430	3 000	12 000	
15	28	28	16	9	15	28	3.5	2.75	0.3	12 200	26 800	1 250	2 730	2 800	11 000	
17	30	30	18	9	17	30	3.5	2.75	0.3	12 700	29 000	1 300	2 960	2 500	10 000	
20	35	35	21	10	20	35	4.5	2.75	0.3	20 200	46 500	2 060	4 700	2 100	8 500	
25	42	42	26	11	25	42	5	3	0.6	27 300	68 000	2 790	6 900	1 800	7 000	
30	47	47	32	11	30	47	5	3	0.6	27 800	72 500	2 840	7 400	1 500	6 000	
	52	52	32	16	30	52	7.5	4.25	0.6	53 000	129 000	5 450	13 100	1 500	6 000	
	60	60	32	18	30	60	5.5	6.25	1	54 000	166 000	5 500	16 900	1 300	5 000	
35	52	52	37	12	35	52	5	3.5	0.6	31 000	87 000	3 150	8 900	1 400	5 500	
	62	62	37	18	35	62	7.5	5.25	1	54 500	139 000	5 550	14 200	1 200	4 900	
	68	68	37	20	35	68	6	7	1	66 500	214 000	6 750	21 800	1 200	4 600	
40	60	60	42	13	40	60	6	3.5	0.6	43 000	121 000	4 350	12 400	1 200	4 800	
	68	68	42	19	40	68	9	5	1	74 500	190 000	7 600	19 400	1 100	4 400	
	78	78	42	22	40	78	7	7.5	1	85 000	277 000	8 700	28 300	1 000	4 000	
	90	90	42	23	40	90	6.5	8.25	1.1	111 000	435 000	11 400	44 000	900	3 600	
45	65	65	47	14	45	65	6	4	0.6	45 500	135 000	4 650	13 800	1 100	4 400	
	73	73	47	20	45	73	9	5.5	1	82 000	222 000	8 400	22 600	1 000	4 100	
	85	85	47	24	45	85	7.5	8.25	1	102 000	345 000	10 400	35 000	900	3 600	
	100	100	47	25	45	100	7	9	1.1	128 000	510 000	13 100	52 000	800	3 200	
50	70	70	52	14	50	70	6	4	0.6	48 500	150 000	4 900	15 300	1 000	4 000	
	78	78	52	22	50	78	9	6.5	1	85 000	238 000	8 650	24 200	950	3 800	
	95	95	52	27	50	95	8	9.5	1.1	125 000	445 000	12 700	45 000	800	3 200	
	110	110	52	27	50	110	8	9.5	1.5	168 000	680 000	17 200	69 000	730	2 900	
55	78	78	57	16	55	78	6	5	0.6	62 500	215 000	6 350	21 900	900	3 600	
	90	90	57	25	55	90	11	7	1	121 000	340 000	12 400	34 500	830	3 300	
	105	105	57	30	55	105	9	10.5	1.1	158 000	570 000	16 100	58 000	730	2 900	
	120	120	57	29	55	120	8	10.5	1.5	186 000	800 000	19 000	81 500	650	2 600	

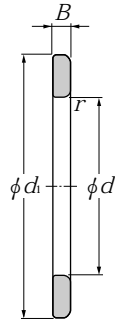
Note 1) Allowable minimum chamfer dimension  $r$ .  
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



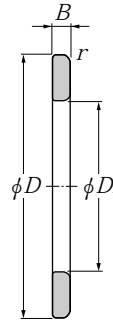
**Type K893**  
(Thrust needle roller  
and cage assy)



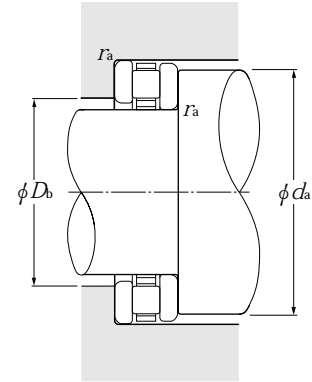
**Type K874**



**WS bearing ring**  
(Inner ring)

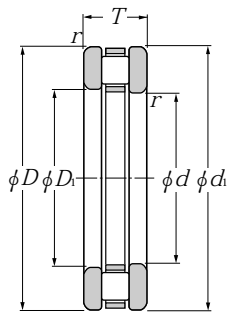


**GS bearing ring**  
(Outer ring)

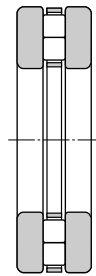


Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	$E_b$	$E_a$	$d_a$ min	$D_b$ max	$r_{as}$ max	811	kg	WS GS
									812	K811	
									893	K812	
									874	K893	
									K874		
81100T2	K81100T2	WS81100	GS81100	13.5	21.3	21	14	0.3	0.0195	0.0035	0.008
81101T2	K81101T2	WS81101	GS81101	15.5	23.3	23	16	0.3	0.022	0.004	0.009
81102T2	K81102T2	WS81102	GS81102	17.2	25.0	25	18	0.3	0.026	0.006	0.010
81103T2	K81103T2	WS81103	GS81103	19.2	27.0	27	20	0.3	0.030	0.008	0.011
81104T2	K81104T2	WS81104	GS81104	22.4	32.3	32	23	0.3	0.040	0.012	0.014
81105T2	K81105T2	WS81105	GS81105	27.6	38.7	39	28	0.6	0.060	0.018	0.021
81106T2	K81106T2	WS81106	GS81106	33.1	43.9	44	33	0.6	0.070	0.020	0.025
81206T2	K81206T2	WS81206	GS81206	32.8	49.0	48	33	0.6	0.140	0.050	0.045
89306	K89306	WS89306	GS89306	34.0	56.4	56	34	1	0.250	0.046	0.100
81107T2	K81107T2	WS81107	GS81107	38.0	48.9	49	38	0.6	0.090	0.024	0.033
81207T2	K81207T2	WS81207	GS81207	39.8	56.0	56	41	1	0.235	0.065	0.085
89307	K89307	WS89307	GS89307	40.0	64.4	64	40	1	0.360	0.064	0.150
81108T2	K81108T2	WS81108	GS81108	43.2	56.4	56	44	0.6	0.135	0.035	0.044
81208T2	K81208T2	WS81208	GS81208	43.7	62.9	63	44	1	0.265	0.085	0.090
89308	K89308	WS89308	GS89308	46.0	74.4	74	46	1	0.520	0.100	0.210
87408	K87408	WS87408	GS87408	46	87	88	45	1.1	0.78	0.12	0.33
81109T2	K81109T2	WS81109	GS81109	48.4	61.6	61	49	0.6	0.150	0.040	0.055
81209T2	K81209T2	WS81209	GS81209	48.8	68.0	68	49	1	0.310	0.100	0.105
89309	K89309	WS89309	GS89309	50.9	81.3	81	51	1	0.670	0.140	0.270
87409	K87409	WS87409	GS87409	53	96	97	52	1.1	1.05	0.17	0.44
81110T2	K81110T2	WS81110	GS81110	53.2	66.4	66	54	0.6	0.165	0.045	0.060
81210T2	K81210T2	WS81210	GS81210	53.7	73.1	73	54	1	0.385	0.105	0.140
89310	K89310	WS89310	GS89310	58.0	90.4	90	58	1	0.940	0.180	0.380
87410	K87410	WS87410	GS87410	56	106	107	55	1.5	1.38	0.26	0.56
81111T2	K81111T2	WS81111	GS81111	57.8	75.2	75	58	0.6	0.250	0.060	0.095
81211T2	K81211T2	WS81211	GS81211	60.1	83.4	83	61	1	0.610	0.190	0.210
89311	K89311	WS89311	GS89311	63.9	100.3	100	64	1	1.270	0.240	0.520
87411	K87411	WS87411	GS87411	66	116	117	65	1.5	1.77	0.3	0.74

Type 811  
Type 812  
Type 893  
Type 874



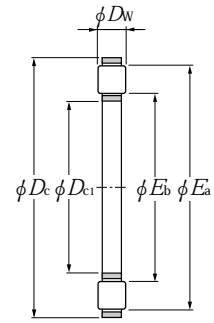
Type 811  
Type 812  
(Bearing)



Type 893  
(Bearing)



Type 874



Type K811, type K812  
(Thrust needle roller  
and cage assy)

d 60~100mm

d	Boundary dimensions									Basic load ratings				Limiting speeds	
	D	d <sub>1</sub>	D <sub>1</sub>	T	D <sub>c1</sub>	D <sub>c</sub>	D <sub>w</sub>	B	r <sub>s</sub> (min <sup>1</sup> )	dynamic	static	dynamic	static	grease	oil
	mm	mm	mm	mm	mm	mm	mm	mm	mm	N	N	kgf	kgf		
60	85	85	62	17	60	85	7.5	4.75	1	69 000	215 000	7 000	21 900	830	3 300
	95	95	62	26	60	95	11	7.5	1	126 000	365 000	12 800	37 000	780	3 100
	110	110	62	30	60	110	9	10.5	1.1	162 000	600 000	16 500	61 500	680	2 700
	130	130	62	32	60	130	9	11.5	1.5	223 000	950 000	22 700	97 000	630	2 500
65	90	90	67	18	65	90	7.5	5.25	1	73 000	236 000	7 450	24 100	780	3 100
	100	100	67	27	65	100	11	8	1	130 000	385 000	13 300	39 500	730	2 900
	115	115	67	30	65	115	9	10.5	1.1	167 000	635 000	17 000	64 500	650	2 600
	140	140	68	34	65	140	10	12	2	258 000	1 090 000	26 300	111 000	580	2 300
70	95	95	72	18	70	95	7.5	5.25	1	76 500	257 000	7 800	26 200	730	2 900
	105	105	72	27	70	105	11	8	1	134 000	410 000	13 700	42 000	680	2 700
	125	125	72	34	70	125	10	12	1.1	205 000	790 000	20 900	81 000	600	2 400
	150	150	73	36	70	150	11	12.5	2	315 000	1 330 000	32 000	136 000	550	2 200
75	100	100	77	19	75	100	7.5	5.75	1	78 000	268 000	7 950	27 300	680	2 700
	110	110	77	27	75	110	11	8	1	138 000	435 000	14 100	44 500	650	2 600
	135	135	77	36	75	135	11	12.5	1.5	239 000	920 000	24 400	94 000	550	2 200
	160	160	78	38	75	160	12	13	2	370 000	1 600 000	38 000	163 000	500	2 000
80	105	105	82	19	80	105	7.5	5.75	1	79 500	279 000	8 100	28 400	650	2 600
	115	115	82	28	80	115	11	8.5	1	143 000	460 000	14 500	47 000	630	2 500
	140	140	82	36	80	140	11	12.5	1.5	246 000	970 000	25 100	98 500	530	2 100
	170	170	83	41	80	170	12	14.5	2.1	390 000	1 740 000	40 000	178 000	480	1 900
85	110	110	87	19	85	110	7.5	5.75	1	83 000	300 000	8 450	30 500	630	2 500
	125	125	88	31	85	125	12	9.5	1	169 000	550 000	17 200	56 500	580	2 300
	150	150	88	39	85	150	12	13.5	1.5	281 000	1 100 000	28 700	113 000	500	2 000
	180	180	88	42	85	180	13	14.5	2.1	430 000	1 890 000	44 000	192 000	450	1 800
90	120	120	92	22	90	120	9	6.5	1	112 000	395 000	11 400	40 500	580	2 300
	135	135	93	35	90	135	14	10.5	1.1	213 000	680 000	21 700	69 500	530	2 100
	155	155	93	39	90	155	12	13.5	1.5	289 000	1 160 000	29 500	118 000	480	1 900
	190	190	93	45	90	190	13	16	2.1	450 000	2 060 000	46 000	210 000	430	1 700
100	135	135	102	25	100	135	11	7	1	158 000	555 000	16 100	57 000	500	2 000

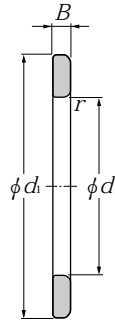
Note 1) Allowable minimum chamfer dimension  $r$ .  
2) The dimensional tolerance for a bearing with a T2 suffix is E12.



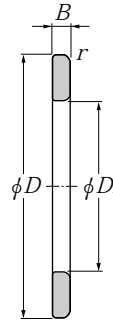
**Type K893**  
(Thrust needle roller  
and cage assy)



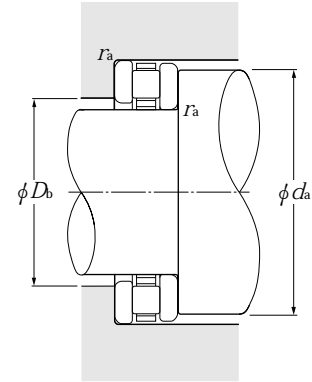
**Type K874**



**WS bearing ring**  
(Inner ring)



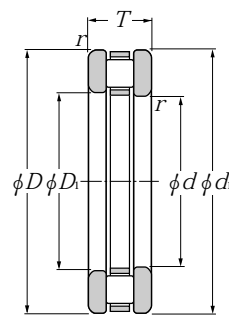
**GS bearing ring**  
(Outer ring)



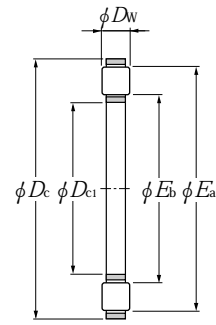
Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	$E_b$	$E_a$	$d_a$ min	$D_b$ max	$r_{as}$ max	811	kg	WS GS
									812	K811	
									893	K812	
									874	K893	
									K874		
81112T2	K81112T2	WS81112	GS81112	63.7	80.1	80	65	1	0.285	0.083	0.101
81212T2	K81212T2	WS81212	GS81212	64.9	88.4	88	66	1	0.660	0.200	0.230
89312	K89312	WS89312	GS89312	68.9	105.3	105	69	1	1.350	0.250	0.550
87412	K87412	WS87412	GS87412	70	126	127	69	1.5	2.27	0.38	0.94
81113T2	K81113T2	WS81113	GS81113	68.8	85.2	85	70	1	0.340	0.090	0.125
81213T2	K81213T2	WS81213	GS81213	69.9	93.3	93	71	1	0.775	0.215	0.280
89313	K89313	WS89313	GS89313	73.9	110.3	110	74	1	1.430	0.260	0.580
87413	K87413	WS87413	GS87413	74	136	137	73	2	2.75	0.47	1.14
81114T2	K81114T2	WS81114	GS81114	73.7	90.1	90	74	1	0.365	0.097	0.135
81214T2	K81214T2	WS81214	GS81214	75.0	98.4	98	76	1	0.815	0.225	0.295
89314	K89314	WS89314	GS89314	79.8	120.2	120	80	1	1.930	0.340	0.800
87414	K87414	WS87414	GS87414	77	145	146	76	2	3.37	0.65	1.36
81115T2	K81115T2	WS81115	GS81115	78.7	95.1	95	80	1	0.425	0.115	0.155
81215T2	K81215T2	WS81215	GS81215	80.1	103.7	103	81	1	0.860	0.240	0.310
89315	K89315	WS89315	GS89315	84.7	129.2	129	85	1.5	2.410	0.470	0.970
87415	K87415	WS87415	GS87415	81	155	156	80	2	4.02	0.8	1.61
81116T2	K81116T2	WS81116	GS81116	83.7	100.1	100	85	1	0.445	0.119	0.165
81216T2	K81216T2	WS81216	GS81216	84.8	108.4	106	86	1	0.950	0.250	0.350
89316	K89316	WS89316	GS89316	89.8	134.2	134	90	1.5	2.530	0.490	1.020
87416	K87416	WS87416	GS87416	91	165	166	90	2.1	5.32	0.88	2.02
81117T2	K81117T2	WS81117	GS81117	88.7	105.3	105	89	1	0.475	0.125	0.175
81217	K81217	WS81217	GS81217	92.2	116.9	116	92	1	1.280	0.300	0.490
89317	K89317	WS89317	GS89317	95.8	144.2	144	96	1.5	3.140	0.590	1.280
87417	K87417	WS87417	GS87417	94	174	175	93	2.1	5.53	1.03	2.25
81118T2	K81118T2	WS81118	GS81118	94.7	114.3	114	95	1	0.670	0.170	0.250
81218J	K81218J	WS81218	GS81218	97.9	126.7	126	97	1	1.820	0.540	0.640
89318	K89318	WS89318	GS89318	100.8	149.2	149	101	1.5	3.280	0.620	1.330
87418	K87418	WS87418	GS87418	104	183	184	103	2.1	6.65	1.13	2.76
81120T2	K81120T2	WS81120	GS81120	105.1	128.7	128	106	1	1.000	0.300	0.350

Type 811

Type 812



**Type 811  
Type 812  
(Bearing)**

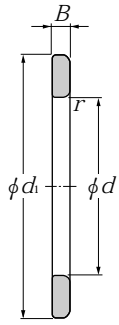


**Type K811, type K812  
(Thrust needle roller  
and cage assy)**

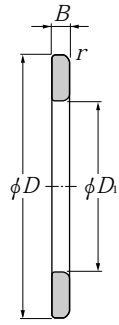
$d$  100~160mm

$d$	Boundary dimensions									Basic load ratings				Limiting speeds	
	$D$	$d_1$	$D_1$	$T$	$D_{c1}$	$D_c$	$D_w$	$B$	$r$ (s min <sup>-1</sup> )	dynamic	static	dynamic	static	grease	oil
	mm									N	N	kgf	kgf		
		$\begin{smallmatrix} -0.2 \\ -0.5 \end{smallmatrix}$	$\begin{smallmatrix} +0.5 \\ +0.2 \end{smallmatrix}$		E11	a13	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	h11		$C_a$	$C_{oa}$	$C_a$	$C_{oa}$		
<b>100</b>	150	150	103	38	100	150	15	11.5	1.1	243 000	795 000	24 800	81 000	480	1 900
	170	170	103	42	100	170	13	14.5	1.5	335 000	1 370 000	34 500	140 000	430	1 700
<b>110</b>	145	145	112	25	110	145	11	7	1	165 000	605 000	16 800	61 500	480	1 900
	160	160	113	38	110	160	15	11.5	1.1	258 000	885 000	26 400	90 000	450	1 800
	190	190	113	48	110	190	15	16.5	2	430 000	1 770 000	44 000	180 000	400	1 600
<b>120</b>	155	155	122	25	120	155	11	7	1	172 000	655 000	17 500	66 500	450	1 800
	170	170	123	39	120	170	15	12	1.1	264 000	930 000	26 900	94 500	430	1 700
<b>130</b>	170	170	132	30	130	170	12	9	1	197 000	755 000	20 100	77 000	400	1 600
	190	187	133	45	130	190	19	13	1.5	360 000	1 210 000	36 500	123 000	380	1 500
<b>140</b>	180	178	142	31	140	180	12	9.5	1	206 000	815 000	21 000	83 000	380	1 500
	200	197	143	46	140	200	19	13.5	1.5	370 000	1 280 000	38 000	130 000	350	1 400
<b>150</b>	190	188	152	31	150	190	12	9.5	1	214 000	870 000	21 800	89 000	350	1 400
<b>160</b>	200	198	162	31	160	200	12	9.5	1	221 000	930 000	22 600	95 000	330	1 300

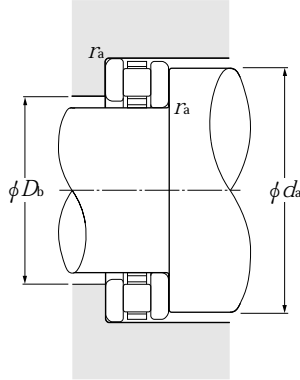
Note 1) Allowable minimum chamfer dimension  $r$ .



**WS bearing ring  
(Inner ring)**

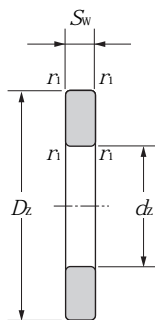


**GS bearing ring  
(Outer ring)**



Bearing numbers				Reference dimensions mm		Abutment dimensions mm			Mass		
bearing	thrust cylindrical roller and cage assembly	inner ring	outer ring	$E_b$	$E_a$	$d_a$ min	$D_b$ max	$r_{as}$ max	811	kg	WS GS
									812	K811	
									893	K812	
									874	K893	
										K874	
<b>81220</b>	<b>K81220</b>	<b>WS81220</b>	<b>GS81220</b>	109.2	140.0	139	109	1	2.240	0.620	0.810
<b>89320</b>	<b>K89320</b>	<b>WS89320</b>	<b>GS89320</b>	110.6	163.0	163	110	1.5	4.190	0.810	1.690
<b>81122T2</b>	<b>K81122T2</b>	<b>WS81122</b>	<b>GS81122</b>	115.0	138.8	138	116	1	1.100	0.325	0.385
<b>81222</b>	<b>K81222</b>	<b>WS81222</b>	<b>GS81222</b>	119.2	150.0	149	119	1	2.450	0.685	0.880
<b>89322</b>	<b>K89322</b>	<b>WS89322</b>	<b>GS89322</b>	122.5	183.0	183	122	2	6.030	1.150	2.440
<b>81124T2</b>	<b>K81124T2</b>	<b>WS81124</b>	<b>GS81124</b>	125.0	148.8	148	126	1	1.170	0.340	0.415
<b>81224</b>	<b>K81224</b>	<b>WS81224</b>	<b>GS81224</b>	129.2	160.0	159	129	1	2.690	0.730	0.980
<b>81126</b>	<b>K81126</b>	<b>WS81126</b>	<b>GS81126</b>	137.7	162.4	162	137	1	1.740	0.415	0.663
<b>81226</b>	<b>K81226</b>	<b>WS81226</b>	<b>GS81226</b>	140.1	179.0	178	140	1.5	4.200	1.140	1.530
<b>81128</b>	<b>K81128</b>	<b>WS81128</b>	<b>GS81128</b>	147.8	172.5	172	147	1	1.950	0.450	0.750
<b>81228</b>	<b>K81228</b>	<b>WS81228</b>	<b>GS81228</b>	150.1	189.0	188	150	1.5	4.570	1.200	1.690
<b>81130</b>	<b>K81130</b>	<b>WS81130</b>	<b>GS81130</b>	157.7	182.4	182	157	1	2.070	0.470	0.800
<b>81132</b>	<b>K81132</b>	<b>WS81132</b>	<b>GS81132</b>	167.8	192.5	192	167	1	2.190	0.500	0.840



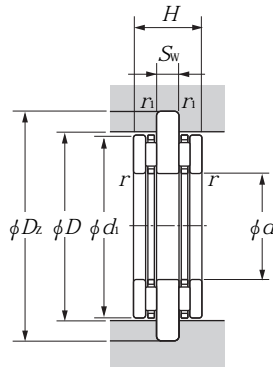


**Type ZS**

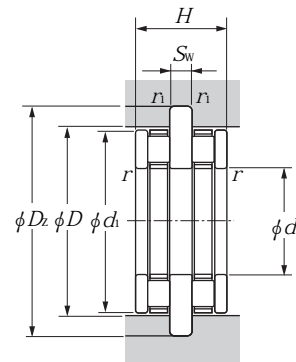
Type ARA <sup>2)</sup> Basic load ratings dynamic static kgf C <sub>a</sub> C <sub>0a</sub>	Limiting speeds		Bearing numbers			Mass kg (approx.)			
	min <sup>-1</sup>		Type AXA <sup>1)</sup>	Type ARA <sup>2)</sup>	Central washer Type ZS	Type AXA	Type ARA	Central washer Type ZS	
	grease	oil							
1 250	2 730	2 800	11 000	AXA 2102	ARA 82102T2	ZS 1027	0.047	0.053	0.021
1 300	2 960	2 500	10 000	AXA 2103	ARA 82103T2	ZS 1229	0.052	0.061	0.023
2 060	4 700	2 100	8 500	AXA 2104	ARA 82104T2	ZS 1534	0.069	0.083	0.031
2 790	6 900	1 800	7 000	AXA 2105	ARA 82105T2	ZS 2041	0.102	0.124	0.046
2 840	7 400	1 500	6 000	AXA 2106	ARA 82106T2	ZS 2546	0.126	0.152	0.062
3 150	8 900	1 400	5 500	AXA 2107	ARA 82107T2	ZS 3051	0.165	0.195	0.081
4 350	12 400	1 200	4 700	AXA 2108	ARA 82108T2	ZS 3059	0.248	0.307	0.125
4 650	13 800	1 100	4 300	AXA 2109	ARA 82109T2	ZS 3564	0.305	0.346	0.156
4 900	15 300	1 000	3 900	AXA 2110	ARA 82110T2	ZS 4069	0.356	0.4	0.19
6 350	21 900	900	3 500	AXA 2111	ARA 82111T2	ZS 4577	0.485	0.545	0.235
7 000	21 900	800	3 200	AXA 2112	ARA 82112T2	ZS 5084	0.596	0.684	0.316
7 450	24 100	750	3 000	AXA 2113	ARA 82113T2	ZS 5589	0.692	0.79	0.36
7 800	26 200	750	2 900	AXA 2114	ARA 82114T2	ZS 5594	0.828	0.9	0.44
7 950	27 300	700	2 700	AXA 2115	ARA 82115T2	ZS 6099	0.902	1.01	0.47
8 100	28 400	650	2 600	AXA 2116	ARA 82116T2	ZS 65104	0.992	1.06	0.5
8 450	30 500	600	2 400	AXA 2117	ARA 82117T2	ZS 70109	1.09	1.21	0.612
11 400	40 500	600	2 300	AXA 2118	ARA 82118T2	ZS 75119	1.5	1.67	0.828
16 100	57 000	500	2 000	AXA 2120	ARA 82120T2	ZS 85134	2.11	2.48	1.18
16 800	61 500	480	1 900	AXA 2122	ARA 82122T2	ZS 95144	2.44	2.85	1.43
17 500	66 500	430	1 700	AXA 2124	ARA 82124T2	ZS 100154	2.92	3.34	1.83
20 100	77 000	400	1 600	AXA 2126	ARA 82126	ZS 110169	3.95	4.37	2.21
21 000	83 000	380	1 500	AXA 2128	ARA 82128	ZS 120179	4.4	4.85	2.46
21 800	89 000	350	1 400	AXA 2130	ARA 82130	ZS 130189	4.79	5.08	2.74
22 600	95 000	330	1 300	AXA 2132	ARA 82132	ZS 140199	5.21	5.72	3.03

Note 3) Allowable minimum chamfer dimension  $r_1$ .  
 4) Allowable minimum chamfer dimension  $r_1$ .

## Type AXB21 Type ARA821



Type AXB

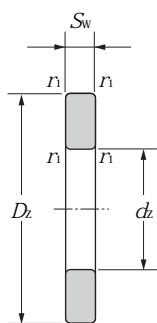


Type ARB

$d_z$  15~160mm

Shaft dia. $d$ mm	Boundary dimensions										Type AXA <sup>1)</sup>				Type ARA <sup>2)</sup>	
	$d_z$ $+0.5$ $+0.3$	$D_z$ $-0.1$ $-0.2$	$d_1$	$d_1$ $-0.2$ $-0.5$	$H$		$S_w$ h11	$l_s$ min <sup>3)</sup>	$l_s$ min <sup>4)</sup>	dynamic N	Basic load ratings		static kgf	Basic load ratings		
					Type AXB	Type ARB					static $C_{oa}$	dynamic $C_a$		dynamic N	static $C_{oa}$	
15	15	34	15	28	15	18	5.5	0.3	0.3	11 300	36 000	1 150	3 700	12 200	26 800	
20	20	41	20	35	15.5	20.5	6	0.3	0.3	13 200	46 500	1 340	4 750	20 200	46 500	
25	25	46	25	42	17	23	7	0.6	0.3	14 600	58 000	1 490	5 900	27 300	68 000	
30	30	51	30	47	18	24	8	0.6	0.3	16 300	69 500	1 660	7 100	27 800	72 500	
35	35	64	35	52	20	26	9	0.6	0.6	17 800	81 500	1 820	8 300	31 000	87 000	
40	40	69	40	60	23	29	10	0.6	0.6	27 400	110 000	2 790	11 300	43 000	121 000	
45	45	77	45	65	24	30	10	0.6	0.6	29 800	128 000	3 050	13 100	45 500	135 000	
50	50	84	50	70	25.5	31.5	11.5	0.6	0.6	31 500	143 000	3 250	14 500	48 500	150 000	
55	55	89	55	78	28	34	12	0.6	0.6	38 000	186 000	3 850	19 000	62 500	215 000	
60	60	99	60	85	28	37	12.5	1	1	44 500	234 000	4 550	23 900	69 000	215 000	
65	65	104	65	90	29	38	12.5	1	1	46 500	254 000	4 750	25 900	73 000	236 000	
70	70	109	70	95	33	40	14.5	1	1	53 500	253 000	5 500	25 800	76 500	257 000	
75	75	119	75	100	35.5	42.5	16	1	1	55 000	266 000	5 650	27 100	78 000	268 000	
85	85	134	85	110	37.5	44.5	18	1	1	57 500	291 000	5 850	29 700	83 000	300 000	
100	100	154	100	135	44	58	22	1	1	90 000	550 000	9 200	56 500	158 000	555 000	
110	110	169	110	145	44	58	22	1	1	93 500	590 000	9 550	60 500	165 000	605 000	
120	120	179	120	155	45	59	23	1	1	99 000	650 000	10 100	66 500	172 000	655 000	
130	130	189	130	170	52	66	24	1	1	140 000	900 000	14 300	92 000	197 000	755 000	
140	140	199	140	178	54	68	25	1	1	145 000	960 000	14 800	97 500	206 000	815 000	
150	150	214	150	188	56	70	27	1	1	149 000	1 020 000	15 200	104 000	214 000	870 000	
160	160	224	160	198	58	72	29	1	1	154 000	1 070 000	15 700	110 000	221 000	930 000	

Note 1)  $\frac{AXB21}{\text{Arrangement bearing}} = \frac{AXK11}{\text{Thrust needle roller bearing with cage (2)}} + \frac{WS811}{\text{Inner ring (2)}} + \frac{ZS}{\text{Central washer (1)}}$  2)  $\frac{ARB21}{\text{Arrangement bearing}} = \frac{K811}{\text{Thrust cylindrical roller bearing with cage (2)}} + \frac{WS811}{\text{Inner ring (1)}} + \frac{ZS}{\text{Central washer (1)}}$


**Type ZS**

Type ARA <sup>2)</sup> Basic load ratings dynamic static kgf $C_a$ $C_{0a}$	Limiting speeds $\text{min}^{-1}$ grease oil		Bearing numbers			Abutment dimensions Shaft dia. $D$ min	Mass kg (approx.)			
	Type AXB <sup>1)</sup>	Type ARB <sup>2)</sup>	Central washer Type ZS	Type AXB	Type ARB		Central washer Type ZS			
1 250	2 730	2 800	11 000	AXB 2102	ARB 82102T2	ZS 1534	28.5	0.057	0.063	0.031
2 060	4 700	2 100	8 500	AXB 2104	ARB 82104T2	ZS 2041	35.5	0.084	0.098	0.046
2 790	6 900	1 800	7 000	AXB 2105	ARB 82105T2	ZS 2546	42.5	0.118	0.14	0.062
2 840	7 400	1 500	6 000	AXB 2106	ARB 82106T2	ZS 3051	47.5	0.145	0.171	0.081
3 150	8 900	1 400	5 500	AXB 2107	ARB 82107T2	ZS 3564	53	0.24	0.27	0.156
4 350	12 400	1 200	4 700	AXB 2108	ARB 82108T2	ZS 4069	61	0.314	0.373	0.191
4 650	13 800	1 100	4 300	AXB 2109	ARB 82109T2	ZS 4577	66	0.384	0.425	0.235
4 900	15 300	1 000	3 900	AXB 2110	ARB 82110T2	ZS 5084	71	0.481	0.526	0.316
6 350	21 900	900	3 500	AXB 2111	ARB 82111T2	ZS 5589	79	0.61	0.67	0.36
7 000	21 900	800	3 200	AXB 2112	ARB 82112T2	ZS 6099	86	0.75	0.838	0.47
7 450	24 100	750	3 000	AXB 2113	ARB 82113T2	ZS 65104	91	0.832	0.93	0.5
7 800	26 200	750	2 900	AXB 2114	ARB 82114T2	ZS 70109	96	1	1.07	0.612
7 950	27 300	700	2 700	AXB 2115	ARB 82115T2	ZS 75119	101	1.26	1.37	0.828
8 450	30 500	600	2 400	AXB 2117	ARB 82117T2	ZS 85134	111	1.66	1.78	1.18
16 100	57 000	500	2 000	AXB 2120	ARB 82120T2	ZS 100154	136	2.76	3.13	1.83
16 800	61 500	480	1 900	AXB 2122	ARB 82122T2	ZS 110169	146	3.22	3.63	2.21
17 500	66 500	430	1 700	AXB 2124	ARB 82124T2	ZS 120179	156	3.55	3.97	2.46
20 100	77 000	400	1 600	AXB 2126	ARB 82126	ZS 130189	171	4.48	4.9	2.74
21 000	83 000	380	1 500	AXB 2128	ARB 82128	ZS 140199	181	4.97	5.42	3.03
21 800	89 000	350	1 400	AXB 2130	ARB 82130	ZS 150214	191	5.88	6.37	3.83
22 600	95 000	330	1 300	AXB 2132	ARB 82132	ZS 160224	202	6.53	7.04	4.35

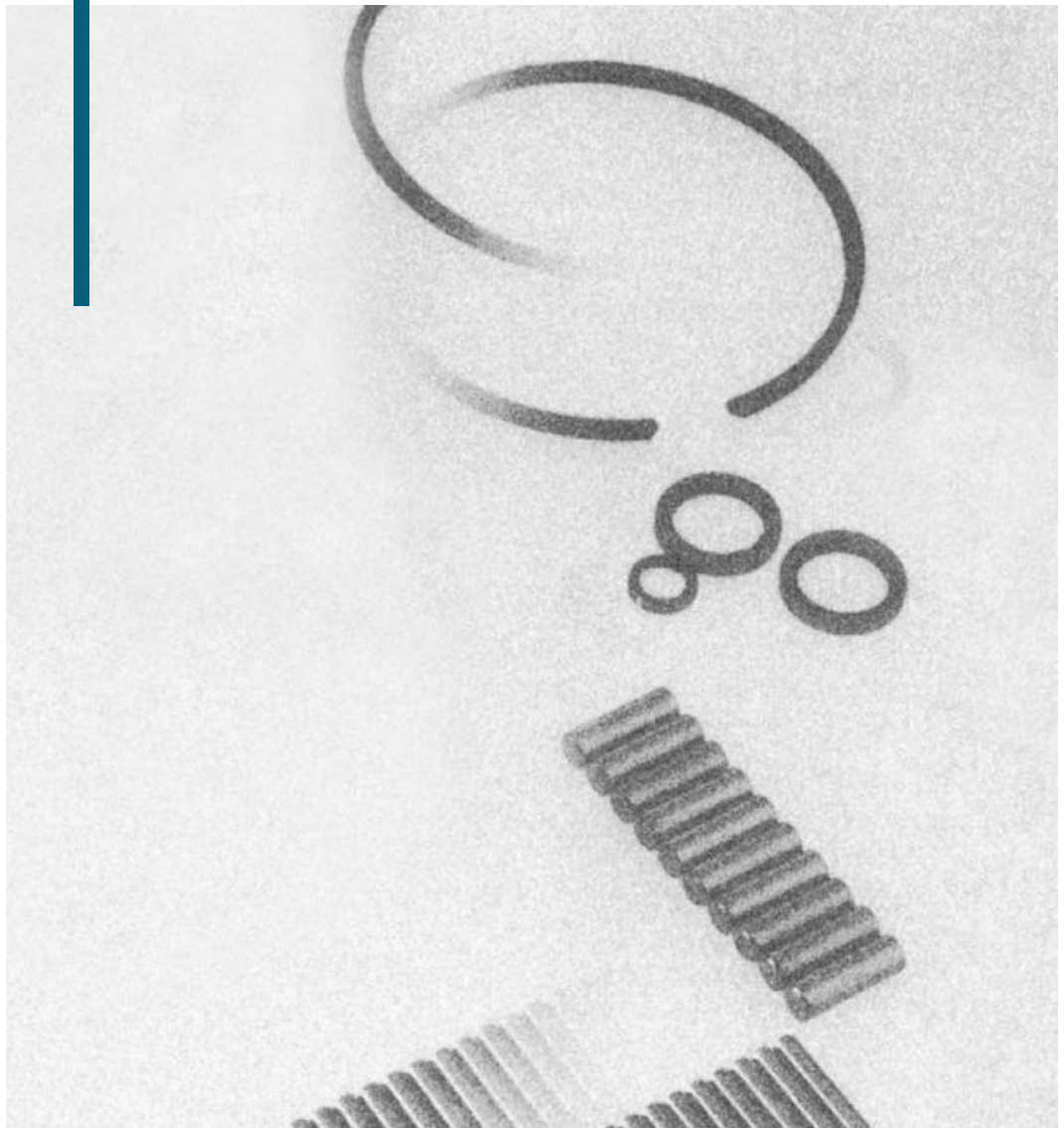
 Note 3) Allowable minimum chamfer dimension  $r_1$ .

 4) Allowable minimum chamfer dimension  $r_1$ .



# COMPONENTS

## Needle Rollers/Snap Rings/Seals





## Needle Rollers

NTN needle rollers are all made of high carbon chrome bearing steel, fine-finished by grinding and polishing after heat-treated, and the hardness thereof ranges from HRC60 to 65. These needle rollers are supplied as not only rolling element but also pin and shaft individuals.

### End face profile of needle roller

F-type needle roller bearing with flat end face is standard type, while A-type with round end face is semi-standard type. In addition to these two types, another needle roller type (nominal number with (suffix E) capable of damping edge load is also available. Feel free to contact NTN for the detail thereof.

Table 1 End face profile

Type	Name	Profile
F	Flat	
A	Round	

### Composition of needle roller number

The needle roller number comprises type code (end face profile), dimension code [diameter ( $D_w$ ) $\times$ length ( $L_w$ )] and a suffix.

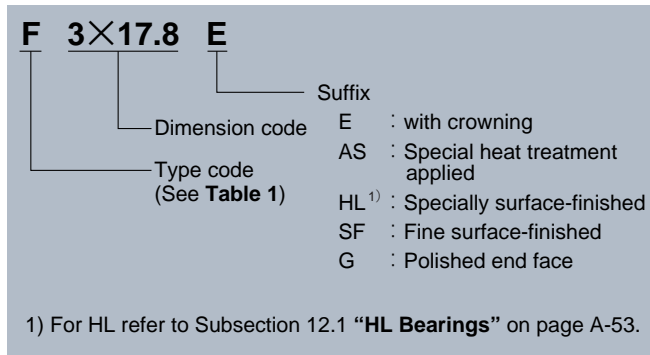


Fig. 1

### Needle roller tolerances

The NTN needle rollers are manufactured per the dimensional accuracy and profile accuracy specified in JIS B 1506 "Rollers for roller bearings". (Refer to Table 2 in this page.)

Table 2 Needle roller tolerances

Unit:  $\mu\text{m}$

Characteristics	Tolerance and allowable value
Tolerance for mean value of diameter $D_w$	0 $\sim$ -10
Mutual deviation of diameter $D_w$	2
Roundness of diameter $D_w$ , Diameter variation in a single radial plane	1.0 ( $L_w/D_w \leq 6$ ) 1.5 ( $L_w/D_w > 6$ )
Tolerance for length $L_w$	h13
Accuracy class	Class-2

The needle rollers are delivered contained in same package after the mutual deviation of diameter  $D_w$  was assorted to  $2\mu\text{m}$  and less. Before being delivered, the needle rollers are identified by label colors such as red, dark blue, blue, etc. according to the respective dimensional tolerances.

**Further, mixed use of needle rollers contained in packages of different label colors is prohibited.**

Table 3 Discrimination of needle rollers

Label color	Dimensional tolerance range $\mu\text{m}$	Discrimination
Red	0 $\sim$ - 2	Standard
Dark blue	-1 $\sim$ - 3	
Blue	-2 $\sim$ - 4	
Black	-3 $\sim$ - 5	
White	-4 $\sim$ - 6	
Gray	-5 $\sim$ - 7	Semi-standard
Green	-6 $\sim$ - 8	
Brown	-7 $\sim$ - 9	
Yellow	-8 $\sim$ -10	

**Application of needle rollers**

When configuring a full complement needle roller bearing using standard needle rollers, the shaft diameter ( $d$ ), housing bore diameter ( $D$ ), circumferential clearance ( $\Delta C$ ) and radial internal clearance ( $\Delta r$ ) can be determined based on the needle roller diameter ( $D_w$ ) and number of rollers ( $Z$ ) by using the formula below (refer to Fig. 2).

Determine the minimum value of circumferential clearance ( $\Delta C$ ) using formula (1). The radial internal clearance ( $\Delta r$ ) of an intended needle roller bearing can be determined based on the shaft diameter and projected bearing operating conditions by referring to Table 5.1 in Sec. 5.1 "Bearing radial internal clearance" (page A-30). Generally, any full complement roller bearing needs a greater radial internal clearance compared with a needle roller and cage assembly.

$$\Delta C = (0.005 \sim 0.020) \times Z \text{ mm (minimum value)} \quad (1)$$

Then, determine the minimum value of housing bore diameter ( $D$ ) and the maximum value of shaft diameter ( $d$ ) using the formulas (2) and (3).

$$D = \frac{1}{\sin\left(\frac{\pi}{Z}\right)} \cdot \left(D_w + \frac{\Delta C}{Z}\right) + D_w \text{ mm (minimum value)} \quad (2)$$

$$d = D - 2D_w - \Delta r \text{ mm (maximum value)} \quad (3)$$

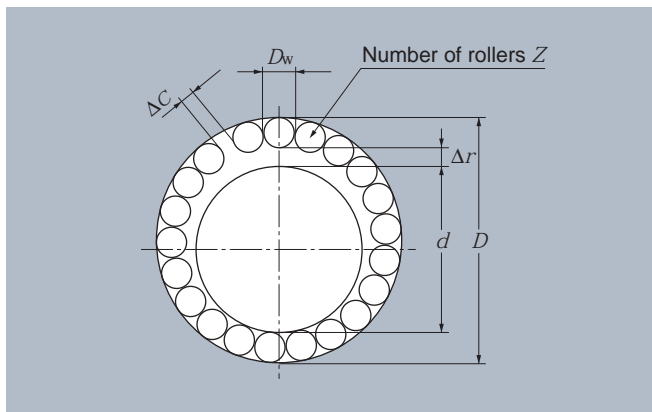


Fig. 2

The maximum value of housing bore diameter ( $D$ ) required to retain needle rollers in a housing by a keystone can be determined from the minimum diameter value ( $D_{w \text{ min}}$ ) of the roller and the number of rollers using formula (4). The coefficient  $K$  to be used in that time is as shown in Table 4.

$$D = K \cdot D_{w \text{ min}} \text{ mm (max.)} \quad (4)$$

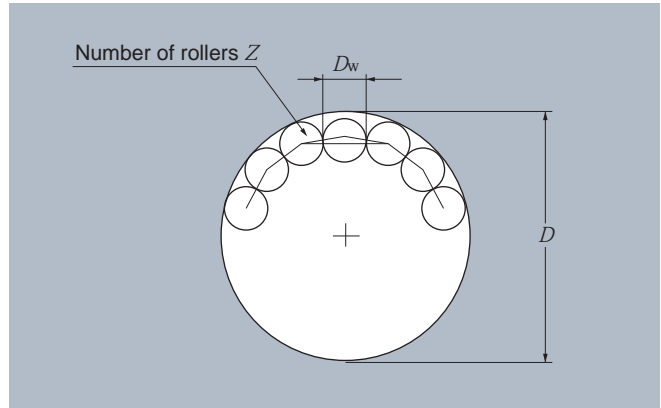
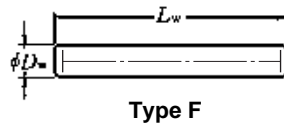


Fig. 3

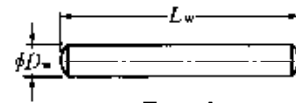
Table 4 Coefficient  $K$  value

$Z$	$K$	$Z$	$K$
8	3.6763333	17	6.4536463
9	3.9709394	18	6.7689303
10	4.2727719	19	7.0846088
11	4.5789545	20	7.4006100
12	4.8879667	21	7.7168786
13	5.1989251	22	8.0333713
14	5.5112799	23	8.3500534
15	5.8246707	24	8.6668970
16	6.1388508	25	8.9838796

## Type F Type A



Type F



Type A

$D_w$  1.5~4.5mm

Boundary dimensions mm		Bearing numbers		Mass	Boundary dimensions mm		Bearing numbers		Mass
$D_w$	$L_w$	flat type	disk type	kg per 1 000 pcs	$D_w$	$L_w$	flat type	disk type	kg per 1 000 pcs
1.5	5.8	<b>F1.5 × 5.8</b>	A1.5 × 5.8	0.080	3	23.8	<b>F3 × 23.8</b>	A3 × 23.8	1.34
	6.8	<b>F1.5 × 6.8</b>	A1.5 × 6.8	0.090		25.8	<b>F3 × 25.8</b>	A3 × 25.8	1.45
	7.8	<b>F1.5 × 7.8</b>	A1.5 × 7.8	0.104		27.8	<b>F3 × 27.8</b>	A3 × 27.8	1.56
	9.8	<b>F1.5 × 9.8</b>	A1.5 × 9.8	0.131	3.5	11.8	<b>F3.5 × 11.8</b>	A3.5 × 11.8	0.849
	11.8	<b>F1.5 × 11.8</b>	A1.5 × 11.8	0.159		13.8	<b>F3.5 × 13.8</b>	A3.5 × 13.8	1.00
	13.8	<b>F1.5 × 13.8</b>	A1.5 × 13.8	0.186		15.8	<b>F3.5 × 15.8</b>	A3.5 × 15.8	1.15
2	6.8	<b>F2 × 6.8</b>	A2 × 6.8	0.158		17.8	<b>F3.5 × 17.8</b>	A3.5 × 17.8	1.30
	7.8	<b>F2 × 7.8</b>	A2 × 7.8	0.183		19.8	<b>F3.5 × 19.8</b>	A3.5 × 19.8	1.45
	9.8	<b>F2 × 9.8</b>	A2 × 9.8	0.232		21.8	<b>F3.5 × 21.8</b>	A3.5 × 21.8	1.60
	11.8	<b>F2 × 11.8</b>	A2 × 11.8	0.281	23.8	<b>F3.5 × 23.8</b>	A3.5 × 23.8	1.75	
	13.8	<b>F2 × 13.8</b>	A2 × 13.8	0.330	25.8	<b>F3.5 × 25.8</b>	A3.5 × 25.8	1.90	
	15.8	<b>F2 × 15.8</b>	A2 × 15.8	0.379	29.8	<b>F3.5 × 29.8</b>	A3.5 × 29.8	2.20	
17.8	<b>F2 × 17.8</b>	A2 × 17.8	0.428	31.8	<b>F3.5 × 31.8</b>	A3.5 × 31.8	2.35		
19.8	<b>F2 × 19.8</b>	A2 × 19.8	0.477	34.8	<b>F3.5 × 34.8</b>	A3.5 × 34.8	2.58		
2.5	7.8	<b>F2.5 × 7.8</b>	A2.5 × 7.8	0.284	4	13.8	<b>F4 × 13.8</b>	A4 × 13.8	1.27
	9.8	<b>F2.5 × 9.8</b>	A2.5 × 9.8	0.351		15.8	<b>F4 × 15.8</b>	A4 × 15.8	1.50
	11.8	<b>F2.5 × 11.8</b>	A2.5 × 11.8	0.438		17.8	<b>F4 × 17.8</b>	A4 × 17.8	1.70
	13.8	<b>F2.5 × 13.8</b>	A2.5 × 13.8	0.514		19.8	<b>F4 × 19.8</b>	A4 × 19.8	1.89
	15.8	<b>F2.5 × 15.8</b>	A2.5 × 15.8	0.591		21.8	<b>F4 × 21.8</b>	A4 × 21.8	2.09
	17.8	<b>F2.5 × 17.8</b>	A2.5 × 17.8	0.668		23.8	<b>F4 × 23.8</b>	A4 × 23.8	2.26
	19.8	<b>F2.5 × 19.8</b>	A2.5 × 19.8	0.745		25.8	<b>F4 × 25.8</b>	A4 × 25.8	2.48
	21.8	<b>F2.5 × 21.8</b>	A2.5 × 21.8	0.821		27.8	<b>F4 × 27.8</b>	A4 × 27.8	2.68
23.8	<b>F2.5 × 23.8</b>	A2.5 × 23.8	0.898	29.8	<b>F4 × 29.8</b>	A4 × 29.8	2.87		
3	9.8	<b>F3 × 9.8</b>	A3 × 9.8	0.556	31.8	<b>F4 × 31.8</b>	A4 × 31.8	3.07	
	11.8	<b>F3 × 11.8</b>	A3 × 11.8	0.671	34.8	<b>F4 × 34.8</b>	A4 × 34.8	3.31	
	13.8	<b>F3 × 13.8</b>	A3 × 13.8	0.784	37.8	<b>F4 × 37.8</b>	A4 × 37.8	3.62	
	15.8	<b>F3 × 15.8</b>	A3 × 15.8	0.897	39.8	<b>F4 × 39.8</b>	A4 × 39.8	3.82	
	17.8	<b>F3 × 17.8</b>	A3 × 17.8	1.01	4.5	17.8	<b>F4.5 × 17.8</b>	A4.5 × 17.8	2.11
	19.8	<b>F3 × 19.8</b>	A3 × 19.8	1.12		19.8	<b>F4.5 × 19.8</b>	A4.5 × 19.8	2.36
	21.8	<b>F3 × 21.8</b>	A3 × 21.8	1.23		21.8	<b>F4.5 × 21.8</b>	A4.5 × 21.8	2.61

$D_w$  4.5~5mm

Boundary dimensions mm		Bearing numbers		Mass
$D_w$	$L_w$	flat type	disk type	kg per 1 000 pcs
4.5	23.8	<b>F4.5×23.8</b>	A4.5×23.8	2.86
	25.8	<b>F4.5×25.8</b>	A4.5×25.8	3.11
	29.8	<b>F4.5×29.8</b>	A4.5×29.8	3.62
	31.8	<b>F4.5×31.8</b>	A4.5×31.8	3.87
	34.8	<b>F4.5×34.8</b>	A4.5×34.8	4.25
	37.8	<b>F4.5×37.8</b>	A4.5×37.8	4.63
	39.8	<b>F4.5×39.8</b>	A4.5×39.8	4.88
	44.8	<b>F4.5×44.8</b>	A4.5×44.8	5.51
5	19.8	<b>F5 ×19.8</b>	A5 ×19.8	2.89
	21.8	<b>F5 ×21.8</b>	A5 ×21.8	3.20
	23.8	<b>F5 ×23.8</b>	A5 ×23.8	3.52
	25.8	<b>F5 ×25.8</b>	A5 ×25.8	3.82
	29.8	<b>F5 ×29.8</b>	A5 ×29.8	4.45
	31.8	<b>F5 ×31.8</b>	A5 ×31.8	4.74
	34.8	<b>F5 ×34.8</b>	A5 ×34.8	5.11
	37.8	<b>F5 ×37.8</b>	A5 ×37.8	5.55
	39.8	<b>F5 ×39.8</b>	A5 ×39.8	5.85
	49.8	<b>F5 ×49.8</b>	A5 ×49.8	7.33

## Snap Rings

These snap rings are used exclusively for fixing or guiding a needle roller bearing ring or cage in axial direction. Furthermore, these snap rings have the profile identical to C-type concentric snap ring specified in JIS B 2806 and, in addition, snap rings with smaller section height (*b*) and also available in smaller dimension range are manufactured according to application of needle roller bearings. These snap rings are manufactured using hard steel wire rod and, after manufactured, chemical conversion treatment is applied to the surface thereof.

### Types of snap ring

Two types of snap ring are available; one is **Type WR** designed for application to shaft and another is **Type BR** for application to bearing housing.

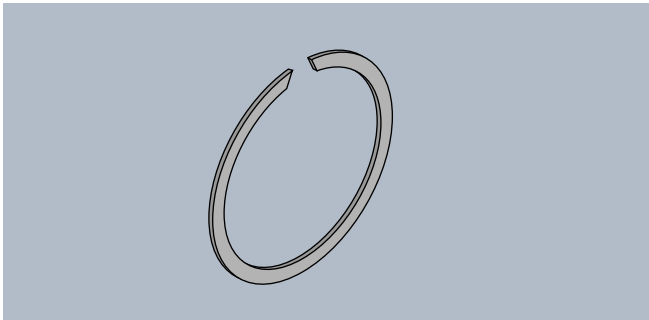


Fig. 1 WR snap ring

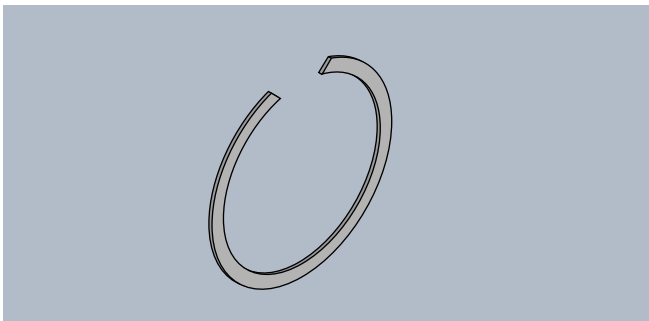


Fig. 2 BR snap ring

Table 1 Cut section angle of snap ring ( $\alpha$ )

Type	Nominal number	Cut section angle( $\alpha$ )
Type WR	WR4, WR5	40°
	Type WR6 up to	60°
Type BR	All nominal numbers	90°

### Composition of snap ring number

The snap ring number is composed of type code (**WR** or **BR**) and dimension code. The dimension code represents applicable shaft diameter in **Type WR** and applicable housing bore diameter in **Type BR**.

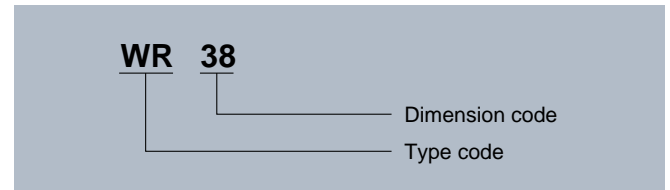


Fig. 3

### Allowable running speed

The allowable running speed for **Type WR** for shaft application is as described in applicable Dimensions Table. This means the running speed when snap ring begins to get loose with opening of its cut ends.

### Mounting relation

It is recommended to insert a spacer between snap ring and cage for guiding the cage in axial direction (Refer to **Fig. 4**.) On occasion, snap ring is difficult to remove, but limited to a portion in which a pull-out tool can not be inserted easily. In such a case, consider the cross-sectional height of the needle roller bearing in question, and then judge whether or not an ordinary retaining ring (JIS B 2804 "Retaining rings-C type") can be used.

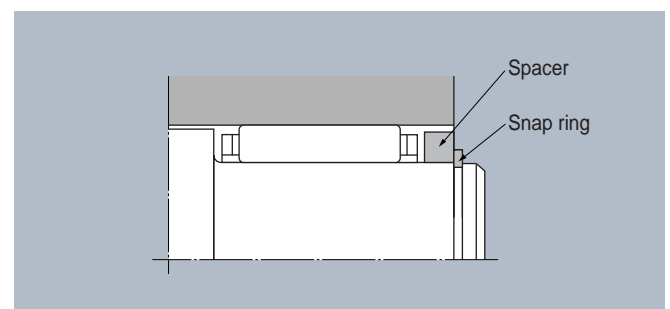
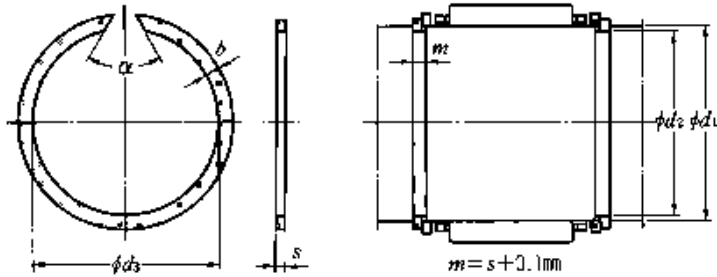


Fig. 4

For shaft

Type WR

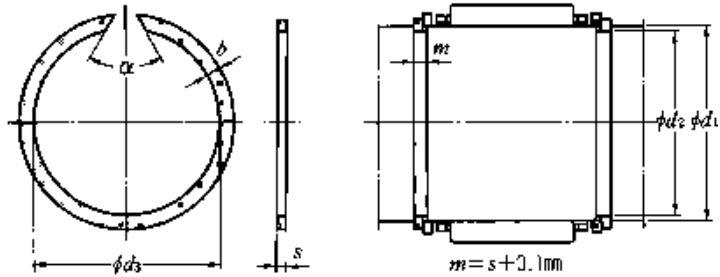


Bearing numbers	Boundary dimensions					Limiting speeds min <sup>-1</sup>
	d <sub>1</sub>	d <sub>3</sub> max	b	s ±0.06	c <sub>2</sub>	
WR 4	4	3.7	0.8	0.5	3.8	275 000
WR 5	5	4.7	1	0.5	4.8	192 000
WR 6	6	5.6	1.1	0.7	5.7	141 000
WR 7	7	6.5	1.2	0.7	6.7 <sup>-0.09</sup>	134 000
WR 8	8	7.4	1.3	1	7.6	108 000
WR 9	9	8.4	1.3	1	8.6	80 000
WR10	10	9.4	1.3	1	9.6	68 000
WR11	11	10.2	1.3	1	10.5	64 500
WR12	12	11.2	1.3	1	11.5	53 000
WR13	13	12.2	1.3	1	12.5	49 600
WR14	14	13.1	1.5	1.2	13.5	45 900
WR15	15	14	1.75	1.2	14.4 <sup>-0.11</sup>	44 500
WR16	16	15	1.75	1.2	15.4	38 000
WR17	17	16	1.75	1.2	16.4	34 500
WR18	18	17	1.75	1.2	17.4	30 000
WR19	19	17.9	1.75	1.2	18.4	28 900
WR20	20	18.7	1.75	1.2	19.2	26 200
WR21	21	19.7	1.75	1.2	20.2	23 400
WR22	22	20.7	1.75	1.2	21.2	20 800
WR23	23	21.7	1.75	1.2	22.2	19 500
WR24	24	22.5	1.75	1.2	23 <sup>-0.13</sup>	18 100
WR25	25	23.5	1.75	1.2	24	16 400
WR26	26	24.5	1.75	1.2	25	14 800
WR28	28	26.5	2.3	1.5	27	15 400
WR29	29	27.5	2.3	1.5	28	14 400
WR30	30	28.5	2.3	1.5	29	13 200
WR32	32	30.2	2.3	1.5	30.8	13 300
WR35	35	33.2	2.3	1.5	33.8 <sup>-0.16</sup>	10 700

Bearing numbers	Boundary dimensions					Limiting speeds min <sup>-1</sup>
	d <sub>1</sub>	d <sub>3</sub> max	b	s ±0.06	c <sub>2</sub>	
WR 37	37	35.2	2.3	1.5	35.8	9 200
WR 38	38	36.2	2.3	1.5	36.8	8 700
WR 40	40	37.8	2.3	1.5	38.5	8 100
WR 42	42	39.8	2.3	1.5	40.5	7 000
WR 43	43	40.8	2.3	1.5	41.5 <sup>-0.16</sup>	6 800
WR 45	45	42.8	2.3	1.5	43.5	5 800
WR 47	47	44.8	2.3	1.5	45.5	5 500
WR 48	48	45.8	2.3	1.5	46.5	5 300
WR 50	50	47.8	2.3	1.5	48.5	4 800
WR 52	52	49.8	2.3	1.5	50.5	4 300
WR 55	55	52.6	2.3	1.5	53.5	4 400
WR 58	58	55.6	2.3	1.5	56.5	3 900
WR 60	60	57.6	2.3	1.5	58.5	3 500
WR 61	61	58.6	2.3	1.5	59.5	3 300
WR 62	62	59.6	2.3	1.5	60.5	3 200
WR 63	63	60.6	2.3	1.5	61.5	3 100
WR 64	64	61.6	2.3	1.5	62.5 <sup>-0.19</sup>	2 900
WR 65	65	62.6	2.3	1.5	63.5	2 800
WR 68	68	65.4	2.8	2	66.2	2 900
WR 70	70	67.4	2.8	2	68.2	2 700
WR 72	72	69.4	2.8	2	70.2	2 600
WR 73	73	70.4	2.8	2	71.2	2 500
WR 75	75	72.4	2.8	2	73.2	2 300
WR 80	80	77.4	2.8	2	78.2	1 950
WR 85	85	82	3.4	2.5	83	2 300
WR 90	90	87	3.4	2.5	88	2 000
WR 95	95	92	3.4	2.5	93 <sup>-0.22</sup>	1 750
WR100	100	97	3.4	2.5	98	1 560

For shaft

Type WR

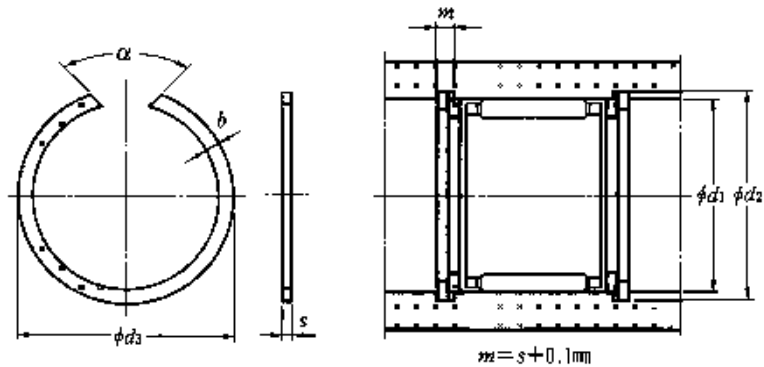


Bearing numbers	Boundary dimensions					Limiting speeds r/min
	$d_1$	$d_3$ max	$b$	$s$ $\pm 0.06$	$d_2$	
WR105	105	101.7	3.4	2.5	102.7	1 390
WR110	110	106.7	3.4	2.5	107.7	1 240
WR115	115	111.7	3.4	2.5	112.7	$0$ -0.22 1 100
WR120	120	116.7	3.4	2.5	117.7	1 000
WR125	125	121.7	3.4	2.5	122.7	920
WR130	130	126.7	3.4	2.5	127.7	830
WR135	135	131.6	4	2.5	132.4	830
WR140	140	136.6	4	2.5	137.4	760
WR145	145	141.6	4	2.5	142.4	690
WR150	150	146.6	4	2.5	147.4	640
WR155	155	151.6	4	2.5	152.4	$0$ -0.25 590
WR160	160	156.6	4	2.5	157.4	550
WR165	165	161.6	4	2.5	162.4	500
WR170	170	166.6	4	2.5	167.4	470
WR175	175	171.6	4	2.5	172.4	440
WR180	180	175.6	5	3	177	430
WR185	185	180.6	5	3	182	590
WR190	190	185.6	5	3	187	540
WR195	195	190.6	5	3	192	510
WR200	200	195.6	5	3	197	480
WR210	210	205.6	5	3	207	420
WR220	220	215.6	5	3	217	$0$ -0.29 380
WR225	225	220.6	5	3	222	360
WR230	230	225.6	5	3	227	350
WR240	240	235.6	5	3	237	310
WR250	250	245.6	5	3	247	270
WR260	260	253	7.5	4	255	430
WR265	265	258	7.5	4	260	$0$ -0.32 410

Bearing numbers	Boundary dimensions					Limiting speeds r/min
	$d_1$	$d_3$ max	$b$	$s$ $\pm 0.06$	$d_2$	
WR270	270	263	7.5	4	265	380
WR280	280	273	7.5	4	275	360
WR285	285	278	7.5	4	280	350
WR290	290	283	7.5	4	285	$0$ -0.32 340
WR300	300	293	7.5	4	295	300
WR305	305	298	7.5	4	300	290
WR310	310	303	7.5	4	305	280
WR320	320	313	7.5	4	315	260
WR330	330	323	7.5	4	325	240
WR340	340	333	7.5	4	335	220
WR350	350	343	7.5	4	345	210
WR360	360	353	7.5	4	355	$0$ -0.36 190
WR370	370	363	7.5	4	365	180
WR380	380	373	7.5	4	375	170
WR390	390	383	7.5	4	385	160
WR400	400	393	7.5	4	395	150

## For housing

### Type BR

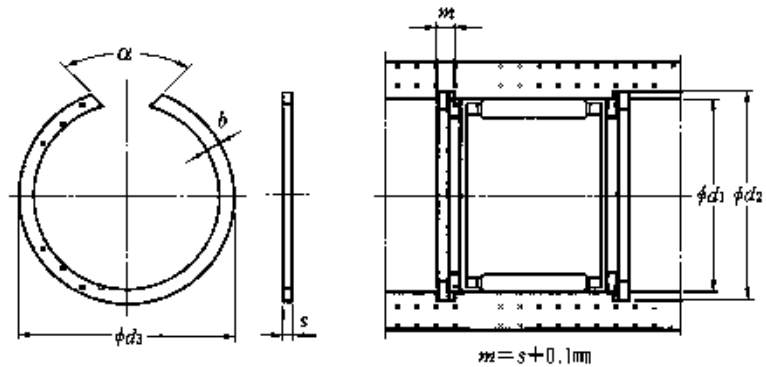


Bearing numbers	Boundary dimensions					
	$d_1$	$d_2$ min	$b$	$s$ $\pm 0.06$	$d_2$	
BR 7	7	7.5	1	0.8	7.3	$+0.09$ 0
BR 8	8	8.5	1	0.8	8.3	
BR 9	9	9.5	1.1	0.8	9.3	
BR10	10	10.6	1.2	0.8	10.4	$+0.11$ 0
BR11	11	11.6	1.3	1	11.4	
BR12	12	12.7	1.3	1	12.4	
BR13	13	13.8	1.3	1	13.5	
BR14	14	14.8	1.3	1	14.5	
BR15	15	15.8	1.3	1	15.5	$+0.13$ 0
BR16	16	16.8	1.6	1.2	16.5	
BR17	17	17.8	1.6	1.2	17.5	
BR18	18	18.9	1.75	1.2	18.5	
BR19	19	19.9	1.75	1.2	19.6	
BR20	20	21	1.75	1.2	20.6	
BR21	21	22	1.75	1.2	21.6	
BR22	22	23	1.75	1.2	22.6	$+0.16$ 0
BR23	23	24	1.75	1.2	23.6	
BR24	24	25.2	1.75	1.2	24.8	
BR25	25	26.2	1.75	1.2	25.8	
BR26	26	27.2	1.75	1.2	26.8	
BR27	27	28.2	1.75	1.2	27.8	
BR28	28	29.2	1.75	1.2	28.8	
BR29	29	30.2	1.75	1.2	29.8	
BR30	30	31.4	2.3	1.5	31	$+0.16$ 0
BR31	31	32.4	2.3	1.5	32	
BR32	32	33.4	2.3	1.5	33	
BR33	33	34.4	2.3	1.5	34	
BR34	34	35.4	2.3	1.5	35	

Bearing numbers	Boundary dimensions					
	$d_1$	$d_2$ min	$b$	$s$ $\pm 0.06$	$d_2$	
BR35	35	36.4	2.3	1.5	36	$+0.16$ 0
BR36	36	37.8	2.3	1.5	37.2	
BR37	37	38.8	2.3	1.5	38.2	
BR38	38	39.8	2.3	1.5	39.2	
BR39	39	40.8	2.3	1.5	40.2	
BR40	40	41.8	2.3	1.5	41.2	
BR41	41	42.8	2.3	1.5	42.2	
BR42	42	43.8	2.3	1.5	43.2	
BR43	43	44.8	2.3	1.5	44.2	
BR44	44	45.8	2.3	1.5	45.2	
BR45	45	46.8	2.3	1.5	46.2	
BR46	46	47.8	2.3	1.5	47.2	$+0.19$ 0
BR47	47	48.8	2.3	1.5	48.2	
BR48	48	49.8	2.3	1.5	49.2	
BR49	49	50.8	2.3	1.5	50.2	
BR50	50	51.8	2.3	1.5	51.2	
BR52	52	54.3	2.3	1.5	53.5	
BR53	53	55.3	2.3	1.5	54.5	
BR54	54	56.3	2.3	1.5	55.5	
BR55	55	57.3	2.3	1.5	56.5	
BR57	57	59.3	2.3	1.5	58.5	
BR58	58	60.3	2.3	1.5	59.5	
BR60	60	62.3	2.3	1.5	61.5	
BR61	61	63.3	2.3	1.5	62.5	$+0.19$ 0
BR62	62	64.3	2.3	1.5	63.5	
BR63	63	65.3	2.3	1.5	64.5	
BR64	64	66.3	2.3	1.5	65.5	
BR65	65	67.3	2.3	1.5	66.5	

## For housing

### Type BR



Bearing numbers	Boundary dimensions				
	$d_1$	$d_2$ min	$b$	$s$ $\pm 0.06$	$d_2$
BR 66	66	68.3	2.3	1.5	67.5
BR 68	68	70.3	2.3	1.5	69.5
BR 70	70	72.3	2.3	1.5	71.5
BR 72	72	74.6	2.8	2	73.8
BR 73	73	75.6	2.8	2	74.8
BR 74	74	76.6	2.8	2	75.8
BR 75	75	77.6	2.8	2	76.8
BR 76	76	78.6	2.8	2	77.8
BR 77	77	79.6	2.8	2	78.8
BR 78	78	80.6	2.8	2	79.8
BR 79	79	81.6	2.8	2	80.8
BR 81	81	83.6	2.8	2	82.8
BR 82	82	84.6	2.8	2	83.8
BR 83	83	85.6	2.8	2	84.8
BR 85	85	87.6	2.8	2	86.8
BR 86	86	88.6	2.8	2	87.8
BR 88	88	91	3.4	2.5	90
BR 90	90	93	3.4	2.5	92
BR 92	92	95	3.4	2.5	94
BR 93	93	96	3.4	2.5	95
BR 95	95	98	3.4	2.5	97
BR 97	97	100	3.4	2.5	99
BR 98	98	101	3.4	2.5	100
BR100	100	103	3.4	2.5	102
BR102	102	105.3	3.4	2.5	104.3
BR103	103	106.3	3.4	2.5	105.3
BR105	105	108.3	3.4	2.5	107.3
BR107	107	110.3	3.4	2.5	109.3

Bearing numbers	Boundary dimensions				
	$d_1$	$d_2$ min	$b$	$s$ $\pm 0.06$	$d_2$
BR108	108	111.3	3.4	2.5	110.3
BR110	110	113.3	3.4	2.5	112.3
BR112	112	115.3	3.4	2.5	114.3
BR113	113	116.3	3.4	2.5	115.3
BR115	115	118.3	3.4	2.5	117.3
BR117	117	120.3	3.4	2.5	119.3
BR118	118	121.3	3.4	2.5	120.3
BR120	120	123.3	3.4	2.5	122.3
BR123	123	126.3	3.4	2.5	125.3
BR125	125	128.3	3.4	2.5	127.3
BR127	127	130.3	3.4	2.5	129.3
BR130	130	133.3	3.4	2.5	132.3
BR133	133	136.3	3.4	2.5	135.3
BR135	135	138.3	3.4	2.5	137.3
BR137	137	140.3	3.4	2.5	139.3
BR140	140	143.6	4	2.5	142.6
BR143	143	146.6	4	2.5	145.6
BR150	150	153.6	4	2.5	152.6
BR153	153	156.6	4	2.5	155.6
BR160	160	163.6	4	2.5	162.6
BR163	163	166.6	4	2.5	165.6
BR165	165	168.6	4	2.5	167.6
BR170	170	173.6	4	2.5	172.6
BR173	173	176.6	4	2.5	175.6
BR175	175	178.6	4	2.5	177.6
BR180	180	183.6	4	2.5	182.6
BR183	183	186.6	4	2.5	185.6
BR190	190	194.5	5	3	193

Bearing numbers	Boundary dimensions					
	$d_1$	$d_3$ min	mm		$d_2$	
			$b$	$s$ $\pm 0.06$		
<b>BR195</b>	195	199.5	5	3	198	
<b>BR200</b>	200	204.5	5	3	203	
<b>BR205</b>	205	209.5	5	3	208	
<b>BR210</b>	210	214.5	5	3	213	+0.29 0
<b>BR215</b>	215	219.5	5	3	218	
<b>BR220</b>	220	224.5	5	3	223	
<b>BR225</b>	225	229.5	5	3	228	
<b>BR230</b>	230	234.5	5	3	233	
<b>BR240</b>	240	244.5	5	3	243	
<b>BR250</b>	250	254.5	5	3	253	
<b>BR260</b>	260	267	7.5	4	265	+0.32 0
<b>BR270</b>	270	277	7.5	4	275	
<b>BR280</b>	280	287	7.5	4	285	
<b>BR300</b>	300	307	7.5	4	305	
<b>BR320</b>	320	327	7.5	4	325	
<b>BR325</b>	325	332	7.5	4	330	
<b>BR350</b>	350	357	7.5	4	355	
<b>BR355</b>	355	362	7.5	4	360	
<b>BR360</b>	360	367	7.5	4	365	+0.36 0
<b>BR375</b>	375	382	7.5	4	380	
<b>BR380</b>	380	387	7.5	4	385	
<b>BR385</b>	385	392	7.5	4	390	
<b>BR395</b>	395	402	7.5	4	400	
<b>BR400</b>	400	407	7.5	4	405	
<b>BR415</b>	415	422	7.5	4	420	
<b>BR420</b>	420	427	7.5	4	425	+0.40 0
<b>BR440</b>	440	447	7.5	4	445	

## Seals

### Seals

These are the special-purposed seals for needle roller bearings whose cross sectional height is designed so small as to match applicable needle roller bearings. These contact seals are made of synthetic rubber reinforced with steel plate, being then used in operating temperature range of -25 to +120°C and, under continuous running, at 100°C and less. Further, feel free to contact NTN for the use of these seals under special operating condition, e.g. operating temperature of over 120°C.

### Types of seal

Two different seal types are available; one is **Type G** with one lip and another is **Type GD** with two lips. In addition to these two, sliding rubber seals (**LEG**, **LEGD**), wherein lubrication property was assigned to a rubber material fulfilling low torque under a non-lubrication environment, are also manufactured. Feel free to contact NTN for the detail of these seal types.

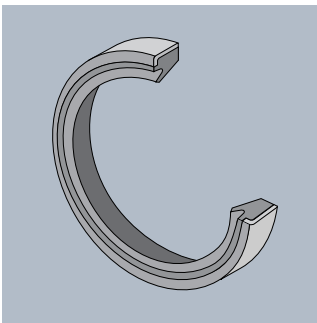


Fig. 1 Type G (LEG)

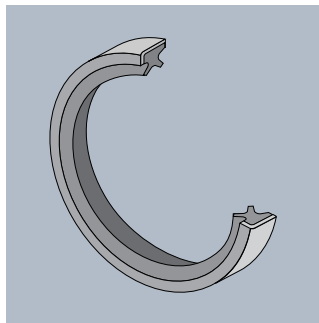


Fig. 2 Type GD (LEGD)

Where seal contact surface and lubricating condition are good, **Type G** with one lip can be used up to 10m/s maximum at peripheral speed and **Type GD** with two lips used up to 6m/s maximum.

**This seal is intended to hold grease and to prevent dust invasion from outside. It has no function to hold lubrication oil, etc. unlike oil seal.**

### Composition of seal number

The seal number is composed of type code (G, GD) and dimension code (bore dia. × outer dia. × width).

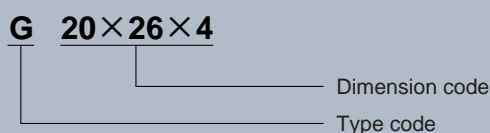


Fig. 3

### Fitting relations

The seal contact surface must be finished by grinding, after hardened, to get its good sealing performance. In addition, harmful flaw and indent are not allowed to exist on the seal contact surface. Where the inner ring raceway surface is used as seal contact surface, a wide inner ring must be used.

When fitting a seal in a bearing, it is desirable to taper the shaft end face or the housing end face so as to protect the seal lip and outer surface from damaging, as illustrated in **Fig. 4**. Where shaft end is not tapered or chamfered (rounded), it is recommended to a fitting jig as illustrated in **Fig. 5**. Regarding the seal to housing interference, a adequate interference can be got in the usual housing tolerance range of G7 to R7.

**Furthermore, it is recommended to apply pre-coat of a lubricant to the seal lip before fitting seals G and GD, for better lubrication. Further, when fitting a seal and inserting it through a shaft, take good care to protect its lip from deforming.**

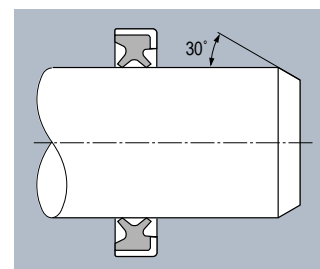


Fig. 4

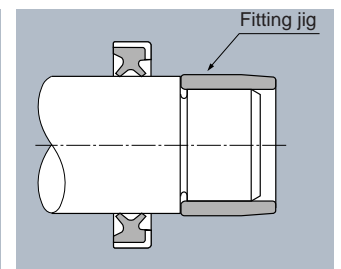


Fig. 5

### Seal application examples

**Figs. 6 to 8** illustrate design examples using these seals.

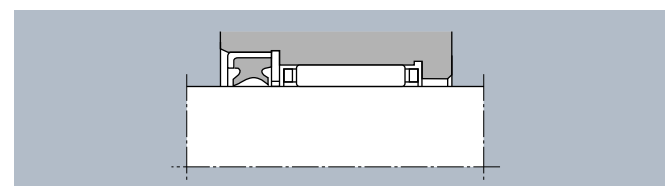


Fig. 6

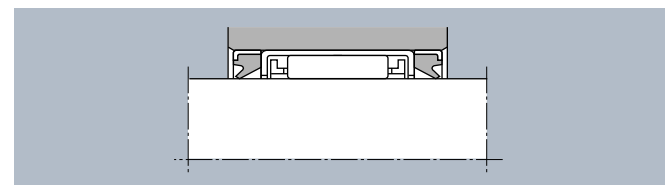


Fig. 7

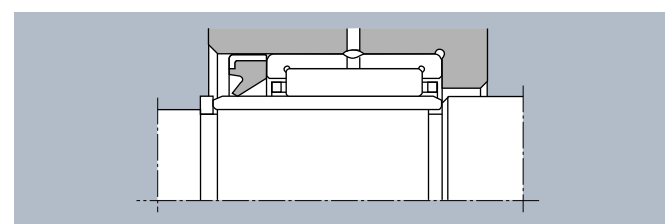
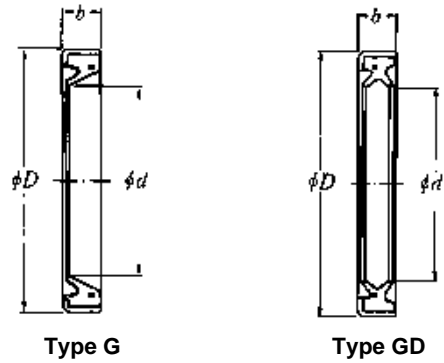


Fig. 8

Type G  
Type GD

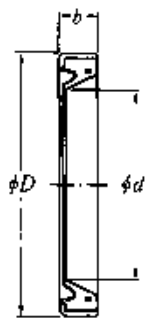


Bearing numbers		Boundary dimensions mm			Mass ×10 <sup>-3</sup> kg	
Type G	Type GD	d	D <sup>1)</sup>	b <sub>+0.2 0</sub>	G	GD
G 4×8×2	—	4	8	2	0.18	—
G 5×9×2	—	5	9	2 <sub>+0.081</sub>	0.19	—
G 5×10×2	—	5	10	2 <sub>+0.023</sub>	0.22	—
G 6×10×2	—	6	10	2	0.21	—
G 6×12×2	—	6	12	2	0.38	—
G 7×11×2	—	7	11	2	0.25	—
G 7×14×2	—	7	14	2	0.52	—
G 8×12×3	—	8	12	3	0.41	—
G 8×15×3	—	8	15	3	0.74	—
G 9×13×3	—	9	13	3 <sub>+0.098 +0.028</sub>	0.44	—
G 9×16×3	—	9	16	3	0.69	—
G10×14×3	—	10	14	3	0.50	—
G10×17×3	—	10	17	3	0.87	—
G12×16×3	—	12	16	3	0.56	—
G12×18×3	—	12	18	3	0.86	—
G12×19×3	—	12	19	3	0.94	—
G13×19×3	—	13	19	3	0.87	—
G14×20×3	GD14×20×3	14	20	3	0.96	0.99
G14×21×3	GD14×21×3	14	21	3	1.1	1.1
G14×22×3	GD14×22×3	14	22	3	1.3	1.2
G15×21×3	GD15×21×3	15	21	3	1.0	1.0
G15×23×3	GD15×23×3	15	23	3 <sub>+0.119 +0.035</sub>	1.3	1.3
G16×22×3	GD16×22×3	16	22	3	1.3	1.1
G16×24×3	GD16×24×3	16	24	3	1.3	1.3
G16×25×3	GD16×25×3	16	25	3	1.6	1.6
G17×23×3	GD17×23×3	17	23	3	1.3	1.1
G17×25×3	GD17×25×3	17	25	3	1.5	1.4
G18×24×3	GD18×24×3	18	24	3	1.2	1.2

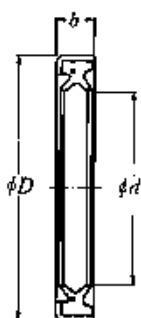
Bearing numbers		Boundary dimensions mm			Mass ×10 <sup>-3</sup> kg	
Type G	Type GD	d	D <sup>1)</sup>	b <sub>+0.2 0</sub>	G	GD
G18×26×4	GD18×26×4	18	26	4	1.8	1.8
G19×27×4	GD19×27×4	19	27	4	2.0	1.9
G20×26×4	GD20×26×4	20	26	4	1.8	1.8
G20×28×4	GD20×28×4	20	28	4 <sub>+0.119 +0.035</sub>	2.1	2.1
G21×29×4	GD21×29×4	21	29	4	2.2	2.1
G22×28×4	GD22×28×4	22	28	4	1.8	1.9
G22×30×4	GD22×30×4	22	30	4	2.2	2.3
G24×32×4	GD24×32×4	24	32	4	2.5	2.4
G25×32×4	GD25×32×4	25	32	4	2.3	2.2
G25×33×4	GD25×33×4	25	33	4	2.5	2.5
G25×35×4	GD25×35×4	25	35	4	2.6	2.6
G26×34×4	GD26×34×4	26	34	4	2.6	2.6
G28×35×4	GD28×35×4	28	35	4	2.4	2.5
G28×37×4	GD28×37×4	28	37	4	3.1	2.8
G29×37×4	GD29×37×4	29	37	4	2.7	2.7
G29×38×4	GD29×38×4	29	38	4	3.2	2.9
G30×37×4	GD30×37×4	30	37	4 <sub>+0.143 +0.043</sub>	2.7	2.6
G30×40×4	GD30×40×4	30	40	4	3.6	3.3
G32×42×4	GD32×42×4	32	42	4	3.7	3.9
G32×45×4	GD32×45×4	32	45	4	5.1	5.2
G35×42×4	GD35×42×4	35	42	4	3.0	2.9
G35×45×4	GD35×45×4	35	45	4	4.1	3.6
G37×47×4	GD37×47×4	37	47	4	4.0	3.8
G38×48×4	GD38×48×4	38	48	4	4.4	4.0
G40×47×4	GD40×47×4	40	47	4	3.3	3.5
G40×50×4	GD40×50×4	40	50	4	4.6	4.0
G40×52×5	GD40×52×5	40	52	5 <sub>+0.173</sub>	4.8	4.7
G42×52×4	GD42×52×4	42	52	4 <sub>+0.053</sub>	4.7	4.2

Note 1) The outer diameter tolerance is the mean value of the measured values at two measuring points.

Type G  
Type GD



Type G



Type GD

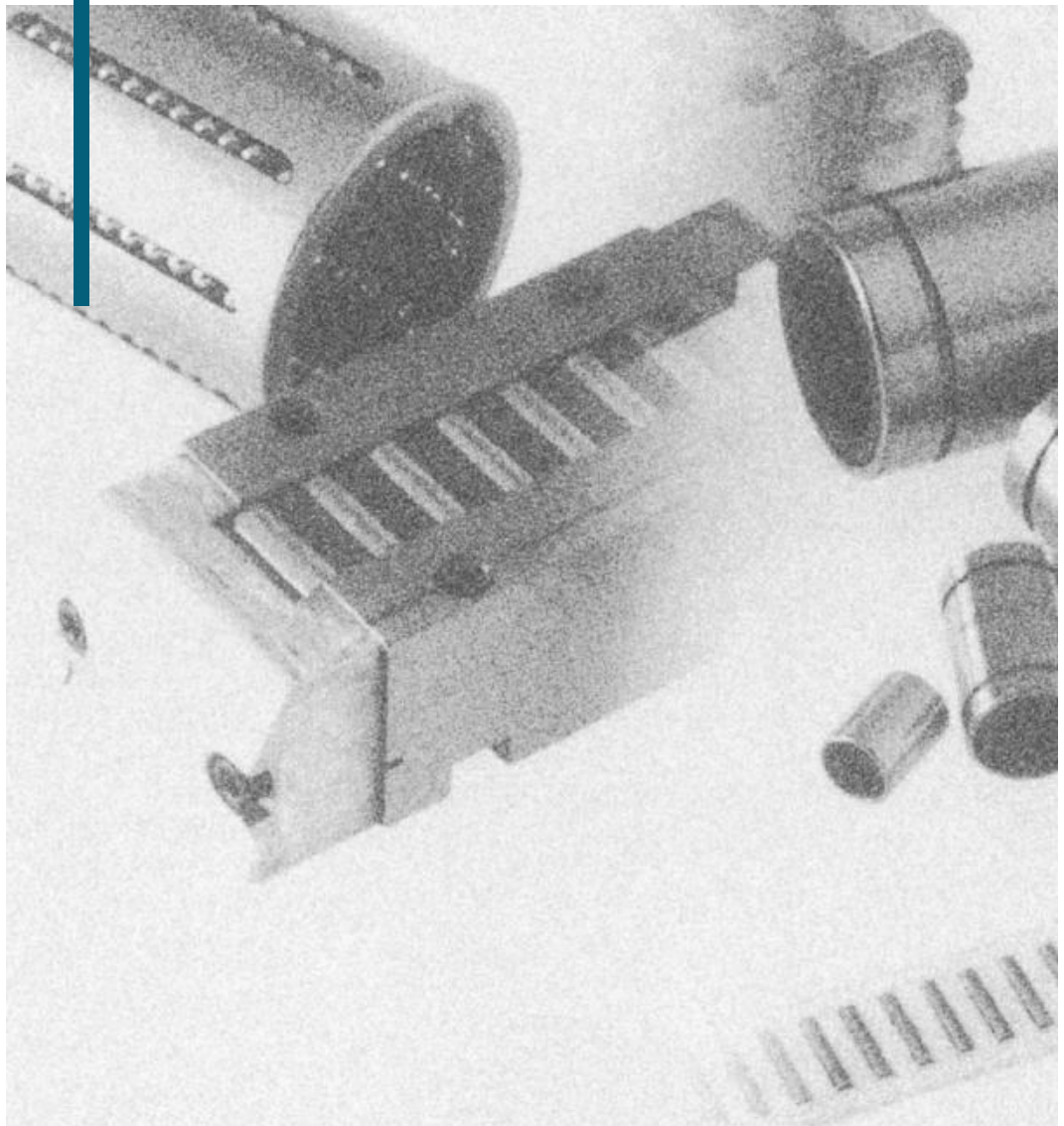
Bearing numbers		Boundary dimensions			Mass	
Type G	Type GD	mm			×10 <sup>-3</sup> kg	
		<i>d</i>	<i>D</i> <sup>1)</sup>	<i>b</i> <sub>+0.2 0</sub>	G	GD
<b>G43×53×4</b>	<b>GD43×53×4</b>	43	53	4	4.8	4.3
<b>G45×52×4</b>	<b>GD45×52×4</b>	45	52	4	3.8	3.8
<b>G45×55×4</b>	<b>GD45×55×4</b>	45	55 <sub>+0.053</sub> <sup>+0.173</sup>	4	5.2	5.5
<b>G50×58×4</b>	<b>GD50×58×4</b>	50	58	4	4.5	5.2
<b>G50×62×5</b>	<b>GD50×62×5</b>	50	62	5	10.4	10

Note 1) The outer diameter tolerance is the mean value of the measured values at two measuring points.

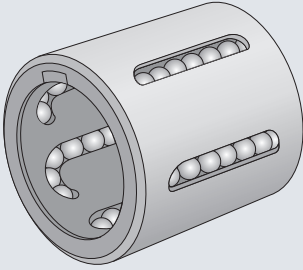
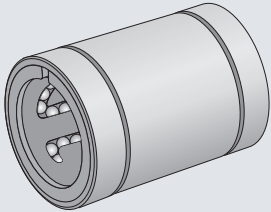
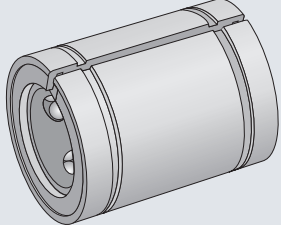
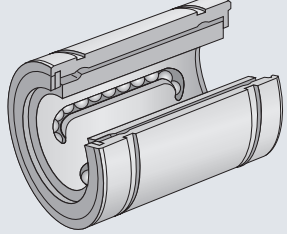
# LINEAR BEARINGS

## LINEAR BALL BEARINGS:

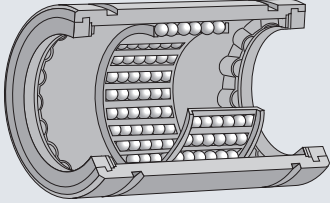
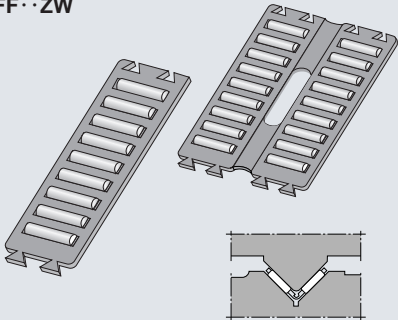
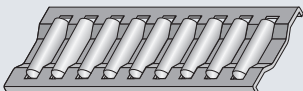
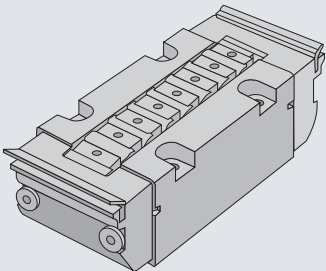
Drawn Cup, Solid, Stroke, Linear Flat Roller,  
and Linear Roller Bearing Types



## Linear Ball Bearings

Type	Applicable shaft diameter (mm)	Composition of bearing number
<p><b>KH</b></p>  <p>This type is composed of an outer ring, steel balls and a cage and the outer ring is cylindrical similarly to that of Type KLM and drawn from a steel plate by precision deep drawing, then enabling to design a compact bearing construction of low section and lightweight. This type also ensures precise and smooth infinite linear motion similarly to other types.</p>	<p><math>\phi 6 - \phi 50</math></p> <p>With seal <math>\phi 10 - \phi 50</math></p>	<p><b>KH 20 30 LL/3AS</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— LL: Seal</li> <li>— 3AS: Grease code</li> <li>— Width</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>
<p><b>KLM</b></p>  <p>This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity.</p>	<p><math>\phi 3 - \phi 40</math></p>	<p><b>KLM 06 LL/3AS</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— LL: Seal</li> <li>— 3AS: Grease code</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>
<p><b>KLM··S</b></p>  <p>This type is composed of an outer ring, steel balls and a cage. And both of the outer ring and the cage have an axial slit, as illustrated, so as to enable to shrink the inscribed circle diameter of the cage by pressing the outer ring in radial direction from the housing and to thereby adjust radial clearance from shaft. Thus, this type also ensures precise and smooth infinite linear motion.</p>	<p><math>\phi 16 - \phi 40</math></p>	<p><b>KLM 30 S</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— S: Clearance-adjustable</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>
<p><b>KLM··P</b></p>  <p>This type is composed of an outer ring, steel balls and a cage. And the outer ring and the cage are of arc sectional shape, from which one row of balls (equivalent to 50° to 60° degree spacing) is removed. Thus, the arc cross-sectional ring and cage with 50° to 60° degree opening allows the bearing assembly to pass through a shaft support truss or a shaft support stand on midway of the shaft stroke. This type also ensures precise and smooth infinite linear motion, similarly to other types. The bearing radial clearance can be also adjusted.</p>	<p><math>\phi 16 - \phi 40</math></p>	<p><b>KLM 30 P LL/3AS</b></p> <ul style="list-style-type: none"> <li>— Suffix</li> <li>— P: Open configuration</li> <li>— LL: Seal</li> <li>— 3AS: Grease code</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>

Components	Infinite motion	Finite motion	Rotating motion	Remarks
Roller set bore diameter: $\phi 20$ Width: 30 Seal: Double-side seal Grease: Prefilled	○	○	×	<p>The cages of the bearing types KLM, KLM, S, KLM,P and KH are all molded from polyamide resin and, therefore, these bearing types shall be used at allowable temperature 120°C and, under continuous running, at 100°C and less.</p> <p>To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100°C.</p> <p>These bearing types can't rotate.</p>
Roller set bore diameter: $\phi 6$ Seal: Double-side seal Grease: Prefilled	○	○	×	
Roller set bore diameter: $\phi 30$ Type: Clearance-adjustable type	○	○	×	
Roller set bore diameter: $\phi 30$ Type: Open type Seal: Double-side seal Grease: Prefilled	○	○	×	

Type	Applicable shaft diameter (mm)	Composition of bearing number
<p><b>KD</b></p> 	<p>This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity.</p>	<p>Shaft diameter <math>\phi 10 - \phi 80</math></p> <p><b>KD 20 32 45 LL/3AS</b></p> <ul style="list-style-type: none"> <li>— Suffix LL: Seal 3AS: Grease</li> <li>— Width</li> <li>— Outer diameter</li> <li>— Roller set bore diameter</li> <li>— Type code</li> </ul>
<p><b>FF</b> <b>FF · ZW</b></p> 	<p>This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction actor by being inserted between two planes in relative position. The cage made of polyamide resin is provided with grooved joint at its both ends so several cages can be jointed together into one unit.</p>	<p>Roller diameter <math>\phi 2 - \phi 3.5</math></p> <p><b>FF 25 18 ZW</b></p> <ul style="list-style-type: none"> <li>— Suffix ZW: Double row</li> <li>— Width</li> <li>— Roller diameter <math>\times 10</math></li> <li>— Type code</li> </ul>
<p><b>BF (RF)</b></p> 	<p>This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction factor by being inserted between two planes in relative position. Press-formed steel plate cage (BF) and polyamide resin cage (RF) are selectively available. However, in the case of this bearing type several bearings can't not be jointed together into one unit.</p>	<p>Roller diameter <math>\phi 3 - \phi 7</math></p> <p><b>BF 30 20 / 1000</b></p> <ul style="list-style-type: none"> <li>— Cage overall length</li> <li>— Width</li> <li>— Roller diameter <math>\times 10</math></li> <li>— Type code</li> </ul>
<p><b>RLM</b></p> 	<p>This type is composed of a track frame, a separator and rollers. This type has the function enabling cylindrical rollers to circulate within the track frame and ensures infinite linear motion on a plane.</p>	<p>Section height 16—38</p> <p><b>RLM 26 × 86</b></p> <ul style="list-style-type: none"> <li>— Bearing overall length</li> <li>— Section height</li> <li>— Type code</li> </ul>

Components	Infinite motion	Finite motion	Rotating motion	Remarks
Roller set bore diameter: $\phi 20$ Outer diameter: f32 Width: 45 Seal: Double-side seal Grease: Prefilled	×	○	○	To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100°C.
Roller diameter: $\phi 2.5$ Width: 18 ZW: Double-row type Number of rows: Two	○	○	×	Due to its resin cage, this bearing shall be used at allowable temperature 90°C and, under continuous running, at 80°C and less. The double-row type has an elastic joint on the cage center so double rows of flat rollers can be bent to any optional angle along the elastic joint by heating them in oil of 70 to 90°C. By cooling down the double-row rollers with the bent angle held unchanged for several seconds after having bent them to any optional angle, the bent shape of the double rows can be held unchanged so that the double-row rollers can be mounted on a V-shaped surface as illustrated.
Roller diameter: $\phi 3$ Width: 20 Cage length: 1000	○	○	×	Where the resin cage RF is used, the bearing shall be used at allowable temperature 90°C and, under continuous running, at 80°C and less.  The standard length of the bearing unit with BF cage is 1000 mm. The standard length of the bearing unit with RF cage is 705 mm. Two or more bearings of this type can't be jointed with each other, but it can be supplied at any desired length on request.
Section height: 26 Bearing overall length: 86	○	○	×	

## Linear Ball Bearings, Drawn Cup and Solid Types

Four to nine rows of balls are configured equally in the outer ring (outer cylinder). The ball rows circulate in axial direction while being guided by the cage. Thus, these bearing types move infinitely on a shaft in axial direction. However, these bearing types can't rotate.

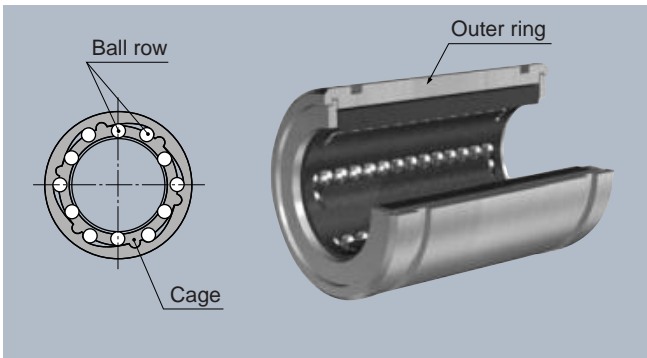


Fig. 1

### Dimensional accuracy

Because of its thin-walled outer ring, the **Type KH** (drawn cup type) unavoidably develops certain degree of deformation in various manufacturing steps, in particular in the heat treatment process. Nevertheless, this bearing type has been designed so that when press-fitted into a housing of accurate dimensions, its deformation is corrected and it can restore its original accuracy to fully develop its design functions. For a method for determining dimensional accuracy of this bearing, contact **NTN Engineering** for technical assistance.

The dimensional accuracies in boundary dimensions, ball set bore diameter ( $F_w$ ), outside diameter ( $D$ ) and width ( $C$ ) of the **Type KLM** (solid type) are listed in the relevant dimension table. Upon request, **NTN** will supply linear ball bearing products for higher accuracy. For details, contact **NTN Engineering**.

### Bearing fit

By employing a shaft or housing featuring dimensional tolerance in **Table 1** in this page, an appropriate radial internal clearance can be provided in the installed bearing. When a further smaller radial internal clearance is needed, achieve selective fit to obtain an intended radial internal clearance by selecting a relevant bearing-shaft or bearing-housing combination.

Table 1 Bearing fit

Type	Shaft	Housing
series HK Drawn-cup type	h6 (j5)	H7 (H6) - steel series - K7 (K6) - light metal alloy series -
series KLM Solid type	g6 (g5)	H7 (H6)

Note) The parenthesized data is applied to shaft/housing subjected to higher accuracy or of vertical construction.

### Shaft and housing requirements

Any shaft /housing on/in which these bearing types are fitted must meet the requirements specified in **Table 2**.

Table 2 Shaft and housing requirements (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT3	IT4
Cylindricity (max)	IT2	IT4
Surface roughness (max.)	0.4a	1.6a
Surface hardness	HRC58~64	—
Case depth (min)	0.4mm	—

### How to mount

The **Type KH** (drawn cup) bearing is press-fitted into the housing in interference fit mode: therefore this type of bearing does not need axial positioning with a means such as a snap ring. For press-fitting, force the marking side on the outer ring with a mandrel illustrated in **Fig. 2**.

The **Type KLM** (solid type) cannot be locked to the housing by interference alone. This type of bearing needs to be axially located with a snap ring.

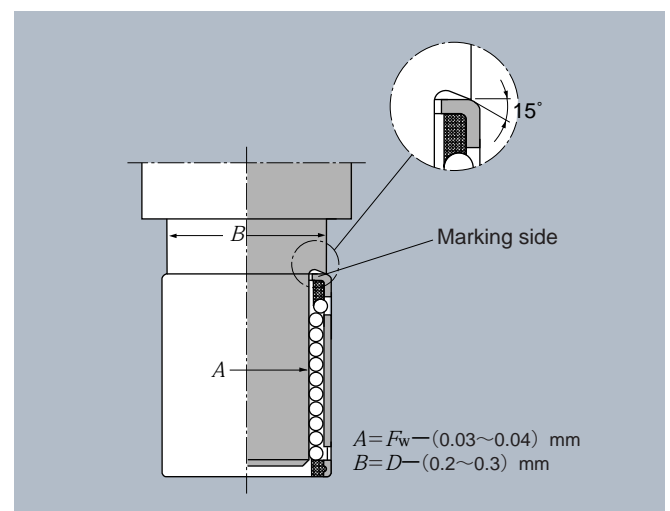
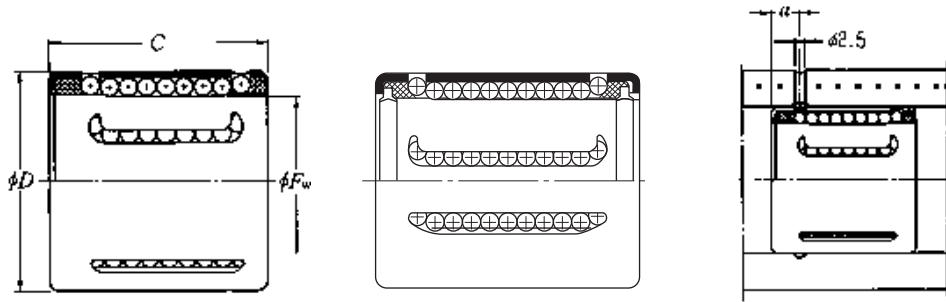


Fig. 2 Series KH

### Accessories

Shafts, shaft support stands and housings exclusive for **NTN** linear ball bearings are also offerable. Feel free to contact **NTN** for the detailed information.

Type KH  
Type KH · LL



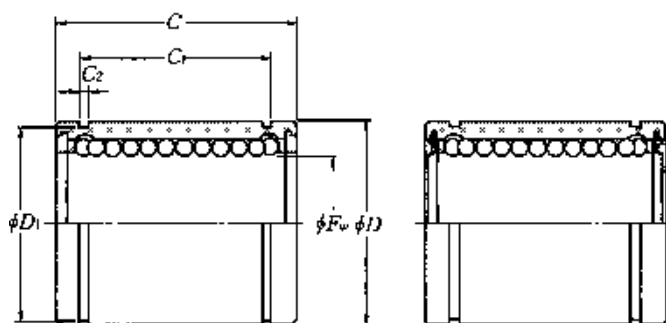
With seal

$F_w$  6~50mm

Boundary dimensions				Bearing numbers	Basic load ratings				Number of ball rows	Mass kg (approx.)
mm					dynamic	static	dynamic	static		
$F_w$	$D$	$C$	$a^{1)}$		$C_r$	$C_{or}$	$C_r$	$C_{or}$		
6	12	22	4	KH0622 <sup>2)</sup>	380	225	39	23	4	0.007
8	15	24	5	KH0824 <sup>2)</sup>	420	255	43	26	4	0.012
10	17	26	5	KH1026 <sup>2)</sup>	480	325	49	33	4	0.015
12	19	28	6	KH1228	605	495	62	51	5	0.018
	19	28	6	KH1228LL/3AS	605	495	62	51	5	0.018
14	21	28	6	KH1428	600	505	61	51	5	0.021
16	24	30	7	KH1630	775	600	79	61	5	0.027
	24	30	7	KH1630LL/3AS	775	600	79	61	5	0.027
20	28	30	7	KH2030	1 050	880	107	90	6	0.033
	28	30	7	KH2030LL/3AS	1 050	880	107	90	6	0.033
25	35	40	8	KH2540	1 930	1 560	196	159	6	0.066
	35	40	8	KH2540LL/3AS	1 930	1 560	196	159	6	0.066
30	40	50	8	KH3050	2 700	2 450	275	250	7	0.095
	40	50	8	KH3050LL/3AS	2 700	2 450	275	250	7	0.095
40	52	60	9	KH4060	4 250	4 000	435	410	8	0.18
50	62	70	9	KH5070	5 300	5 700	540	580	9	0.24

Note 1) Showing a-value from the side face with stamped mark thereon.  
2) Imported product from INA, Germany.

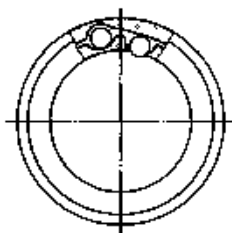
Type KLM      Type KLM · · LL  
 Type KLM · · S    Type KLM · · SLL  
 Type KLM · · P    Type KLM · · PLL



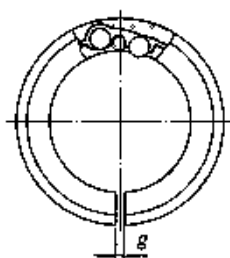
With seal

$F_w$  3~35mm

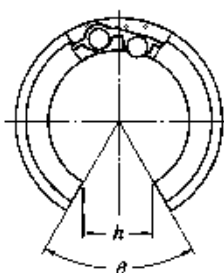
Boundary dimensions										Basic load ratings				Bearing numbers	Number of ball rows	Mass kg (approx.)
$F_w$	$D$	$C$	mm			$g$	$h$	$\theta$	dynamic N	static kgf	dynamic N	static kgf				
			$C_1$	$C_2$	$D_1$				$C_r$	$C_{or}$	$C_r$	$C_{or}$				
<b>3</b>	$\begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	—	—	—	—	—	51	40	5	4	<b>KLM03</b>	4	0.002	
<b>4</b>	$\begin{smallmatrix} 0 \\ -0.008 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	—	—	—	—	—	71	52	7	5	<b>KLM04</b>	4	0.003	
<b>5</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	—	—	—	—	—	118	90	12	9	<b>KLM05</b>	4	0.005	
<b>6</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	13.3	1.1	11.5	—	—	130	107	13	11	<b>KLM06</b>	4	0.009	
<b>8</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	11.3	1.1	14.3	—	—	115	94	12	9	<b>KLM08</b>	4	0.012	
		$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	17.3	1.1	14.3	—	—	234	188	24	19	<b>KLM08-1</b>	4	0.017	
<b>10</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	21.7	1.3	18	—	—	440	297	45	30	<b>KLM10</b>	4	0.028	
<b>12</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	22.7	1.3	21	—	—	545	455	55	46	<b>KLM12</b>	5	0.042	
<b>13</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	22.7	1.3	22	—	—	540	455	55	46	<b>KLM13</b>	5	0.045	
<b>16</b>	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	28	37	26.5	1.6	27	—	—	995	805	102	82	<b>KLM16</b>	5	0.075	
		$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	26.5	1.6	27	0.6	—	995	805	102	82	<b>KLM16S</b>	5	0.075	
		28	37	26.5	1.6	27	—	8.2	60°	995	805	102	82	<b>KLM16P</b>	4	0.062
<b>20</b>	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	32	42	30.3	1.6	30.5	—	—	1 320	1 150	135	117	<b>KLM20</b>	6	0.10	
		$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	30.3	1.6	30.5	0.6	—	1 320	1 150	135	117	<b>KLM20S</b>	6	0.10	
		32	42	30.3	1.6	30.5	—	8.6	50°	1 320	1 150	135	117	<b>KLM20P</b>	5	0.085
<b>25</b>	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	40	59	40.7	1.85	38	—	—	2 560	2 340	261	238	<b>KLM25</b>	6	0.22	
		$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	40.7	1.85	38	0.6	—	2 560	2 340	261	238	<b>KLM25S</b>	6	0.22	
		40	59	40.7	1.85	38	—	10.8	50°	2 560	2 340	261	238	<b>KLM25P</b>	5	0.19
<b>30</b>	$\begin{smallmatrix} 0 \\ -0.010 \end{smallmatrix}$	45	64	44.2	1.85	43	—	—	2 540	2 370	259	241	<b>KLM30</b>	6	0.26	
		$\begin{smallmatrix} 0 \\ -0.014 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	44.2	1.85	43	0.6	—	2 540	2 370	259	241	<b>KLM30S</b>	6	0.26	
		45	64	44.2	1.85	43	—	13.0	50°	2 540	2 370	259	241	<b>KLM30P</b>	5	0.22
<b>35</b>	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	52	70	49.2	2.2	49	—	—	3 650	3 350	375	340	<b>KLM35</b>	6	0.40	
		$\begin{smallmatrix} 0 \\ -0.017 \end{smallmatrix}$	$\begin{smallmatrix} 0 \\ -0.120 \end{smallmatrix}$	49.2	2.2	49	1.2	—	3 650	3 350	375	340	<b>KLM35S</b>	6	0.40	
		52	70	49.2	2.2	49	—	15.1	50°	3 650	3 350	375	340	<b>KLM35P</b>	5	0.34



Type KLM  
(Standard type)



Type KLM·S  
(Clearance-adjustable type)



Type KLM·P  
(Open type)

$F_w$  40mm

$F_w$	Boundary dimensions									Basic load ratings				Bearing numbers	Number of ball rows	Mass kg (approx.)
	$D$	$C$	mm		$D_1$	$g$	$h$	$\theta$	dynamic	static	dynamic	static				
			$C_1$ $\pm 0.300$	$C_2$					N	N	kgf	kgf				
40 <sub>-0.012</sub> <sup>0</sup>	60 <sub>-0.017</sub> <sup>0</sup>	80 <sub>-0.120</sub> <sup>0</sup>	60.3	2.1	57	—	—	—	3 950	3 750	400	380	KLM40	6	0.62	
	60 <sub>-0.017</sub> <sup>0</sup>	80 <sub>-0.120</sub> <sup>0</sup>	60.3	2.1	57	1.2	—	—	3 950	3 750	400	380	KLM40S	6	0.62	
	60 <sub>-0.017</sub> <sup>0</sup>	80 <sub>-0.120</sub> <sup>0</sup>	60.3	2.1	57	—	17.2	50°	3 950	3 750	400	380	KLM40P	5	0.53	

## Linear Ball Bearings, Stroke Type

The bearing cage with multiple ball rows (several balls per row) configured circumferentially therein can move within the outer ring in both circumferential and axial directions. Thus, this bearing type can rotate and reciprocate (but at a limited stroke) on a shaft.

### Bearing construction

Maximum available length of the reciprocal stroke is two times as long as the stroke at which the cage can reciprocate within the outer ring. The outer ring is provided at its both ends with a snap ring acting as a stopper and a wave spring is provided between the snap ring and the cage to damp a shock acting on the cage as well as to prevent wear of the cage.

In addition to the standard type, a special type with synthetic rubber seal (Tail code: LL) on the both ends of its outer ring is also available.

### Dimensional accuracy of Bearing

Table 1 the bearing tolerance.

Table 1 Dimensional accuracy

Characteristics	Dimensional tolerance
Ball inscribed circle diameter ( $F_w$ )	F6
Outer ring outer diameter ( $D$ )	h5

### Bearing fit and radial internal clearance

Linear ball bearings need to be used with minimum possible radial internal clearance. In particular, when a linear bearing is used on a vertical shaft or higher accuracy is needed, it is desirable to combine a bearing with a selected shaft and use the bearing-shaft combination with a radial internal clearance in a range of 0 to -5 mm (guideline).

Table 2 shows the bearing fits on shaft and in housing.

Table 2 Bearing fits (recommended)

Operating conditions	Shaft	Housing
Usual operating conditions	k5 (m5)	H6 (H7)
Vertical shaft and high accuracy applications	n5 (p5) <sup>1</sup>	J6 (J7)

<sup>1</sup> Selective fit

### Shaft and housing requirements

Table 3 specifies the requirements for shaft and housing which of the outer surfaces are used as the direct raceway.

Table 3 Shaft and housing requirements (recommended)

Characteristics	Shaft	Housing
Roundness (max)	IT2	IT4
Cylindricity (max)	IT2	IT4
Surface roughness (max)	0.2a	1.6a
Surface hardness	HRC58~64	—
Hardened layer depth (min)	0.4mm	—

### How to mount

This bearing type can't be fixed perfectly to a housing with interference only and, therefore, it is fixed in axial direction using a snap ring. (Refer to Fig. 1)

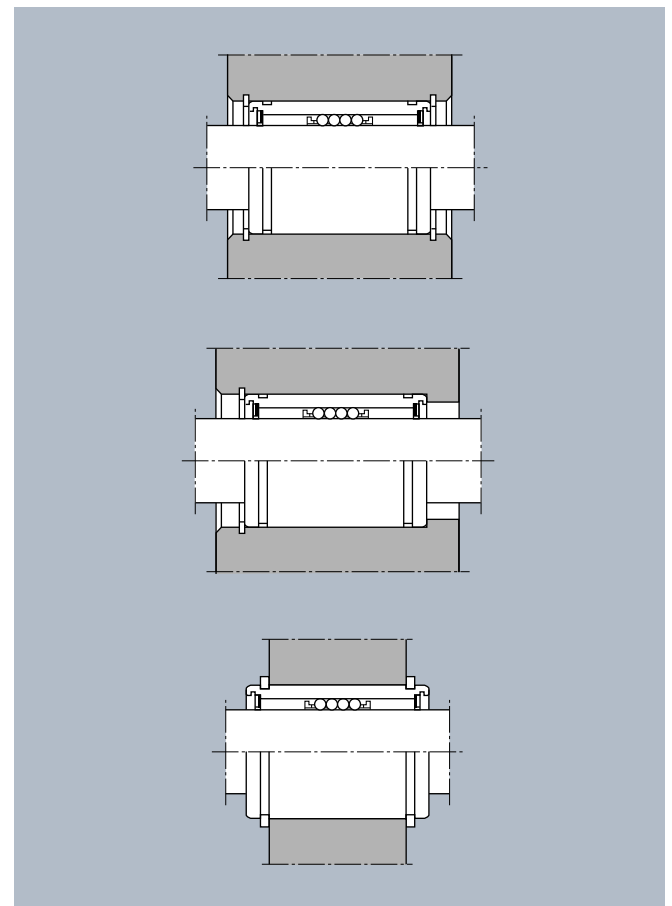


Fig. 1 Axial fixing of bearing

For adjusting the cage so it locates at the outer ring center after a shaft was mounted, push the cage in the arrow direction in **Fig. 2** by inserting the shaft into the outer ring that was press-fitted in the housing. (**Fig. 2**)

In this condition, insert slowly the shaft up to the center point of the reciprocating stroke and, thereafter, further push-in the shaft by  $1/2$  of the stroke. (**Fig. 3**) Then, return the shaft by  $1/2$  of the stroke to thereby locate the cage at the outer ring center and the shaft at the center point of the reciprocating stroke. (**Fig. 4**)

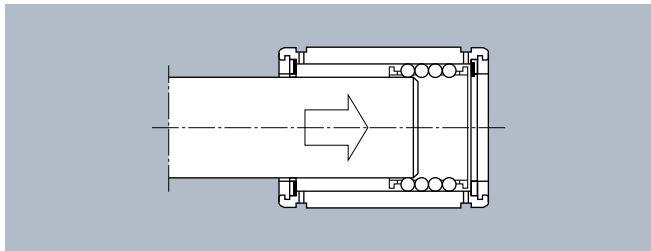


Fig. 2

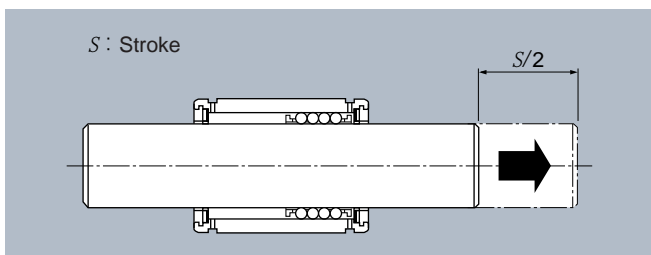


Fig. 3

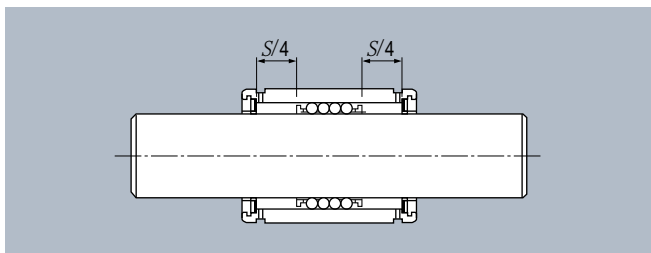
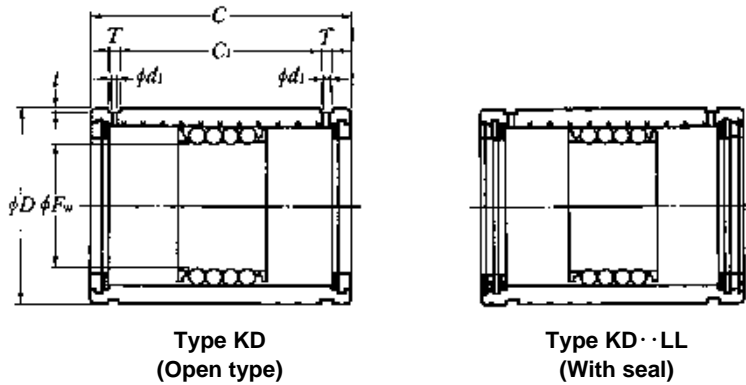


Fig. 4

The outer ring must be press-fitted so its grease feed hole locates at load non-acting side.  
Where moment load acts on a bearing due to use of a vertical shaft, the load could act on the grease feed hole. Caution it.

## Type KD Type KD··LL



$F_w$  10~80mm

$F_w$ F6	Boundary dimensions mm										Bearing numbers		Basic load ratings				Mass (approx.) kg	
	$D$ h5	$C^{1)}$	$T$	$t$	$d_1$	$C_1$	Type KD Max. stroke	Type KD··LL Max. stroke	Type KD	Type KD··LL	dynamic N	static	dynamic kgf	static	Type KD	Type KD··LL		
											$C_r$	$C_{or}$	$C_r$	$C_{or}$				
10	19	30	1.7	0.4	1.5	22.7	27	15.5	19	KD101930	KD101930LL/3AS	720	535	74	55	0.028	0.030	
12	23	32	1.7	0.4	1.5	24.5	30	17.1	22	KD122332	KD122332LL/3AS	920	725	94	74	0.052	0.055	
16	28	37	1.7	0.5	1.5	29.1	33	21.1	26	KD162837	KD162837LL/3AS	1 480	1 070	151	109	0.073	0.078	
20	32	45	2.2	0.5	2	35.8	55	26.8	46	KD203245	KD203245LL/3AS	1 670	1 230	171	125	0.100	0.105	
25	37	45	2.2	0.6	2	35.8	55	26.8	46	KD253745	KD253745LL/3AS	1 890	1 410	192	144	0.115	0.120	
30	45	65	2.7	0.7	2.5	53.5	81	45.1	73	KD304565	KD304565LL/3AS	3 800	3 100	390	315	0.265	0.265	
35	52	70	2.7	0.7	2.5	58.5	90	50.1	79	KD355270	KD355270LL/3AS	4 200	3 500	430	355	0.405	0.405	
40	60	80	2.7	0.7	2.5	68.3	103	59.9	93	KD406080	KD406080LL/3AS	5 900	4 750	600	485	0.635	0.635	
45	65	80	2.7	0.7	2.5	68.3	103	59.9	93	KD456580	KD456580LL/3AS	6 400	5 300	655	540	0.675	0.680	
50	72	100	3.2	1	3	86.4	136	77.4	125	KD5072100	KD5072100LL/3AS	8 500	6 850	870	695	1.00	1.02	
55	80	100	3.2	1	3	86.4	136	77.4	125	KD5580100	KD5580100LL/3AS	9 200	7 550	940	770	1.34	1.36	
60	85	100	3.2	1	3	86.4	136	77.4	122	KD6085100	KD6085100LL/3AS	9 900	8 250	1 010	840	1.41	1.43	
70	95	100	3.2	1	3	86.4	136	77.4	122	KD7095100	KD7095100LL/3AS	10 600	9 000	1 080	920	1.61	1.63	
80	110	100	3.2	1.2	3	86	129	77	116	KD80110100	KD80110100LL/3AS	13 300	10 900	1 350	1 110	2.37	2.40	

Note 1) The tolerance for dimension- $C$  is 0, -0.120 mm against  $F_w \leq 50$  mm and 0, -0.150 mm against  $F_w > 50$  mm.



## Linear Flat Rollers

### Linear Flat Rollers

This bearing type composed of a needle roller and flat cage assembly (needle rollers are configured in the flat cage) ensures smooth reciprocating motion with less friction coefficient.

### Types

For **Type FF**, the polyamide resin cage has a dovetail joint groove on its both ends so that several cages can be jointed together into one unit.

For **Type FF·ZW**, two rows of needle rollers are configured in the cage and the cage has an elastic joint on its center so as to enable to bend two rows of flat rollers to any optional angle at the elastic joint by heating them in oil of 70 to 90°C. The two roller rows bent to any optional angle can hold the bent shape unchanged, even under normal operating temperature, by being cooled down for several seconds, with the bending angle held unchanged.

For **Type BF**, the cage is press-formed from steel plate and the standard length of the bearing unit is 1000 mm.

For **Type RF**, the cage is of polyamide resin and the standard length of the bearing unit is 705 mm. The both are unavailable for cage to cage inter-jointing, but a bearing unit of any desired length is offerable upon request. Feel free to contact NTN for the detailed information.

### Needle roller tolerance

The needle rollers contained in the flat roller cage are manufactured within the dimensional tolerance range of 0 to -2 mm against the nominal diameter ( $D_w$ ).

### Raceway surface requirements

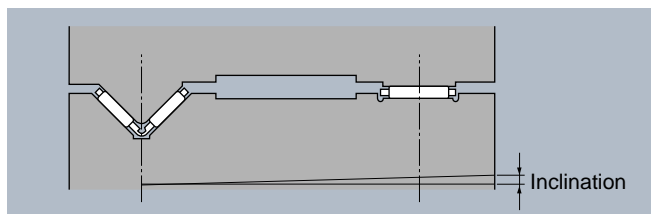
**Table 1** shows the requirements for raceway surface applied to the linear flat roller bearings.

**Table 1 Raceway surface requirements (recommended)**

Characteristics	Tolerance
Surface roughness (max)	0.2a
Surface hardness <sup>1</sup>	HRC58~64
Effective hardened layer depth (min)	0.4mm
Mounting accuracy (max) <sup>2</sup>	0.1 mm per 1000 mm

<sup>1</sup> Where raceway surface hardening not allowed, a quenched spring plate may be used.

<sup>2</sup> Mounting accuracy is expressed with an inclination value in **Fig. 1**.

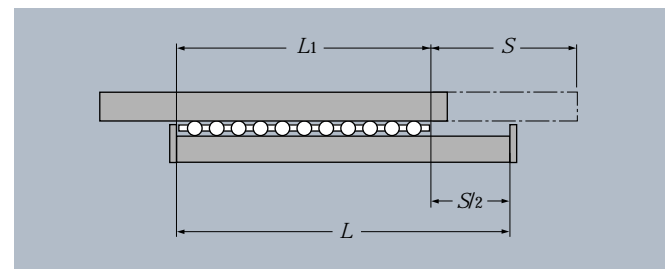


**Fig. 1**

### How to mount

Theoretically the linear flat roller bearing moves by 1/2 of table moving stroke in same direction as the table moving direction. The relationship of bed length ( $L$ ) - stroke ( $S$ ) - cage length ( $L_1$ ) can be expressed in **formula (1)**. (**Fig. 2**)

$$L = S/2 + L_1 \dots\dots\dots (1)$$

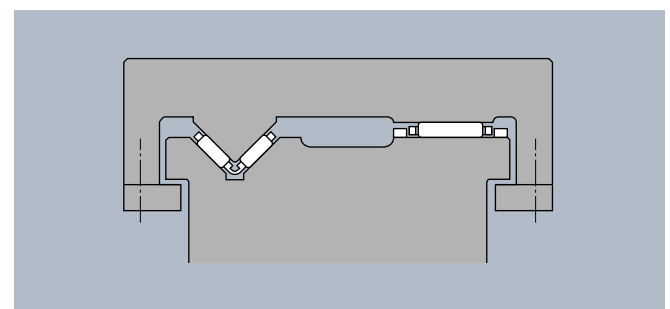


**Fig. 2**

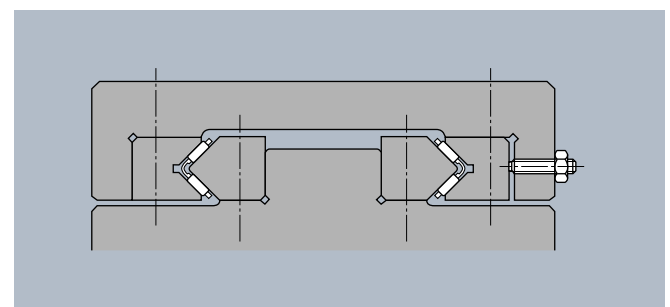
The linear flat roller bearing results in moving deviation due to profile deviation of raceway surface, uneven load or vibration. Therefore, the table or the bed must be equipped with a stopper at its end portion to prevent overrun of the flat roller bearing. (**Fig. 5**)

**Figs. 3 and 4** illustrate application examples of the linear flat roller bearing unit.

If a separate raceway surface having undergone heat treatment and grinding is installed to a machine main body, be careful to avoid deformation of the bearing that can result from tightening.



**Fig. 3 General application**



**Fig. 4 When overhung load acts on**

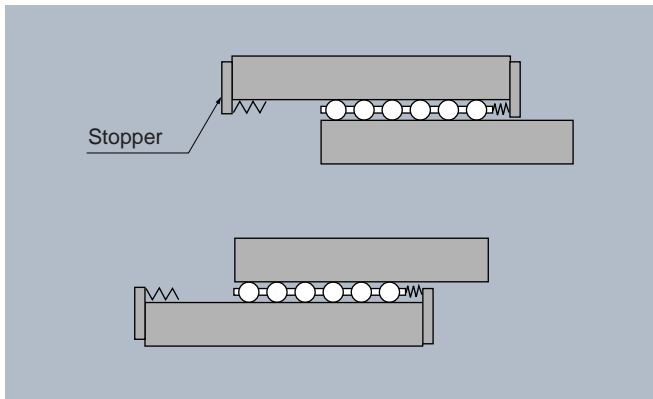
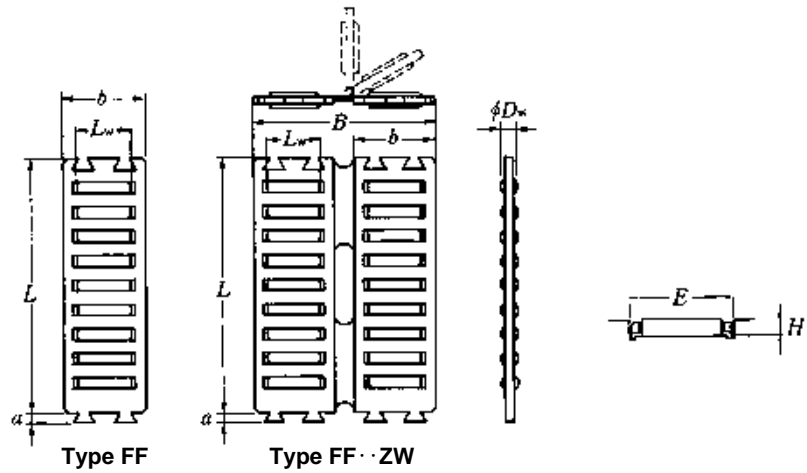


Fig. 5

Type FF  
Type FF··ZW



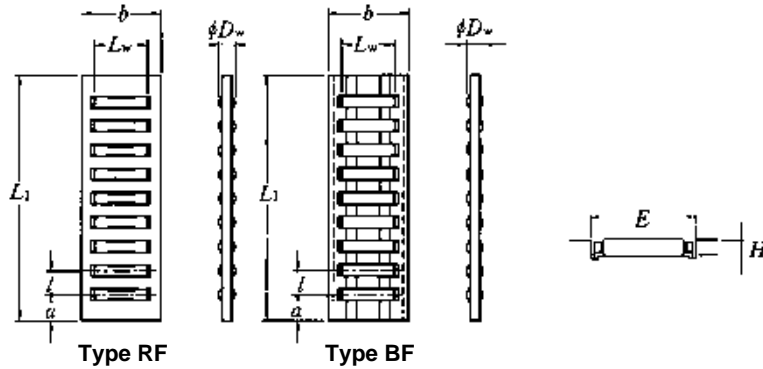
$D_w$  2~3.5mm

Boundary dimensions						Basic load ratings				Bearing numbers	Number of rolls	Abutment dimensions		Mass
mm						dynamic	static	dynamic	static			mm		
$D_w^{1)}$	$b$	$B$	$L$	$L_w$	$a$	$C_r$	$C_{or}$	$C_r$	$C_{or}$			$E$	$H$	(approx.)
2	10	—	32	6.8	2	8 500	19 700	865	2 010	FF2010	7	10.3 <sup>+0.1</sup> <sub>0</sub>	1.7 <sup>0</sup> <sub>-0.2</sub>	0.0020
2	10	25	32	6.8	2	15 500	39 500	1 580	4 000	FF2025ZW	14	25.3 <sup>+0.1</sup> <sub>0</sub>	1.7 <sup>0</sup> <sub>-0.2</sub>	0.0043
2.5	15	—	45	9.8	2.4	17 100	41 400	1 740	4 200	FF2515	8	15.3 <sup>+0.1</sup> <sub>0</sub>	2.2 <sup>0</sup> <sub>-0.2</sub>	0.0038
2.5	15	35	45	9.8	2.4	29 300	82 500	2 980	8 450	FF2535ZW	16	35.3 <sup>+0.1</sup> <sub>0</sub>	2.2 <sup>0</sup> <sub>-0.2</sub>	0.0082
3	20	—	60	13.8	3	31 000	79 500	3 150	8 100	FF3020	9	20.4 <sup>+0.1</sup> <sub>0</sub>	2.7 <sup>0</sup> <sub>-0.2</sub>	0.0089
3	20	45	60	13.8	3	53 500	159 000	5 450	16 200	FF3045ZW	18	45.4 <sup>+0.1</sup> <sub>0</sub>	2.7 <sup>0</sup> <sub>-0.2</sub>	0.019
3.5	25	—	75	17.8	3.2	50 000	132 000	5 100	13 500	FF3525	10	25.4 <sup>+0.1</sup> <sub>0</sub>	3.2 <sup>0</sup> <sub>-0.2</sub>	0.017
3.5	25	55	75	17.8	3.2	86 000	265 000	8 800	27 000	FF3555ZW	20	55.4 <sup>+0.1</sup> <sub>0</sub>	3.2 <sup>0</sup> <sub>-0.2</sub>	0.035

Note 1) The dimensional tolerance for needle roller diameter  $D_w$  is 0 to -2  $\mu$ m.

Type BF

Type RF



$D_w$  3~7mm

Boundary dimensions						Basic load ratings <sup>3)</sup>				Bearing numbers	Abutment dimensions		Mass <sup>4)</sup>
mm						dynamic	static	dynamic	static		mm		
$D_w^{1)}$	$b$	$L_1^{2)}$	$L_w$	$l$	$a$	$C_r$	$C_{0r}$	$C_r$	$C_{0r}$		$E$	$H$	(approx.)
3	20	705	13.8	6	4.5	34 000	88 500	3 450	9 000	RF3020/705	20.4 <sup>+0.1</sup> <sub>0</sub>	2.7 <sup>0</sup> <sub>-0.2</sub>	0.015
3	20	1 000	15.8	6	5	38 000	102 000	3 850	10 400	BF3020/1000	20.4 <sup>+0.1</sup> <sub>0</sub>	2.7 <sup>0</sup> <sub>-0.2</sub>	0.037
5	23	1 000	19.8	8	8	87 000	211 000	8 850	21 500	BF5023/1000	23.4 <sup>+0.1</sup> <sub>0</sub>	4.7 <sup>0</sup> <sub>-0.2</sub>	0.054
5	32	1 000	27.8	8	8	114 000	299 000	11 600	30 500	BF5032/1000	32.4 <sup>+0.1</sup> <sub>0</sub>	4.7 <sup>0</sup> <sub>-0.2</sub>	0.073
7	28	1 000	24	11	10.5	138 000	305 000	14 000	31 000	BF7028/1000	28.5 <sup>+0.1</sup> <sub>0</sub>	6.7 <sup>0</sup> <sub>-0.2</sub>	0.091
7	35	1 000	30	11	10.5	185 000	445 000	18 900	45 500	BF7035/1000	35.5 <sup>+0.1</sup> <sub>0</sub>	6.7 <sup>0</sup> <sub>-0.2</sub>	0.110

Note 1) The dimensional tolerance for needle roller diameter  $D_w$  is 0 to  $-2 \mu m$ .

2) The standard length  $L_1$  of the cage shall be 1000 mm for Type BF and 705 mm for Type RF.

Where special cage length is required, the nominal bearing number is followed by the numerical length value as exemplified below.

Ex. Where  $L_1 = 500$  mm is required for **BF3020**, **BF302/500**

3) The listed basic load ratings are subject to use of 10 flat rollers. Calculate the basic load ratings for any optional cage length  $L_1$  by the following formula.

$$C = \hat{f}^{7/9} \cdot C_r$$

$$C_0 = \hat{f} \cdot C_{0r}$$

$$\text{Herein, } \hat{f} = 0.1 (L_1 + l - 2a) / l$$

4) The listed weights are subject to  $L_1 = 100$  mm.

Remarks: For **Type BF**

1. On occasion, the length of an ordered unit could be shorter by  $l$  dimension shown in each Dimensions Table because the roller and cage assy is cut at the minimum unit of each pocket so as to match the required length.

2. Where this bearing unit is used frequently at various lengths, it is more economical to cut the standard bearing of 1000 mm length to each desired length at your side.

## Linear Roller Bearings

This roller bearing with cylindrical rollers having the function capable of circulating within the raceway block ensures smooth infinite linear motion on a flat surface. The cylindrical rollers are retained and guided by the cage and the ribs of the raceway block.

The cage is of such a construction as not allow adjacent rollers to contact with one another. Hence, the friction coefficient is low.

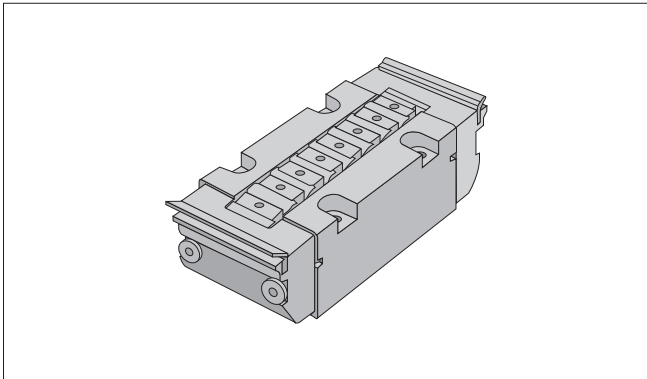


Fig. 1

### Bearing accuracy

All the linear roller bearings are manufactured within the dimensional tolerance range of 0 to  $-2.5\mu\text{m}$  for bearing height ( $H$ ). And these bearings are delivered classified into 5-stepped tolerance classes. (See **Table 1**)

Table 1 Classification of bearing height  $H$  by accuracy class

Unit:  $\mu\text{m}$

Class code	Tolerance for height ( $H$ )
1H	0 ~ -5
2H	-5 ~ -10
3H	-10 ~ -15
4H	-15 ~ -20
5H	-20 ~ -25

### Requirements and tolerances for raceway surface and mounting surface

Table 2 shows the requirements and tolerances for the raceway surface, on which linear roller bearing rolls, and the bearing mounting surface. Where adhesion of a hard foreign matter to the raceway surface is forecast, the raceway surface must be protected with a proper protective cover.

The reference surface for mounting is the back face and opposite face to NTN mark.

Table 2 Requirements for raceway surface and mounting surface (recommended)

Characteristics	Allowable value or tolerance range
Raceway surface roughness (max)	0.2a
Raceway surface hardness	HRC58~64
Effective hardened layer depth of raceway surface (min)	as described in applicable Dimensions Table
Parallelism of mounting surface	
$\Delta x$ (See Fig. 2)	0.05 mm per 100 mm
$\Delta y$ (See Fig. 3)	0.01 mm per 100 mm

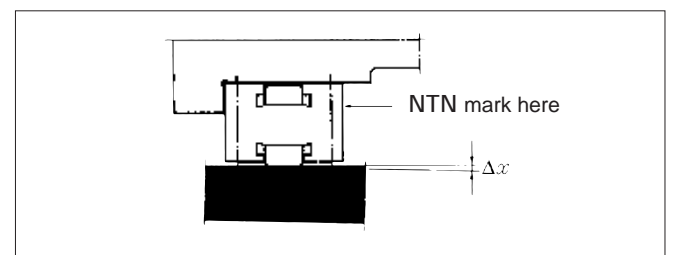


Fig. 2

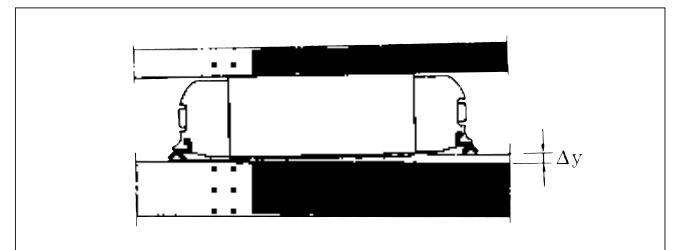


Fig. 3

### How to mount

Fix linear roller bearing using the tapped holes which are provided on the mounting reference surface. (See **Fig. 4**)

If a plurality of bearing units are installed on a same plane, select the units that belong to a same bearing height  $H$  dimensional accuracy class (**Table 1**) so that the load is uniformly distributed onto them.

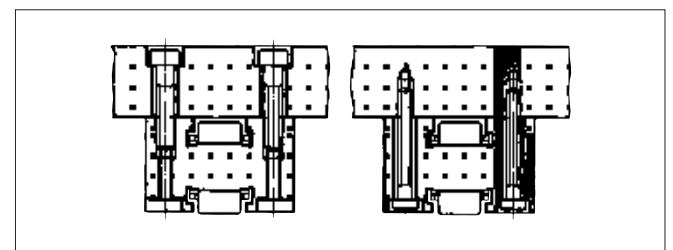
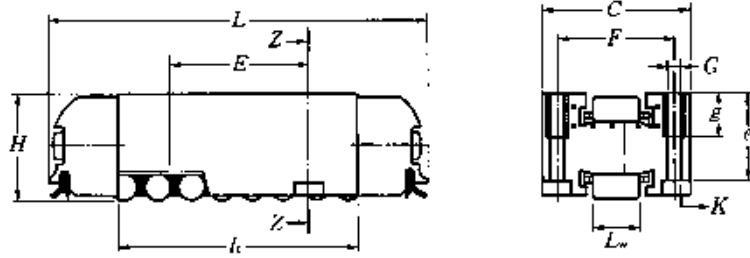


Fig. 4

## Type RLM



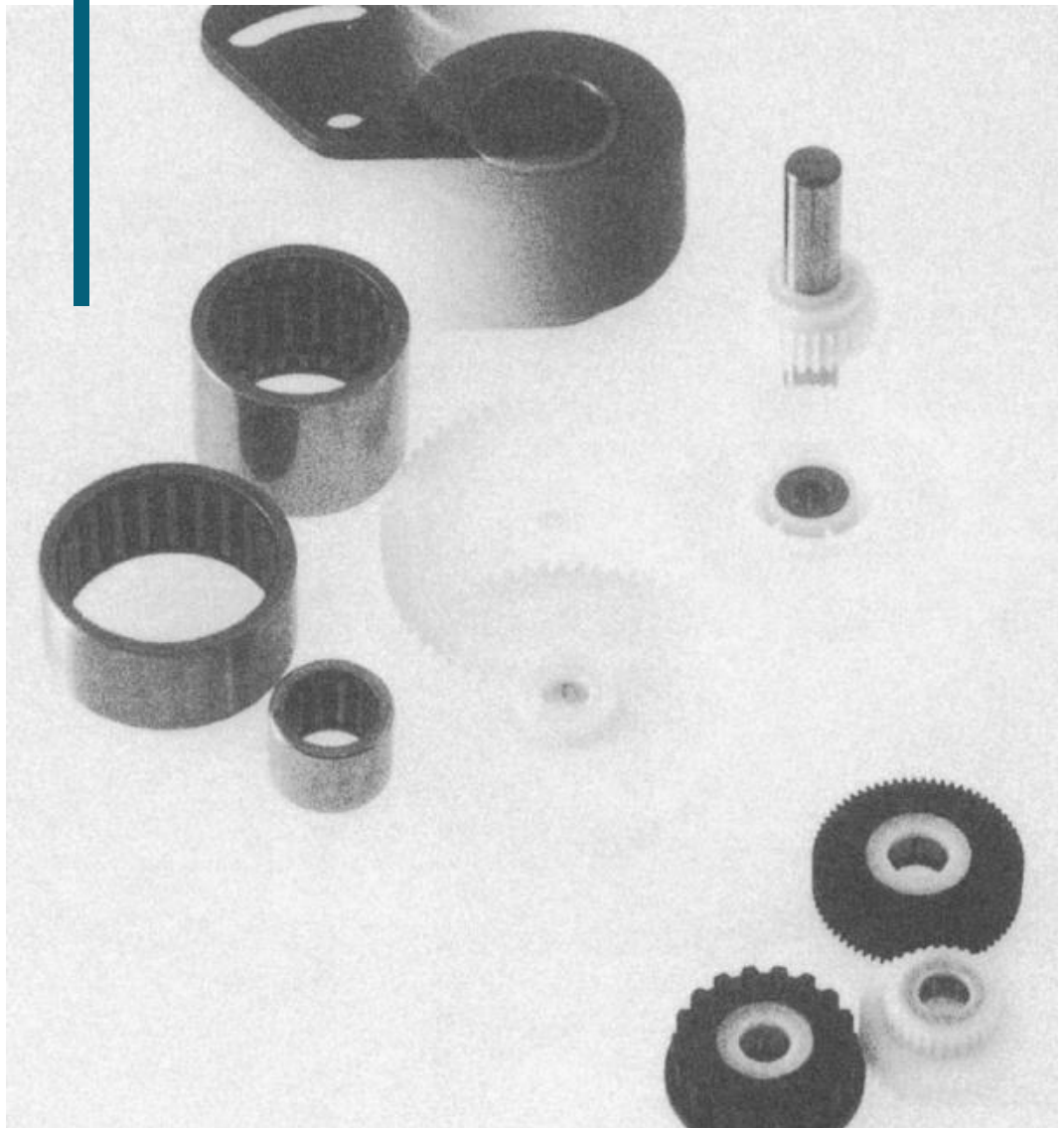
Section Z-Z

**H** 16~38mm

Boundary dimensions											Bearing numbers	Basic load ratings				Required case depth on track (min.) mm	Mass kg (approx.)
mm												dynamic	static	dynamic	static		
H	C	L	L <sub>w</sub>	E	F	G	L <sub>t</sub>	e	g	K		N	N	kgf	kgf		
16	25	62	8	17	19	M4	35.5	12.5	6	φ 3.2	<b>RLM16× 62A</b>	15 400	34 000	1 570	3 450	0.3	0.11
19	27	69	10	25.5	20.6	M4	43.4	15.5	6	φ 3.2	<b>RLM19× 69B</b>	26 100	58 000	2 660	5 900	0.3	0.16
26	40	86	14	28	30	M6	52.4	21	10	φ 4.5	<b>RLM26× 86A</b>	50 000	106 000	5 100	10 800	0.4	0.41
26	40	102	14	44	30	M6	67.9	21	10	φ 4.5	<b>RLM26× 102A</b>	62 500	142 000	6 350	14 400	0.4	0.53
26	40	126	14	68	30	M6	91.8	21	10	φ 4.5	<b>RLM26× 126A</b>	80 000	195 000	8 150	19 900	0.4	0.70
38	52	134	20	51	41	M8	85.7	31	14	φ 6.5	<b>RLM38× 134B</b>	124 000	270 000	12 600	27 500	0.5	1.3



# One-way Clutches Tension Pulleys, Bottom Roller Bearings



## One-way Clutches

This is a compact and roller type one-way clutch which formed a cam face on its outer ring. (Available shaft diameter range: 6 to 35 mm) When the outer ring begins to turn in the counterclockwise direction (direction marked on the outer ring width surface) relative to the shaft, the force of spring causes the rollers to advance to the engagement positions on the outer ring cam face, thereby the wedge action taking place between the outer ring cam face and the shaft drives the shaft. (See Fig. 1) When the outer ring rotates clockwise against the shaft, the shaft rotates counterclockwise relative to the outer ring and, as the result, the rollers get away from the outer ring cam face and simultaneously the outer ring idles against the shaft. (See Fig. 2)

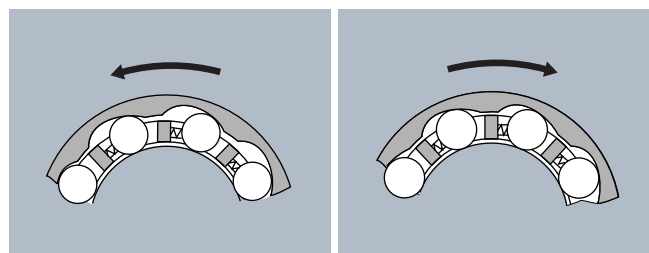
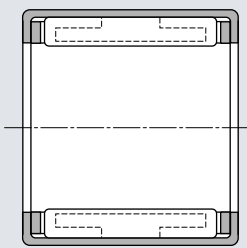
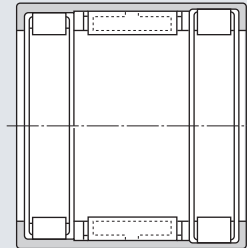


Fig. 1  
One-way clutch in engagement

Fig. 2  
One-way clutch in idling

Type	Applied shaft diameter (mm)	Composition of nominal clutch number	Remarks
<b>Type HF</b> 	$\phi 6 - \phi 35$	<b>HF 10 12</b> ————— Width ————— Bore diameter ————— Type code	One-way clutch HF composed of an outer ring drawn from a thin steel plate by precision drawing has the clutching function only. <b>In order for a oneway clutch to be able to carry a radial load and smoothly rotate, its both ends each need to be supported by a radial load carrying bearing.</b>
<b>Type HFL</b> 	$\phi 8 - \phi 35$	<b>HFL 10 22</b> ————— Width ————— Bore diameter ————— Type code	One-way clutch HFL has an outer ring drawn from thin steel plate by precision drawing, a clutching function, and an integral needle roller and cage assembly capable of supporting radial load at its both ends respectively. Thus, this HFL can function as clutch and, in addition, support radial load.

Both of Type HF and HFL use a polyamide resin cage and press the needle rollers to a wedge, which is formed between the outer ring cam face and the shaft, by action of a plate spring supported with the cage.

### Clutch fit

Table 1 shows the one-way clutch fits on shaft and in housing. Both of Type HF and HFL are only press-fitted in a housing, needing no axial fixing by use of a snap ring, etc.

However, due to the outer ring drawn from thin steel by precision drawing, the performance of the both is directly affected by the dimensional and profile deviations of the shaft/housing. To avoid such an inverse affect, shaft and housing accuracy must be controlled with good care. Any housing is required to have the wall thickness of a specified value or more. Table 2 shows the recommended value.

Table 1 Clutch fits (recommended)

Type	Shaft	Housing	
		Iron series	Light metal alloy
HF	h5 (h6)	N6 (N7)	R6 (R7)
HFL			

Table 2 Recommended housing wall thickness (recommended)

Housing material	Housing wall thickness
Iron-based	0.75 ( $D - F_w$ ) and over
Light metal alloy	1.5 ( $D - F_w$ ) and over

For values of  $D$  and  $F_w$ , refer to the relevant dimension table.

### Shaft and housing requirements

Table 3 shows the shaft and housing requirements.

Table 3 Shaft and housing requirements (recommended)

Characteristics	Shaft		Housing	
	Type HF	Type HFL	Type HF	Type HFL
Roundness (max)	IT3 (IT4)		IT4 (IT5)	
Cylindricity (max)	IT3 (IT4)		IT4 (IT5)	
Surface roughness	0.2a		1.6a	
Surface hardness	HRC58—64		—	
Effective hardened layer depth (min)	0.4mm		—	

## Lubrication

Oil lubrication is optimum for these one-way clutches, but generally grease lubrication is mostly applied to this type of one-way clutch. NTN one-way clutches are filled up with a suitable grease. These clutches need no further grease replenishment, but subject to general applications.

In replenishing, good care must be exercised of too much grease filling. Too much filling could cause interference with smooth clutching.

For selection of an appropriate lubricant, contact NTN Engineering for technical assistance.

## Allowable operating temperature

For **Type HF** and **HFL**...Oil lubrication : -10 to 120°C  
Grease lubrication : -10 to 70°C

When intending to use the oneway clutch at the upper or lower limit for its allowable operating temperature range, contact NTN Engineering for technical assistance.

## How to mount

It is convenient to use a press-fitting mandrel as illustrated in **Fig. 3** for assembling and mounting these one-way clutches. In that case, press-fit the outer ring, with its stamped mark side kept in contact with the mandrel shoulder.

**In assembling, be careful to prevent the outer ring from twisting. Avoid to hammer directly the outer ring and, in press-fitting, bring a proper jig in contact with the outer ring side face without fail. Furthermore, when press-fitting in an housing with shoulder, good care must be exercised to prevent the bearing side face from coming into contact with the housing shoulder and to thereby avoid deformation of the bearing.**

Also, shaft can be easily assembled by turning it in clutch idling direction. Where impossible to do so, provide the shaft end with a tapered (chamfered) guide to facilitate assembling-in.

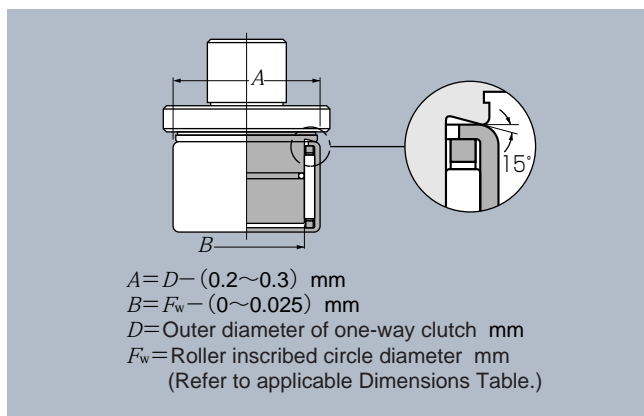


Fig. 3

## Precautions in selecting

NTN is verifying the functions of its oneway clutch products under various test conditions. However, if an NTN oneway clutch is used under a higher load torque, in high oscillation cycles and fine oscillation mode, or when a greater radial load acts on the oneway clutch, or if the hardness of the mating shaft is low, the life of oneway clutch can become shorter.

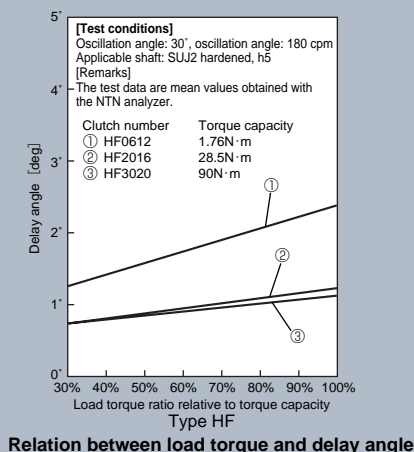
Furthermore, lock failure could occur in the cases of fast idling speed, frequent use in idling, and application incurring vibration.

When using these one-way clutches under the special conditions stated above, feel free to contact NTN for further instructions.

**If loss of the clutching function of oneway clutch (slipping occurs during engagement motion) can impose severe damage to personnel or equipment, a positive safety device needs to be separately provided for the machine.**

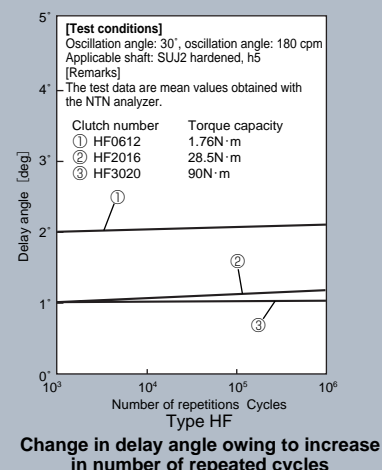
### Delay angle

“Delay angle” means the difference ( $\theta_i - \theta_o$ ) between the angle of rotation of the input shaft ( $\theta_i$ ) and the angle of rotation of the output shaft ( $\theta_o$ ). The delay angle of NTN oneway clutch can vary depending on the oneway clutch designation and the magnitude of torque the oneway clutch carries. The chart in the right graphically illustrates the trend in relation between load torque and delay angle (data measured with an NTN analyzer).

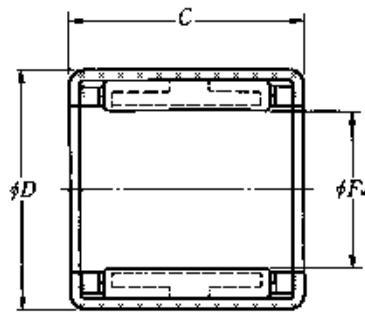


### Life

NTN has verified that even if a torque as high as the torque capacity of NTN oneway clutch products is exerted, and when the number of engagement cycles exceeds  $10^6$ , change in the delay angle on NTN oneway clutches is small (data obtained from the NTN analyzer).



## Type HF



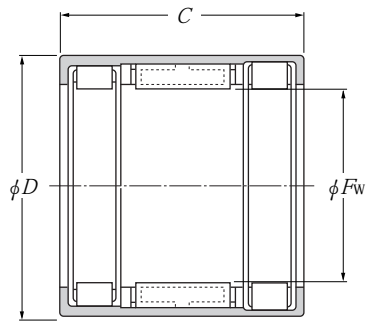
Type HF

$F_w$  6~35mm

Boundary dimensions			Torque capacity		Bearing numbers	Mass	Part number by radial load	
$F_w$	mm $D$	$C$ $0$ $-0.25$	N·m	kgf·m			kg (approx.)	(approx.) needle roller bearing    oil retaining bearing
6	10	12	1.76	0.18	HF0612	0.003	HK0609T2	B-S6-22
8	12	12	3.15	0.32	HF0812	0.0035	HK0810	B-S8-25
10	14	12	5.30	0.54	HF1012	0.004	HK1010	B-S10-21
12	18	16	12.2	1.24	HF1216	0.0116	HK1212	B-S12-32
14	20	16	17.3	1.76	HF1416	0.013	HK1412	B-S14-13
16	22	16	20.5	2.09	HF1616	0.014	HK1612	B-S16-13
18	24	16	24.1	2.46	HF1816	0.0155	HK1812	B-S18-8
20	26	16	28.5	2.91	HF2016	0.017	HK2012	B-S20-19
25	32	20	66	6.73	HF2520	0.0309	HK2512	B-S25-11
30	37	20	90	9.18	HF3020	0.036	HK3012	B-S30-19
35	42	20	121	12.3	HF3520	0.040	HK3512	B-S35-7

Remarks: Type HF is subject to delivery of INA product instead.  
Type HFL is the imported product from INA, Germany.

## Type HFL



Type HFL

$d$  8~35mm

Shaft dia. mm $d$	Boundary dimensions			Basic load ratings				Bearing numbers	Torque capacity		Mass kg (approx.)
	$F_w$	mm $D$	$C$ $0$ $-0.25$	dynamic N $C_r$	static $C_{or}$	dynamic kgf $C_r$	static $C_{or}$		N·mm	kgf·m	
8	8	12	22	4 050	413	4 150	423	HFL0822	3.15	0.32	0.0063
10	10	14	22	4 300	438	4 650	474	HFL1022	5.30	0.54	0.0074
12	12	18	26	6 300	642	6 500	663	HFL1226	12.2	1.24	0.018
14	14	20	26	7 100	724	7 700	785	HFL1426	17.3	1.76	0.020
16	16	22	26	7 300	744	8 400	857	HFL1626	20.5	2.09	0.022
18	18	24	26	8 300	846	10 300	1 050	HFL1826	24.1	2.46	0.024
20	20	26	26	8 200	836	10 400	1 060	HFL2026	28.5	2.91	0.027
25	25	32	30	10 900	1 110	14 100	1 440	HFL2530	66.0	6.73	0.044
30	30	37	30	12 600	1 280	17 600	1 790	HFL3030	90.0	9.18	0.051
35	35	42	30	13 000	1 330	19 300	1 970	HFL3530	121	12.3	0.058

## Bottom Roller Bearings for Textile Machinery

These are needle roller bearings that support the bottom rollers (fluted rollers) on fine spinning machines, roving frames or drawing frames. **Type FRIS** is applied to a fine spinning machine and a roving frame, and **Type FR** applied to a drawing frame.

### Types and construction

Bottom roller bearing **FRIS** is used to support the bottom rollers of a fine spinning machine and a roving frame. The outer ring outer profile of this bearing type is spherical, which can allow, to some extent, mounting error in the bottom rollers. On the other hand, the inner ring is provided with a rib at its both ends and a clearance between the outer ring and each inner ring rib is minimized. Furthermore, the rib outer surface is knurled to prevent invasion of cotton pieces into the bearing.

These bottom roller bearings are classified into internationally interchangeable **A-series** bearings with bearing fixing saddle (to fix a bearing to a support stand) and **B-series** bearings adaptable to the dimensions of JIS Fluted Rollers.

**A-series** bearings are further classified into one bearing type (suffix **SA**) wherein inner ring and outer ring are separable from one another according to saddle type and another bearing type (suffix **SB**) wherein inner ring and outer ring are non-separable. Of course, these bearings can also be supplied without saddle.

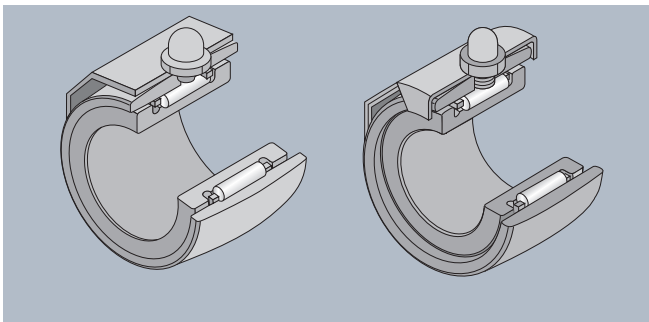


Fig. 1 Type FRIS · SA

Fig. 2 Type FRIS · SB

On the other hand, **B-series** bearings are further classified into bearing type with grease nipple (suffix **N**), bearing type with knock pin on its outer ring (suffix **P**) and bearing type with knock hole on its outer ring (suffix **W**) (latter two types-classified by the fixing method applied).

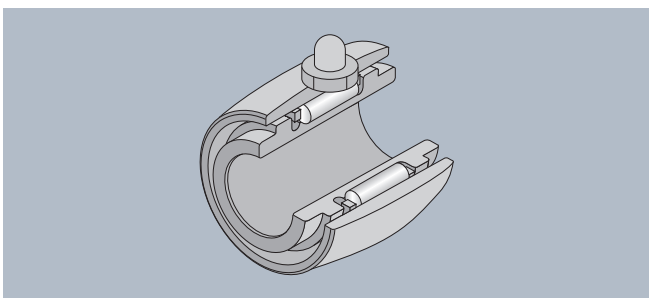


Fig.3 Type FRIS

These bearings can be supplied with saddle thereon on request, similarly to **A-series**.

Type **FR** is used to support the rollers of a drawing frame. This bearing type is composed of two drawn cup type needle roller bearings which are configured in a housing. These have no inner ring and use a shaft as the direct raceway surface. Synthetic rubber seal is fitted in the both ends of the housing. This bearing type is fixed to a support stand with knock pins press-fitted in the housing. The knock pin is provided with an grease hole to enable grease replenishing.

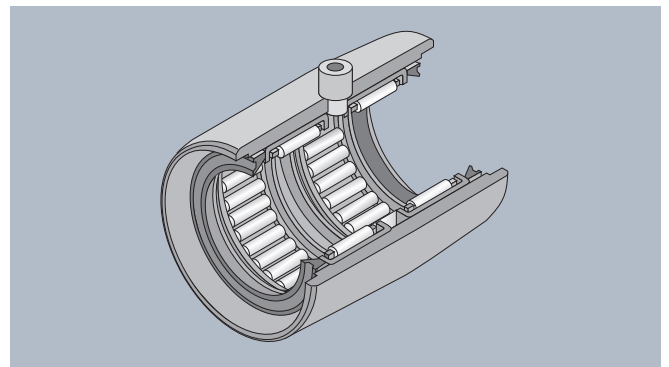


Fig. 4 Type FR

### Composition of bearing number

The bearing number comprises type code, dimension code [diameter (*d* or *F<sub>w</sub>*)] and a suffix.

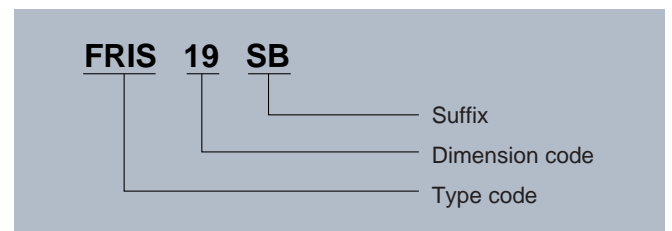


Fig.5

### Bearing fits

Table 1 shows bearing fits on/in shaft and housing.

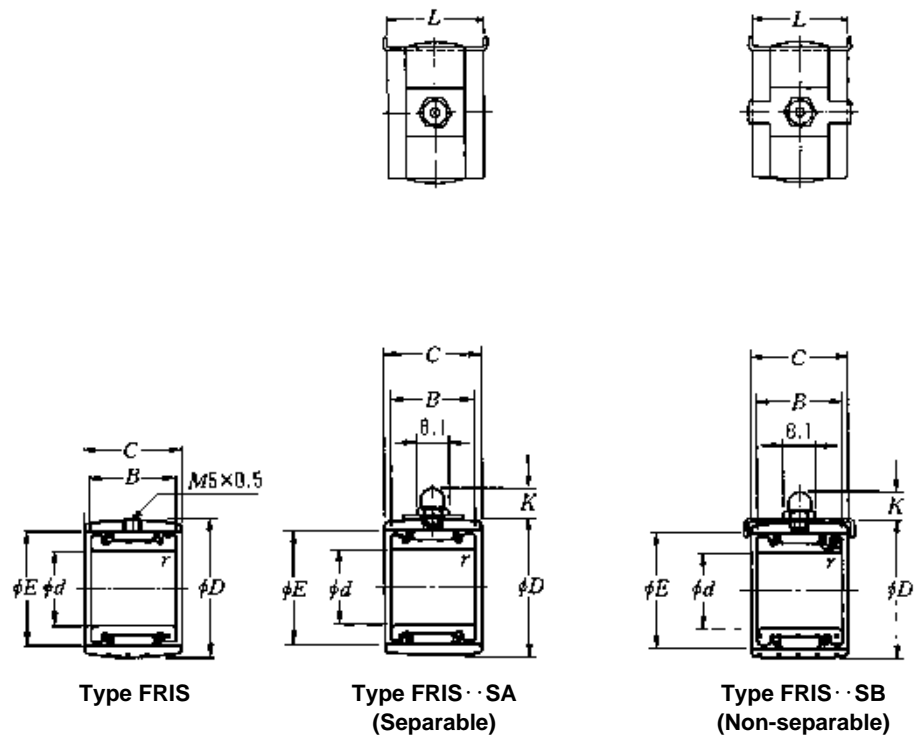
Table 1 Bearing fits

Bearing type	Shaft		Housing (stand)
	Screwed joint	Spline joint	
FRIS	g5 (g6)	j5 (j6)	H10
FR	h5 (h6)		H10

**Precautions for mounting**

- (1) For the shaft shoulder dimensions of the Type FRIS, refer to the dimensions  $d_1$  and  $G$  in the relevant dimension table. To be able to prevent entanglement with fly and avoid adverse effect onto spinning quality, it is necessary to promptly remove entangling fly without stopping the machine. In this context, the conditions that must be satisfied to allow the bearing to fully develop its functions and maintain spinning quality by provide sufficiently deep and wide shaft shoulder.
- (2) To axially position the bottom roller connected to the machine, use a thrust bearing on the gear end side so that axial movement of the bottom roller is positively prevented.
- (3) When rinsing the bottom roller with cleaning liquid such as light oil, be careful not to allow the cleaning liquid to enter the bearing.
- (4) When installing the bearing to a stand, position the outer ring to the middle of the inner ring width.
- (5) Carefully install the bottom roller so that its runout is not greater than 0.05 mm.

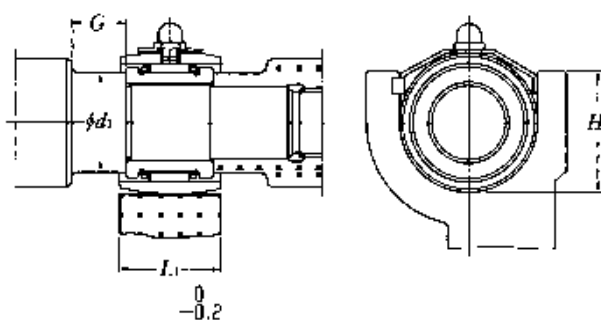
## Type FRIS Series A (For fine spinning machine/ roving frame)



$d$  16.5~25mm

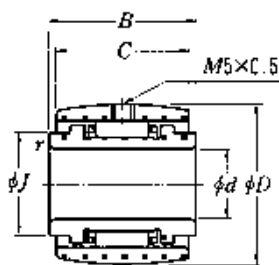
Boundary dimensions								Basic load ratings				
$d$ -0.010	$D$	$B$ -0.050	mm			$r_s \min^1)$	$L$	$K$	dynamic	static	dynamic	static
			$C$ -0.120	$E$	$E$				$E$	N	kgf	
<b>16.5</b>	28 0 -0.020	19	22	23.5	0.3	22.2	7.7	10 200	14 600	1 040	1 480	
<b>19</b>	32 0	20	23	27	0.3	22.2	7.7	11 800	18 500	1 200	1 880	
	36 -0.025	22	25	29	0.3	22.2	9.8	12 700	17 600	1 300	1 800	
<b>22</b>	42 0 -0.025	25	29	35	0.3	26.4	10.2	19 500	25 300	1 980	2 580	
<b>25</b>	45 0 -0.025	25	29	37	0.3	26.4	10.2	21 300	29 100	2 170	2 970	

Note 1) Allowable minimum chamfer dimension  $r$ .

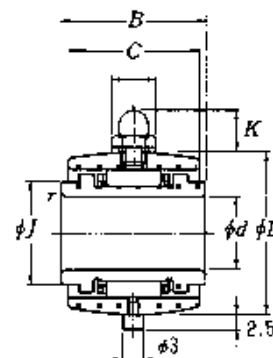


Bearing numbers			Abutment dimensions				Mass
bearing	bearing with saddle		mm				kg bearing with saddle (approx.)
	Type SA	Type SB	$L_1$	$d_1$	$G$	$H$	
FRIS16.5	FRIS16.5SA	FRIS16.5SB	22	21	13	24~26	0.059
FRIS19	FRIS19SA	FRIS19SB	22	24	15	27~29	0.081
FRIS19-5	FRIS19-5SA	FRIS19-5SB	22	26	15	30~32	0.120
FRIS22-2	FRIS22-2SA	—	26	30	15	35~37	0.208
FRIS25	FRIS25SA	—	26	33	15	37~39	0.226

**Type FRIS Series B**  
(For fine spinning machine/  
roving frame)



Type FRIS



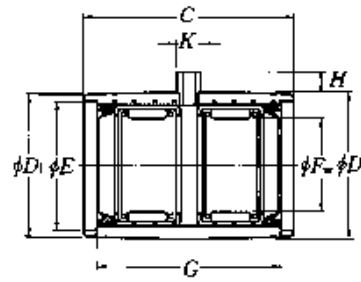
Type FRIS·NP  
(With grease nipple/knock pin)<sup>2)</sup>

d 15~25mm

d 0 -0.010	Boundary dimensions							Basic load ratings				Bearing numbers		Mass (approx.) kg Type FRIS·NP
	D	mm			J	rs min <sup>1)</sup>	K	dynamic		static		Type FRIS	Type FRIS·NP	
		B	C	J				N	kgf	C <sub>r</sub>	C <sub>or</sub>			
15	28	0 -0.020	24	22	22	0.3	7.7	10 200	14 600	1 040	1 480	FRIS15	—	0.070
15.875	30	0 -0.020	25.4	22	22	0.3	7.1	10 200	14 600	1 040	1 480	FRIS15.87	FRIS15.87NP	0.082
16	28	0 -0.020	26	22	22	0.3	7.7	10 200	14 600	1 040	1 480	FRIS16	FRIS16NP	0.083
	30	0 -0.020	26	22	22	0.3	7.1	10 200	14 600	1 040	1 480	FRIS16-2	FRIS16-2NP	0.098
18	31.750	0 -0.025	24	23	24	0.3	7.7	11 800	18 500	1 200	1 880	FRIS18	FRIS18NP	0.083
	32	0 -0.025	26	23	24	0.3	7.7	11 800	18 500	1 200	1 880	FRIS18-2	FRIS18-2NP	0.088
19.050	31.750	0 -0.025	23.81	23	24	0.3	7.7	11 800	18 500	1 200	1 880	FRIS19.05	—	0.078
	34	0 -0.025	25.4	23	26	0.3	7.7	12 700	17 600	1 300	1 800	FRIS19.05-1	FRIS19.05-1NP	0.098
20	34	0 -0.025	24	23	26	0.3	7.7	12 700	17 600	1 300	1 800	FRIS20-2	FRIS20-2NP	0.089
	34	0 -0.025	26	23	26	0.3	7.7	12 700	17 600	1 300	1 800	—	FRIS20-4NP	0.097
	36	0 -0.025	26	23	26	0.3	7.1	12 700	17 600	1 300	1 800	—	FRIS20-7NP	0.125
22	40	0 -0.025	26	24	30	0.6	7.1	16 200	22 300	1 650	2 280	FRIS22-1	FRIS22-1NP	0.154
22.225	40	0 -0.025	25.4	24	30	0.6	7.1	16 200	22 300	1 650	2 280	FRIS22.22	FRIS22.22NP	0.145
25	42	0 -0.025	26	24	32	0.6	7.1	16 000	22 500	1 640	2 290	FRIS25-1	FRIS25-1NP	0.154
	44	0 -0.025	26	24	34	0.6	7.1	17 200	25 100	1 750	2 560	FRIS25-2	FRIS25-2NP	0.174

Note 1) Allowable minimum chamfer dimension J.  
2) Example of bearing with grease nipple: Ex. FRIS 18N  
Bearing with knock pin only: Ex. FRIS 15.87P

Type FR  
(Drawing frame)



Type FR

$F_w$  17.462~22mm

$F_w$	Boundary dimensions							Basic load ratings				Bearing numbers	Mass kg (approx.)
	$D$ -0.050	$C$ -0.20	$E$	$G$	$H$	$K$	$D_1$	dynamic N	static	dynamic kgf	static		
<b>17.462</b> +0.053 +0.010	26.5	46	24	31	5	5	26	10 200	16 600	1 040	1 690	<b>FR17.46P</b>	0.066
	26.5	47.6	24.6	42.86	4.76	4.76	26	14 400	25 900	1 470	2 640	<b>FR17.46-1P</b>	0.075
	26.5	52.38	24.6	42.86	4.76	4.76	26	14 400	25 900	1 470	2 640	<b>FR17.46-2P</b>	0.082
	26.988	41.28	24	31	5	5	26.5	10 200	16 600	1 040	1 690	<b>FR17.46-3P</b>	0.068
<b>19.050</b> +0.053 +0.020	31.750	52.38	28	42.86	4.76	4.76	31.2	16 700	25 800	1 700	2 630	<b>FR19.05P</b>	0.134
<b>22</b> +0.053 +0.020	34	46	28	43	4.76	4.76	33.5	23 400	44 000	2 380	4 500	<b>FR22P</b>	0.150

## Tensioner Pulleys for Textile Machinery

These pulleys are used to guide and tension the tapes and belts driving the spindles of a fine spinning machine, a roving frame, a false twister, etc.

A pulley drawn precisely from steel plate by precision deep drawing is press-fitted in the outer ring of shaft bearing in place of inner ring.

### Types and construction

Single-row or double-row ball bearing is built in this pulley, which is internally pre-filled with lithium soap base grease. Grease is replenished through a grease hole which is internally provided in the stud. Two different mounting methods are available as follows for these pulleys; one method is to bolt a pulley to the roller carrier of machine with holder bolt using a special-purposed holder (Type code: **JF** · **S**) and another method is to bolt directly a pulley to machine frame using the bolting hole drilled in the stud and a corresponding hexagon head bolt. A knock pin press-fitted in the stud end face is to lock the bolt after tightened.

When a pulley is directly bolted to machine frame, provide the hexagon head bolt center with a grease through-hole for grease replenishing and screw a grease nipple in its end face.

In mounting a double-row ball bearing type tension pulley, insert the stud directly into machine frame and tighten it with nut, without using the special-purposed holder. Replenish grease using the box nut.

### Composition of pulley number

The pulley number of a given NTN tension pulley consists of a type code (**JPU** · **S**), dimension code [pulley outside diameter (*D*)] and a suffix. A pulley having a special holder is marked with the holder number of that holder added to the suffix.

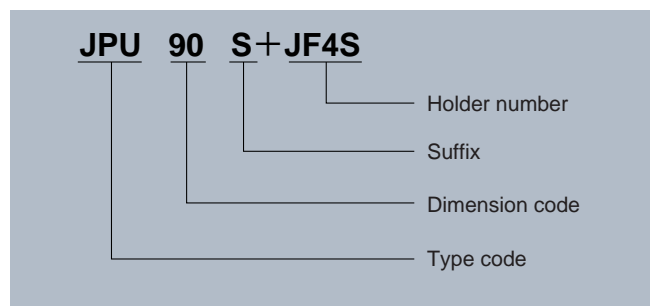
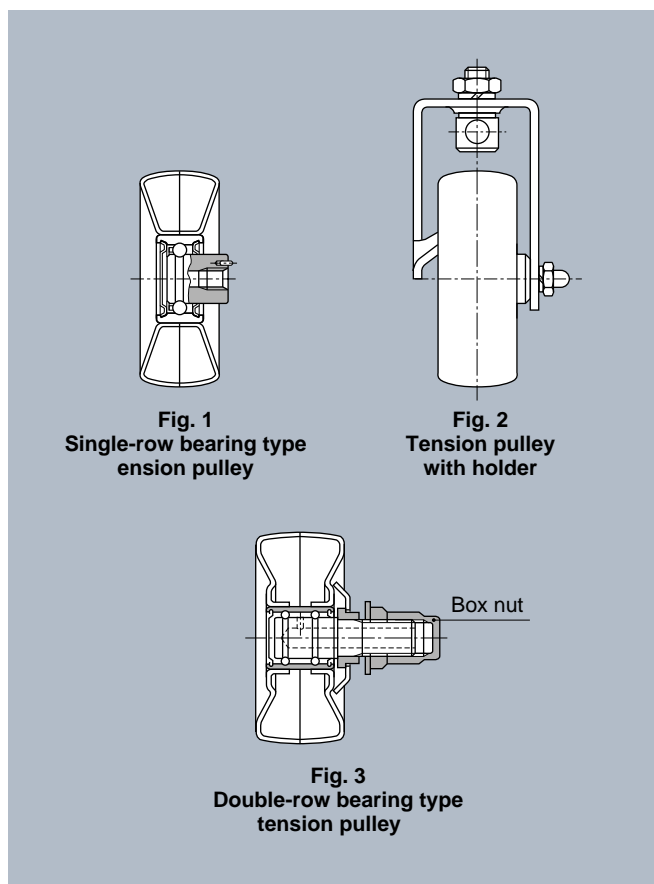
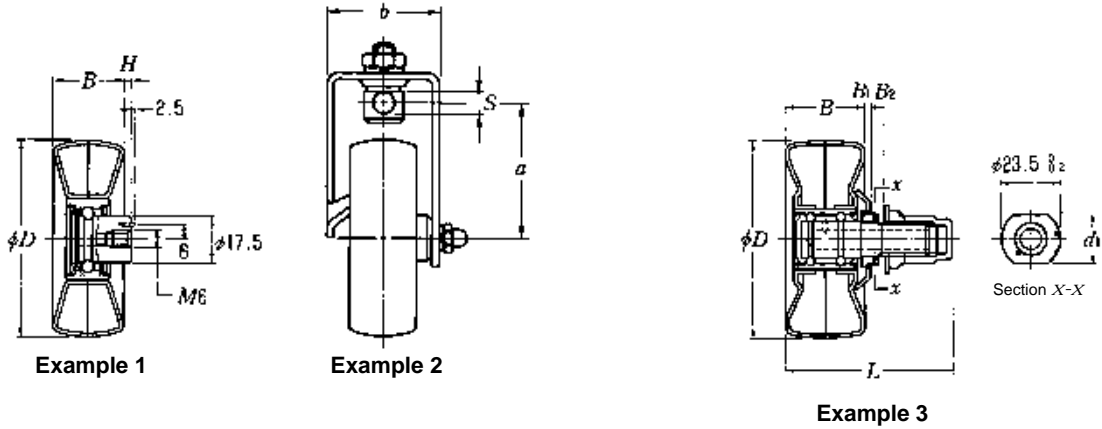


Fig. 4





D 60~100mm

Boundary dimensions										Bearing numbers	Sample number	Mass kg (approx.)	
D	B	B <sub>1</sub>	H	mm									
				d <sub>1</sub> 0 -0.3	a	b	S	L	B <sub>2</sub>				
60	25	—	3.5	—	—	—	—	—	—	—	JPU60S	1	0.140
	25	—	3.5	—	—	—	—	—	—	—	JPU70S	1	0.160
70	25	—	3.5	—	48	39	10.2	—	—	—	JPU70S+JF1S	2	0.235
	30	2	—	21	—	—	—	67	~71	5~9	JPU70-2S	3	0.245
	32	—	—	—	—	—	—	—	—	—	JPU70-1S	1	0.175
	32	—	—	—	48	46	10.2	—	—	—	JPU70-1S+JF2S	2	0.250
90	25	—	3.5	—	—	—	—	—	—	—	JPU90S	1	0.215
	25	—	3.5	—	58	39	10.2	—	—	—	JPU90S+JF3S	2	0.300
	32	—	—	—	—	—	—	—	—	—	JPU90-1S	1	0.230
	32	—	—	—	58	46	10.2	—	—	—	JPU90-1S+JF4S	2	0.320
	32	3.5	—	21	—	—	—	70.5~74.5	—	5~9	JPU90-9S	3	0.325
	45	3.5	—	21	—	—	—	83.5~87.5	—	5~9	JPU90-10S	3	0.380
100	32	3.5	—	21	—	—	—	70.5~74.5	—	5~9	JPU100-14S	3	0.290
	40	3.5	—	21	—	—	—	78.5~82.5	—	5~9	JPU100-12S	3	0.390



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Approximate conversion values against Rockwell C hardness of steel materials<sup>1)</sup>

Rockwell C scale hardness <sup>2)</sup>	Pickers hardness (DPH)	Brinell hardness 100 mm ball, load 3000 kgf			Rockwell hardness <sup>2)</sup>			Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm <sup>2</sup> Approx. value	Rockwell C scale hardness <sup>2)</sup>
		Standard ball	Hultgren ball	Tungsten carbide ball	A scale Load 60kgf brale indenter	B scale Load 100 kgf dia. 1/16in. ball	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgfkgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
68	940	—	—	—	85.6	—	76.9	93.2	84.4	75.4	97	—	68
67	900	—	—	—	85.0	—	76.1	92.9	83.6	74.2	95	—	67
66	865	—	—	—	84.5	—	75.4	92.5	82.8	73.3	92	—	66
65	832	—	—	739	83.9	—	74.5	92.2	81.9	72.0	91	—	65
64	800	—	—	722	83.4	—	73.8	91.8	81.1	71.0	88	—	64
63	772	—	—	705	82.8	—	73.0	91.4	80.1	69.9	87	—	63
62	746	—	—	688	82.3	—	72.2	91.1	79.3	68.8	85	—	62
61	720	—	—	670	81.8	—	71.5	90.7	78.4	67.7	83	—	61
60	697	—	613	654	81.2	—	70.7	90.2	77.5	66.6	81	—	60
59	674	—	599	634	80.7	—	69.9	89.8	76.6	65.5	80	—	59
58	653	—	587	615	80.1	—	69.2	89.3	75.7	64.3	78	—	58
57	633	—	575	595	79.6	—	68.5	88.9	74.8	63.2	76	—	57
56	613	—	561	577	79.0	—	67.7	88.3	73.9	62.0	75	—	56
55	595	—	546	560	78.5	—	66.9	87.9	73.0	60.9	74	212	55
54	577	—	534	543	78.0	—	66.1	87.4	72.0	59.8	72	205	54
53	560	—	519	525	77.4	—	65.4	86.9	71.2	58.6	71	199	53
52	544	500	508	512	76.8	—	64.6	86.4	70.2	57.4	69	192	52
51	528	487	494	496	76.3	—	63.8	85.9	69.4	56.1	68	186	51
50	513	475	481	481	75.9	—	63.1	85.5	68.5	55.0	67	179	50
49	498	464	469	469	75.2	—	62.1	85.0	67.6	53.8	66	172	49
48	484	451	455	455	74.7	—	61.4	84.5	66.7	52.5	64	167	48
47	471	442	443	443	74.1	—	60.8	83.9	65.8	51.4	63	161	47
46	458	432	432	432	73.6	—	60.0	83.5	64.8	50.3	62	156	46
45	446	421	421	421	73.1	—	59.2	83.0	64.0	49.0	60	151	45
44	434	409	409	409	72.5	—	58.5	82.5	63.1	47.8	58	146	44
43	423	400	400	400	72.0	—	57.7	82.0	62.2	46.7	57	141	43
42	412	390	390	390	71.5	—	56.9	81.5	61.3	45.5	56	136	42
41	402	381	381	381	70.9	—	56.2	80.9	60.4	44.3	55	132	41
40	392	371	371	371	70.4	—	55.4	80.4	59.5	43.1	54	127	40
39	382	362	362	362	69.9	—	54.6	79.9	58.6	41.9	52	124	39
38	372	353	353	353	69.4	—	53.8	79.4	57.7	40.8	51	120	38
37	363	344	344	344	68.9	—	53.1	78.8	56.8	39.6	50	118	37
36	354	336	336	336	68.4	(109.0)	52.3	78.3	55.9	38.4	49	114	36
35	345	327	327	327	67.9	(108.5)	51.5	77.7	55.0	37.2	48	110	35
34	336	319	319	319	67.4	(108.0)	50.8	77.2	54.2	36.1	47	108	34
33	327	311	311	311	66.8	(107.5)	50.0	76.6	53.3	34.9	46	105	33
32	318	301	301	301	66.3	(107.0)	49.2	76.1	52.1	33.7	44	102	32
31	310	294	294	294	65.8	(106.0)	48.4	75.6	51.3	32.5	43	100	31
30	302	286	286	286	65.3	(105.5)	47.7	75.0	50.4	31.3	42	97	30
29	294	279	279	279	64.7	(104.5)	47.0	74.5	49.5	30.1	41	95	29
28	286	271	271	271	64.3	(104.0)	46.1	73.9	48.6	28.9	41	93	28
27	279	264	264	264	63.8	(103.0)	45.2	73.3	47.7	27.8	40	90	27
26	272	258	258	258	63.3	(102.5)	44.6	72.8	46.8	26.7	38	88	26
25	266	253	253	253	62.8	(101.5)	43.8	72.2	45.9	25.5	38	86	25
24	260	247	247	247	62.4	(101.0)	43.1	71.6	45.0	24.3	37	84	24
23	254	243	243	243	62.0	100.0	42.1	71.0	44.0	23.1	36	82	23
22	248	237	237	237	61.5	99.0	41.6	70.5	43.2	22.0	35	80	22
21	243	231	231	231	61.0	98.5	40.9	69.9	42.3	20.7	35	79	21
20	238	226	226	226	60.5	97.8	40.1	69.4	41.5	19.6	34	77	20
(18)	230	219	219	219	—	96.7	—	—	—	—	33	75	(18)
(16)	222	212	212	212	—	95.5	—	—	—	—	32	72	(16)
(14)	213	203	203	203	—	93.9	—	—	—	—	31	69	(14)
(12)	204	194	194	194	—	92.3	—	—	—	—	29	66	(12)
(10)	196	187	187	187	—	90.7	—	—	—	—	28	63	(10)
( 8)	188	179	179	179	—	89.5	—	—	—	—	27	61	( 8)
( 6)	180	171	171	171	—	87.1	—	—	—	—	26	59	( 6)
( 4)	173	165	165	165	—	85.5	—	—	—	—	25	56	( 4)
( 2)	166	158	158	158	—	83.5	—	—	—	—	24	54	( 2)
( 0)	160	152	152	152	—	81.7	—	—	—	—	24	53	( 0)

Note 1) Approximate values were determined from SAE J 417.

2) Some of the parenthesized values in the above table are not used so frequently.

°C-°F temperature conversion table

°C		F	°C		F	°C		F	°C		F
-73	-100	-148	-1.6	29	84.2	17.7	64	147.2	37.1	99	210.2
-62	- 80	-112	-1.1	30	86.0	18.2	65	149.0	37.7	100	212
-51	- 60	- 76	-0.6	31	87.8	18.8	66	150.8	40.6	105	221
-40	- 40	- 40	0	32	89.6	19.3	67	152.6	43	110	230
-29	- 20	- 4	0.5	33	91.4	19.9	68	154.4	49	120	248
-23.3	- 10	14	1.1	34	93.2	20.4	69	156.2	54	130	266
-17.7	0	32	1.6	35	95.0	21.0	70	158.0	60	140	284
-17.2	1	33.8	2.2	36	96.8	21.5	71	159.8	65	150	302
-16.6	2	35.6	2.7	37	98.6	22.2	72	161.6	71	160	320
-16.1	3	37.4	3.3	38	100.4	22.7	73	163.4	76	170	338
-15.5	4	39.2	3.8	39	102.2	23.3	74	165.2	83	180	356
-15.0	5	41.0	4.4	40	104.0	23.8	75	167.0	88	190	374
-14.4	6	42.8	4.9	41	105.8	24.4	76	168.8	93	200	392
-13.9	7	44.6	5.4	42	107.6	25.0	77	170.6	121	250	482
-13.3	8	46.4	6.0	43	109.4	25.5	78	172.4	149	300	572
-12.7	9	48.2	6.6	44	111.2	26.2	79	174.2	177	350	662
-12.2	10	50.0	7.1	45	113.0	26.8	80	176.0	204	400	752
-11.6	11	51.8	7.7	46	114.8	27.3	81	177.8	232	450	842
-11.1	12	53.6	8.2	47	116.6	27.7	82	179.6	260	500	932
-10.5	13	55.4	8.8	48	118.4	28.2	83	181.4	288	550	1 022
-10.0	14	57.2	9.3	49	120.2	28.8	84	183.2	315	600	1 112
- 9.4	15	59.0	9.9	50	122.0	29.3	85	185.0	343	650	1 202
- 8.8	16	61.8	10.4	51	123.8	29.9	86	186.8	371	700	1 292
- 8.3	17	63.6	11.1	52	125.6	30.4	87	188.6	399	750	1 382
- 7.7	18	65.4	11.5	53	127.4	31.0	88	190.4	426	800	1 472
- 7.2	19	67.2	12.1	54	129.2	31.5	89	192.2	454	850	1 562
- 6.6	20	68.0	12.6	55	131.0	32.1	90	194.0	482	900	1 652
- 6.1	21	69.8	13.2	56	132.8	32.6	91	195.8	510	950	1 742
- 5.5	22	71.6	13.7	57	134.6	33.3	92	197.6	538	1 000	1 832
- 5.0	23	73.4	14.3	58	136.4	33.8	93	199.4	593	1 100	2 012
- 4.4	24	75.2	14.8	59	138.2	34.4	94	201.2	648	1 200	2 192
- 3.9	25	77.0	15.6	60	140.0	34.9	95	203.0	704	1 300	2 372
- 3.3	26	78.8	16.1	61	141.8	35.5	96	204.8	760	1 400	2 552
- 2.8	27	80.6	16.6	62	143.6	36.1	97	206.6	815	1 500	2 732
- 2.2	28	82.4	17.1	63	145.4	36.6	98	208.4	871	1 600	2 937

(How to read this table)

For example, for conversion from 38°C to °F read 38 in 4th row box (10th line from the top) and then read the right-side °F box. 38°C is equivalent to 100.4°F upon reading. Furthermore, for conversion from 38°F to °C read the left-side °C box.

°F38 is equivalent to 3.3°C upon reading.

$$C = 5/9(F - 32)$$

$$F = 9/5C + 32$$

Approximate conversion values against Vickers hardness of steel materials<sup>1)</sup>

Vickers hardness (DPH)	Brinell hardness 10 mm ball, load 3000 kgf			Rockwell hardness <sup>2)</sup>				Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm <sup>2</sup> Approx. value	Vickers hardness Load 50kgf
	Standard ball	Hultgren ball	Tungsten carbide ball	A scale Load 60 kgf brale indenter	B scale Load 100 kgf dia. 1/16in. ball	C-scale Load 150 kgf brale indenter	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
940	—	—	—	85.6	—	68.0	76.9	93.2	84.4	75.4	97	—	940
920	—	—	—	85.3	—	67.5	76.5	93.0	84.0	74.8	96	—	920
900	—	—	—	85.0	—	67.0	76.1	92.9	83.6	74.2	95	—	900
880	—	—	767	84.7	—	66.4	75.7	92.7	83.1	73.6	93	—	880
860	—	—	757	84.4	—	65.9	75.3	92.5	82.7	73.1	92	—	860
840	—	—	745	84.1	—	65.3	74.8	92.3	82.2	72.2	91	—	840
820	—	—	733	83.8	—	64.7	74.3	92.1	81.7	71.8	90	—	820
800	—	—	722	83.4	—	64.0	73.8	91.8	81.1	71.0	88	—	800
780	—	—	710	83.0	—	63.3	73.3	91.5	80.4	70.2	87	—	780
760	—	—	698	82.6	—	62.5	72.6	91.2	79.7	69.4	86	—	760
740	—	—	684	82.2	—	61.8	72.1	91.0	79.1	68.6	84	—	740
720	—	—	670	81.8	—	61.0	71.5	90.7	78.4	67.7	83	—	720
700	—	615	656	81.3	—	60.1	70.8	90.3	77.6	66.7	81	—	700
690	—	610	647	81.1	—	59.7	70.5	90.1	77.2	66.2	—	—	690
680	—	603	638	80.8	—	59.2	70.1	89.8	76.8	65.7	80	—	680
670	—	597	630	80.5	—	58.8	69.8	89.7	76.4	65.3	—	—	670
660	—	590	620	80.3	—	58.3	69.4	89.5	75.9	64.7	79	—	660
650	—	585	611	80.0	—	57.8	69.0	89.2	75.5	64.1	—	—	650
640	—	578	601	79.8	—	57.3	68.7	89.0	75.1	63.5	77	—	640
630	—	571	591	79.5	—	56.8	68.3	88.8	74.6	63.0	—	—	630
620	—	564	582	79.2	—	56.3	67.9	88.5	74.2	62.4	75	—	620
610	—	557	573	78.9	—	55.7	67.5	88.2	73.6	61.7	—	—	610
600	—	550	564	78.6	—	55.2	67.0	88.0	73.2	61.2	74	—	600
590	—	542	554	78.4	—	54.7	66.7	87.8	72.7	60.5	—	210	590
580	—	535	545	78.0	—	54.1	66.2	87.5	72.1	59.9	72	206	580
570	—	527	535	77.8	—	53.6	65.8	87.2	71.7	59.3	—	202	570
560	—	519	525	77.4	—	53.0	65.4	86.9	71.2	58.6	71	199	560
550	505	512	517	77.0	—	52.3	64.8	86.6	70.5	57.8	—	195	550
540	496	503	507	76.7	—	51.7	64.4	86.3	70.0	57.0	69	190	540
530	488	495	497	76.4	—	51.1	63.9	86.0	69.5	56.2	—	186	530
520	480	487	488	76.1	—	50.5	63.5	85.7	69.0	55.6	67	183	520
510	473	479	479	75.7	—	49.8	62.9	85.4	68.3	54.7	—	179	510
500	465	471	471	75.3	—	49.1	62.2	85.0	67.7	53.9	66	174	500
490	456	460	460	74.9	—	48.4	61.6	84.7	67.1	53.1	—	169	490
480	448	452	452	74.5	—	47.7	61.3	84.3	66.4	52.2	64	165	480
470	441	442	442	74.1	—	46.9	60.7	83.9	65.7	51.3	—	160	470
460	433	433	433	73.6	—	46.1	60.1	83.6	64.9	50.4	62	156	460
450	425	425	425	73.3	—	45.3	59.4	83.2	64.3	49.4	—	153	450
440	415	415	415	72.8	—	44.5	58.8	82.8	63.5	48.4	59	149	440
430	405	405	405	72.3	—	43.6	58.2	82.3	62.7	47.4	—	144	430
420	397	397	397	71.8	—	42.7	57.5	81.8	61.9	46.4	57	140	420
410	388	388	388	71.4	—	41.8	56.8	81.4	61.1	45.3	—	136	410
400	379	379	379	70.8	—	40.8	56.0	81.0	60.2	44.1	55	131	400
390	369	369	369	70.3	—	39.8	55.2	80.3	59.3	42.9	—	127	390
380	360	360	360	69.8	(110.0)	38.8	54.4	79.8	58.4	41.7	52	123	380

continued

Vickers hardness (DPH)	Brinell hardness 10 mm ball, load 3000 kgf			Rockwell hardness <sup>2)</sup>				Rockwell special hardness special brake indenter			Shore hardness	Tensile strength kgf/mm <sup>2</sup> Approx. value	Vickers hardness Load 50kgf
	Standard ball	Hultgren ball	Tungsten carbide ball	A scale Load 60 kgf brale indenter	B scale Load 100 kgf dia. 1/16in. ball	C-scale Load 150 kgf brale indenter	D-scale Load 100 kgf brale indenter	15-N scale Load 15 kgf	30-N scale Load 30 kgf	45-N scale load 45 kgf			
370	350	350	350	69.2	—	37.7	53.6	79.2	57.4	40.4	—	120	370
360	341	341	341	68.7	(109.0)	36.6	52.8	78.6	56.4	39.1	50	115	360
350	331	331	331	68.1	—	35.5	51.9	78.0	55.4	37.8	—	112	350
340	322	322	322	67.6	(108.0)	34.4	51.1	77.4	54.4	36.5	47	109	340
330	313	313	313	67.0	—	33.3	50.2	76.8	53.6	35.2	—	105	330
320	303	303	303	66.4	(107.0)	32.2	49.4	76.2	52.3	33.9	45	103	320
310	294	294	294	65.8	—	31.0	48.4	75.6	51.3	32.5	—	100	310
300	284	284	284	65.2	(105.5)	29.8	47.5	74.9	50.2	31.1	42	97	300
295	280	280	280	64.8	—	29.2	47.1	74.6	49.7	30.4	—	96	295
290	275	275	275	64.5	(104.5)	28.5	46.5	74.2	49.0	29.5	41	94	290
285	270	270	270	64.2	—	27.8	46.0	73.8	48.4	28.7	—	92	285
280	265	265	265	63.8	(103.5)	27.1	45.3	73.4	47.8	27.9	40	91	280
275	261	261	261	63.5	—	26.4	44.9	73.0	47.2	27.1	—	89	275
270	256	256	256	63.1	(102.0)	25.6	44.3	72.6	46.4	26.2	38	87	270
265	252	252	252	62.7	—	24.8	43.7	72.1	45.7	25.2	—	86	265
260	247	247	247	62.4	(101.0)	24.0	43.1	71.6	45.0	24.3	37	84	260
255	243	243	243	62.0	—	23.1	42.2	71.1	44.2	23.2	—	82	255
250	238	238	238	61.6	99.5	22.2	41.7	70.6	43.4	22.2	36	81	250
245	233	233	233	61.2	—	21.3	41.1	70.1	42.5	21.1	—	79	245
240	228	228	228	60.7	98.1	20.3	40.3	69.6	41.7	19.9	34	78	240
230	219	219	219	—	96.7	(18.0)	—	—	—	—	33	75	230
220	209	209	209	—	95.0	(15.7)	—	—	—	—	32	71	220
210	200	200	200	—	93.4	(13.4)	—	—	—	—	30	68	210
200	190	190	190	—	91.5	(11.0)	—	—	—	—	29	65	200
190	181	181	181	—	89.5	(8.5)	—	—	—	—	28	62	190
180	171	171	171	—	87.1	(6.0)	—	—	—	—	26	59	180
170	162	162	162	—	85.0	(3.0)	—	—	—	—	25	56	170
160	152	152	152	—	81.7	(0.0)	—	—	—	—	24	53	160
150	143	143	143	—	78.7	—	—	—	—	—	22	50	150
140	133	133	133	—	75.0	—	—	—	—	—	21	46	140
130	124	124	124	—	71.2	—	—	—	—	—	20	44	130
120	114	114	114	—	66.7	—	—	—	—	—	—	40	120
110	105	105	105	—	62.3	—	—	—	—	—	—	—	110
100	95	95	95	—	56.2	—	—	—	—	—	—	—	100
95	90	90	90	—	52.0	—	—	—	—	—	—	—	95
90	86	86	86	—	48.0	—	—	—	—	—	—	—	90
85	81	81	81	—	41.0	—	—	—	—	—	—	—	85

Note 1) Approximate values were determined from **SAE J 417**.

2) Some of the parenthesized values in the above table are not used so frequently.

Contrast table of SI and CGS system units, gravitation system units

Unit system	Quantity	Length <i>L</i>	Mass <i>M</i>	Time <i>T</i>	Acceleration	Force	Stress	Pressure	Energy
SI		m	kg	s	m/s <sup>2</sup>	N	Pa	Pa	J
CGS system		cm	g	s	Gal	dyn	dyn/cm <sup>2</sup>	dyn/cm <sup>2</sup>	erg
Gravitation system		m	kgf · s <sup>2</sup> /m	s	m/s <sup>2</sup>	kgf	kgf/m <sup>2</sup>	kgf/m <sup>2</sup>	kgf · m

Conversion to SI unit

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Angle	Degree	°	$\pi/180$	Radian	rad
	Minute	'	$\pi/10\ 800$		
	Second	" (sec)	$\pi/648\ 000$		
Length	Meter	m	1	Meter	m
	Micron	$\mu$	$10^{-6}$		
	Angstrom	Å	$10^{-10}$		
Area	Square meter	m <sup>2</sup>	1	Square meter	m <sup>2</sup>
	Are	a	$10^2$		
	Hector	ha	$10^4$		
Volume	Cubic meter	m <sup>3</sup>	1	Cubic meter	m <sup>3</sup>
	Liter	R.L	$10^{-3}$		
Mass	kilogram	kg	1	Kilogram	kg
	Ton	t	$10^3$		
	Weight kilogram.square second per meter	kgf · s <sup>2</sup> /m	9.806 65		
Time	Second	s	1	Second	s
	Minute	min	60		
	Hour	h	3 600		
	Day	d	86 400		
Speed	Meter per second	m/s	1	Meter per second	m/s
	Knot	kn	1 852/3 600		
Frequency and vibration	Cycle	s <sup>-1</sup> (pps)	1	Hertz	Hz
Revolutions (rotational speed)	Revolutions per minute per second	rpm (r/min)	1/60	Per second	s <sup>-1</sup>
Angular speed	Radian per second	rad/s	1	Radian per second	rad/s
Acceleration	Meter per second per second	m/s <sup>2</sup>	1	Meter per second per second	m/s <sup>2</sup>
	G	G	9.806 65		
Force	Weight kilogram	kgf	9.806 65	Newton	N
	Weight ton	tf	9 806.65		
	Dyne	dyn	$10^{-5}$		
Force moment	Weight kilogram meter	kgf · m	9.806 65	Newton meter	N · m
Inertia moment	Weight kilogram per square meter	kgf · m · s <sup>2</sup>	9.806 65	kilogram square meter	kg · m <sup>2</sup>
Stress	Weight kilogram per square meter	kgf/m <sup>2</sup>	9.806 65	Pascal or Newton per square meter	Pa or N/m <sup>2</sup>
Pressure	Weight kilogram per square meter	kgf/m <sup>2</sup>	9.806 65	Pascal	Pa
	Water column meter	mH <sub>2</sub> O	9 806.65		
	Mercury column meter	mHg	101 325/0.76		
	Torr	Torr	101 325/760		
	Atmospheric pressure	atm	101 325		
	Bar	bar	$10^5$		
Energy	Erg	erg	$10^{-7}$	Joule	J
	IT calorie	cal <sub>IT</sub>	4.186 8		
	Weight kilogram meter	kgf · m	9.806 65		
	Kilowatt per hour	kW · h	$3.600 \times 10^6$		
	Horse power per hour	PS · h	$2.647\ 79 \times 10^6$		
Power rate and power	Watt	W	1	Watt	W
	Horse power	PS	735.5		
	Weight kilogram meter per second	kgf · m/s	9.806 65		

Unit system \ Quantity	Power rate	Temperature	Viscosity	Dynamic viscosity	Magnetic flux	Flux density	Magnetic field strength
SI	W	K	Pa · s	m <sup>2</sup> /s	Wb	T	A/m
CGS system	erg/s	°C	P	St	Mx	Gs	Oe
Gravitation system	kgf · m/s	°C	kgf · s/m <sup>2</sup>	m <sup>2</sup> /s	—	—	—

### Conversion to SI unit

Quantity	Unit designation	Symbol	Conversion rate to SI	SI unit designation	Symbol
Viscosity	Poise	P	10 <sup>-1</sup>	Pascal second	Pa · s
	Centi poise	cP	10 <sup>-3</sup>		
	Weight kilogram second per square meter	kgf · s/m <sup>2</sup>	9.806 65		
Dynamic viscosity	Stokes	St	10 <sup>-4</sup>	Square meter per second	m <sup>2</sup> /s
	Centistokes	cSt	10 <sup>-6</sup>		
Temperature	Degree	°C	+273.15	Kelvin	K
Radioactive Dosage	Curie	Ci	3.7 × 10 <sup>10</sup>	Becquere	Bq
	Roentgen	R	2.58 × 10 <sup>-4</sup>	Coulomb per kilogram	C/kg
Absorption dosage	Rad	rad	10 <sup>-2</sup>	Gray	Gy
Dosage equivalent	Rem	rem	10 <sup>-2</sup>	Sivert	Sv
Magnetic flux	Maxwell	Mx	10 <sup>-8</sup>	Weber	Wb
Flux density	Gamma	γ	10 <sup>-9</sup>	Tesler	T
	Gauss	Gs	10 <sup>-4</sup>		
Magnetic field strength	Oersted	Oe	10 <sup>3</sup> /4 π	Ampere per meter	A/m
Quantity of electricity	Coulomb	C	1	Coulomb	C
Potential difference	Volt	V	1	Volt	V
Electric resistance	Ohm	Ω	1	Ohm	Ω
Current	Ampere	A	1	Ampere	A

### Integer multiplication of SI unit 10

Unit × multiple	Initial letter	
	Name	Symbol
10 <sup>18</sup>	Exa	E
10 <sup>15</sup>	Peta	P
10 <sup>12</sup>	Tera	T
10 <sup>9</sup>	Giga	G
10 <sup>6</sup>	Mega	M
10 <sup>3</sup>	Kilo	k
10 <sup>2</sup>	Hect	h
10	Deca	da
10 <sup>-1</sup>	Deci	d
10 <sup>-2</sup>	Centi	c
10 <sup>-3</sup>	Mili	m
10 <sup>-6</sup>	Micro	μ
10 <sup>-9</sup>	Nano	n
10 <sup>-12</sup>	Pico	p
10 <sup>-15</sup>	Femt	f
10 <sup>-18</sup>	Atto	a

kgf-N conversion table

kgf		N	kgf		N	kgf		N
0.1020	1	9.8066	3.4670	34	333.43	6.8321	67	657.04
0.2039	2	19.613	3.5690	35	343.23	6.9341	68	666.85
0.3059	3	29.420	3.6710	36	353.04	7.0361	69	676.66
0.4079	4	39.227	3.7730	37	362.85	7.1380	70	686.46
0.5099	5	49.033	3.8749	38	372.65	7.2400	71	696.27
0.6118	6	58.840	3.9769	39	382.46	7.3420	72	706.08
0.7138	7	68.646	4.0789	40	392.27	7.4440	73	715.88
0.8158	8	78.453	4.1808	41	402.07	7.5459	74	725.69
0.9177	9	88.260	4.2828	42	411.88	7.6479	75	735.50
1.0197	10	98.066	4.3848	43	421.68	7.7499	76	745.30
1.1217	11	107.87	4.4868	44	431.49	7.8518	77	755.11
1.2237	12	117.68	4.5887	45	441.30	7.9538	78	764.92
1.3256	13	127.49	4.6907	46	451.10	8.0558	79	774.72
1.4276	14	137.29	4.7927	47	460.91	8.1578	80	784.53
1.5296	15	147.10	4.8946	48	470.72	8.2597	81	794.34
1.6316	16	156.91	4.9966	49	480.52	8.3617	82	804.14
1.7335	17	166.71	5.0986	50	490.33	8.4637	83	813.95
1.8355	18	176.52	5.2006	51	500.14	8.5656	84	823.76
1.9375	19	186.33	5.3025	52	509.94	8.6676	85	833.56
2.0394	20	196.13	5.4045	53	519.75	8.7696	86	843.37
2.1414	21	205.94	5.5065	54	529.56	8.8716	87	853.18
2.2434	22	215.75	5.6085	55	539.36	8.9735	88	862.98
2.3454	23	225.55	5.7104	56	549.17	9.0755	89	872.79
2.4473	24	235.36	5.8124	57	558.98	9.1775	90	882.60
2.5493	25	245.17	5.9144	58	568.78	9.2794	91	892.40
2.6513	26	254.97	6.0163	59	578.59	9.3814	92	902.21
2.7532	27	264.78	6.1183	60	588.40	9.4834	93	912.02
2.8552	28	274.59	6.2203	61	598.20	9.5854	94	921.82
2.9572	29	284.39	6.3223	62	608.01	9.6873	95	931.63
3.0592	30	294.20	6.4242	63	617.82	9.7893	96	941.44
3.1611	31	304.01	6.5262	64	627.62	9.8913	97	951.24
3.2631	32	313.81	6.6282	65	637.43	9.9932	98	961.05
3.3651	33	323.62	6.7302	66	647.24	10.0952	99	970.86

[How to read the table]

For example, for conversion from 10kgf to N read 10 on center stage of 1st row box and then read the right-side N. 10kgf is equivalent to 98.066 upon reading. Furthermore, for conversion from 10N to kgf read the right side kgf box. 10N is equivalent to 1.0197kg upon reading.

1kgf=9.80665N  
1N=0.101972kgf

Viscosity conversion table

Dynamic viscosity mm <sup>2</sup> /s	Saybolt SUS (sec)	Redwood R" (sec)	Engler E (deg.)
2.7	35	32.2	1.18
4.3	40	36.2	1.32
5.9	45	40.6	1.46
7.4	50	44.9	1.60
8.9	55	49.1	1.75
10.4	60	53.5	1.88
11.8	65	57.9	2.02
13.1	70	62.3	2.15
14.5	75	67.6	2.31
15.8	80	71.0	2.42
17.0	85	75.1	2.55
18.2	90	79.6	2.68
19.4	95	84.2	2.81
20.6	100	88.4	2.95
23.0	110	97.1	3.21
25.0	120	105.9	3.49
27.5	130	114.8	3.77
29.8	140	123.6	4.04
32.1	150	132.4	4.32
34.3	160	141.1	4.59
36.5	170	150.0	4.88
38.8	180	158.8	5.15
41.0	190	167.5	5.44
43.2	200	176.4	5.72
47.5	220	194.0	6.28
51.9	240	212	6.85
56.5	260	229	7.38
60.5	280	247	7.95
64.9	300	265	8.51
70.3	325	287	9.24
75.8	350	309	9.95
81.2	375	331	10.7
86.8	400	353	11.4
92.0	425	375	12.1
97.4	450	397	12.8

Dynamic viscosity mm <sup>2</sup> /s	Saybolt SUS (sec)	Redwood R" (sec)	Engler E (deg.)
103	475	419	13.5
108	500	441	14.2
119	550	485	15.6
130	600	529	17.0
141	650	573	18.5
152	700	617	19.9
163	750	661	21.3
173	800	705	22.7
184	850	749	24.2
195	900	793	25.6
206	950	837	27.0
217	1 000	882	28.4
260	1 200	1 058	34.1
302	1 400	1 234	39.8
347	1 600	1 411	45.5
390	1 800	1 587	51
433	2 000	1 763	57
542	2 500	2 204	71
650	3 000	2 646	85
758	3 500	3 087	99
867	4 000	3 526	114
974	4 500	3 967	128
1 082	5 000	4 408	142
1 150	5 500	4 849	156
1 300	6 000	5 290	170
1 400	6 500	5 730	185
1 510	7 000	6 171	199
1 630	7 500	6 612	213
1 740	8 000	7 053	227
1 850	8 500	7 494	242
1 960	9 000	7 934	256
2 070	9 500	8 375	270
2 200	10 000	8 816	284

**Ordinary tolerance for cutting dimensions**

JIS B 0405

Ordinary tolerance is applied to cutting dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerances shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
  - (2) Applicable Standard No. and tolerance class
- Ex. Ordinary tolerance shall conform to the "Medium Class" specified in JIS B 0405.

Unit : mm

Dimensional division	Class		
	Fine class	Medium class	Coarse class
0.5 and over 3 incl. Over 3 6 incl.	±0.05	±0.1	—
			±0.2
Over 6 30 incl. Over 30 120 incl. Over 120 315 incl.	±0.15	±0.3	±0.5
			±0.8
			±1.2
Over 315 1000 incl. Over 1000 2000 incl.	±0.5	±1.2	±2
			±3

Reference: The numerical values given above every each of "Fine Class", "Medium class" and "Coarse Class" match "Fine series, Medium series", and "Coarse series" specified in ISO 2768 (Permissible Machining Variations in Dimensions without Tolerance Indication).

**Ordinary tolerances for castings**

JIS B 0403

This Standard specifies the ordinary tolerances for the as-casted length and wall thickness dimensions (hereinafter referred to as "ordinary tolerance") of gray castings and spherical graphite

castings molded using sand molds (excluding precision mold and other equivalent).

The ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
  - (2) Applicable Standard No. and tolerance class
- Ex. JIS B 0403, Coarse class

Ordinary tolerance for length

Unit : mm

Dimensional division	Gray castings		Spherical graphite castings	
	Fine class	Coarse class	Fine class	Coarse class
120 incl.	±1	± 1.5	±1.5	± 2
Over 120 250 incl.	±1.5	± 2	±2	± 2.5
Over 250 400 incl.	±2	± 3	±2.5	± 3.5
Over 400 800 incl.	±3	± 4	±4	± 5
Over 800 1600 incl.	±4	± 6	±5	± 7
Over 1600 3150 incl.	—	±10	—	±10

Ordinary tolerance for wall thickness

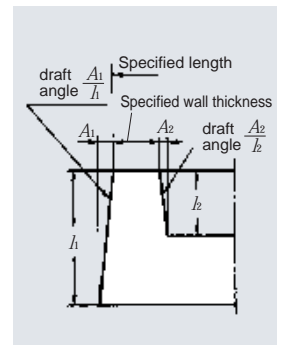
Unit : mm

Dimensional division	Gray castings		Spherical graphite castings	
	Fine class	Coarse class	Fine class	Coarse class
10 incl.	±1	±1.5	±1.2	±2
Over 10 18 incl.	±1.5	±2	±1.5	±2.5
Over 18 30 incl.	±2	±3	±2	±3
Over 30 50 incl.	±2	±3.5	±2.5	±4

Dimension-A for draft angle

Unit : mm

Dimensional division	Dimension A (max)
18 incl.	1
Over 18 30 incl.	1.5
Over 30 50 incl.	2
Over 50 120 incl.	2.5
Over 120 315 incl.	3.5
Over 315 630 incl.	6
Over 630 1000 incl.	9



Remarks : *l* means *h<sub>1</sub>* and *h<sub>2</sub>* in the above sketch.  
*A* means *A<sub>1</sub>*, *A<sub>2</sub>* in the above sketch.

**Ordinary tolerances for press-formed metal parts**

JIS B 0408

This Standard specifies the ordinary tolerances for the punching, bending and drawing dimensions, bending angle of press-formed metal parts (hereinafter referred to as "ordinary tolerance").

Ordinary tolerance is applied to the dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
  - (2) Applicable Standard No. and tolerance class
- Ex. JIS B0408, Class-A

Ordinary tolerance for punching Unit : mm

Dimensional division	Class		
	Class-A	Class-B	Class-C
6 incl.	$\pm 0.05$	$\pm 0.1$	$\pm 0.3$
Over 6 30 incl.	$\pm 0.1$	$\pm 0.2$	$\pm 0.5$
Over 30 120 incl.	$\pm 0.15$	$\pm 0.3$	$\pm 0.8$
Over 120 400 incl.	$\pm 0.2$	$\pm 0.5$	$\pm 1.2$
Over 400 1000 incl.	$\pm 0.3$	$\pm 0.8$	$\pm 2$
Over 1000 2000 incl.	$\pm 0.5$	$\pm 1.2$	$\pm 3$

Ordinary tolerance for bending angle Unit : mm

Dimensional division	Class		
	Class-A	Class-B	Class-C
6 incl.	$\pm 0.1$	$\pm 0.3$	$\pm 0.5$
Over 6 30 incl.	$\pm 0.2$	$\pm 0.5$	$\pm 1$
Over 30 120 incl.	$\pm 0.3$	$\pm 0.8$	$\pm 1.5$
Over 120 400 incl.	$\pm 0.5$	$\pm 1.2$	$\pm 2.5$
Over 400 1000 incl.	$\pm 0.8$	$\pm 2$	$\pm 4$
Over 1000 2000 incl.	$\pm 1.2$	$\pm 3$	$\pm 6$

**Ordinary tolerances for sheared metal plates**

JIS B 0410

This Standard specifies the ordinary tolerances for the shearing width and ordinary tolerances for the straightness and perpendicularity (hereinafter generically referred to as "ordinary tolerance") of metal plates of 12mm and less in thickness which were sheared by direct shearing machines such as gear pusher, square shear, etc.

The ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
- (2) Applicable standard No. and tolerance class

Ex. 1. JIS B 0410, Class-B

- 2. Cutting width, straightness: JIS B 0410, Class-B
- Perpendicularity: JIS B 0410, Class-A

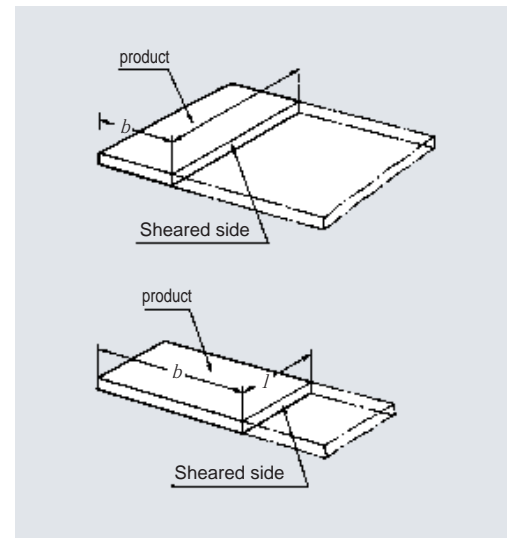
Definition of the terms: The terms used in this Standard are as defined in JIS B 0111 (Terminology relating to press machines) and, in addition, defined as follows.

- (1) Cutting width: Distance from one side sheared by shear cutter to opposite side, as illustrated in Fig. *b*
- (2) Cutting length: length of one side sheared by shear cutter, as illustrated in Fig. *l*.

Ordinary tolerance for shearing width

Unit : mm

Cutting width division <i>b</i>	Classification by plate thickness ( <i>t</i> )							
	$t \leq 1.6$		$1.6 < t \leq 3$		$3 < t \leq 6$		$6 < t \leq 12$	
	Class							
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	±0.1	±0.3	—	—	—	—	—	—
Over 30 120 incl.	±0.2	±0.5	±0.3	±0.5	±0.8	±1.2	—	±1.5
Over 120 400 incl.	±0.3	±0.8	±0.4	±0.8	±1	±1.5	—	±2
Over 400 1000 incl.	±0.5	±1	±0.5	±1.2	±1.5	±2	—	±2.5
Over 1000 2000 incl.	±0.8	±1.5	±0.8	±2	±2	±3	—	±3
Over 2000 4000 incl.	±1.2	±2	±1.2	±2.5	±3	±4	—	±4



Ordinary tolerance for straightness

Unit : mm

Cutting length division	Classification by plate thickness ( <i>t</i> )							
	$t \leq 1.6$		$1.6 < t \leq 3$		$3 < t \leq 6$		$6 < t \leq 12$	
	Class							
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	0.1	0.2	—	—	—	—	—	—
Over 30 120 incl.	0.2	0.3	0.2	0.3	0.5	0.8	—	1.5
Over 120 400 incl.	0.3	0.5	0.3	0.5	0.8	1.5	—	2
Over 400 1000 incl.	0.5	0.8	0.5	1	1.5	2	—	3
Over 1000 2000 incl.	0.8	1.2	0.8	1.5	2	3	—	4
Over 2000 4000 incl.	1.2	2	1.2	2.5	3	5	—	6

Ordinary tolerance for squareness

Unit : mm

Narrow side length division	Classification by plate thickness ( <i>t</i> )					
	$t \leq 3$		$3 < t \leq 6$		$6 < t \leq 12$	
	Class					
	Class-A	Class-B	Class-A	Class-B	Class-A	Class-B
30 and less	—	—	—	—	—	—
Over 30 120 incl.	0.3	0.5	0.5	0.8	—	1.5
Over 120 400 incl.	0.8	1.2	1	1.5	—	2
Over 400 1000 incl.	1.5	3	2	3	—	3
Over 1000 2000 incl.	3	6	4	6	—	6
Over 2000 4000 incl.	6	10	6	10	—	10

**Ordinary tolerance for sintered metal parts**

JIS B 0411

This Standard specifies the ordinary tolerance which is applied to the machining dimensions of sintered mechanical parts and sintered oil-contained bearing, of sintered metal parts, but excluding machining methods other (e.g. cutting, etc.) than the machining method specific for sintered metal parts.

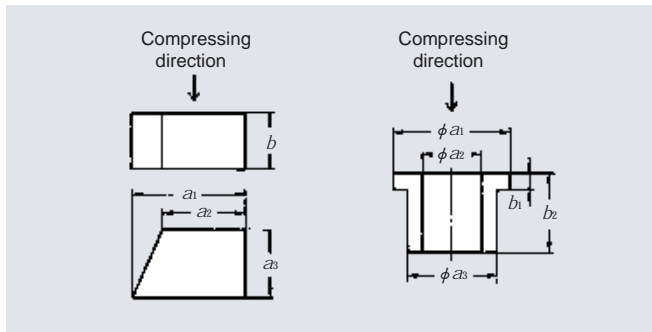
Ordinary tolerance is applied to the dimensions for which special accuracy is not required functionally and, therefore, applicable tolerances are indicated in batch, without individual indication of them, in relevant specification, drawings, etc.

Ordinary tolerance shall be indicated by either one of the following methods (1) and (2).

- (1) Numerical value table for each dimensional division
- (2) Applicable Standard No. and tolerance class  
Ex. JIS B0411, Fine Class

Definition of terms: The terms used in this Standard are as defined below.

- (1) Width: Perpendicular dimension against compressing direction in compressive molding of powders, as illustrated in Fig. *a*.
- (2) Height: Dimension parallel to compressing direction in molding of powders, as illustrated in Fig. *b*.



Class: The ordinary tolerance class shall be three classes of “Fine Class”, “Medium Class” and “Coarse class”.

Reference: The numerical values every each class of “Fine Class”, “Medium Class” and “Coarse class” match “Fine Series, Medium Series and Coarse Series specified in ISO 2768 (Permissible machining variations in dimensions without tolerance indication)

Ordinary tolerance for width

Unit : mm

Dimensional division \ class	class		
	Fine class	Medium class	Coarse class
6 and less	±0.05	±0.1	±0.2
Over 6 - 30 incl.	±0.1	±0.2	±0.5
Over 30 - 120 incl.	±0.15	±0.3	±0.8
Over 120 - 315 incl.	±0.2	±0.5	±1.2

Ordinary tolerance for height

Unit : mm

Dimensional division \ class	class		
	Fine class	Medium class	Coarse class
6 and less	±0.1	±0.2	±0.6
Over 6 - 30 incl.	±0.2	±0.5	±1
Over 30 - 120 incl.	±0.3	±0.8	±1.8

Dimensional tolerance for shaft (JIS B 0401-2)

Diameter division mm		a13		c12		d6		e6		e13		f5		f6		g5		g6	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	-270	-450	-70	-190	-30	-38	-20	-28	-20	-200	-10	-15	-10	-18	-4	-9	-4	-12
6	10	-280	-500	-80	-230	-40	-49	-25	-34	-25	-245	-13	-19	-13	-22	-5	-11	-5	-14
10	18	-290	-560	-95	-275	-50	-61	-32	-43	-32	-302	-16	-24	-16	-27	-6	-14	-6	-17
18	30	-300	-630	-110	-320	-65	-78	-40	-53	-40	-370	-20	-29	-20	-33	-7	-16	-7	-20
30	40	-310	-700	-120	-370	-80	-96	-50	-66	-50	-440	-25	-36	-25	-41	-9	-20	-9	-25
40	50	-320	-710	-130	-380	-100	-119	-60	-79	-60	-520	-30	-43	-30	-49	-10	-23	-10	-29
50	65	-340	-800	-140	-440	-120	-142	-72	-94	-72	-612	-36	-51	-36	-58	-12	-27	-12	-34
65	80	-360	-820	-150	-450	-145	-170	-85	-110	-85	-715	-43	-61	-43	-68	-14	-32	-14	-39
80	100	-380	-920	-170	-520	-170	-199	-100	-129	-100	-820	-50	-70	-50	-79	-15	-35	-15	-44
100	120	-410	-950	-180	-530	-190	-222	-110	-142	-110	-920	-56	-79	-56	-88	-17	-40	-17	-49
120	140	-460	-1 090	-200	-600	-210	-246	-125	-161	-125	-1 015	-62	-87	-62	-98	-18	-43	-18	-54
140	160	-520	-1 150	-210	-610	-230	-270	-135	-175	-135	-1 105	-68	-95	-68	-108	-20	-47	-20	-60
160	180	-580	-1 210	-240	-700	-260	-720	-145	-189	-145	-1 189	-76	-120	-76	-130	-22	-54	-22	-66
180	200	-660	-1 380	-240	-700	-290	-340	-160	-210	-160	-210	-80	-130	-80	-142	-24	-60	-24	-74
200	225	-740	-1 460	-260	-720	-170	-226	-170	-226	-170	-226	-86	-142	-86	-142	-26	-66	-26	-82
225	250	-820	-1 540	-280	-740	-195	-261	-195	-261	-195	-261	-98	-164	-98	-164	-28	-74	-28	-94
250	280	-920	-1 730	-300	-820	-230	-270	-230	-270	-230	-270	-110	-188	-110	-188	-30	-82	-30	-108
280	315	-1 050	-1 860	-330	-850	-260	-304	-260	-304	-260	-304	-122	-210	-122	-210	-32	-90	-32	-116
315	355	-1 200	-2 090	-360	-930	-290	-376	-290	-376	-290	-376	-134	-232	-134	-232	-34	-98	-34	-124
355	400	-1 350	-2 240	-400	-970	-320	-416	-320	-416	-320	-416	-146	-254	-146	-254	-36	-106	-36	-132
400	450	-1 500	-2 470	-440	-1 070	-350	-468	-350	-468	-350	-468	-158	-276	-158	-276	-38	-114	-38	-140
450	500	-1 650	-2 620	-480	-1 110	-390	-468	-390	-468	-390	-468	-170	-298	-170	-298	-40	-122	-40	-148
500	560	-	-	-	-	-260	-304	-145	-189	-	-	-	-	-76	-120	-	-	-22	-66
560	630	-	-	-	-	-290	-340	-160	-210	-	-	-	-	-80	-130	-	-	-24	-74
630	710	-	-	-	-	-290	-340	-160	-210	-	-	-	-	-80	-130	-	-	-24	-74
710	800	-	-	-	-	-320	-376	-170	-226	-	-	-	-	-86	-142	-	-	-26	-82
800	900	-	-	-	-	-320	-376	-170	-226	-	-	-	-	-86	-142	-	-	-26	-82
900	1 000	-	-	-	-	-350	-416	-195	-261	-	-	-	-	-98	-164	-	-	-28	-94
1 000	1 120	-	-	-	-	-350	-416	-195	-261	-	-	-	-	-98	-164	-	-	-28	-94
1 120	1 250	-	-	-	-	-390	-468	-220	-298	-	-	-	-	-110	-188	-	-	-30	-108
1 250	1 400	-	-	-	-	-390	-468	-220	-298	-	-	-	-	-110	-188	-	-	-30	-108
1 400	1 600	-	-	-	-	-390	-468	-220	-298	-	-	-	-	-110	-188	-	-	-30	-108

Diameter division mm		j5		js5		j6		js6		j7		k4		k5		k6		m5	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+3	-2	+2.5	-2.5	+6	-2	+4	-4	+8	-4	+5	+1	+6	+1	+9	+1	+9	+4
6	10	+4	-2	+3	-3	+7	-2	+4.5	-4.5	+10	-5	+5	+1	+7	+1	+10	+1	+12	+6
10	18	+5	-3	+4	-4	+8	-3	+5.5	-5.5	+12	-6	+6	+1	+9	+1	+12	+1	+15	+7
18	30	+5	-4	+4.5	-4.5	+9	-4	+6.5	-6.5	+13	-8	+8	+2	+11	+2	+15	+2	+17	+8
30	40	+6	-5	+5.5	-5.5	+11	-5	+8	-8	+15	-10	+9	+2	+13	+2	+18	+2	+20	+9
40	50	+6	-5	+5.5	-5.5	+11	-5	+8	-8	+15	-10	+9	+2	+13	+2	+18	+2	+20	+9
50	65	+6	-7	+6.5	-6.5	+12	-7	+9.5	-9.5	+18	-12	+10	+2	+15	+2	+21	+2	+24	+11
65	80	+6	-7	+6.5	-6.5	+12	-7	+9.5	-9.5	+18	-12	+10	+2	+15	+2	+21	+2	+24	+11
80	100	+6	-9	+7.5	-7.5	+13	-9	+11	-11	+20	-15	+13	+3	+18	+3	+25	+3	+28	+13
100	120	+6	-9	+7.5	-7.5	+13	-9	+11	-11	+20	-15	+13	+3	+18	+3	+25	+3	+28	+13
120	140	+7	-11	+9	-9	+14	-11	+12.5	-12.5	+22	-18	+15	+3	+21	+3	+28	+3	+33	+15
140	160	+7	-11	+9	-9	+14	-11	+12.5	-12.5	+22	-18	+15	+3	+21	+3	+28	+3	+33	+15
160	180	+7	-11	+9	-9	+14	-11	+12.5	-12.5	+22	-18	+15	+3	+21	+3	+28	+3	+33	+15
180	200	+7	-13	+10	-10	+16	-13	+14.5	-14.5	+25	-21	+18	+4	+24	+4	+33	+4	+37	+17
200	225	+7	-13	+10	-10	+16	-13	+14.5	-14.5	+25	-21	+18	+4	+24	+4	+33	+4	+37	+17
225	250	+7	-13	+10	-10	+16	-13	+14.5	-14.5	+25	-21	+18	+4	+24	+4	+33	+4	+37	+17
250	280	+7	-16	+11.5	-11.5	+16	-16	+16	-16	+26	-26	+20	+4	+27	+4	+36	+4	+43	+20
280	315	+7	-16	+11.5	-11.5	+16	-16	+16	-16	+26	-26	+20	+4	+27	+4	+36	+4	+43	+20
315	355	+7	-18	+12.5	-12.5	+18	-18	+18	-18	+29	-28	+22	+4	+29	+4	+40	+4	+46	+21
355	400	+7	-18	+12.5	-12.5	+18	-18	+18	-18	+29	-28	+22	+4	+29	+4	+40	+4	+46	+21
400	450	+7	-20	+13.5	-13.5	+20	-20	+20	-20	+31	-32	+25	+5	+32	+5	+45	+5	+50	+23
450	500	+7	-20	+13.5	-13.5	+20	-20	+20	-20	+31	-32	+25	+5	+32	+5	+45	+5	+50	+23
500	560	-	-	-	-	-	-	+22	-22	-	-	-	-	-	-	+44	0	-	-
560	630	-	-	-	-	-	-	+22	-22	-	-	-	-	-	-	+44	0	-	-
630	710	-	-	-	-	-	-	+25	-25	-	-	-	-	-	-	+50	0	-	-
710	800	-	-	-	-	-	-	+25	-25	-	-	-	-	-	-	+50	0	-	-
800	900	-	-	-	-	-	-	+28	-28	-	-	-	-	-	-	+56	0	-	-
900	1 000	-	-	-	-	-	-	+28	-28	-	-	-	-	-	-	+56	0	-	-
1 000	1 120	-	-	-	-	-	-	+33	-33	-	-	-	-	-	-	+66	0	-	-
1 120	1 250	-	-	-	-	-	-	+33	-33	-	-	-	-	-	-	+66	0	-	-
1 250	1 400	-	-	-	-	-	-	+39	-39	-	-	-	-	-	-	+78	0	-	-
1 400	1 600	-	-	-	-	-	-	+39	-39	-	-	-	-	-	-	+78	0	-	-

Unit :  $\mu\text{m}$

h4		h5		h6		h7		h8		h9		h10		h11		h13		js4		Diameter division mm	
High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	Over	incl.
0	-4	0	-5	0	-8	0	-12	0	-18	0	-30	0	-48	0	-75	0	-180	+2	-2	3	6
0	-4	0	-6	0	-9	0	-15	0	-22	0	-36	0	-58	0	-90	0	-220	+2	-2	6	10
0	-5	0	-8	0	-11	0	-18	0	-27	0	-43	0	-70	0	-110	0	-270	+2.5	-2.5	10	18
0	-6	0	-9	0	-13	0	-21	0	-33	0	-52	0	-84	0	-130	0	-330	+3	-3	18	30
0	-7	0	-11	0	-16	0	-25	0	-39	0	-62	0	-100	0	-160	0	-390	+3.5	-3.5	30	40
																				40	50
0	-8	0	-13	0	-19	0	-30	0	-46	0	-74	0	-120	0	-190	0	-460	+4	-4	50	65
																				65	80
0	-10	0	-15	0	-22	0	-35	0	-54	0	-87	0	-140	0	-220	0	-540	+5	-5	80	100
																				100	120
0	-12	0	-18	0	-25	0	-40	0	-63	0	-100	0	-160	0	-250	0	-630	+6	-6	120	140
																				140	160
																				160	180
0	-14	0	-20	0	-29	0	-46	0	-72	0	-115	0	-185	0	-290	0	-720	+7	-7	180	200
																				200	225
																				225	250
0	-16	0	-23	0	-32	0	-52	0	-81	0	-130	0	-210	0	-320	0	-810	+8	-8	250	280
																				280	315
0	-18	0	-25	0	-36	0	-57	0	-89	0	-140	0	-230	0	-360	0	-890	+9	-9	315	355
																				355	400
0	-20	0	-27	0	-40	0	-63	0	-97	0	-155	0	-250	0	-400	0	-970	+10	-10	400	450
																				450	500
-	-	-	-	0	-44	0	-70	0	-110	0	-175	0	-280	0	-440	0	-	-	-	500	560
																				560	630
-	-	-	-	0	-50	0	-80	0	-125	0	-200	0	-320	0	-500	0	-	-	-	630	710
																				710	800
-	-	-	-	0	-56	0	-90	0	-140	0	-230	0	-360	0	-560	0	-	-	-	800	900
																				900	1 000
-	-	-	-	0	-66	0	-105	0	-165	0	-260	0	-420	0	-660	0	-	-	-	1 000	1 120
																				1 120	1 250
-	-	-	-	0	-78	0	-125	0	-195	0	-310	0	-500	0	-780	0	-	-	-	1 250	1 400
																				1 400	1 600

Unit :  $\mu\text{m}$

m6		n5		n6		p5		p6		r6		r7		Basic tolerance				Diameter division mm	
High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	IT2	IT3	IT5	IT7	Over	incl.
+12	+4	+13	+8	+16	+8	+17	+12	+20	+12	+23	+15	+27	+15	1.5	2.5	5	12	3	6
+15	+6	+16	+10	+19	+10	+21	+15	+24	+15	+28	+19	+34	+19	1.5	2.5	6	15	6	10
+18	+7	+20	+12	+23	+12	+26	+18	+29	+18	+34	+23	+41	+23	2	3	8	18	10	18
+21	+8	+24	+15	+28	+15	+31	+22	+35	+22	+41	+28	+49	+28	2.5	4	9	21	18	30
+25	+9	+28	+17	+33	+17	+37	+26	+42	+26	+50	+34	+59	+34	2.5	4	11	25	30	40
																		40	50
+30	+11	+33	+20	+39	+20	+45	+32	+51	+32	+60	+41	+71	+41	3	5	13	30	50	65
																		65	80
+35	+13	+38	+23	+45	+23	+52	+37	+59	+37	+73	+51	+86	+51	4	6	15	35	80	100
																		100	120
+40	+15	+45	+27	+52	+27	+61	+43	+68	+43	+88	+63	+103	+63	5	8	18	40	120	140
																		140	160
																		160	180
+46	+17	+51	+31	+60	+31	+70	+50	+79	+50	+106	+77	+123	+77	7	10	20	46	180	200
																		200	225
																		225	250
+52	+20	+57	+34	+66	+34	+79	+56	+88	+56	+126	+94	+146	+94	8	12	23	52	250	280
																		280	315
+57	+21	+62	+37	+73	+37	+87	+62	+98	+62	+144	+108	+165	+108	9	13	25	57	315	355
																		355	400
+63	+23	+67	+40	+80	+40	+95	+68	+108	+68	+166	+126	+189	+126	10	15	27	63	400	450
																		450	500
+70	+26	-	-	+88	+44	-	-	+122	+78	+194	+150	+220	+150	-	-	-	70	500	560
																		560	630
+80	+30	-	-	+100	+50	-	-	+138	+88	+225	+175	+255	+175	-	-	-	80	630	710
																		710	800
+90	+34	-	-	+112	+56	-	-	+156	+100	+235	+185	+265	+185	-	-	-	90	800	900
																		900	1 000
+106	+40	-	-	+132	+66	-	-	+186	+120	+266	+210	+300	+210	-	-	-	105	1 000	1 120
																		1 120	1 250
+126	+48	-	-	+156	+78	-	-	+218	+140	+316	+250	+355	+250	-	-	-	125	1 250	1 400
																		1 400	1 600

Dimensional tolerance for housing bore (JIS B 0401-2)

Diameter division mm		E7		E10		E11		E12		F6		F7		F8		G6		G7		H6	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+32	+20	+68	+20	+95	+20	+140	+20	+18	+10	+22	+10	+28	+10	+12	+4	+16	+4	+8	0
6	10	+40	+25	+83	+25	+115	+25	+175	+25	+22	+13	+28	+13	+35	+13	+14	+5	+20	+5	+9	0
10	18	+50	+32	+102	+32	+142	+32	+212	+32	+27	+16	+34	+16	+43	+16	+17	+6	+24	+6	+11	0
18	30	+61	+40	+124	+40	+170	+40	+250	+40	+33	+20	+41	+20	+53	+20	+20	+7	+28	+7	+13	0
30	40	+75	+50	+150	+50	+210	+50	+300	+50	+41	+25	+50	+25	+64	+25	+25	+9	+34	+9	+16	0
40	50																				
50	65	+90	+60	+180	+60	+250	+60	+360	+60	+49	+30	+60	+30	+76	+30	+29	+10	+40	+10	+19	0
65	80																				
80	100	+107	+72	+212	+72	+292	+72	+422	+72	+58	+36	+71	+36	+90	+36	+34	+12	+47	+12	+22	0
100	120																				
120	140	+125	+85	+245	+85	+335	+85	+485	+85	+68	+43	+83	+43	+106	+43	+39	+14	+54	+14	+25	0
140	160																				
160	180																				
180	200	+146	+100	+285	+100	+390	+100	+560	+100	+79	+50	+96	+50	+122	+50	+44	+15	+61	+15	+29	0
200	225																				
225	250																				
250	280	+162	+110	+320	+110	+430	+110	+630	+110	+88	+56	+108	+56	+137	+56	+49	+17	+69	+17	+32	0
280	315																				
315	355	+182	+125	+355	+125	+485	+125	+695	+125	+98	+62	+119	+62	+151	+62	+54	+18	+75	+18	+36	0
355	400																				
400	450	+198	+135	+385	+135	+535	+135	+765	+135	+108	+68	+131	+68	+165	+68	+60	+20	+83	+20	+40	0
450	500																				
500	560	+215	+145	-	-	-	-	-	-	+120	+76	+146	+76	+186	+76	+66	+22	+92	+22	+44	0
560	630																				
630	710	+240	+160	-	-	-	-	-	-	+130	+80	+160	+80	+205	+80	+74	+24	+104	+24	+50	0
710	800																				
800	900	+260	+170	-	-	-	-	-	-	+142	+86	+176	+86	+226	+86	+82	+26	+116	+26	+56	0
900	1000																				
1000	1120	+300	+195	-	-	-	-	-	-	+164	+98	+203	+98	+263	+98	+94	+28	+133	+28	+66	0
1120	1250																				
1250	1400	+345	+220	-	-	-	-	-	-	+188	+110	+235	+110	+305	+110	+108	+30	+155	+30	+78	0
1400	1600																				
1600	1800	+390	+240	-	-	-	-	-	-	+212	+120	+270	+120	+350	+120	+124	+32	+182	+32	+92	0
1800	2000																				

Unit:  $\mu\text{m}$

Diameter division mm		K6		K7		M6		M7		N6		N7		P6		P7		R6		R7	
Over	incl.	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
3	6	+2	-6	+3	-9	-1	-9	0	-12	-5	-13	-4	-16	-9	-17	-8	-20	-12	-20	-11	-23
6	10	+2	-7	+5	-10	-3	-12	0	-15	-7	-16	-4	-19	-12	-21	-9	-24	-16	-25	-13	-28
10	18	+2	-9	+6	-12	-4	-15	0	-18	-9	-20	-5	-23	-15	-26	-11	-29	-20	-31	-16	-34
18	30	+2	-11	+6	-15	-4	-17	0	-21	-11	-24	-7	-28	-18	-31	-14	-35	-24	-37	-20	-41
30	40	+3	-13	+7	-18	-4	-20	0	-25	-12	-28	-8	-33	-21	-37	-17	-42	-29	-42	-25	-50
40	50																				
50	65	+4	-15	+9	-21	-5	-24	0	-30	-14	-33	-9	-39	-26	-45	-21	-51	-35	-54	-30	-60
65	80																				
80	100	+4	-18	+10	-25	-6	-28	0	-35	-16	-38	-10	-45	-30	-52	-24	-59	-44	-66	-38	-73
100	120																				
120	140	+4	-21	+12	-28	-8	-33	0	-40	-20	-45	-12	-52	-36	-61	-28	-68	-56	-81	-48	-88
140	160																				
160	180																				
180	200	+5	-24	+13	-33	-8	-37	0	-46	-22	-51	-14	-60	-41	-70	-33	-79	-68	-97	-60	-106
200	225																				
225	250																				
250	280	+5	-27	+16	-36	-9	-41	0	-52	-25	-57	-14	-66	-47	-79	-36	-88	-85	-117	-74	-126
280	315																				
315	355	+7	-29	+17	-40	-10	-46	0	-57	-26	-62	-16	-73	-51	-87	-41	-98	-97	-133	-87	-144
355	400																				
400	450	+8	-32	+18	-45	-10	-50	0	-63	-27	-67	-17	-80	-55	-95	-45	-108	-103	-153	-103	-166
450	500																				
500	560	0	-44	0	-70	-26	-70	-26	-96	-44	-88	-44	-114	-78	-122	-78	-148	-150	-194	-150	-220
560	630																				
630	710	0	-50	0	-80	-30	-80	-30	-100	-50	-100	-50	-130	-88	-138	-88	-168	-155	-199	-155	-225
710	800																				
800	900	0	-56	0	-90	-34	-90	-34	-124	-56	-112	-56	-146	-100	-156	-100	-190	-175	-225	-175	-225
900	1000																				
1000	1120	0	-66	0	-105	-40	-106	-40	-145	-66	-132	-66	-171	-120	-186	-120	-225	-210	-266	-210	-300
1120	1250																				
1250	1400	0	-78	0	-125	-48	-126	-48	-173	-78	-156	-78	-203	-140	-218	-140	-265	-220	-276	-220	-310
1400	1600																				
1600	1800	0	-92	0	-150	-58	-150	-58	-208	-92	-184	-92	-242	-170	-262	-170	-320	-300	-378	-300	-425
1800	2000																				

Unit :  $\mu\text{m}$

H7	H8	H9	H10	H11	H13	J6	Js6		J7	Js7		K5	Diameter division mm	
							High	Low		High	Low		Over	incl.
+ 12 0	+ 18 0	+ 30 0	+ 48 0	+ 75 0	+180 0	+ 5 -3	+ 4 - 4	+ 6 - 6	+ 6 - 6	+ 6 - 6	0 - 5	3	6	
+ 15 0	+ 22 0	+ 36 0	+ 58 0	+ 90 0	+220 0	+ 5 -4	+ 4.5 - 4.5	+ 8 - 7	+ 7.5 - 7.5	+ 1 - 5	+1 - 5	6	10	
+ 18 0	+ 27 0	+ 43 0	+ 70 0	+110 0	+270 0	+ 6 -5	+ 5.5 - 5.5	+10 - 8	+ 9 - 9	+2 - 6	+2 - 6	10	18	
+ 21 0	+ 33 0	+ 52 0	+ 84 0	+130 0	+330 0	+ 8 -5	+ 6.5 - 6.5	+12 - 9	+10.5 -10.5	+1 - 8	+1 - 8	18	30	
+ 25 0	+ 39 0	+ 62 0	+100 0	+160 0	+390 0	+10 -6	+ 8 - 8	+14 -11	+12.5 -12.5	+2 - 9	+2 - 9	30	40	
												40	50	
+ 30 0	+ 46 0	+ 74 0	+120 0	+190 0	+460 0	+13 -6	+ 9.5 - 9.5	+18 -12	+15 -15	+3 -10	+3 -10	50	65	
												65	80	
+ 35 0	+ 54 0	+ 87 0	+140 0	+220 0	+540 0	+16 -6	+11 -11	+22 -13	+17.5 -17.5	+2 -13	+2 -13	80	100	
												100	120	
+ 40 0	+ 63 0	+100 0	+160 0	+250 0	+630 0	+18 -7	+12.5 -12.5	+26 -14	+20 -20	+3 -15	+3 -15	120	140	
												140	160	
												160	180	
+ 46 0	+ 72 0	+115 0	+185 0	+290 0	+720 0	+22 -7	+14.5 -14.5	+30 -16	+23 -23	+2 -18	+2 -18	180	200	
												200	225	
												225	250	
+ 52 0	+ 81 0	+130 0	+210 0	+320 0	+810 0	+25 -7	+16 -16	+36 -16	+26 -26	+3 -20	+3 -20	250	280	
												280	315	
+ 57 0	+ 89 0	+140 0	+230 0	+360 0	+890 0	+29 -7	+18 -18	+39 -18	+28.5 -28.5	+3 -22	+3 -22	315	355	
												355	400	
+ 63 0	+ 97 0	+155 0	+250 0	+400 0	+970 0	+33 -7	+20 -20	+43 -20	+31.5 -31.5	+2 -25	+2 -25	400	450	
												450	500	
+ 70 0	+110 0	+175 0	+280 0	+440 0	- 0	- -	+22 -22	- -	+35 -35	- -	- -	500	560	
												560	630	
+ 80 0	+125 0	+200 0	+320 0	+500 0	- 0	- -	+25 -25	- -	+40 -40	- -	- -	630	710	
												710	800	
+ 90 0	+140 0	+230 0	+360 0	+560 0	- 0	- -	+28 -28	- -	+45 -45	- -	- -	800	900	
												900	1 000	
+105 0	+165 0	+260 0	+420 0	+660 0	- 0	- -	+33 -33	- -	+52.5 -52.5	- -	- -	1 000	1 120	
												1 120	1 250	
+125 0	+195 0	+310 0	+500 0	+780 0	- 0	- -	+39 -39	- -	+62.5 -62.5	- -	- -	1 250	1 400	
												1 400	1 600	
+150 0	+230 0	+370 0	+600 0	+920 0	- 0	- -	+46 -46	- -	+75 -75	- -	- -	1 600	1 800	
												1 800	2 000	

Inch - Millimeter conversion table

1in.=25.4mm

Inch		0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
Fraction	Decimals										
1/64	0.015625	0.397	25.400	50.800	76.200	101.600	127.000	152.400	177.800	203.200	228.600
1/32	0.031250	0.794	25.797	51.197	76.597	101.997	127.397	152.797	178.197	203.597	228.997
3/64	0.046875	1.191	26.194	51.594	76.994	102.394	127.794	153.194	178.594	203.994	229.394
1/16	0.062500	1.588	26.591	51.991	77.391	102.791	128.191	153.591	178.991	204.391	229.791
5/64	0.078125	1.984	26.988	52.388	77.788	103.188	128.588	153.988	179.388	204.788	230.188
3/32	0.093750	2.381	27.384	52.784	78.184	103.584	128.984	154.384	179.784	205.184	230.584
7/64	0.109375	2.778	27.781	53.181	78.581	103.981	129.381	154.781	180.181	205.581	230.981
1/ 8	0.125000	3.175	28.178	53.578	78.978	104.378	129.778	155.178	180.578	205.978	231.378
9/64	0.140625	3.572	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775
5/32	0.156250	3.969	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172
11/64	0.171875	4.366	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569
3/16	0.187500	4.762	29.766	55.166	80.566	105.966	131.366	156.766	182.166	207.566	232.966
13/64	0.203125	5.159	30.162	55.562	80.962	106.362	131.762	157.162	182.562	207.962	233.362
7/32	0.218750	5.556	30.559	55.959	81.359	106.759	132.159	157.559	182.959	208.359	233.759
15/64	0.234375	5.953	30.956	56.356	81.756	107.156	132.556	157.956	183.356	208.756	234.156
1/ 4	0.250000	6.350	31.353	56.753	82.153	107.553	132.953	158.353	183.753	209.153	234.553
17/64	0.265625	6.747	31.750	57.150	82.550	107.950	133.350	158.750	184.150	209.550	234.950
9/32	0.281250	7.144	32.147	57.547	82.947	108.347	133.747	159.147	184.547	209.947	235.347
19/64	0.296875	7.541	32.544	57.944	83.344	108.744	134.144	159.544	184.944	210.344	235.744
5/16	0.312500	7.938	32.941	58.341	83.741	109.141	134.541	159.941	185.341	210.741	236.141
21/64	0.328125	8.334	33.338	58.738	84.138	109.538	134.938	160.338	185.738	211.138	236.538
11/32	0.343750	8.731	33.734	59.134	84.534	109.934	135.334	160.734	186.134	211.534	236.934
23/64	0.359375	9.128	34.131	59.531	84.931	110.331	135.731	161.131	186.531	211.931	237.331
3/ 8	0.375000	9.525	34.528	59.928	85.328	110.728	136.128	161.528	186.928	212.328	237.728
25/64	0.390625	9.922	34.925	60.325	85.725	111.125	136.525	161.925	187.325	212.725	238.125
13/32	0.406250	10.319	60.722	60.722	86.122	111.522	136.922	162.322	187.722	213.122	238.522
27/64	0.421875	10.716	61.119	61.119	86.519	111.919	137.319	162.719	188.119	213.519	238.919
7/16	0.437500	11.112	61.516	61.516	86.916	112.316	137.716	163.116	188.516	213.916	239.316
29/64	0.453125	11.509	61.912	61.912	87.312	112.712	138.112	163.512	188.912	214.312	239.712
15/32	0.468750	11.906	62.309	62.309	87.709	113.109	138.509	163.909	189.309	214.709	240.109
31/64	0.484375	12.303	62.706	62.706	88.106	113.506	138.906	164.306	189.706	215.106	240.506
1/ 2	0.500000	12.700	63.103	63.103	88.503	113.903	139.303	164.703	190.103	215.503	240.903
33/64	0.515625	13.097	63.500	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300
17/32	0.531250	13.494	63.897	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697
35/64	0.546875	13.891	64.294	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094
9/16	0.562500	14.288	64.691	64.691	90.091	115.491	140.891	166.291	191.691	217.091	242.491
37/64	0.578125	14.684	90.488	90.488	90.488	115.888	141.283	166.688	192.088	217.488	242.888
19/32	0.593750	15.081	65.484	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284
39/64	0.609375	15.478	65.881	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681
5/ 8	0.625000	15.875	66.278	66.278	91.678	117.078	142.478	167.878	193.278	218.678	244.078
41/64	0.640625	16.272	66.675	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475
21/32	0.656250	16.669	67.072	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872
43/64	0.671875	17.066	67.469	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269
11/16	0.687500	17.462	67.866	67.866	93.266	118.666	144.066	169.466	194.866	220.266	245.666
45/64	0.703125	17.859	68.262	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062
23/32	0.718750	18.256	68.659	68.659	94.059	119.459	144.859	170.259	195.659	221.056	246.459
47/64	0.734375	18.653	69.056	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856
3/ 4	0.750000	19.050	69.453	69.453	94.853	120.253	145.653	171.053	196.453	221.853	247.253
49/64	0.765625	19.447	69.850	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650
25/32	0.781250	19.844	70.247	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047
51/64	0.796875	20.241	70.644	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444
13/16	0.812500	20.638	71.041	71.041	96.441	121.841	147.241	172.641	198.041	223.441	248.841
53/64	0.828125	21.034	71.438	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238
27/32	0.843750	21.431	71.834	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634
55/64	0.859375	21.828	72.231	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031
7/ 8	0.875000	22.225	72.628	72.628	98.028	123.428	148.828	174.228	199.628	225.028	250.428
57/64	0.890625	22.622	73.025	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825
39/32	0.906250	23.019	73.422	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222
59/64	0.921875	23.416	73.819	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619
15/16	0.937500	23.812	74.216	74.216	99.616	125.016	150.416	175.816	201.216	226.616	252.016
61/64	0.953125	24.209	74.612	74.612	100.012	125.412	150.812	176.212	201.612	227.012	252.412
31/32	0.968750	24.606	75.009	75.009	100.409	125.809	151.209	176.609	202.009	227.409	252.809
63/64	0.984375	25.003	75.406	75.406	100.806	126.206	151.606	177.006	202.406	227.806	253.206
		25.003	50.403	75.803	101.203	126.603	152.003	177.403	202.803	228.203	253.603